EXCAVATION OF A JORNADA MOGOLLON PITHOUSE ALONG U.S. 380, SOCORRO COUNTY, NEW MEXICO

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ADMINISTRATIVE SUMMARY

From November 6, 1991, to February 4, 1992, the Office of Archaeological Studies (OAS), Museum of New Mexico, conducted a data recovery program at LA 71276, a Jornada Mogollon pit structure along U.S. 380 in Socorro County, New Mexico. The site is approximately [redacted] of Bingham, on land belonging to the state of New Mexico.

This site was tested by the OAS during a two-week period from March 25 to April 5, 1991. Portions of the site extended into the existing right-of-way; the New Mexico State Highway and Transportation Department planned road modification activity within the existing right-of-way in this area.

During the testing phase, LA 71276 was found to be a dense ceramic and lithic artifact scatter associated with the Tajo phase (A.D. 800-1000) of the Jornada Mogollon Culture, on both sides of U.S. 380. Testing revealed a pit structure, a charcoal stain, and a subsurface feature with charcoal fill within the project limits. During data recovery, six features were examined. These included the pit structure, three undefined surficial charcoal stains, an extramural hearth, and a burial.

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INTRODUCTION

From November 6, 1991, to February 4, 1992, the Office of Archaeological Studies (OAS), Museum of New Mexico, conducted a data recovery program at LA 71276, a Jornada Mogollon pit structure along U.S. 380 in Socorro County, New Mexico. The site is approximately [redacted] of Bingham, on land belonging to the state of New Mexico (Fig. 1).

The site was tested in the spring of 1991. Testing revealed a pit structure and associated extramural features dating to the Tajo phase (A.D. 800-1000) of the Jornada Mogollon Culture. During data recovery, these features were completely excavated, as were additional features that were uncovered. The project was directed by Daisy F. Levine, who was assisted by Laurie G. Evans, Joan K. Gaunt, and Marcy T. Snow.

The pit structure measured 3.9 m in diameter, and averaged 1.06 m in depth. The structure was dug into the natural soil deposit and had unprepared walls. The structure was not burned; however, a few pieces of unburned roof latillas were found in the pit fill and in the floor fill. Remodeling was indicated by the presence of two floors, about 10 cm apart. Both floors were unprepared, and both had hearths. The hearth on the upper floor was simply an ashy burned area. The lower floor had a formal basin-shaped hearth, 80 cm in diameter and 10-12 cm deep.

Site location and legal description are provided in Appendix 4. (This appendix has been removed from copies in general circulation.) The excavation was completed under State of New Mexico permit no. SE-63.

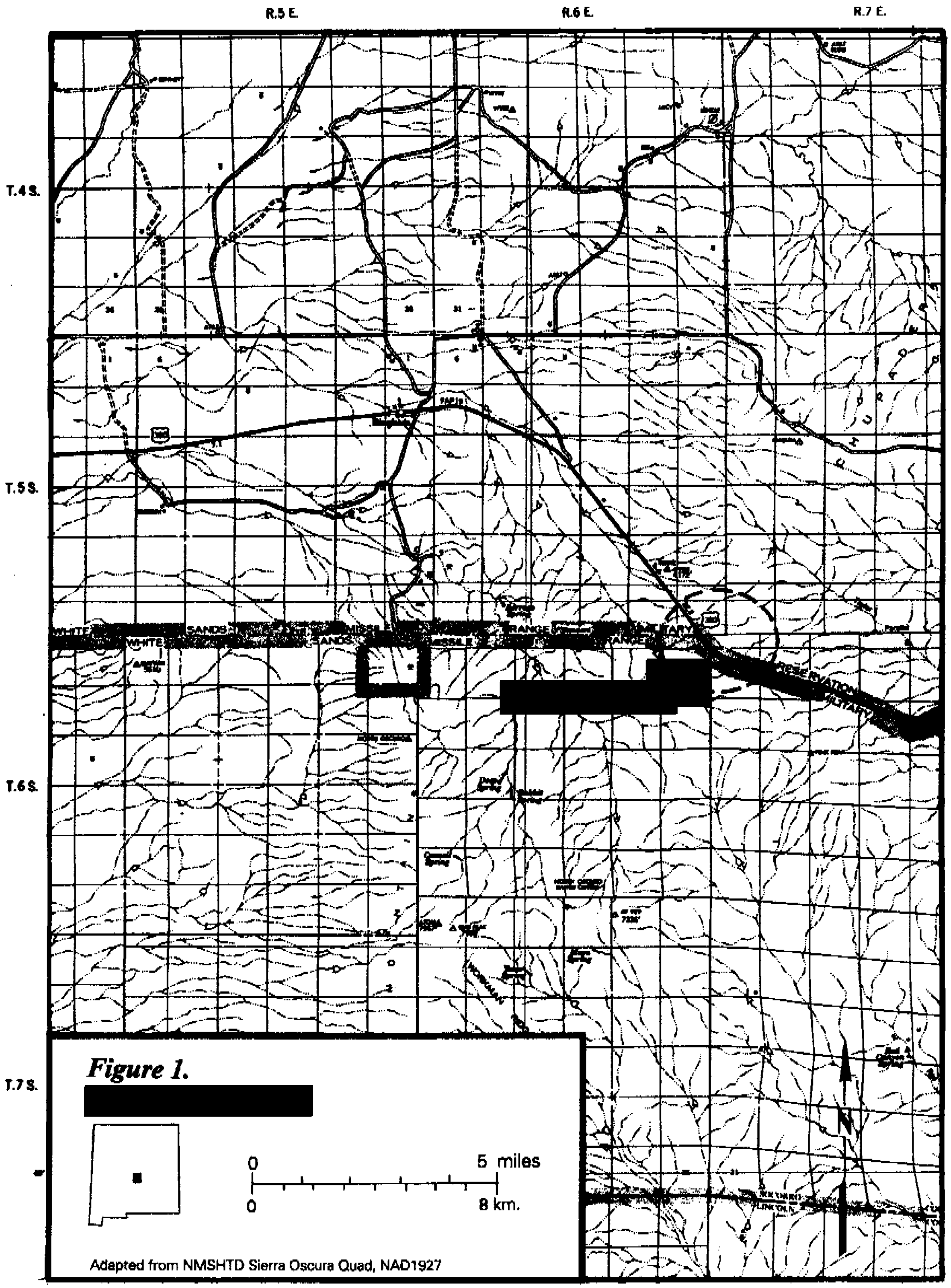

Figure 1.
[redacted]
Adapted from NMSHTD Sierra Oscura Quad, NAD1927

ENVIRONMENT

LA 71276 is located at the south end of Chupadera Mesa, at an elevation of 1,924 m (6,310 ft), on either side of a large unnamed drainage, 1.6 km (1 mile) southeast of Lonnie Moon Peak. It is on a flat to gently sloping alluvial plain. The north end of the Oscura Mountains are about 9.6 km (6 miles) to the southwest, Taylor Draw is 9.6 km (6 miles) to the east, and the west edge of the Jornada del Muerto is approximately 16 km (10 miles) west. There is no permanent water supply in the vicinity, though numerous intermittent streams flowing out of Chupadera Mesa drain the area.

Soils in the area are of the La Fonda Association, and consist of the La Fonda loam and Alicia loam. La Fonda soils develop on the lower portions of alluvial fans (Neher and Bailey 1976:14). These soils are deep and well drained. They have developed from moderately fine-textured alluvial sediments on old alluvial fans. La Fonda soils are moderately permeable with high available water capacity. Plant roots can grow to a depth of at least 15 cm (6 inches). Given enough annual moisture, these soils are suitable for agriculture (Neher and Bailey 1976:14).

Climatic data is from Bingham, 9.6 km (6 miles) northwest of the site, and Carrizozo, 45 km (28 miles) east of the site. The project area has a semi-arid climate with a mean annual precipitation of 240 mm (9.46 inches) at Bingham, and 300 mm (11.82 inches) at Carrizozo. Most of the rain falls in July through September as a result of summer thunderstorms. Mean annual temperature is 12.3 degrees C (54.2 degrees F), with average summer highs of 24.3 degrees C (75.7 degrees F) and winter lows of 2.8 degrees C (37.1 degrees F). The frost-free period is 200-230 days (Tuan et al. 1973:192; Peckham 1976:39).

LA 71276 is in the piñon-juniper ecozone at the foot of Chupadera Mesa. Piñon and juniper are associated with grasses, including various forms of grama, giant dropseed, and alkali sacaton. Other vegetation in the area includes banana yucca, soaptree yucca, mountain mahogany, and snakeweed.

The only fauna observed were pronghorn and oryx; oryx are being raised experimentally on the adjacent White Sands Missile Range property. Fauna reported in the area include deer, coyote, badger, skunk, porcupine, jackrabbit, cottontail, and various rodents (Peckham 1976:39).

CULTURAL OVERVIEW

Very little work has been done in the project area, though recent surveys by Human Systems Research on the White Sands Missile Range to the south (Shields and Laumbach 1989; Sale 1988; Shields 1987; Laumbach 1986; Clifton 1985; Laumbach and Kirkpatrick 1985) have greatly contributed to the knowledge of local cultural developments and the documentation of site types found. Otherwise, research that has produced established cultural syntheses refer to areas 72 km (45 miles) to the east, where Kelley (1984) defined the prehistoric sequence of the northern Sacramento and Jicarilla mountains; 48 km (30 miles) to the west, where Marshall and Walt (1984) defined the riverine sequences in the Rio Abajo region; 64 km (40 miles) to the north, where Caperton (1981) discussed developmental sequences of the northern Chupadera and Jumanes mesas; and the Tularosa Basin to the south and east, which Lehmer (1948) defined as the Jornada Branch of the Mogollon. This leaves a wide undocumented area, roughly from San Antonio on the west, to Carrizozo on the east, and into the southern Chupadera Mesa to the north.

Paleoindian

The Paleoindian period is characterized by large, fluted lance points used in the hunting of now-extinct mammoth *(Mammuthus primegenus)* and bison *(Bison antiguus)*. Archaeological remains in the area are minimally documented, with the exception of the Mockingbird Gap site, 27 km (17 miles) to the west in the northern Jornada del Muerto. Weber, who investigated Mockingbird Gap (1966), located extensive Paleoindian campsites with hearths and light artifact scatters. Sites are often multicomponent, with diagnostic projectile points ranging from Clovis, Folsom, and Midland to Plano (Marshall 1976). Only one campsite was excavated, and to date there is no published report. The area, now a dry basin, was once the location of numerous early Pleistocene lakes, a typical situation for Paleoindian sites.

On the White Sands Missile Range, evidence for Paleoindian occupation is limited to two Folsom point fragments, both found in questionable contexts (Laumbach and Kirkpatrick 1985:66). However, as Laumbach and Kirkpatrick suggest, the extensive grassy plains to the west of the project area may have been an ideal environment to support the Pleistocene megafauna hunted by the Paleoindian population.

Archaic

Around 7000 B.C., the large game animals were replaced by smaller species, and plant resources were diminished. The subsistence economy gradually shifted from one of complete nomadism to a round of seasonal resource procurement. Irwin-Williams (1973) has defined the Oshara tradition of the Archaic period for the northern part of the state. Her sequence begins with the Jay phase, at 5500 B.C., and ends with the En Medio phase, around A.D. 400.

Weber (1963) has modified Irwin-Williams's sequence to apply to the southern part of the state, specifically to his work in the Rio Abajo area. He has recognized typological equivalents of both Chiricahua and San Pedro Cochise, elements of the Oshara Tradition, and several components of the Bat Cave sequence among projectile points that characterize Archaic complexes of the area. He characterizes Archaic sites as mainly scattered camp sites with abundant lithic artifacts, ground stone, and hearths. Locations range from river terraces, open plains, mountain foothills, canyons, and high ridges and saddles (Weber 1963:228).

A few Archaic sites have been found on White Sands Missile Range to the south of the project area. Sites include lithic artifact scatters, hearths, and rockshelters. Sites are generally small and artifact assemblages are limited, suggesting a small population and a limited period of occupation (Laumbach and Kirkpatrick 1985:67).

Pithouse and Pueblo Periods

Problems arise when discussing the Pithouse and Pueblo periods, because, as stated earlier, the project area is surrounded by four different regional phase sequences, and it is just outside the northwest corner of what Lehmer (1948) has described as the Jornada Branch of the Mogollon. Therefore, rather than discuss all four, only the Rio Abajo synthesis, for the region directly to the west, will be discussed because it most aptly applies to the study area, based on ceramic typology. The boundaries of the Capitan phase are unclear, and it may encompass the study area, but this is a poorly defined and documented phase (Wiseman 1985). Table 1 presents the other phase sequences, with references. The following discussion is abstracted from Marshall and Walt (1984).

San Marcial Phase (A.D. 300-800)

The San Marcial phase is the earliest representation of sedentary riverine adaptation in the Rio Abajo area. It is partially contemporaneous with the Basketmaker III and Pueblo I periods in the north and northwest. Site locations correspond to areas of high Archaic site density, suggesting that this complex evolved from the Archaic tradition. Settlements are small, averaging four noncontiguous rooms per site; site size ranges from one to eight rooms. Surface structures are rock-based jacal and cobble masonry. Pit structures are rare. Midden debris is most frequently scattered over the site, rather than in a concentrated deposition.

The ceramic complex was first recognized by Mera (1935). It consists predominantly of plain brown Mogollon wares in association with San Marcial Black-on-white, a Basketmaker III ware. Small amounts of red-slipped brown wares, a Mogollon red-on-terracotta ware, and Anasazi plain gray wares were found at the type site. Collections by Marshall and Walt at several early Puebloan sites in the Rio Abajo area revealed brown wares but a lack of San Marcial and Cibola Gray Ware. They therefore extended the definition of this phase to include all early formative sites that exhibit a brown ware industry. This rule cannot be consistently applied, though, since plain brown complexes serve as the foundation of Mogollon cultural development throughout the southern province. The lack of information on this phase is a problem, and there will have to be more archaeological investigation to accurately define it.

Table 1. Generalized Artifact-Phase Sequences in the Area

Cultural Periods	Rio Abajo	N. Chupadera Mesa	N. Sacramentos	Tularosa Basin	N. Jornada[1]
Paleoindian ca. 12,000 B.C.	Clovis[2] Folsom[3]	?	Folsom[4]	Folsom[5]	
Archaic ca. 5500 B.C. A.D. 300	Jay Bajada San Jose Chiricahua San Pedro Shumla[3]	?	San Jose Chiricahua San Pedro[4]	Jay Bajada San Jose San Pedro Shumla[6])	?
Ceramic Period A.D. 300	San Marcial phase San Marcial B/w	San Marcial(?) phase brown ware[7]	?	Mesilla phase[8]	
A.D. 800	Early Tajo phase Red Mesa B/w Pitoche Brown	?	San Andres R/t		
A.D. 900	Late Tajo phase Red Mesa/ Puerco B/w & brown wares		?		Capitan phase
A.D. 1000	Elmendorf phase Elmendorf B/w & brown wares	Chupadero B/w[10]			
A.D. 1100			Early Glencoe/ Corona[9]	Dona Ana Phase	Three Rivers Phase
A.D. 1200				El Paso Phase	San Andres Phase
A.D. 1300 A.D. 1400	Glaze A	Glaze A	Late Glencoe/ Lincoln		

(Adapted from Laumbach and Kirkpatrick 1985; Wiseman 1985)

[1] Lehmer 1948; [2] Weber 1966; [3] Marshall and Walt 1984; [4] Laumbach 1984; [5] Eidenbach 1983; [6] Wimberly and Rogers 1980, Eidenbach 1983, Laumbach 1980; [7] Fenenga 1956; [8] Lehmer 1948, Whalen 1977; [9] Kelley 1984; [10] Caperton 1981

Tajo Phase (A.D. 800-1000)

The Tajo phase is the first major sedentary occupation of the riverine environment in the Rio Abajo. Along the Rio Grande, sites are small clusters of one to ten surface rooms with occasional pit structures. Pit structures are usually found adjacent to surface houses, most often on benches. Most surface structures are linear unit houses of cobble-based jacal construction. During the Rio Abajo survey (Marshall and Walt 1984), 15 Tajo phase sites were recorded, 6 of which had pit structures, either singly or in association with room blocks.

The ceramic complex is mainly plain brown wares, with some Red Mesa Black-on-white occurring at all sites. This is an intrusive Cibola Ware from the north and northwest; there appears to be no native white ware industry during this phase. Minor amounts of Cibola Gray Ware, Mimbres White Ware, and Elmendorf White Ware are found on some late Tajo sites. Red Mesa Black-on-white is found more often on early Tajo phase sites, while Puerco- and Gallup-style Cibola White Wares occur in the late Tajo phase, though always in association with Red Mesa Black-on-white. The occurrence of Cibolan ceramics indicates a blending of Anasazi and Mogollon populations during this time.

The only excavated site in the project area is a late Tajo phase settlement excavated by Peckham (1976). This site, LA 6565, is the largest of a cluster of 25 sites along Taylor Draw, near the southern end of Chupadera Mesa. LA 6565 consists of 4 pithouses, a kiva, and 22 slab-lined surface rooms. Plain brown ware comprised over 90 percent of the ceramic assemblage, with small amounts of Red Mesa Black-on-white present.

Most of the ceramic sites recorded during survey of the White Sands Missile Range fall temporally within the Tajo phase, indicated by brown wares and Red Mesa Black-on-white. So far, over 20 sites of this phase have been recorded (site lists in Sale 1988; Shields 1987; Laumbach 1986; Clifton 1985; Laumbach and Kirkpatrick 1985). Recently, a possible pit structure with associated surface rooms and Tajo phase ceramics were recorded during survey (Karl Laumbach and Mark Seachrist, pers. comm. 1991).

Early Elmendorf Phase (A.D. 950-1100)

The Early Elmendorf phase is roughly contemporaneous with the Pueblo II period. The architecture during this time is similar to the Tajo phase, with small jacal pueblos and occasional pit structures. The essential difference is the clustering of the room blocks into village groups, with a series of small, closely spaced unit houses. Small settlements averaged 4 rooms per site; large settlements averaged 54 per site.

Because the number of rooms did not change much from the Tajo phase, Marshall and Walt (1984) believe that the population did not increase, but rather shifted from small scattered communities into aggregated villages, indicating major changes in social organization.

Pit structures are found at almost half of early Elmendorf sites. Diameters average 4-6 m, though one large rectangular pit structure was found.

Prior to this period, the population in the south imported white wares from the adjacent Anasazi area. During the early Elmendorf phase, the people of the Rio Grande district produced their own types, known as Elmendorf White Wares. These types resemble Chupadera Black-on-white (Casa Colorado Black-on-white is defined as an unscored Chupadera Black-on-white, and Elmendorf Black-on-white as a carbon-painted Chupadera Black-on-white), and thus have not been clearly recognized. The brown ware industry is similar to that of the Tajo phase. Plain brown wares primarily occur, but there is a slight increase in textured types, such as Pitoche Ribbed and Pitoche Rubbed-ribbed.

Late Elmendorf Phase (A.D. 1100-1300)

This phase is contemporary with the Pueblo III period. It is characterized by the aggregation of Pueblo II village populations into large fortified pueblos. Unstable social factors are seen as the cause for the coalescence of the population.

Masonry was frequently used, but cobble-jacal structures are also found. There was considerable architectural variety, suggesting a period of experimentation and diversity. The population of the Rio Abajo region increased slightly, but most pueblos exhibited very little midden deposition, suggesting a brief occupation.

Late Elmendorf sites are found in two distinct situations. Isolated pueblos and small villages continue to be built on benches, characteristic of the Tajo and early Elmendorf phases. However, this included a minority of the Elmendorf population. Large masonry pueblos, 22-54 rooms, were built on elevated buttes, knolls, and benches in potentially defensive locations.

Pit structures are found occasionally, often in plazas and thus resembling kivas. Most are circular, 4 to 8 m in diameter, though a few rectangular pit structures have been recorded.

The ceramic assemblage is similar to that of the early Elmendorf phase. Pitoche Brown Wares and Elmendorf White Wares still occur, with an increase in the textured brown wares. The presence of intrusive White Mountain Redware is diagnostic of this period.

Piro Phase (A.D. 1300-1680)

The Piro phase has been divided into the Ancestral and Colonial phases. The Ancestral Piro phase (A.D. 1300-1540) begins with the emergence of the glazeware ceramic industry and ends at the time of Spanish contact. It is characterized by the coalescence of the population into large plaza villages, a substantial increase in population, and the expansion into or colonization of riverside areas that were previously unoccupied (Marshall and Walt 1984). Multistoried and terraced noncontiguous room blocks of masonry or puddled, coursed adobe were built around plazas.

Glaze A is the dominant type in the ceramic assemblage. Minor amounts of Glaze C and D are found, though Glaze B is notably absent. Utility wares are plain gray Rio Grande wares.

During the Colonial Piro phase (A.D. 1540-1680), the population dropped substantially, probably from European diseases introduced as a result of Spanish contact. Large sections of Ancestral pueblos were abandoned, and Colonial occupations were restricted to certain room block areas. However, numerous small Colonial style and large traditional style villages were established during this period. Room blocks contained large square rooms aligned in grid patterns, often incorporating elements such as courtyards, portals, and corral enclosures. The Spanish built missions and imposed the *encomienda* system on the Piro pueblos during this time. As the Piros attempted to escape from Spanish domination, a substantial portion of the population moved west, settling in two large pueblos near Magdalena.

The ceramic assemblage is characterized by local variants of Glaze E and F types, in association with Rio Grande gray wares. Smaller amounts of majolica and Mexican earthenwares are present. Occasionally, Tabira, Jemez, and Tewa white ware intrusives are found.

In Mera's study of the Rio Grande glaze paint area (Mera 1940), he examined numerous sites, which he grouped into five time periods. Period 1 is dated A.D. 1350-1450 and is characterized by the presence of Glaze A and Glaze B. There is a dense cluster of sites along Chupadera Arroyo, at the base of Chupadera Mesa, dating to this time period. Almost all of these sites represent permanent habitations rather than seasonally occupied sites. This area is roughly 10-12 miles northwest of the project area. Mera documented more Period 1 Piro sites here than along the Rio Grande.

During subsequent periods, the population was more spread out, and only a few sites were present along Chupadera Arroyo. A small group of sites was present in Period 5 (A.D. 1650-1700: Glaze F). Again, most are permanent habitations.

Historic Period

There is no archaeological evidence of occupation of the White Sands Missile Range, immediately south of the project area, from roughly A.D. 1050 until the late 1800s. The general area was utilized by Apaches historically (Basehart 1973); however, only one Apache site has been found on surveys of the White Sands area (site list in Laumbach 1986:17). Small portions of the prehistoric population may have lasted longer, based on the presence of a fieldhouse with Mimbres Classic Black-on-white at Taylor Draw, but no later ceramic assemblages have been documented. Only two glaze ware sherds were found on the Sgt. York survey (Laumbach and Kirkpatrick 1985:68), though the surrounding areas (Rio Abajo to the west, Sierra Blanca region to the east, and Salinas region to the north) were heavily populated (Marshall and Walt 1984; Kelley 1984; Caperton 1981).

During the late nineteenth-early twentieth century, the area was homesteaded and the inhabitants were ranchers and miners. Raising cattle and horses for sale and sheep and goats for wool was the primary occupation (Laumbach and Kirkpatrick 1985:71). Mines were worked in the Oscura Mountains to the south and near Bingham to the west. Today, residents primarily ranch or work for White Sands Missile Range.

DATA RECOVERY PLAN
(from Levine 1991)

Very little work has been done in the project area, as is discussed in the Cultural Overview section. Numerous surveys have been conducted to the south, on White Sands Missile Range (Shields and Laumbach 1989; Sale 1988; Shields 1987; Laumbach 1986; Clifton 1985; Laumbach and Kirkpatrick 1985), but only one site in the project vicinity has been excavated. Therefore, comparative data is sorely lacking. Peckham (1976) excavated LA 6565 at Taylor Draw, 9.6 km (6 miles) east of LA 71276. Four Tajo phase pithouses and a kiva were excavated, providing our only local comparative study. Oakes (1986) excavated LA 45884, 50 km (31 miles) to the west. Five Tajo phase pit structures were excavated, three of which were definite habitation units, while two may have been used for storage. LA 45884 was a habitation and storage site that was occupied year-round based on the presence of storage features and interior hearths. The inhabitants apparently practiced a wild food gathering and hunting subsistence economy, with some dependence upon stored goods, and produced a well-made brown ware pottery. Both LA 45884 and LA 6565 can provide important comparative information on site function, seasonality, and subsistence.

Phase sequences also need to be evaluated at LA 71276. As discussed in the Cultural Overview section, the project area is surrounded by four different regional phase sequences, and is just outside what Lehmer (1948) has described as the Jornada Branch of the Mogollon. The sequence chosen for comparative purposes for this project is from the Rio Abajo. Here, the ceramic period begins with the San Marcial phase (A.D. 300 to 800), followed by the Tajo phase (A.D. 800 to 1000) and the Elmendorf phase (A.D. 950 to 1300). Based on ceramic typologies, LA 71276 appears to be affiliated with the Tajo phase. Marshall and Walt (1984) have defined this phase in detail; their information, however, is based wholly on survey. Therefore, information obtained from LA 71276 can add to our knowledge of regional phase sequences. Because LA 6565 and LA 45884 are the only Tajo phase sites that have been excavated, *any* information from LA 71276 will add to our data base from this period. Specific issues can be examined, such as variation in architectural and ceramic styles between the Rio Abajo region and the project area, and to what degree subsistence and settlement patterns vary during the Tajo phase.

While important information can be learned from excavation at LA 71276, the questions we can ask are determined by the nature of the site and the lack of comparative data. From data gained during the testing phase, LA 71276 may be a limited activity site, indicated by the small number of features and the lack of midden deposits. Therefore, our research objectives are aimed at providing baseline data on site function, seasonality, and subsistence.

Research Questions

What was the function of the site, and was it occupied seasonally or year-round?

The two possible functions for the buried feature at LA 71276 are habitation or storage. Several criteria will be examined, such as feature size, presence or absence of hearths, presence or absence of postholes, and artifact type and density. The presence of interior features would indicate a habitation; absence of these features, coupled with small feature size and a low number of artifacts, would indicate either a storage feature or a seasonally occupied habitation.

Several differences are expected when differentiating between a permanent and a seasonal occupation of a site, as discussed previously by several researchers including Lancaster (in Vierra and Lancaster 1987:15-16), Binford (1978), B. Moore (1978), Adams (1978), J. Moore (1989), Preucel (1990), and James (1990). The following model is abstracted from Lancaster (Vierra and Lancaster 1987).

1. Food storage facilities, such as subsurface pits, surface rooms, and large storage vessels would be found at sites occupied on a year-round basis. A seasonally-occupied site would not need extensive storage facilities.

2. Extensive food-processing facilities, such as mealing bins, would be expected at sites occupied year round.

3. Sites occupied only during the summer would have outdoor hearths and activity areas, while year-round sites would have indoor hearths.

4. A greater amount and diversity of artifacts would be expected at a year-round site. Artifacts would reflect a broader range of activities, such as axes or mauls, hoes, bone awls, a variety of chipped and ground stone artifacts, and ritual objects. In addition, larger and more varied trash deposits would be expected.

5. Floral and faunal remains reflect the season of occupation at a site. Therefore, a seasonally occupied site would yield evidence only of remains that could have been collected during the season it was occupied. A site occupied year-round would have a greater diversity of remains.

From the data gained during the testing phase, LA 71276 seems to have been seasonally occupied. No other subsurface features were found that could be food storage pits, other than Feature 1. The lack of a substantial midden suggests a short-term occupation. No ground stone or agricultural implements, indicators of food processing and varied activities, were found. Features 2 and 3 may be extramural hearths or activity areas, also an indication of a seasonally occupied site.

To address this question, all of Features 1, 2, and 3 will be excavated. If Feature 1 is a pit structure, we will look for subsurface and extramural storage features. Pollen and flotation samples will be taken in association with any ground stone that is recovered to ascertain seasonality. If there are no floor or subsurface features present, a determination of site function will be based on comparative studies, combined with field data. Augering and surface stripping around the features (discussed in the following chapter) will be used to search for any additional buried features.

If the feature at LA 71276 is a pit structure, how does it compare to other known pit structures in the area?

Because LA 6565 and LA 45884 (Peckham 1976; Oakes 1986) are the only excavated pit structures in the project vicinity, detailed comparisons will be conducted between LA 71276 and these sites. LA 6565 is only 9.6 km (6 miles) to the east; LA 45884 is 50 km (31 miles) west. Four pithouses were excavated at LA 6565. Two were round and two were oval or rounded to rectangular. Two were shallow (less than 1 m deep) and two were over 1 m deep. All had a four-post roof support system, and all had a central hearth. None of the pit structures had subfloor storage pits (Peckham 1976). These traits, as well as other characteristics such as orientation of ventilator, type of entry, and floor area, will be compared to LA 71276 (providing the feature at LA 71276 is a pit structure). Besides adding to the understanding of the area, this may indicate a relationship between LA 6565 and LA 71276, not unlikely based on their proximity.

Five pit structures were excavated at LA 45884, three of which were definite habitation units, while two may have been used for habitation or storage. Habitation units were determined by artifact diversity, internal hearths, and associated surface debris. A possible storage function was indicated by lack of internal features and low artifact density, though these same factors could also indicate a summer occupation (Oakes 1986:19). At this site, the three habitation units were round and the two possible storage units were oval. Dimensions varied from 2 to 4 m in diameter, and depth varied from 0.3 m to 1.3 m. Again, these characteristics, along with floor preparation, posthole pattern, and presence or absence of hearths, will be compared to LA 71276. Although LA 45884 is farther away than LA 6565, it may ultimately prove more useful for comparative purposes if the feature at LA 71276 turns out to be a storage unit rather than a habitation.

Though considerable work has been done in the Sacramento Mountains to the east (Kelley 1984; Vierra and Lancaster 1987; Farwell and Oakes 1992), these pit structures are all later than preliminary ceramic analysis indicates at LA 71276. If, however, absolute dates are obtained from LA 71276 that more closely approximate these Glencoe phase sites, they will be used for comparative studies.

Excavation of the whole pit structure is necessary to answer this question. If it served as a habitation, it will be compared to LA 6565 and LA 45884. Internal features will be recorded and used to compare LA 71276 to these previously recorded pit structures. A comparative study may include post hole pattern, hearths, orientation of ventilator, type of entry, shape and depth of the pit structure, and floor area.

What was the basic subsistence pattern at the site? Were the inhabitants farmers?

Again, floral and faunal remains are expected to help answer this question. The La Fonda soil association, which occurs around LA 71276, are deep, well-drained soils, and suitable for agriculture. The site location itself is conducive to farming, in a flat to gently sloping plain. There is no permanent water source nearby, but intermittent streams border the site on two sides and flow during summer storms.

At nearby LA 6565, Peckham (1976:62-63) found evidence for an agricultural and hunting economy. The arable land in the valley bottoms, the presence of numerous surface granaries, and the occurrence of corn all point to farming as an important element in local subsistence. The frequency of projectile points indicated the hunting of wild game. Various forms of wild foods were plentiful in the area, such as piñon nuts, yucca fruit, and prickly pear.

During the testing phase at LA 71276, burned corn and several projectile points were recovered, thus already providing the potential for a mixed agricultural and hunting subsistence economy. Analysis of pollen, phytolith, and botanical samples will shed more light on the question of subsistence at LA 71276.

Several lines of evidence will be looked at to address this question. Analysis of botanical and faunal remains can determine whether food sources were domesticated or wild. Faunal analysis will aid in determining hunting patterns and show how large a role hunting played in the subsistence economy (discussed in the next section--Field and Analytical Methods). Off-site pollen samples will be collected from within the proposed project boundary to look for evidence of prehistoric agriculture. Ground stone analysis can provide information on types of plants being processed, and types of wear observed on tools during lithic analysis can provide information on activities that occurred at the site.

Will excavation of LA 71276 aid in defining the age, characteristics, and geographic delineation of the Tajo phase?

LA 71276 is in the northwest corner of the Jornada Mogollon region. Very little archaeological investigation has been done in this area. In the last decade, Human Systems Research has conducted numerous surveys of large tracts of land on the White Sands Missile Range to the south, greatly adding to our archaeological knowledge of that area. Yet to the north into the foothills of Chupadera Mesa, and to the east and west, virtually no work has occurred. The exceptions are Peckham's (1976) excavations at Taylor Draw (LA 6565) and Oakes's (1986) excavations at the Fite Ranch site (LA 45884), both Tajo phase sites and thus relevant to this project.

Consequently, the Tajo phase, with which the site so far seems affiliated, is not well known. Marshall and Walt's (1984) survey of the Rio Abajo region was confined to the riverine area, and did not extend into the Jornada del Muerto. Their information was derived wholly from survey. Thus, excavation of LA 71276 may further define the age and characteristics of the Tajo phase, particularly when compared to data collected at LA 6565, and aid in delineating the eastern boundary of this phase.

Chronometric data gathered from LA 71276 will help refine dates for this phase. Charcoal for C-14 dating was collected during the testing phase of this project, and more will be collected during data recovery. If we find hearths, archaeomagnetic samples will be collected, and appropriate wood sample will be collected for dendrochronological studies.

Information on seasonality and agriculture, addressed in Questions 1 and 3, will add to our knowledge of the Tajo phase. Additionally, data gained from excavation of LA 71276 may contribute to our understanding regarding patterns of settlement, mobility, and exchange during this time.

FIELD METHODS

A grid system of 1-by-1-m grids was established that incorporated the 1-by-1-m test pits excavated during the testing phase. The northeast corner of each grid was used as the grid datum. The grid system was oriented to true north, and grid designations were north and east of the main site datum on the south side of the highway. Site subdatums were set from the two datums established during the testing phase. Features identified during the testing and data recovery phase were completely excavated. All features were recorded, mapped, and photographed. A backhoe was used to surface strip and define outlines around known features and expose additional features around the pit structure. The backhoe was also used to trench the length of the site to look for additional cultural manifestations. The trench was oriented northwest-southeast and was parallel to the fenceline.

Excavation was generally in 1-by-1-m grids, and conducted in 10-cm levels until natural or cultural strata could be defined, after which excavation followed the strata. The original intention was to excavate the pit structure in quadrants, but due to the ambiguity of its outline and the difficulty in defining the walls, it was excavated in grids. Fill was removed to 10 cm above the floor, and floor fill was then excavated in quadrants. Once the lower floor had been completely recorded, the crew excavated below the floor to look for subfloor features. Stratigraphic, floor, and feature profiles were drawn. All fill was screened through ¼-inch mesh screens, and artifacts were collected for analysis. Artifact bags were labelled as to grid or quadrant, level or stratigraphic horizon, and feature. Chronometric samples, including archeomagnetic, radiocarbon, and dendrochronology, were collected. Pollen and flotation samples were collected from features and the pit structure floors.

The site was extensively augered during the testing phase. Upon completion of the excavation of each feature during the data recovery phase, augering was done to check for any additional subsurface cultural material.

Following completion of excavation, the site was mapped using a transit and stadia rod or tape. The site map incorporated all cultural features, the grid system, and areas excavated by the backhoe.

SITE DESCRIPTION

LA 71276 is on a bench above an unnamed drainage in a rolling piñon-juniper woodland at the base of Chupadera Mesa. It was originally recorded as a large (56 m north-south by 100 m east-west) ceramic and lithic artifact scatter, on both sides of U.S. 380. The site limits extend outside of the right-of-way on both sides of the highway, but the densest part of the site was within the right-of-way. Testing revealed a pit structure, a charcoal stain, and a subsurface feature with charcoal fill within the project limits. During data recovery, six features were examined. These included the pit structure, an extramural hearth, a burial, and three undefined surficial charcoal stains (Fig. 2). Occupation occurred during the Tajo phase of the Jornada Mogollon Culture, between A.D. 800 and 1000.

Pit Structure

The pit structure (Feature 1) was found during the testing phase, when a test pit was placed in an area of high artifact concentration and soil staining on the south side of the highway. Artifact counts in this grid were high, averaging 60-70 per 10-cm level through Stratum 9. In addition, burned corn and large amounts of charcoal were found. A culturally sterile stratum, the top of which was thought to be a floor, was encountered in Stratum 10 (90-100 cm below surface). This was an uneven layer, with large chunks of adobelike material, which may be wall fall. Augering confirmed that fill below Stratum 10 was culturally sterile.

The pit structure was fully excavated during the data recovery phase (Figs. 3, 4). It measured 3.9 m in diameter, and averaged 1.06 m in depth (below present ground surface). A 1-by-1-m pit excavated to the floor indicated two main stratigraphic horizons. The structure was apparently trash-filled, probably from another pit structure that existed before the construction of U.S. 380, as represented in the upper stratum (Stratum 1). This layer consisted of a dark brown loose clayey sand with a high charcoal and artifact density (Fig. 5). The color is brown to dark brown, 10YR 4/3. This stratum varies in thickness from 36 to 70 cm. The lower stratum (Stratum 2) was orangier and contained less charcoal than Stratum 1, but the artifact frequency was still high. Stratum 2 was a hard, compact, clayey sand, which may be a mixture of wall slump and roof fall. The color is dark yellowish brown, 10YR 4/4. There are scattered ash lenses and deposits in Stratum 2.

The structure was originally dug into the natural soil deposit, which was an orange-brown sandy soil. The walls are unprepared, and were recognizable because they were lighter and more compact than the dark ashy fill. Generally, there was compacted wall fall against the walls in the fill and on the floor. This material was the same color and texture as the walls, and was distinguished from the actual wall by the presence of charcoal in the wall fall and the irregularity of its shape. The structure was not burned, and very little roofing material was found. A few pieces of unburned roof latillas were found in the pit fill and in the floor fill.

Floors

There were two floors in the structure. Both floors were unprepared, and were 1-3 cm thick. The floors were visible in profile as two thin dark layers separated by about 10 cm of noncultural orange fill. The upper floor was a thin dark gray layer, darker towards the center of the pit structure and lighter and more ephemeral towards the walls. In some areas the floor was impossible to follow around the wall. The lower floor slopes up to the upper floor, blending into the upper floor approximately 70-80 cm from the walls throughout the structure. The edge of the floor stops at 20-27 cm from the interior walls. This may indicate some degree of remodeling, or it may be the interior wall line. The adobelike wall fall may have been a combination of plaster from the lower portion of the interior walls and slump from the above-ground walls. The lower floor was especially difficult to trace in the northwest quad, as there was a lot of compact clay and adobelike fill towards the outer edges of this quadrant. If the "possible ramp" (see below) was really a ramp, this would explain the difficulty in finding a floor here; the compact clay may have resulted from ramp preparation.

Ramp

This possible feature showed in profile in the northwest quad of the pit structure, in Grids 108N/99E and 108N/100E. Dark ashy fill overlay what looked like orange culturally sterile soil, sloping up to the north, which was to the outside of the pit structure. However, when the dark fill was removed, it was apparent that the orange layer was not culturally sterile or compacted and was full of charcoal and artifacts. There was no longer an apparent slant, and cultural fill continued to the level of floor fill. The fill contained large chunks of charcoal, several small pieces of unburned wood, two pieces of corn, and an intact cloudblower.

Hearths

Hearths were present on both floors. The upper floor had an informal hearth that was simply an ashy burned area in the center of the structure, mostly in Grid 107N/101E. Dense ash and charcoal formed a 65-70 cm diameter roughly circular area; no burned orange sand was present. One cobble and some unburned wood were in this hearth area. Ten centimeters of noncultural fill separated the upper hearth from the lower hearth (Feature 8), which was directly below it. It was 80 cm in diameter, basin shaped, and 10-12 cm deep. The fill was burned orange sand and ash. Two rocks were on the edge of the hearth; one was a piece of decomposing green shale. Artifacts recovered from the fill and floor adjacent to the hearth included seven sherds from a Red Mesa Black-on-white canteen and three lithic artifacts.

Ventilator

The ventilator opening (Feature 5) was in the east wall of the pit structure in Grid 107N/103E. The outside opening of the extramural ventilator shaft was 2 m outside of the edge of the structure, in Grids 107N/105E, 107N/104E, and 106N/104E. A dark ashy stain marking the shaft was apparent on the prehistoric activity surface; on the surface it appeared as an 86 cm north-south by 130 cm east-west pit outline. Excavation revealed a pit about 46 cm deep (below the prehistoric surface)

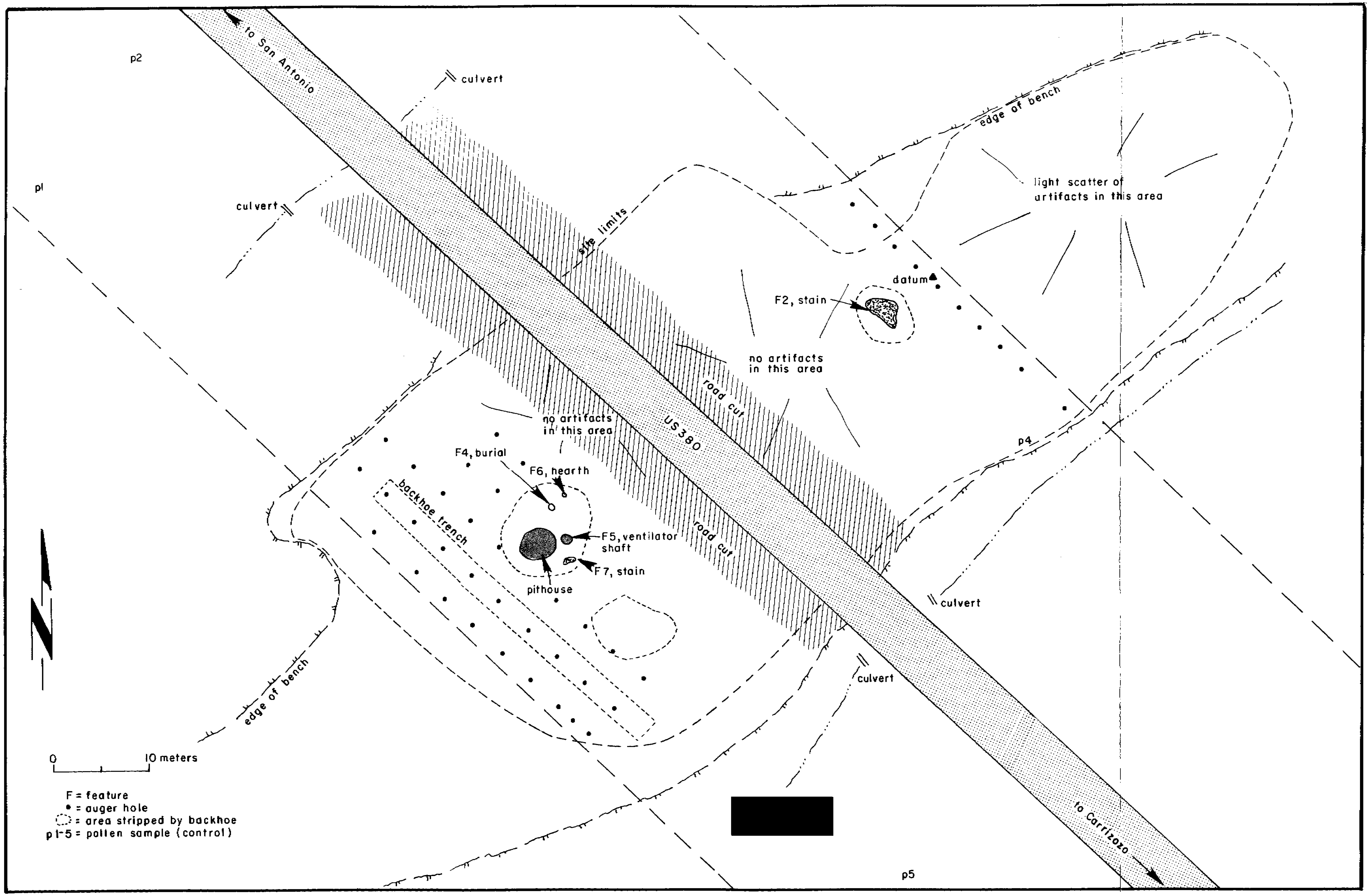

Figure 2. LA 71276 site map.

Figure 3. LA 71276, excavated pit structure.

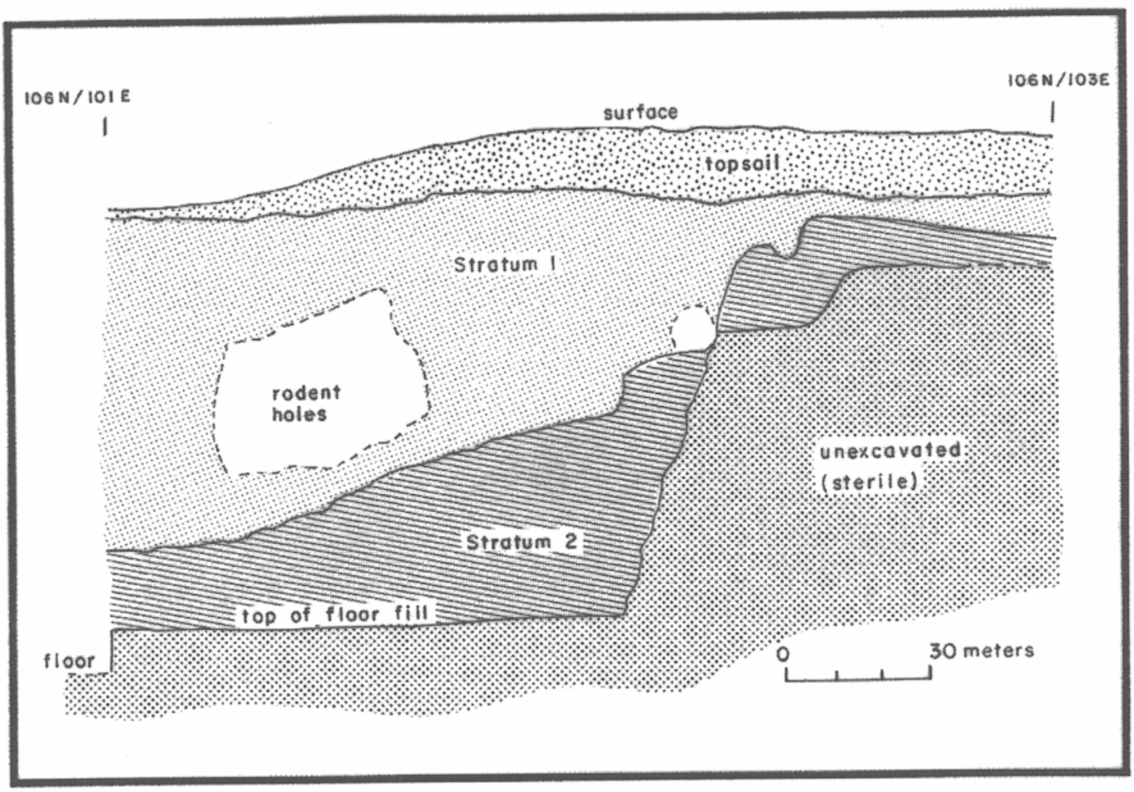

Figure 4. Profile of pit structure fill.

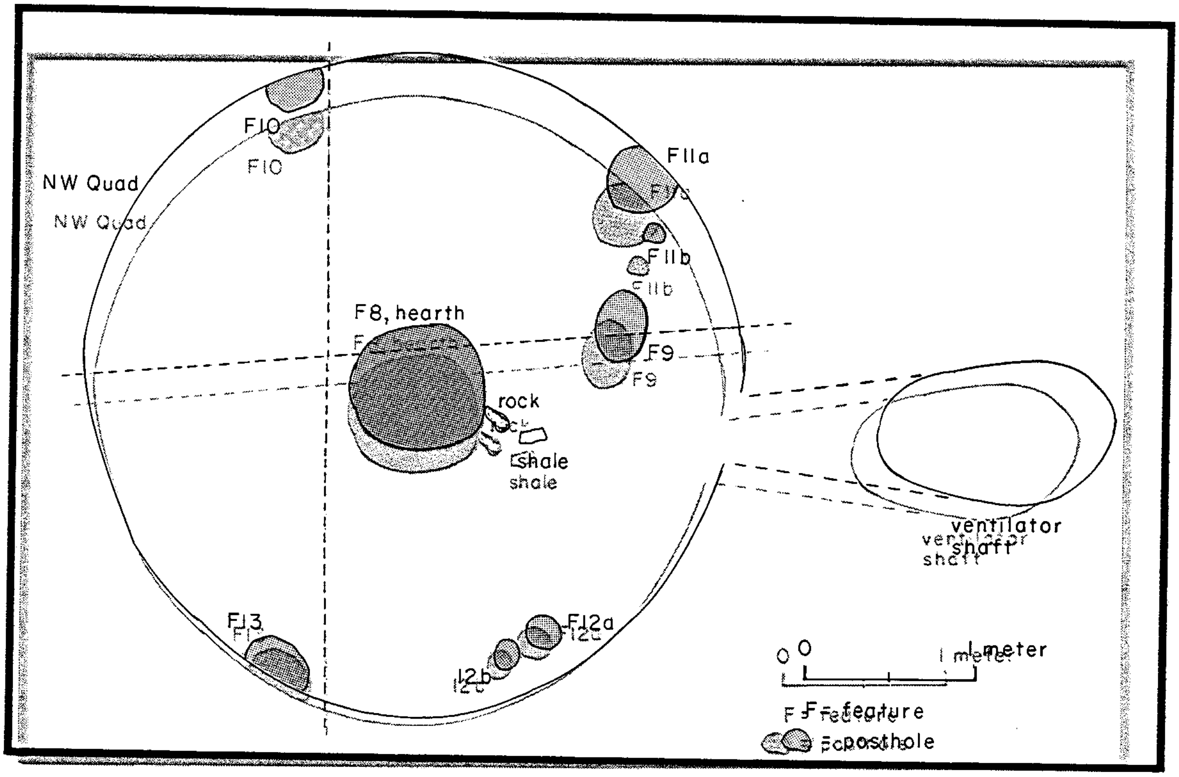

Figure 5. Plan view of excavated pit structure.

prehistoric surface) and 72 cm wide. The pit then drops about 10 cm into a 25 cm wide basin, then again drops into a 12 cm wide basin, 6 cm deep. The top of this basin is level with the bottom of the first basin (Figs. 6, 7). These may be for water catchment to prevent rain and snow from running into the structure. Past the second basin, the pit turns into a tunnel 80 cm long, which is 22 cm below the top of the second basin (Fig. 6, 7). The tunnel ends at the pit structure wall, where the opening was blocked with a large shaped sandstone slab, 41 cm by 31 cm by 3 cm (Figs. 8, 9). This damper slab apparently served to block the ventilator opening to prevent rodents, moisture, and dust from entering the structure when it was unoccupied.

The fill of the ventilator pit was the same as that of Stratum 1 in the pit structure--dark brown ashy clay sand, full of charcoal and artifacts. About 20 cobbles were recovered from the pit and the lower part of the tunnel; they may have been thrown in to fill it. The feature was trash-filled, and contained high numbers of ceramic and lithic artifacts. Ground stone, corn cobs, bone and a piece of unworked turquoise were also found in the fill.

Postholes

The posthole configuration was problematic. There were five possible postholes (Features 9-13). Only one, Feature 9, could definitely be called a posthole. It was located in the northwest quadrant of the pit structure (Fig. 5), about one-third of the way between the wall and center of the structure (60 cm west of the east wall, 110 cm east of the hearth). This is the placement that would be expected if there was a four-post support system. However, no postholes were found in the three other quadrants that would match the position of Feature 9. The features that were found were questionable; they are described below as Features 10, 11a-b, 12a-b, and 13.

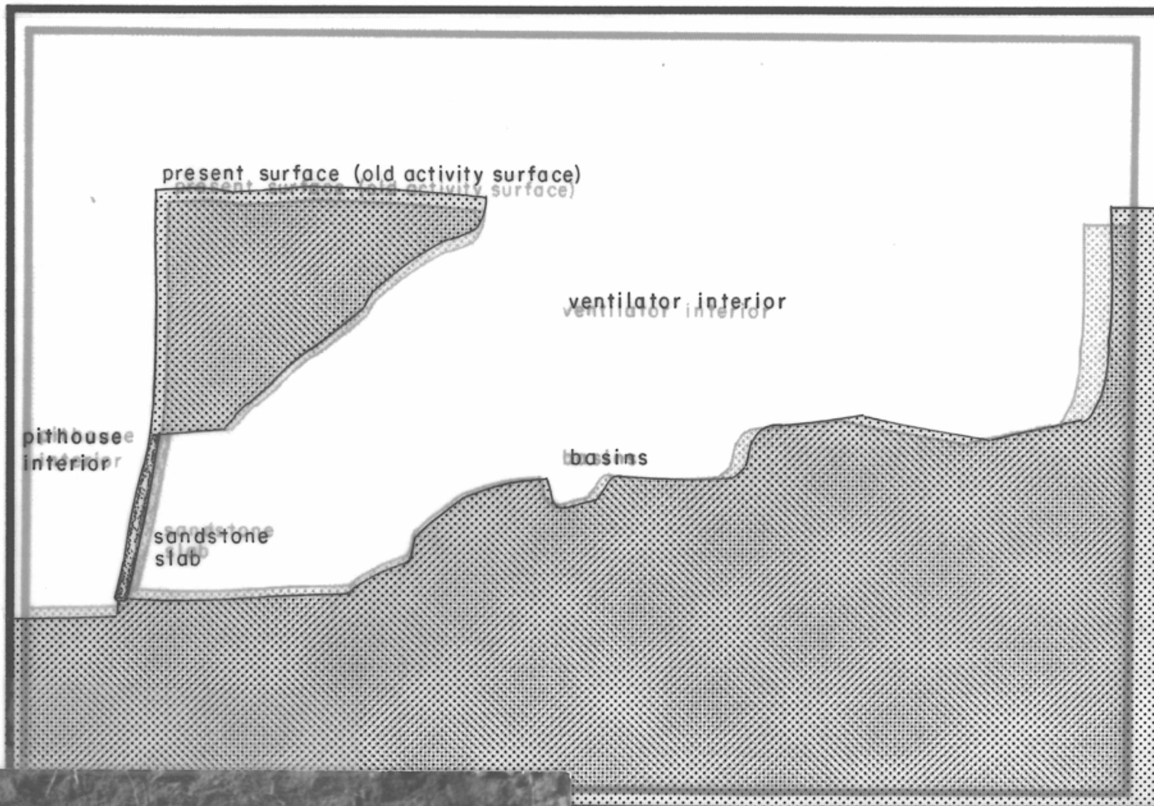

Figure 7. Ventilator tunnel.

Figure 8. Ventilator, with damper slab in place.

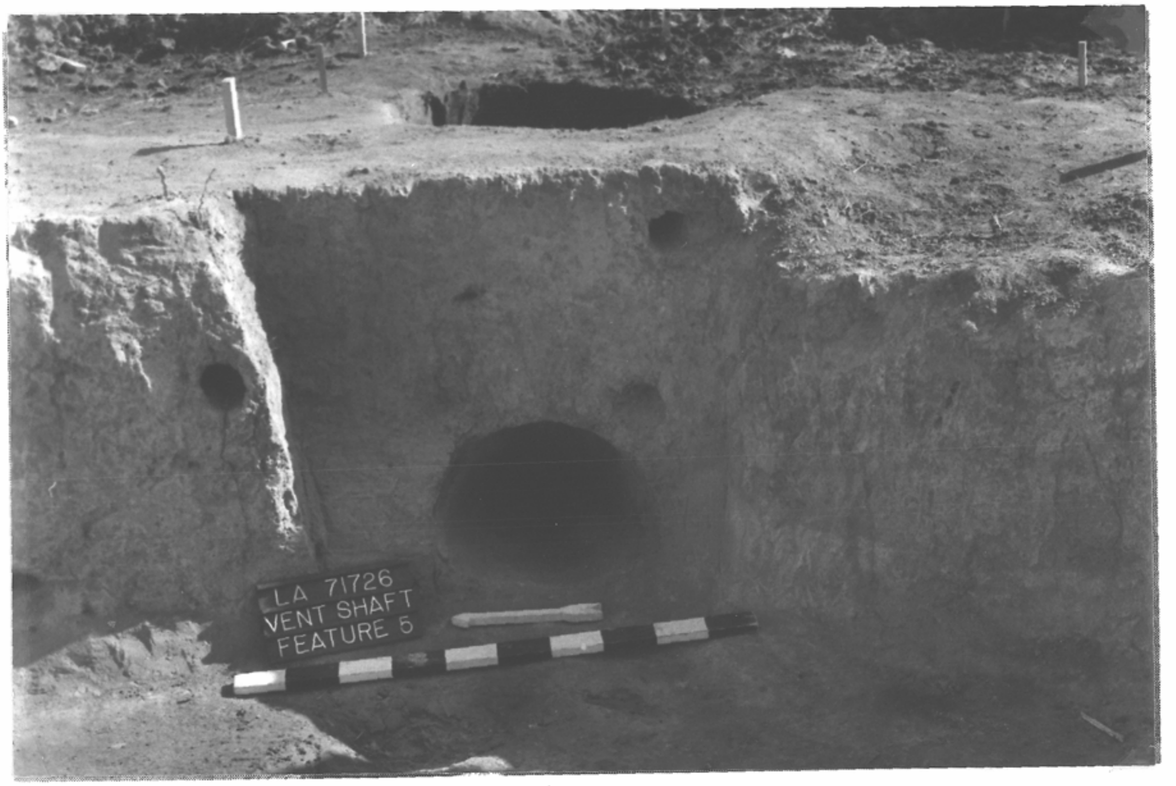

Figure 9. Ventilator, with damper slab removed.

The outline of Feature 9 was not visible on either floor, and was only visible when the lower floor was excavated to search for subfloor features. This was also the case with the four possible postholes. Feature 9 was dug into the sterile fill below the floor, was roughly circular (37 by 33 cm), and extended 28 cm below the lower floor. The sides of the posthole were straight and the base was flat. One large cobble was embedded in the east wall of the posthole, another on the top edge immediately below the floor. The fill was dark and ashy, mixed with charcoal, chunks of unburned wood, ceramic and lithic artifacts, and bone. There were no upright pieces of wood.

Features 10 through 13 are each located in a separate quadrant of the structure, along the interior wall (see Fig. 4). They each angle under the wall and may be rodent tunnels. The only factor in considering them possible postholes was their placement, but they may not be valid cultural features. If they *are* postholes, their placement suggests four posts angling towards a central support system, with Feature 9 serving as an additional support. Slanted postholes were found at the Fite Ranch site (LA 45884). Pit structure A at this site had a four-post pattern, with seven additional postholes sloping towards the center, tapered at the bottom.

Feature 10 was in the northwest quadrant. It measured 27 cm north-south by 30 cm east-west; its depth was 42 cm below the upper floor (the lower floor was not found near the walls). The feature angled slightly under the wall to the north. The fill was dark, ashy, clay sand, showing as a dark circular stain below the floor. Two small pieces of unburned wood, two lithic artifacts, and three bones were found in the feature.

Features 11a and 11b are in the northeast quadrant. Feature 11a appeared as a dark circular stain; the fill angled under the wall when excavated. On the surface (below the lower floor) the stain measured 40-by-36 cm; it was 20 cm deep. The fill was the same as that in Features 9 and 10. Feature 11b was a 15 cm diameter hole 14 cm to the south of Feature 11a. It was 18 cm deep and also had dark ashy fill. Ceramic and lithic artifacts were recovered from Feature 11a.

Features 12a and 12b are in the southeast quadrant. They were both relatively shallow (12 and 14 cm deep). They showed below the lower floor: Feature 12a as an an oval, 23-by-18 cm, and Feature 12b as a 15-cm diameter stain. They slant down slightly towards the wall. Unlike Features 10, 11a, and 13, these holes are about 10 cm away from the wall rather being right against it.

Feature 13 is in the southwest quadrant, against the wall. It measured 38-by-33 cm and 27 cm deep. The fill is the same as the previous possible postholes. Two sides are straight, but the north wall of the feature slants slightly. Ceramic and lithic artifacts, and some bone, were found in the fill.

Prehistoric Surface

This surface was about 10 cm below the present ground surface, covered with loose eolian sand. It was a slightly compacted level, dark brown and stained with ash and charcoal. All extramural features appeared in outline when the present ground surface had been stripped to this level, and therefore it is thought to be the prehistoric living surface.

Burial

A burial (Feature 4) was found during backhoe scraping. It was about 2 m north of the pit structure in Grids 111N/102E and 111N/103E. The remains were badly deteriorated, probably due to proximity to the surface (the burial was just below the cultural surface), and disturbed by the backhoe. Part of the pelvis, one femur, and a clavicle were undisturbed. The burial was not in a midden area and there was no apparent burial pit or grave preparation. Orientation was not possible to determine, but may have been to the north. The fill that was removed by the backhoe from the burial vicinity was screened through ¼-inch mesh screen to recover bones and associated artifacts. The burial is described in detail in the Analysis of Human Remains.

Extramural Hearth

This is a small, shallow hearth, 29 cm diameter and 10 cm deep, located about 3 m northeast of the pit structure. It is in Grids 111N/104E. It showed up as a dark circular stain on the prehistoric surface after backhoe scraping. The hearth is informal and unprepared. The fill contained large amounts of charcoal and burned sand. One burned rock was on the surface of the hearth.

Charcoal Stains

There were three ash and charcoal stains, Features 2, 3, and 7. They are all only 1 to 3 cm thick and of an amorphous shape. These features may be the result of a natural burn rather than having a cultural origin. Feature 2 is the large amorphous charcoal and ash stain on the north side of the road, evidence of which was found during the testing phase. During the testing phase, a semicircular charcoal stain first appeared at the base of Level 1, in Grids 130N/139E and 129N/139E. The stain was more visible at the base of Level 2, and ash and charcoal were present. Burned corn was found 40 cm below surface. This feature was thought to be a hearth or roasting pit during testing. During data recovery, the backhoe stripped a large area around Feature 2 to define the burned area. The stain is about 4-by-2 m, and 3 cm deep, with a 30 cm diameter circular charcoal concentration in the center (Fig. 2). No burned rocks or any obvious hearth preparation was evident.

Feature 3 is on the south side of the highway, around Auger Test 21. During the testing phase, charcoal was found at 27 cm below surface, and the soil was a darker brown than in the surrounding auger tests. Rock was hit at 28 cm below surface, and at the same depth in an adjacent test 30 cm away, which was suspicious due to the lack of surface and subsurface rock in the area. Four additional auger tests were placed around Auger Test 21, each 1 m away in all four directions. Charcoal and dark soil were found in all four tests, from about 20 to 30 cm below surface. By about 45 cm below the ground surface, the soil was sterile. During data recovery, the area around Feature 3 was stripped to the level at which charcoal appeared. There was some slight staining at this level, but no definite outlines. It was amorphously shaped, and measured about 2.3 by 1.6 m. The staining scraped away easily, and the the soil below was culturally sterile.

Feature 7 became apparent during backhoe stripping around the pit structure, in Grid 105N/104E. It is about 1 m south of the ventilator shaft. The stain is similar to Features 2 and 3 in that it is amorphously shaped and is only 1 to 2 cm thick. Feature 7 measures roughly 1.5 by 0.4 m.

Backhoe Trench

This trench was excavated parallel to the fenceline, between the pit structure and the right-of-way fence, running the length of the site (48 m). The depth varied from 1.3 to 1.5 m. Only two soil horizons were visible, both culturally sterile. The upper stratum was dark brown loose organic-looking fill, about 60-70 cm thick. Underlying this was a fine, light tan sand. No cultural features were noted in profile.

CHRONOMETRICS

Four charcoal samples were submitted for radiocarbon analysis. Samples were from the pithouse fill, the ventilator shaft, the hearth on the pithouse floor, and a posthole. Samples were all juniper and assumed to be either structural or fuel wood. Results are presented below in Table 2.

Table 2. Results of C-14 Analysis

Location	Radiocarbon Age	Calibrated Age	One Sigma	Two Sigma
Pithouse fill	A.D. 890 ± 70	A.D. 985	A.D. 894-1021	A.D. 809-1154
Vent shaft	A.D. 1030 ± 70	A.D. 1047, 1091, 1118, 1143, 1153	A.D. 1021-1211	A.D. 980-1260
Hearth	A.D. 910 ± 60	A.D. 999	A.D. 960-1024	A.D. 890-1050
Posthole	A.D. 800 ± 70	A.D. 889	A.D. 785-975	A.D. 680-1020

Three of the dates--from the pithouse fill, the hearth, and the posthole--fit within the Tajo phase (A.D. 800-1000), the ceramic assemblage, the archaeomagnetic results (below), and with other dated Tajo phase sites in the site vicinity. Results from the hearth and the posthole probably most accurately determine occupation of the pithouse. Fill in the vent shaft was probably deposited after abandonment of the pithouse, perhaps by occupants of a slightly later structure that either no longer existed at the time of this data recovery program or was out of the right-of-way. The sample from the pithouse fill was close to the floor, and was probably deposited soon after abandonment of the structure.

An archaeomagnetic sample was taken from the hearth on the lower pithouse floor. This sample dated A.D. 930-1010, very similar to the C-14 sample from the hearth. Appendix 2 shows the sample results.

CERAMIC ANALYSIS

Methodology

The entire assemblage from LA 71276, consisting of 2,082 sherds, was analyzed. The variety of ceramic types encountered was very limited (Table 3). The assemblage was mostly brown wares (93.1 percent), which includes 1.2 percent red-slipped brown wares and 1.2 percent red-on-brown, and one neck-banded brown ware. White wares comprised 6.9 percent of the total assemblage.

Because of the profusion of brown ware type descriptions and the difficulty in actually sorting these types, a descriptive rather than a typological approach was followed during our analysis. Brown wares were coded as plain polished rim or body, plain unpolished rim or body, red-slipped, or red-on-brown. Surface treatment, such as incising or neckbanding, was noted. It was hoped that in using this method, differences would become obvious and sherds could then later be classified into specific types. Types contributing to the confusion include El Paso Brown, Jornada Brown, Alma Plain, Coarsened Alma, Plain Brown, Polished Brown, Common Brown, Roswell Brown, and South Pecos Brown.

Small sherds of red-slipped brown wares were often difficult to code by vessel form. Generally, though, bowls were slipped on the interior and exterior, and jars only on the exterior.

Sherds were assigned to vessel form categories, which in many cases proved to be difficult. Within brown wares, jars predominate, but without a rim or neck sherd, or a sherd that showed definite smoothing or polishing on one side or the other, we did not feel that we could make an

Table 3. Ceramic Types from LA 71276

Ceramic Type	Number	Percent
Plain brown ware	1,886	90.6
Neck-banded brown ware	1	.05
Red-slipped brown ware	25	1.2
Red-on-brown	26	1.2
Boldface Black-on-white	3	0.1
Red Mesa Black-on-white	96	4.6
Gallup Black-on-white	1	.05
Indeterminate white ware	44	2.1
Total	2,082	100.0

accurate determination of vessel form, and these were coded as "Indeterminate body sherds." A further complication was the small size of the sherds; they often were too small to exhibit vessel curvature or form.

Prior to beginning the ceramic analysis, a sample of sherds representing various temper types was submitted for petrographic analysis. The objective was to identify the temper and source areas, and thus determine local vs. nonlocal manufacture. During analysis, temper was examined with a binocular microscope and recorded for all sherds. Magnification ranged from 10x to 45x. Temper size was recorded informally as fine, medium, or coarse.

Other attributes recorded for all sherds included rim form and cross section, paste color and surface color, slip (color and location on vessel), presence of carbon streak, presence of burned exterior, vessel appendages, and any modifications to the sherd, such as drill holes or shaping. Design elements were recorded for white wares and red-on-brown wares. Rim diameter was included in the analysis, but only one vessel had a rim large enough to measure.

Polish and vessel form, as attributes, were included in the type name, as in "Plain polished body, Plain polished rim, Plain unpolished body, and Plain unpolished rim." With the analysis well underway, it became apparent that there were two distinct types of polish present on the sherds. The majority had an uneven streaky polish, while some sherds had an almost glassy overall polish. Since we began coding "type of polish" midway through the analysis, the statistics on this attribute only represent a sample (13.1 percent) of the assemblage.

Attributes from the Office of Archaeological Studies Standardized Ceramic Coding Manual (draft form) were used for the detailed analysis. When analysis was completed, the data were entered into the Statistical Package for the Social Sciences (SPSS).

Type Descriptions

Jornada Brown

Jennings (1940) was the first researcher to describe, but not name, Jornada Brown; it was later named by Mera (1943). Jennings described this type from LA 2000, in the Rio Peñasco Valley east of the Sacramento Mountains, and referred to it as Unnamed, or Common, Brown Ware. It was distinguished from El Paso Brown by rim form and surface finish. Jennings's description follows. Rim forms on both bowls and jars are simple and direct with no appreciable flare or lip treatment. Lips are slightly rounded or square. In contrast, El Paso ollas generally have widely flared rims with thickened lips. Bowl rims, though, are often direct. Jornada Brown is typically smoothed and polished on both surfaces, a striking contrast to El Paso Brown. Color varies from dark brown to a light brown or tan, and is sometimes red. Occasionally the red is the result of a slip or wash. Decoration, when it occurs, is in the form of crudely applied broad red lines. Temper is generally finer and wall thickness greater in Jornada Brown than in El Paso Brown.

In the earlier of the two occupations at LA 2000, Common Brown Ware comprised 92.0 percent of the assemblage. It was accompanied by minor amounts of El Paso Polychrome, Mimbres Black-on-white, Chupadero Black-on-white, and Three Rivers Red-on-terracotta.

Mera (1943:13) noted that when Jornada Brown reached "full development," Mimbres Boldface suddenly became abundant at sites west of the Sacramento Mountains. He attributed this to either trade, the arrival of an intrusive population, or rapid adoption of a style by the indigenous population. At the time of Mera's research, no work had been done in the vicinity of LA 71276; this region appears to have been unaffected by the influx of either the western population or the ceramic style.

Mera felt that Coarsened Alma evolved into Jornada Brown. The difference in these types is questionable and the names may have been used interchangeably in the Jornada area. Whalen (1980a, 1980b) suggests that Jornada Brown is an offshoot of El Paso Brown, distinguishable at about A.D. 900.

Kelley (1984:122) cites the Sierra Blanca region as a manufacturing center of Jornada Brown. Jornada Brown extended east to the Pecos Valley and west to the Gran Quivira area. It is also found in the lower Tularosa Basin and in the middle and lower Rio Grande Valley. As an intrusive type, it has been found as far north as Taos. It has an extensive temporal range, lasting from Pueblo I through Pueblo IV.

Within Jornada Brown there is considerable variation in temper, color, thickness, and other attributes (Kelley 1984:121-122). Kelley elaborated on the original type description. Ollas were globular and generally 25 to 36 cm high; vessel mouths were usually 15 to 18 cm in diameter, with an unthickened, direct rim. Jars outnumber bowls. Bowls tended to have slightly slanting sides. Unpolished vessels were smoothed by hand; when polishing occurred, polishing marks were evident. Kelley found in the Sierra Blanca assemblages that most of the Jornada Brown was unpolished or matte finished. When polishing occurred, it was present on olla exteriors and on bowl interiors, and tool marks were visible. The most common temper was quartz and feldspar. Size of the tempering particles ranged from very fine to coarse, with most falling in the medium range. Pearlite occurred occasionally, and mica was present in most sherds (Kelley 1984:133-135).

Polish in particular seems to vary considerably. Besides being polished or unpolished, surfaces can be floated or semipolished. Vessels can be smoothed by wiping and rubbing, often leaving striations. Polishing may then give the appearance of a float. According to Laumbach and Laumbach (1989:15), unweathered sherds always show the effects of polishing, varying in degree from fairly glossy to perfunctory, on both interior and exterior surfaces. In contrast, El Paso Brown Ware is rarely polished.

Two variants of Jornada Brown were encountered at LA 71276--Jornada Red-on-brown and Jornada Red-slipped. Jornada Red-on-brown has been described by Jennings (1940), Mera (1943) and Kelley (1984). It has broad red line decoration about ¼ inch (about 0.64 cm) wide or red bands about 1 inch wide (2.54 cm). Red-slipped Jornada has a slip applied to a vessel that otherwise would be classified as Jornada Brown (Kelley 1984:135-136).

Jornada Red-on-brown can be confused with San Andres Red-on-terracotta, a type defined by McCluney (1962) from the Hatchet site in the northern Tularosa Basin. The geographic range for San Andres Red-on-terracotta was defined to include the northern Tularosa Basin east of the Rio Grande between the Capitan and San Andres Mountains, 10 miles south of Alamogordo and north to the vicinity of Corona (McCluney 1962:53). Only bowl forms were found. The surface is a dark, reddish brown to a light red, with crude, wide lines radiating downward from the decorated rim and terminating above the bottom of the vessel. The surface color does not approach the orange color characteristic of its successor, Three Rivers Red-on-terracotta. Line width varies from 0.5 cm to 0.8 cm (the line width estimated by Kelley, above, for Jornada Red-on-brown falls within the range for San Andres Red-on-terracotta; in fact, it is the mean width for San Andres Red-on-terracotta). Temper is predominantly quartz sand with occasional feldspar and traces of mica present. San Andres Red-on-terracotta dates from A.D. 1100 to 1300.

Kelley and Peckham (1962) suggest that San Andres Red-on-terracotta developed from the locally made red-on-brown ware, which in turn evolved from Mogollon Red-on-brown. They also suggest that the local red-slipped brown ware is related to San Francisco Red from the Mogollon area to the west.

Red Mesa Black-on-white

Red Mesa Black-on-white has a wide geographic distribution, ranging from the San Juan Basin on the north to the Mogollon region to the south; east-central Arizona on the west to east of the Rio Grande on the east (Schmader 1991:A-16); it has been found as far east as Roswell (Wiseman, pers. comm. 1993). The following description is from Schmader (1991) who has summarized information from Windes (1984), McKenna and Toll (1984), and Breternitz (1966). Paste color ranges from white through light gray to dark gray. Temper is usually angular sandstone, sand and sherd, or sherd. In later assemblages sherd temper predominates. The surface is usually slipped and polished, with both of these attributes being highly variable. Slip can range from thin to heavy, and polish from fairly well polished to streaky. Designs are executed in black or brown iron paint. Motifs can include parallel lines, framing lines with both ticked and unticked solids, saw teeth, squiggle-line hatchure, and checkerboards. Red Mesa had a temporal range of about A.D. 875 to 1050 or 1100.

In the central Rio Grande Valley, Red Mesa is found on all late Pueblo I and Pueblo II sites (Skinner 1965; Vivian and Clendenen 1965; Peckham 1957). Vivian and Clendenen (1955:11-12) described Red Mesa Black-on-white from the Denison site "for eventual comparative studies with similar pottery in the Rio Grande and to the west." Their description is almost identical to later descriptions of this type (above). Interesting temper observations include the fact that half of the sherds were sand tempered, a quarter had sherd only, and the remainder had sherd and sand. A number of sherds had inclusions described as thin and tabular ("silt or clay particles?"), with rounded edges; these are probably clay pellets.

Red Mesa Black-on-white is found on all Tajo phase sites along the Rio Abajo (Marshall and Walt 1984) and on sites dating to that period on the White Sands Missile Range (Sale 1988; Shields 1987; Laumbach 1986; Clifton 1985; Lambauch and Kirkpatrick 1985). It was present on both of the excavated Tajo phase sites in the project vicinity, Fite Ranch and Taylor Draw.

Mangus (Boldface) Black-on-white

Three sherds of Mangus (Boldface), from the Mimbres region to the west, were found. These sherds have a buff paste and were tempered with crushed igneous rock, probably tuff. Designs are in both dark brown and black mineral paint. Two of the sherds exhibit solid lines 4-6 mm in diameter; the third sherd has thin horizontal hatching lines bordered by a 6-mm-thick line.

Temper Descriptions

Two temper types, both containing feldspar, characterized the brown wares--monzonite and hornblende diorite. A third type was found occasionally, which was composed of a weathered, rounded, gray-buff feldspar, generally without hornblende. Monzonite was generally a much coarser temper than hornblende diorite (hornblende diorite had predominantly "medium" sized temper in this assemblage). Monzonite is made up of orthoclase, plagioclase, and quartz with some brown hornblende and biotite. Rock fragments composing tempering material vary considerably within the assemblage from fine to coarse, though coarse monzonite was more common than fine or medium. The feldspars have been altered by sericitization (the process by which clay minerals or feldspar are altered to a form of muscovite known as sericite); the biotite has been altered to hematite and clay minerals. Other minerals found occasionally in the monzonite temper include blue-green pyroxene (probably augite) and magnetite (Hill 1992a).

Brown wares tempered with crushed mozonitic rocks have been found in sites located to the east near the Carrizo, Patos, and the Capitan Mountains, and to the south in the Sacramento Mountains (Stewart et al. 1990; Hill 1992a). These mountain ranges all contain intrusive rocks that can be classified as monzonites.

There is a large diorite dyke about 1.6 km (1 mile) to the southeast of the site, which is a source for the hornblende diorite temper. This outcrop is now bisected by NM 380, but would have been exposed to the surface prior to construction and thus would have been available to the prehistoric potters (Hill 1992a). The intrusive is about 1.6 km (1 mile) long and only about 100 m in width. The material is very friable and easily crushed. The feldspar in the hornblende diorite is usually finer than that in monzonite temper. The predominant mineral is plagioclase, often altered to sericite and clay minerals. Few microinclusions other than yellowish brown to green hornblende were found in the samples submitted for petrographic analysis. Occasional pieces of magnetite and brown biotite are sometimes present.

The third igneous temper type, the weathered, rounded, gray-buff feldspar, was found in only 4.3 percent of the brown ware sherds. It is not known where this material outcrops.

Most of the whiteware sherds submitted for petrographic analysis were tempered with crushed potsherds. The pastes of these specimens were a mottled gray-white with silt-sized quartz inclusions varying from sparse to abundant. Moderately well sorted quartz arenite sandstone was also found in these white ware sherds (Hill 1992a).

A variety of inclusions was present in some of the sampled sherds. Three samples had fragments of igneous rock with abundant magnetite cubes. Similar white ware sherds containing crushed sherd, sandstone, and igneous fragments were observed near Torreon, on Chupadera Mesa (Hill 1992b). Another sherd had an unusual grayish brown paste containing large clay/shale oblate pellets, some of which are over 3 mm in length. Isolated grains of quartz, orthoclase, and microcline are also present with crushed sherds in this sample. Although oblate clay/shale pellets are found in Cibola White Ware from the San Juan Basin, Hill (1992a) feels that the paste of this specimen is sufficiently different to distinguish it from the gray to white pastes usually associated with Cibola White Ware, but that it may be from the southern Cibola (Laguna/Acoma) area.

Another sample was tempered with a sandstone containing occasional quartz grains that were derived from a metamorphic source (Hill 1992a). Cibola White Ware resembling this specimen has been reported from the eastern Red Mesa Valley, although in ceramics that were made at a later time than those at LA 71276 (Garrett 1991).

Four samples had chalcedonic cemented sandstone along with the sherd temper, a common combination in Cibola White Wares from the San Juan Basin (Hill 1992a). Chalcedonic sandstone found within the San Juan Basin is present in the Ojo Alamo and the Morrison Formation, and in the Chuska Sandstone (Cadigan 1967; Warren 1967, 1977).

Two sherds within the sample contained crushed potsherds without sandstone fragments. The paste contained abundant fine isolated angular and subangular quartz, orthoclase, and microcline grains. These mineral grains could represent natural inclusions in the clay or the use of sand temper in the original vessels used for temper (Hill 1992a).

One sample has a light yellowish buff paste and a light gray welded tuff temper. The tuff contains quartz, plagioclase, and sanidine; chalcedony is present within the tuff fragments. A few fragments of basalt were also observed in this specimen. Hell's Mesa Tuff, which outcrops along the Rio Grande to the west in the Socorro/San Antonio area, is the nearest source of volcanic tuff. Basalt fragments are present with this tuff. Tuff-tempered white wares are more common in the vicinity of the Valle Grande or in the Mimbres area. One tuff-tempered white ware sherd was found near Torreon, on Chupadera Mesa (Hill 1992a, 1992b).

Following is the discussion from Hill (1992a) concerning the sample of sherds submitted for petrographic analysis:

> The wide variety of pastes and tempers observed in the current sample is striking. In the case of the plain and decorated brown ware ceramics, it appears that while some ceramic production took place using the local diorite, the majority or the specimens were tempered using crushed monzonite that is only available at outcrop locations several miles to the south.
>
> None of the white ware sherds were locally produced. Sample 37-1 was probably tempered using Hell's Mesa Tuff which outcrops in the Socorro area. White ware ceramics from a contemporary site located near Socorro [Fite Ranch] have also been found to contain Hell's Mesa Tuff (Warren 1986).
>
> The other sherds were tempered using crushed potsherds often containing sandstone fragments with chalcedonic cements. White ware sherds with chalcedonic sandstone temper have been reported from the Fite Ranch site (Warren 1986). Sandstones with chalcedonic cements have been more commonly observed in white wares from the San Juan Basin. The use of sandstones containing quartz from a metamorphic source has also been reported from the San Juan Basin, specifically the Red Mesa Valley. The presence of igneous rock fragments along with the sandstones in Samples 38-1, 41-2, and 50-1 has not been previously observed in Chaco Series Cibola White Ware, although these rock fragments could have been derived from Mesa Verde White Wares used for sherd temper.

Bingham Assemblage

As mentioned above, the assemblage was mostly brown wares (93.1 percent), which includes 1.2 percent red-slipped brown wares and 1.2 percent red-on-brown. Surface color ranged from black to medium brown to light brown (Table 4). Black was the dominant surface color (26.2 percent), followed by the various shades of brown. Small amounts of red-brown, dark gray, and cream also occurred. Medium brown was the dominant paste color (28.6 percent), followed by dark brown and light brown (Table 5). Other paste colors occurring in minor amounts include tan, black, red-brown, gray, orange, and red. Thus, the most common appearance of Jornada Brown sherds in this assemblage was a black surface color with a medium-brown paste. Carbon streaks were present in only 26.2 percent of the brown wares.

During analysis, a high number of bowl sherds with a polished black finish were observed, similar to Reserve or Los Lunas smudged vessel interiors. In the Jornada area, it has been referred to as Jornada Smudged. Looking at only bowl sherds, black was the most common surface color (40.2 percent), followed by dark, medium, and light brown (Table 6). Of those bowls with a black surface color, most had a dark brown paste (37.8 percent), followed by black and medium brown. Polish on these black bowls was generally streaky (72.0 percent) rather than a good overall polish (28.0 percent). Although Jennings does not mention black as a dominant surface color, sherds of

Table 4. Brown Ware Surface Colors

Color	Number	Percent
Dark brown	394	20.6
Medium brown	458	24.0
Light brown	239	12.5
Tan/buff	127	6.6
Orange	10	0.5
Red	11	0.6
Red/orange	5	0.3
Red/brown	41	2.1
Light gray	8	0.4
Dark gray	98	5.1
Black	500	26.2
Cream	11	0.6
Indeterminate	10	0.6

Table 5. Brown Ware Paste Colors

Color	Number	Percent
Dark brown	523	27.4
Medium brown	546	28.6
Light brown	194	10.2
Tan/buff	161	8.4
Orange	18	0.9
Red	14	0.7
Red/orange	23	1.2
Red/brown	129	6.8
Light gray	22	1.2
Dark gray	106	5.5
Black	168	8.8
Cream	7	0.4

Table 6. Surface Color of Brown Ware Bowls

Color	Plain Polished Brown Ware	Plain Unpolished Brown Ware	Red-Slipped Brown Ware	Red-on-Brown	Total/Percent
Dark brown	58	8	3	1	70/16.2
Medium brown	44	16	3	3	66/15.2
Light brown	31	14	0	3	48/11.1
Tan/buff	14	11	1	3	29/6.7
Orange	1	0	0	0	1/0.2
Red	8	0	1	0	9/2.1
Red/orange	1	0	0	1	2/0.5
Red/brown	9	3	0	0	12/2.8
Dark gray	15	2	1	0	18/4.2
Black	165	7	2	0	174/40.2
Cream	3	1	0	0	4/0.9

this polished black ware were observed in the type collection from LA 2000 housed in the Laboratory of Anthropology's type sherd collection.

A potentially important temper difference was observed between the polished and the unpolished brown wares. Monzonite predominated within the polished wares (53.0 percent), the red-slipped brown wares, and the red-on-browns, while hornblende diorite predominated within the unpolished brown sherds (63.1 percent). This may be significant in determining local versus intrusive style differences, since hornblende diorite is a local temper (though the source of the monzonite is unknown). Therefore, the unpolished brown wares may be locally made while the polished, red-slipped brown wares, and red-on-browns may be intrusive. This problem may be resolved with more petrographic study of temper material, directed at locating monzonite sources.

Almost all the brown ware jar rims were straight (93.3 percent), and most of these had a rounded, tapered cross section. One jar sherd had an everted rim with a rounded, tapered cross section, and one had a flared rim with a round cross section. The bowl sherds were similar in that they were almost all straight rims. There was more variation in cross section: most still had a rounded, tapered cross section (69.4 percent), although round, square, and flat-tapered also occurred in lesser quantities. Within rims from indeterminate vessel forms, all were straight, and cross sections were almost evenly split between rounded-tapered and round; a few with a flat, tapered cross sections also occurred.

Because of the difficulty in distinguishing vessel form for brown wares, and the small size of the sherds, 46.1 percent of the brown ware sherds were categorized as Indeterminate vessel form. Jars comprised 30.7 percent of the brown ware assemblage and bowls comprised 23.1 percent. Less than 1 percent included seed jars, ladles, and pipes. One whole and one partial cloudblower and three pipe fragments were present (Fig. 10). (A high frequency of tobacco seeds occurred in the botanical samples--see Macrobotanical Analysis, this volume.) Tubular pipes such as these were also found at PI-PII sites near Albuquerque, LA 3289, 3290, and 3291 (Peckham 1957) and at the Sedillo Site near Isleta (Skinner 1965). Within both the red-on-browns and the red-slipped brown wares, bowl sherds were most common.

All of the 26 red-on-brown sherds that had discernible designs had broad-line red designs, except for one that was only red-slipped on the rim (Fig. 11). Only nine sherds had measurable red line widths. Of these, 3 were 7-9 mm wide, 5 were 10-12 mm wide, and 2 were greater than 12 cm wide (Table 7). These are close to the parameters for Jornada Red-on-brown established by Kelley (see above). Most of these sherds were from bowls (42.3 percent; n = 11); eight were from jars (30.8 percent) and seven (26.9 percent) were indeterminate. The red-slipped brown ware sherds were also mostly from bowls (64 percent).

The white wares comprised 6.9 percent of the total assemblage. There were 96 sherds that were identified as Red Mesa Black-on-white and three as Mangus (Boldface) Black-on-white at LA 71276 (Fig. 11). Another 44 sherds were either unslipped and unpainted, slipped and unpainted, or slipped with mineral paint (not enough to distinguish design), that were probably also Red Mesa Black-on-white, based on the Cibola paste and the quality of the slip.

The majority of the painted sherds were decorated with brown mineral paint (82.1 percent); the mineral paint on the others was black. The most striking feature within the Red Mesa sherds was the boldness of the design, contrasting with the fine lines associated with this type. Though design elements were typical Red Mesa motifs, such as scrolls, triangles, squiggle lines, and parallel lines,

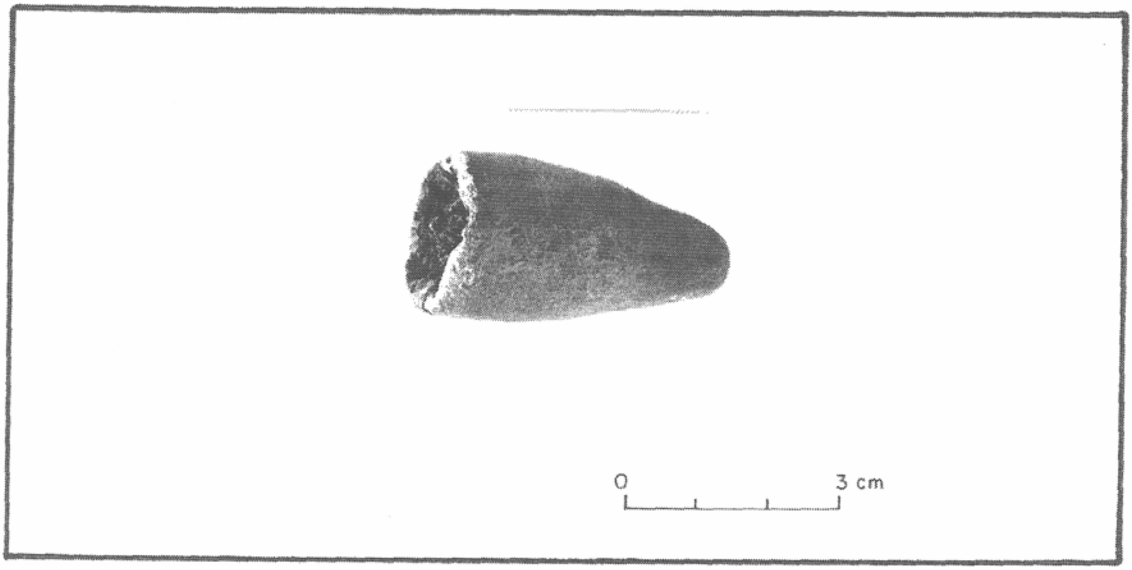

Figure 10. Brown ware cloudblower.

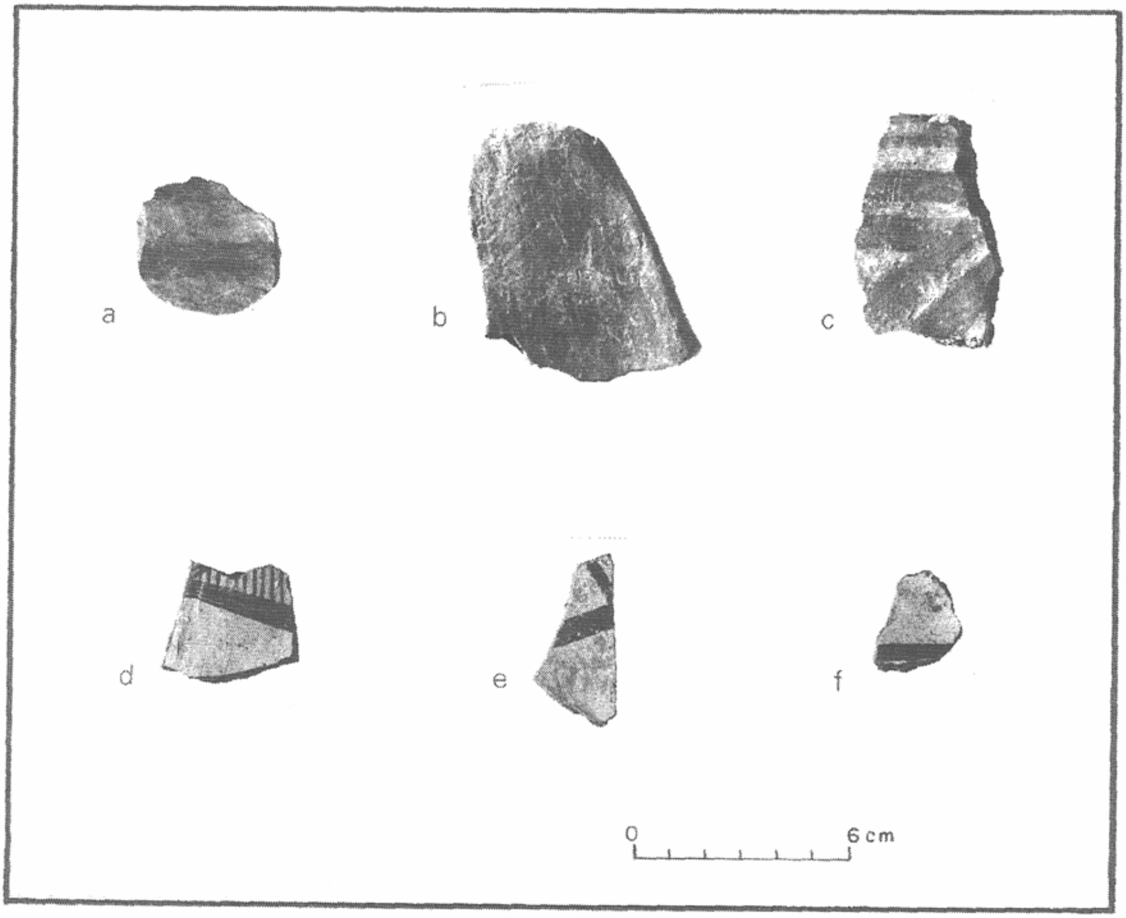

Figure 11. (a-c) Jornada Red-on-brown sherds; (d-f) Mimbres Boldface Black-on-white sherds.

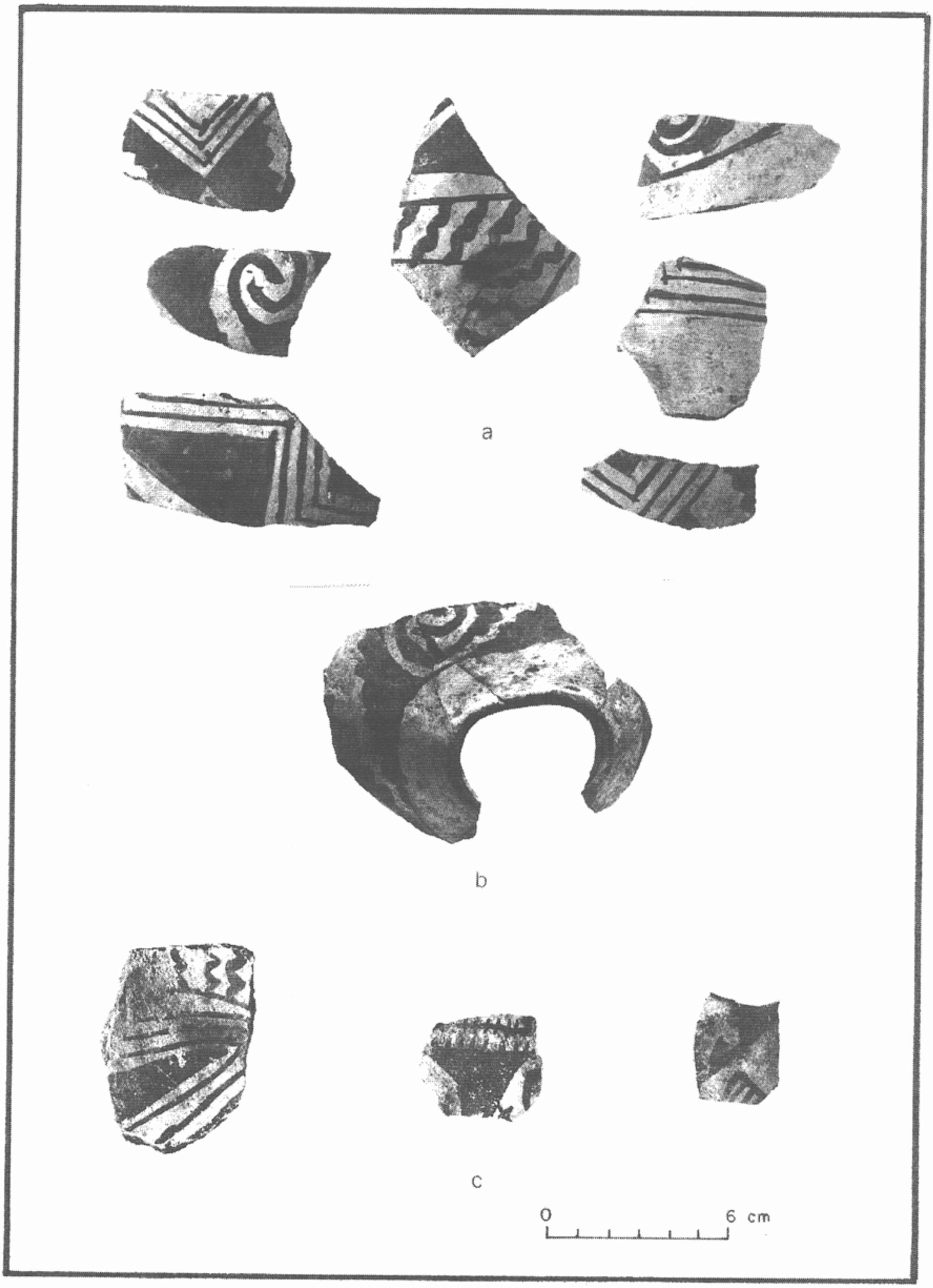

Figure 12. Red Mesa Black-on-white, bold style. Fragments a-b are from the same vessel.

Table 7. Design Band Width for Red-on-brown Ceramics

Width	Frequency and percent
7-9 mm wide	3 (11.5)
10-12 mm wide	5 (19.2)
Greater than 12 mm	2 (7.7)
Indeterminate width	15 (57.7)
Red on rim only	1 (3.8)
Total	26 (100.0)

most were decorated in a bold, sloppy style (Fig. 12). Triangles were large, solid areas with little or no ticking, and lines were thick and uneven. Some sherds were decorated in the "classic Red Mesa style," with finely executed, thin, parallel lines, scrolls, and ticked triangles, though these sherds were in the minority (Fig. 13). Since some of the Red Mesa Black-on-white from Taylor Draw also was decorated in the "bold" style (Peckham, pers. comm. 1993), as well as a few sherds from Fite Ranch, this may be a regional variety of Red Mesa Black-on-white. However, more detailed study of this style is necessary to determine whether a regional distribution exists.

More than half of the white wares were tempered with sandstone and crushed sherd or sand and crushed sherd (73.9 percent). Minor amounts of crushed igneous rock and sand, sand/sandstone, basalt, sand, and clay/shale pellets were observed (Table 8). Paste color was generally light to dark gray; carbon streaks were rare (present in 17.1 percent of the white ware sherds). Jars were the most prevalent vessel form within the white wares (69.5 percent); bowls comprised 25.5 percent. A few canteen sherds and indeterminate forms occurred. Of the seven bowl rims present, all were straight with a round or round-tapered cross section.

Worked Sherds

There were 22 worked sherds in the assemblage. All but three of these were brown wares (Table 9). Modifications included shaped (round and oval), worked edges, and drill holes.

Table 8. White Ware Tempers

Temper	Percent
Sand/sandstone, sherd	53.4
Sand and sherd	20.5
Crushed igneous and sand	8.9
Sand/sandstone	6.2
Crushed igneous	3.4
Crushed igneous, sand, sherd	2.7
Basalt, sand, sherd	2.1
Sand only	2.1
Sand, sherd, clay/shale pellets	0.7

Table 9. Type of Modification on Worked Sherds

Ceramic Type	Drill Hole	Shaped, Round	Shaped, Oval	Shaped, Other	Modified Edge	Total
Plain polished brown ware	3	0	0	0	5	8
Plain unpolished brown ware	2	0	1	1	6	10
Red-on-brown	0	1	0	0	0	1
Red Mesa Black-on-white	0	0	0	1	0	1
Slipped, unpainted	2	0	0	0	0	2
Total	7	1	1	2	11	22

Assemblage Comparisons

The white wares from the Fite Ranch site (LA 45884) were examined to compare design styles with those from the contemporary site of LA 71276. However, the ceramic assemblage described in Baldwin et al. (1986) for LA 45884 was not consistent with what was to be expected from a site of that period. Baldwin et al. (1986) list Affinis Kiatuthlanna Black-on-white, Early Chupadero Black-on-white, and Late Chupadero Black-on-white as white ware types. No Red Mesa Black-on-white was listed, and Chupadero Black-on-white is not typical for a site dating to A.D. 900-1000. Therefore, we reexmained and consequently retyped these sherds. The results of our second analysis provided significantly different results from those reported by Baldwin et al. (1986).

Baldwin et al. (1986) typed four sherds as "Kiatuthlanna Black-on-white," that we called Red Mesa Black-on-white. These sherds are very similar to our Red Mesa Black-on-white, with coarsely executed bold triangles, squiggles, and spirals. The paste is light gray, with sand and sherd temper. There were 23 sherds labeled "Early Chupadero Black-on-white" that are also Red Mesa Black-on-white. All of the decorated sherds are classic Red Mesa style, with fine lines, ticked triangles, and a well-polished white slip (much more finely executed than most of the LA 71276 Red Mesa sherds). Another 25 sherds were also called Early Chupadero Black-on-white that are neither Chupadero nor Red Mesa Black-on-white according to our analysis. They lack the characteristic paste, finish, interior scoring, and design of Chupadero Black-on-white, and were not identified to a specific type. Several of these sherds are from one vessel (jar), with an unslipped and unpolished light gray to buff surface; the design consists of 3-4-mm-wide lines in mineral paint. The temper is coarse quartz sand. Nine sherds, all from one vessel, were typed by Baldwin et al. (1986) as Late Chupadero Black-on-white. These sherds are from a Socorro Black-on-white vessel. They have a fine gray paste, an unslipped and unpolished smoothed gray surface, and basalt and sand temper. Design elements include solids, triangles, and hatching.

The presence of Red Mesa Black-on-white and the lack of Chupadero Black-on-white at LA 45884 is more consistent with the Tajo phase, the temporal period to which this site was assigned. Socorro Black-on-white (A.D. 1050-1275) is late for this period, but it may represent a later pot drop.

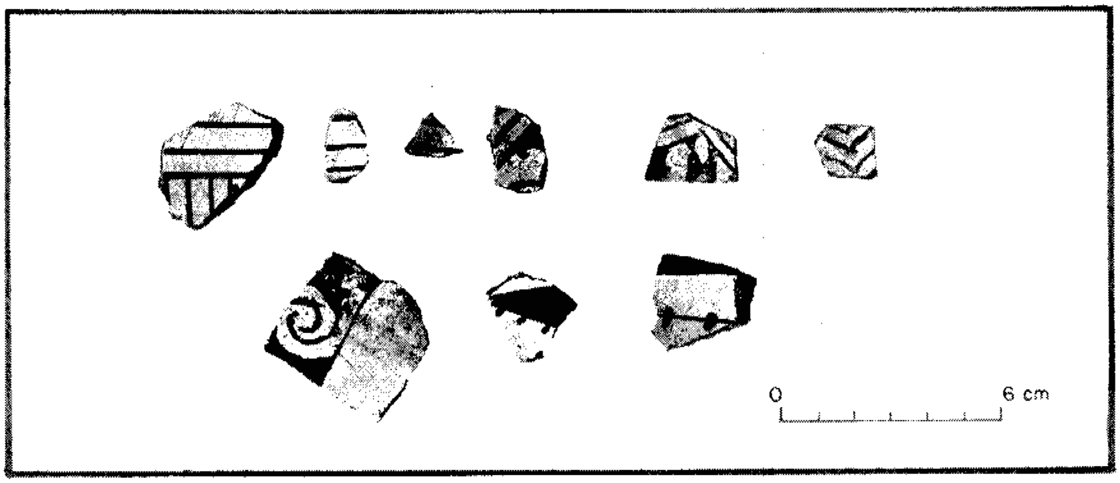

Figure 13. Red Mesa Black-on-white, classic style.

The Taylor Draw (LA 6565) assemblage is almost identical to that from LA 71276. Plain brown wares comprised 90 to 100 percent of the assemblages from the sites. The brown wares were tempered with "fine to only moderately coarse, angular, feldspathic inclusions" (Peckham 1976:51). Interior and exterior surfaces were either polished or smoothed to the degree that temper was only rarely visible on the surface. Vessel rims were direct and were neither thickened nor everted. These attributes are all consistent with the brown wares from LA 71276. Smudging, red-slipping, and broad-line red decoration were also present, more common in bowls than in jars. Red Mesa Black-on-white was present in small amounts. Most was decorated in classic Red Mesa style, with multiple parallel lines, solid triangles with pendant dots, interlocking scrolls, and wavy lines. The bolder variety, which was common at LA 71276, was also present at Taylor Draw, and Peckham (1976:52) suggests that this is a later version of Red Mesa. At Taylor Draw, designs on this type included negative zigzags, large solid elements, and bold checkerboards. Interlocking scrolls, triangles with pendant dots, and multiple parallel lines were either absent or rare. Peckham (1976:52) feels that this bolder type may represent ties to the Acoma-San Jose region. Mangus Black-on-white, a type found only rarely at LA 71276, was absent at Taylor Draw.

Conclusions

The ceramic assemblage from LA 71276 is similar to other Tajo phase sites in the vicinity, and is representative of the Tajo phase, as defined by Marshall and Walt (1984:49) in the Rio Abajo. Marshall and Walt found a prevalence of brown utility wares in association with Anasazi-affiliated Cibola White Wares. Most of the brown ware was plain, though there were traces of textured varieties present; traces of red-slipped brown ware, red-on-brown, and smudged interior plain brown wares were also found. Minor amounts of Cibola Gray Ware and traces of Mimbres White Ware occurred. Red Mesa Black-on-white was found in all Tajo phase assemblages. It was referred to as "classic Plateau variety" and no mention of a bold style was made. The Cibola White Wares, including Gallup and Puerco-Escavada in later Tajo phase assemblages, are intrusives acquired from adjacent Anasazi populations of the Rio Grande Valley to the north and the plateau to the northwest (Marshall and Walt 1984:49).

The Bingham assemblage is comprised mostly of brown wares that may indicate two areas of manufacture. Sherds tempered with hornblende diorite predominate, and this temper outcrops locally. Monzonite-tempered brown wares have been found in sites in the Carrizo, Patos, and Capitan Mountains to the east, and in the Sacramento Mountains to the south. Monzonite occurs in all of these mountain ranges. It is not known whether monzonite occurs closer to LA 71276. This needs to be resolved in order to determine whether the monzonite-tempered brown ware at Bingham was locally produced or intrusive.

None of the white wares are believed to have been locally produced. Most of the Red Mesa Black-on-white sherds were considered to be intrusives from the Red Mesa Valley to the northwest, though a few may have been made in the Socorro area. The few Mangus (Boldface) Black-on-white sherds are from the Mimbres area to the west.

LITHIC ARTIFACTS

by James L. Moore

Methodology

Lithic artifact analysis was completed using OAS's (1990a) standardized methodology and was designed to examine material selection, reduction technology, tool use, and site taphonomy. These topics provide information concerning ties to other regions, mobility, site function, and the reliability of certain attributes. While material selection studies cannot reveal *how* materials were obtained, they can usually provide some indication of *where* they were procured. In particular, by studying the type of cortex on artifacts it is possible to determine whether materials were obtained at the source or from secondary deposits. By studying the reduction strategy employed at a site it is possible to assess the level of residential mobility. The array of tools can be used to estimate the range of activities that occurred at a site and to determine what part of the settlement system is represented. This is especially important at artifact scatters that lack features. Finally, the condition of an assemblage can be used to evaluate the reliability of certain attributes. This entails analysis of artifact breakage and edge-damage patterns to determine the source of that impact. As the percentage of artifacts broken after reduction and the incidence of edges damaged by noncultural processes increase, the reliability of such attributes as artifact size, flake portions, and evidence of use decreases.

All chipped stone artifacts were examined under a binocular microscope to aid in defining morphology, material type, platform type, and evidence of tool use. The level of magnification varied between 15x and 80x; the higher levels of magnification were mostly used for examination of wear patterns. Utilized and modified edge angles were measured with a goniometer; other dimensions were measured using a sliding caliper. Analytical results were entered into a computerized data base using SPSS data entry.

Attributes Examined during the Study

Table 10 lists the attributes examined during this study and indicates which relate to each class of chipped stone artifact. Four general artifact classes were recognized: flakes, angular debris, cores, and formal tools. Flakes were debitage exhibiting definable dorsal and ventral surfaces, a bulb of percussion, and a platform; minimally, broken flakes exhibited definable ventral and dorsal surfaces. Angular debris were debitage on which no ventral or dorsal surfaces could be defined, but which exhibited negative scarring. Cores were pieces of lithic material that exhibited no positive bulb of percussion and had three or more negative scars originating from one or more surfaces. Formal tools were artifacts that were intentionally altered to produce specific shapes or edge angles. Alterations took the form of unifacial or bifacial retouching, and artifacts were considered intentionally shaped when retouch scars extended across two-thirds or more of a surface, or the original shape was no longer distinguishable.

Attributes recorded on all artifacts include material type and quality, artifact morphology and function, amount of surface covered by cortex, portion, evidence of thermal alteration, edge damage, and dimensions. Material type was coded by gross category unless a specific source could

Table 10. Correlation of Attributes Analyzed with Chipped Stone Artifact Categories

Attribute	Flakes	Angular Debris	Cores	Formal Tools
Material type	x	x	x	x
Material quality	x	x	x	x
Artifact morphology	x	x	x	x
Artifact function	x	x	x	x
Cortex	x	x	x	x
Cortex type	x	x	x	x
Portion	x	x	x	x
Platform type	x			
Platform lipping	x			
Dorsal scarring	x			
Distal termination type	x			
Thermal alteration	x	x	x	x
Wear patterns	x	x	x	
Modified edge angles	x	x	x	x
Dimensions	x	x	x	x

be identified. Texture was subjectively measured to examine flakeability. Most materials were divided into fine, medium, and coarse categories depending on grain size. These measures were applied within material types but not across them. Obsidian was classified as glassy by default, and this category was applied to no other material.

Two attributes were used to provide information about artifact form and function. The first was morphology, which categorized artifacts by general form. The second was function, which categorized tools by inferred use. Cortex was recorded by percent in increments of 10, and cortex type (waterworn or nonwaterworn) was defined when possible. All artifacts were coded as whole or fragmentary. When fragmentary, the portion was recorded if it could be determined. Two types of alteration were noted: thermal and edge damage. When present, type and location of thermal alteration were recorded. This information was used to determine whether thermal treatment was purposeful or incidental. Edge damage, both cultural and noncultural, was recorded when present. Edge angles were measured on artifacts demonstrating cultural edge damage or retouch; edges lacking evidence of cultural modification were not measured.

Three dimensions were measured on each artifact. On angular debris and cores length was defined as the largest dimension, width was the second largest dimension and was perpendicular to length, and thickness was perpendicular to both width and length. On flakes and formal tools length was the distance between the platform (or proximal end) and termination (or distal end), width was the maximum distance between the edges paralleling the length, and thickness was the distance between dorsal and ventral surfaces.

Four attributes that were only examined on flakes included platform type, platform lipping, dorsal scarring, and distal termination. Platform type is an indicator of reduction technology and stage. Any modifications to platforms were noted, including missing, collapsed, and damaged platforms. Platform lipping usually indicates soft-hammer reduction (Crabtree 1972), and is often an indication of later reduction stages. Analysis of dorsal scarring entailed noting whether scars originating at the distal end of a flake were present. These opposing scars often evidence removal from a biface. The type of distal termination was noted to help determine whether it was a successful removal or ended prematurely, and to provide data on manufacturing versus post-removal breakage.

Flakes were determined to have been removed from cores or bifaces using a polythetic set of variables (Table 11). A polythetic framework is one in which fulfilling a majority of propositions is both necessary and sufficient for inclusion in a class (Beckner 1959). The polythetic set contains an array of conditions of which only a given percentage in any combination need be fulfilled. This array of conditions models an idealized biface flake and includes information on platform morphology, flake shape, and earlier removals. The polythetic set used here was adapted from Acklen et al. (1983). In keeping with that model, when a flake meets 70 percent of the listed conditions it is classified as a removal from a biface. This percentage is high enough to isolate flakes produced during biface production from those removed from cores, while at the same time it is low enough to permit flakes that were removed from a biface but do not fulfill the entire set of conditions to be properly classified. While not all flakes struck from bifaces can be identified by the polythetic set, those that are may be considered definite evidence of biface reduction. Flakes that meet less than 70 percent of the conditions are classified as core flakes. The polythetic set provides a flexible means of categorizing flakes and helps account for some of the variation seen in flakes removed during experiments.

Distinguishing between biface and core flakes in an assemblage is an important step in defining basic reduction technology. A predominance of biface flakes, particularly those removed from large bifaces serving as cores, suggests a curated reduction strategy, which is generally related to a high degree of residential mobility (Kelly 1988). Conversely, a predominance of core flakes in an assemblage that contains only a few small biface flakes suggests an expedient reduction strategy entailing limited formal tool manufacture by a sedentary population.

Ground Stone Analysis Methods

Ground stone analysis was completed using OAS's (1990b) standardized methodology and was designed to examine material selection, manufacturing technology, and use. Artifacts were examined macroscopically and dimensions were measured with a sliding caliper or metal tape. Analytical results were entered into a computerized data base using SPSS data entry.

Besides providing information on activities occurring at a site, this analysis measured assemblage costs and values. When these measures are compared it is possible to look at differences between artifacts entering and leaving a site, length and type of occupation, processes of site abandonment, and differences in material wealth among site residents. Considering the type of site investigated, the latter cannot be examined but most of the other questions can. For example, in an orderly site abandonment, ground stone tools will be removed if they retain an intrinsic value that outweighs the difficulty of transport. In a hasty or unplanned abandonment, ground stone tools that retain

Table 11. Polythetic Set for Distinguishing Biface Flakes from Core Flakes

Whole Flakes

1. Platform:
   a. has more than one facet
   b. is modified (retouched and/or abraded)
2. Platform is lipped.
3. Platform angle is less than 45 degrees.
4. Dorsal scar orientation is:
   a. parallel
   b. multidirectional
   c. opposing
5. Dorsal topography is regular.
6. Edge outline is even.
7. Flake is less than 5 mm thick.
8. Flake has a relatively even thickness from proximal to distal end.
9. Bulb of percussion is weak (diffuse).
10. There is a pronounced ventral curvature.

Broken Flakes or Flakes with Collapsed Platforms

1. Dorsal scar orientation is:
   a. parallel
   b. multidirectional
   c. opposing
2. Dorsal topography is regular.
3. Edge outline is even.
4. Flake is less than 5 mm thick.
5. Flake has a relatively even thickness from proximal to distal end.
6. Bulb of percussion is weak.
7. There is a pronounced ventral curvature.

Artifact is a Biface Flake When:

-If whole it fulfills 7 of 10 attributes.
-If broken or platform is collapsed it fulfills 5 of 7 attributes.

value and are easily transported may be left behind. A long-term, sedentary occupation should leave behind an array of broken and exhausted ground stone tools demonstrating a wide range of production inputs. A fieldhouse or farmstead, on the other hand, should contain few whole ground stone tools, and those that remain should retain little, if any, value.

Attributes Examined during the Study

Several attributes were recorded for each ground stone artifact; other attributes were only recorded for a few specialized tool types. Those recorded for all ground stone artifacts included material type, material texture and quality, function, portion, preform morphology, production input, plan view outline form, ground surface texture and sharpening, shaping, number of uses, wear patterns, evidence of heating, presence of residues, and dimensions. The only specialized attributes recorded in this analysis were mano cross-section form and the shape of the ground surface in cross section.

By examining function(s), it is possible to define the range of activities in which ground stone tools were used. Because these tools are usually large and durable, they may undergo a number of different uses during their lifetime, even after being broken. Several attributes were designed to provide information on the life-history of ground stone tools, including dimensions, evidence of heating, portion, ground surface sharpening, wear patterns, alterations, and the presence of adhesions. These measures can help identify post-manufacturing changes in artifact shape and function and describe the value of an assemblage by identifying the degree of wear or use. Such attributes as material type, material texture and quality, production input, preform morphology, plan view outline form, and ground stone texture provide information on assemblage cost. In combination they provide data on raw material choice and cost and the expense of producing various tools. Mano cross-section form and ground surface cross section are specialized measures aimed at describing aspects of form for manos and metates; as these tools wear they undergo regular changes in morphology that can be used as relative measures of age.

Chipped Stone Artifacts

A total of 3,126 chipped stone artifacts was recovered from LA 71276, including 449 artifacts from testing and 2,677 from data recovery. While artifacts collected during testing have been examined elsewhere (Moore 1991), that discussion is cursory owing to the limited nature of the data base available from that phase of investigation. Thus, they are combined with the artifacts recovered during data recovery to provide more detailed assemblage information. Preliminary analysis of materials recovered during testing suggested that a simple core-flake strategy was used to reduce materials obtained from local sources (Moore 1991). Formal tools were rare, and there was no evidence of on-site tool manufacture. A more detailed analysis of this larger assemblage will allow these results to be assessed and refined.

Two basic reduction strategies have been identified in the Southwest. Curated strategies entail the manufacture of bifaces that serve as both unspecialized tools and cores, while expedient strategies are based on the removal of flakes from cores for use as informal tools (Kelly 1985, 1988). Technology is related to lifestyle. Curated strategies are usually associated with a high degree of residential mobility, while expedient strategies are typically associated with sedentism. Exceptions to this include highly mobile groups living in areas that contain abundant and widely distributed raw materials or suitable substitutes for stone tools (Parry and Kelly 1987). Neither of these exceptions applies to the Southwest. Prehistoric Southwestern bifacial reduction strategies were similar to the blade technologies of Mesoamerica and Western Europe in that they focused on efficient reduction with little waste. Curated strategies allowed flintknappers to produce the maximum length of usable flake edge per core. By maximizing the return from cores, they were able to reduce the volume of raw material required for the production of informal tools. This helped lower the amount of weight transported between camps. Material waste and transport costs were not important considerations in expedient strategies; flakes were simply struck from cores when needed.

Analysis of the reduction strategy used at a site allows us to determine whether site occupants were residentially mobile or sedentary. Other assemblage attributes provide corroborating data as well as information on additional aspects of site use. The types of materials used and qualities that were selected provide clues about access to specific sources, ties with other regions, and the tasks in which chipped stone artifacts were used. More specific information on chipped stone tool-using activities can be derived from a study of formal and informal tools. Thus, this analysis was aimed at providing information on Tajo phase raw material procurement strategies, chipped stone reduction technology, and tool production and use.

Material Selection and Source

Thirteen material categories were identified in the assemblage (Table 12). Silicified siltstone is by far the dominant material, with undifferentiated cherts a distant second. Except for limestone, other materials comprise less than 1 percent each of the assemblage. This distribution holds for both the debitage and core categories, with silicified siltstone comprising 90 and 95 percent of those assemblages, respectively. However, a different distribution occurs in the formal tool assemblage with cherts comprising 57 percent and silicified siltstone only 29 percent of that category. Obsidian, which makes up only .1 percent of the total assemblage, comprises 14 percent of the formal tools. This distribution suggests that mostly high-quality cryptocrystalline materials were selected for tool manufacture. These types of materials are more amenable to shaping and produce sharp cutting edges; lower quality, coarser-grained materials are better suited to the production of tools that require durable edges.

Cortex. The distribution of cortex type by artifact class is shown in Table 13. Three types of cortex were identified: waterworn, nonwaterworn, and indeterminate. Waterworn cortex is battered and smoothed, indicating that a nodule was transported by a stream. Nonwaterworn cortex can be altered by chemical reactions or weathering, but does not display the heavy battering or smoothing that develops during waterborne transport. Cortex was classified as indeterminate when it was impossible to decide whether weathering was caused by stream transport or exposure to the atmosphere; this category is not considered any further.

It is important to distinguish between cortex types because they provide information about the source of materials reduced at a site. As its name suggests, waterworn cortex denotes transport by water. Artifacts with this type of cortex were usually obtained from gravel deposits along streams, and can occur anywhere from nearby to hundreds of kilometers away from the area in which they outcrop. Thus, no exact source can be assigned. The presence of nonwaterworn cortex indicates that the nodule was not transported away from an outcrop by water, and suggests that it was obtained at or near its source.

Nonwaterworn cortex dominates the assemblage, comprising almost 96 percent of the cortical artifacts. Six formal tools manufactured from silicified siltstone (28.6 percent of the tool assemblage) had nonwaterworn cortical surfaces. No cortex was retained on any of the tools made from chert or obsidian. Approximately 45 percent of the debitage was cortical, and 76 percent of the cores had cortical surfaces. These percentages are rather high, and suggest that the early stages of core reduction dominated at this site. As only silicified siltstone tools retained any cortex it can be suggested that this material was used for different purposes than were the cherts and obsidians. It is also likely that silicified siltstone was simply more abundant locally and was not as carefully reduced.

Table 12. Material Type by Artifact Morphology, Frequencies and Row Percentages

Material Type	Debitage	Cores	Tools	Totals
Chert	197 94.3	1 0.5	11 5.3	209 6.7
Pedernal chert	1 50.0	0 0.0	1 50.0	2 0.1
San Andreas chert	1 100.0	0 0.0	0 0.0	1 0.03
Obsidian	2 40.0	0 0.0	3 60.0	5 0.1
Igneous, undiff.	12 92.3	1 7.7	0 0.0	13 0.4
Basalt	2 100.0	0 0.0	0 0.0	2 0.1
Rhyolite	12 100.0	0 0.0	0 0.0	12 0.4
Chertic rhyolite	2 100.0	0 0.0	0 0.0	2 0.1
Limestone	55 100.0	0 0.0	0 0.0	55 1.8
Sandstone	17 100.0	0 0.0	0 0.0	17 0.5
Silicified siltstone	2758 98.5	36 1.3	6 0.2	2800 89.6
Quartzite	1 100.0	0 0.0	0 0.0	1 0.03
Quartzitic sandstone	7 100.0	0 0.0	0 0.0	7 0.2
Totals Percent	3067 98.1	38 1.2	21 0.7	3126 100.0

Table 13. Cortex Type by Artifact Class, Frequencies and Row Percentages

Cortex Type	Debitage	Cores	Tools	Totals
Waterworn	53 96.4	2 3.6	0 0.0	55 3.9
Nonwaterworn	1323 97.6	27 2.0	6 0.4	1356 95.6
Indeterminate	8 100.0	0 0.0	0 0.0	8 0.6
Totals Percent	1384 97.5	29 2.0	6 0.4	1419 100.0

Table 14. Material Type by Cortex Type, Frequencies and Row Percentages

Material Type	Waterworn	Nonwaterworn	Indeterminate	Totals
Chert	6 9.2	58 89.2	1 1.5	65 4.6
Pedernal chert	0 0.0	1 100.0	0 0.0	1 0.1
San Andreas chert	0 0.0	1 100.0	0 0.0	1 0.1
Obsidian	0 0.0	1 100.0	0 0.0	1 0.1
Igneous undiff.	0 0.0	5 100.0	0 0.0	5 0.3
Basalt	0 0.0	1 100.0	0 0.0	1 0.1
Rhyolite	0 0.0	3 100.0	0 0.0	3 0.2
Limestone	0 0.0	12 100.0	0 0.0	12 0.8
Sandstone	1 14.3	5 71.4	1 14.3	7 0.5
Silicified siltstone	47 3.6	1268 96.1	5 0.4	1320 93.0
Quartzitic sandstone	1 33.3	1 33.3	1 33.3	3 0.2
Totals percent	55 3.9	1356 95.6	8 .6	1419 100.0

Cortex types for each material are illustrated in Table 14. While some chert, sandstone, silicified siltstone, and quartzitic sandstone seem to have been obtained from gravel deposits, the materials reduced at this site were overwhelmingly procured at or near their source. This includes the cortical specimens of obsidian, Pedernal chert, and San Andreas chert, none of which are locally available.

Local versus Exotic Sources. An examination of material sources is critical to discussions of mobility and ties to other regions. Materials are classified as local or exotic depending on how distant their source is from a study area. In general, materials are local if they can be obtained no more than 15 to 20 km from a site. This distance is subjective and represents the approximate resource catchment area around a site that is exploitable in a single day's travel time. While more distant regions were undoubtedly also used, this zone probably represents the area that was most heavily used around a site.

The type of cortex on artifacts must also be taken into account because procurement from secondary deposits is always possible. For example, Jemez obsidian and Pedernal chert outcrop in the Jemez Mountains and Rio Chama Valley, respectively. They also commonly occur in lag gravel deposits along the Rio Grande far south of their original sources. These materials are common in the Albuquerque area, and have been noted as far south as Las Cruces. Thus, knowing the original source of a material is not enough, one must also know whether it could have been obtained from gravel deposits.

Laumbach and Kirkpatrick (1985:40-42) provide a summary of lithic materials that were commonly used in this area. Their study was conducted during survey of an area at the north end of White Sands Missile Range, just south of LA 71276. Eight general material types were identified. Locally outcropping cherts, silicified siltstone, and quartzite accounted for 81 percent of their assemblage. Basalt, obsidian, andesite, rhyolite, and chalcedony complete the array of materials, and none of these materials are available locally.

Most of the local materials outcrop in the Yeso and Abo formations (Laumbach and Kirkpatrick 1985). Cherts were quite variable and had several sources. A minor source was in deposits of small gravels in the southwest part of their survey area. The main source was silicified siltstone in the Yeso formation, which ranges from a cherty silicified siltstone to a siltite or very fine-grained quartzite (Laumbach and Kirkpatrick 1985:41). Thus, this formation contains chert, silicified siltstone, and quartzite, the main difference between these materials being grain size. When no silt grains are visible under low magnification the material is considered a chert; specimens with silt-sized grains are silicified siltstones, and those with larger grains are quartzites (Laumbach and Kirkpatrick 1985:41). During analysis we noted that several artifacts ranged from chert to silicified siltstone or silicified siltstone to quartzite, showing that these materials grade into one another.

The Abo Formation contains siltstone, silicified siltstone, and quartzite which differ from those of the Yeso Formation. Yeso materials are predominantly gray and weather to a distinct light yellow or brown. Materials from the Abo Formation were predominantly red (Laumbach and Kirkpatrick 1985:41). The majority of cherts, silicified siltstones, and quartzites from LA 71276 appear to be from the Yeso Formation. However, 17 pieces of grainy chert may be fine-grained silicified siltstone from the Abo Formation.

Other local materials include limestone, sandstone, and probably quartzitic sandstone. A few pieces of the latter resemble the chert-silicified siltstone-quartzite of the Yeso Formation and are probably also from that source. Most of the other examples may be a local arkose, possibly from the Bursum Formation. One piece of quartzitic sandstone does not resemble any of these types, and may have been carried in from elsewhere.

Only Pedernal chert and obsidian are definitely of exotic origin. As noted earlier, Pedernal chert outcrops in the Rio Chama Valley and occurs in gravel deposits along the Rio Grande. No obsidian sources have been recorded near the study area, but Jemez obsidian occurs in Rio Grande gravels. San Andreas chert may also be an exotic material, but this is uncertain. While this chert is most commonly associated with outcrops of San Andreas limestone in southeast and west-central New Mexico, that formation also outcrops northeast of LA 71276. Thus, while it could have been culturally transported to this area, it is also possible that San Andreas chert was obtained from nearby stream deposits. However, since the only example of this material had nonwaterworn cortex, it was undoubtedly obtained at or near its source.

Other materials like basalt and rhyolite probably derive from exotic sources, but where those sources are is uncertain. Basalt may have been obtained from the Fra Cristobal/Caballo Mountain ranges to the west of the study area. However, it is also possible that both of these materials were procured from gravel deposits along the Rio Grande.

Table 15 shows cortex type by general material source. While a small percentage of local materials were obtained from gravel deposits, all of the exotic and probable exotic materials with cortex were procured at or near their source. Cortex occurs on a third of both the exotic and probable exotic materials. Thus, it is likely that all of these materials were obtained at or near their sources, and it can be suggested that there were ties between the project area and regions to the north and west. The form that those ties took cannot be defined from these limited data, but it is possible that there was either some exchange between regions or the local population could access those areas directly. Of course, the very small numbers of lithic artifacts of exotic origin could also represent materials scavenged from earlier sites, so no conclusions concerning ties to other regions should be drawn from these data alone. Other types of corroborating evidence are necessary.

Material Texture and Quality. Different materials are suited to different tasks (Chapman 1977). For example, while obsidian and chert are well suited to the production of cutting tools because they are easily flaked and possess extremely sharp edges, they are too fragile for heavy-duty chopping use. Conversely, while basalt and quartzite have duller edges and are less efficient as cutting tools, they are well suited to heavy-duty use like chopping because they are durable and resist shattering. The suitability of materials for specific tasks also varies with texture. Fine-grained materials produce sharper edges than coarse materials, and are amenable to the manufacture of formal tools because they are more easily and predictably flaked. For instance, fine-grained basalt produces nearly as good a cutting edge as chert, while coarse-grained basalt may only be suitable for chopping or battering.

Table 16 shows texture by material type. It should be noted that obsidian is glassy by definition and no other materials were assigned to that class. Glassy and fine-grained materials make up 84.8 percent of the assemblage, medium-grained materials comprise nearly 14 percent, and just over 1 percent is coarse-grained. Thus, selection for textures amenable to efficient production of formal tools and cutting edges predominated. While medium- and coarse-grained materials were used, they occur in significantly smaller numbers. Texture by artifact class is illustrated in Table 17. While moderate percentages of the debitage and core assemblages are medium- and coarse-grained materials, only glassy and fine-grained materials were used for formal tools, and fine-grained

Table 15. Material Source by Cortex Type, Frequencies and Row Percentages

Material Source	Waterworn	Nonwaterworn	Indeterminate	Totals
Local	55 3.9	1344 95.5	8 0.6	1407 99.2
Exotic	0 0.0	3 100.0	0 0.0	3 0.2
Probable exotics	0 0.0	9 100.0	0 0.0	9 0.6
Totals Percent	55 3.9	1356 95.6	8 0.6	1419 100.0

Table 16. Material Type by Material Quality, Frequencies and Row Percentages

Material Type	Glassy	Fine	Medium	Coarse	Totals
Chert	0 0.0	167 79.9	28 13.4	14 6.7	209 6.7
Pedernal chert	0 0.0	2 100.0	0 0.0	0 0.0	2 0.1
San Andreas chert	0 0.0	0 0.0	0 0.0	1 100.0	1 0.03
Obsidian	5 100.0	0 0.0	0 0.0	0 0.0	5 0.2
Igneous undiff.	0 0.0	9 69.2	2 15.4	2 15.4	13 0.4
Basalt	0 0.0	2 100.0	0 0.0	0 0.0	2 0.1
Rhyolite	0 0.0	8 66.7	3 25.0	1 8.3	12 0.4
Chertic rhyolite	0 0.0	1 50.0	1 50.0	0 0.0	2 0.1
Limestone	0 0.0	48 87.3	6 10.9	1 1.8	55 1.8
Sandstone	0 0.0	3 17.6	13 76.5	1 5.9	17 0.5
Silicified siltstone	0 0.0	2403 85.8	374 13.4	23 0.8	2800 89.6
Quartzite	0 0.0	1 100.0	0 0.0	0 0.0	1 0.03
Quartzitic sandstone	0 0.0	2 28.6	4 57.1	1 14.3	7 0.2
Totals Percent	8 0.3	2643 84.5	431 13.8	44 1.4	3126 100.0

materials were overwhelmingly selected for use as informal tools. All of the cobble tools were also made from fine-grained materials, suggesting that durability may not have been a consideration in their use.

The textures of materials chosen for formal and informal tools suggest that workability and sharp cutting edges were important characteristics. While both of these characteristics were probably important in formal tool manufacture, the presence of sharp cutting edges was probably the most important factor in the selection of debitage used as informal tools.

The importance of workability in the selection of materials for formal tool manufacture becomes obvious when tool function is examined. Cryptocrystalline materials like obsidian and chert are well suited to formal tool manufacture because they flake predictably and equally well in all directions and are amenable to pressure flaking. Noncryptocrystalline materials usually do not

Table 17. Artifact Classes by Texture, Frequencies and Row Percentages

Artifact Class	Glassy	Fine	Medium	Coarse	Totals
Debitage	2 0.1	2566 84.5	426 14.0	44 1.4	3038 97.2
Cores	0 0.0	35 92.1	3 7.9	0 0.0	38 1.2
Formal tools	3 15.0	14 82.4	0 0.0	0 0.0	17 0.5
Informal tools	0 0.0	27 93.1	2 6.9	0 0.0	29 0.9
Cobble tools	0 0.0	4 100.0	0 0.0	0 0.0	4 0.1
Totals Percent	5 0.2	2646 84.6	431 13.8	44 1.4	3126 100.0

possess these qualities. All of the bifacially flaked formal tools, mostly projectile points, were manufactured from obsidian or chert. Six tools were made from noncryptocrystalline silicified siltstone and included four hammerstones and two scrapers. Thus, the formal tools that required the most shaping, in this case by pressure flaking, were made from glassy or fine-grained cryptocrystalline materials. Noncryptocrystalline materials were only used for formal tools that required little or no shaping.

Material quality is also important in core reduction and tool manufacture. This attribute indicates the presence or absence of visible flaws including cracks, bedding planes, inclusions that can affect flaking, and voids. Flaws can cause a flake to terminate prematurely when they are encountered. In addition, cracks or bedding planes can cause a flake to run in an unwanted direction. Unnoticed flaws can ruin a core or tool by initiating step terminations or splitting the parent material. While this might not be a terrible problem in expedient core reduction, it can lead to critical failure in tool manufacture, as well as in efficient biface-core or blade-core reduction.

Table 18 shows the quality of each material type recovered from LA 71276. Overall, unflawed materials were predominantly selected for reduction. However, there are differences between local and exotic materials. Nearly 86 percent of the local materials are unflawed, while all of the exotic and 93 percent of the probable exotic materials are unflawed. This suggests that materials lacking visible defects that would cause problems during reduction were selected for, particularly when they were obtained outside the local region. Table 19 illustrates general artifact classes by material quality. None of the formal tools were visibly flawed. No flaws were noted on any of the cobble tools either, but as this class of tool was comprised of mostly unmodified nodules, internal flaws would have been concealed. It is interesting that over a quarter of the informal tools were flawed compared with only about 14 percent of the debitage assemblage. However, the relatively small percentage of debitage exhibiting evidence of informal use (0.1 percent) suggests that sample error may be responsible.

Reduction Technology

Several attributes contribute information on reduction technology including amount of dorsal cortex, debitage ratios, platform shape and modification, flake breakage patterns, and types and conditions of formal tools. Debitage are important indicators of reduction technology because they are rarely curated and often constitute the only remaining evidence of reduction on sites where formal tools and cores were removed at the time of abandonment. The approach used to examine reduction technology in this study is complicated because the lithic reduction process can itself be quite complex. Our approach is typological because it is possible to use certain debitage characteristics to determine whether a flake was removed from a core or tool.

Dorsal Cortex. While cortex was discussed in the context of material source and quality, its relation to reduction stage remains to be considered. This section is only concerned with dorsal cortex; platform cortex is discussed elsewhere. Cortex is the weathered outer rind on nodules; it has been chemically altered by exposure to the elements and rarely possesses a suitable surface for reduction or use. Further, the outer sections of water-transported nodules often contain microcracks caused by cobbles striking against one another, producing a zone with unpredictable flaking characteristics. Because cortical surfaces flake differently than nodule interiors and are usually unsuitable for use or further reduction, cortex is typically removed and discarded. In general, flakes have progressively less dorsal cortex as the process of reduction proceeds. Thus, cortex can be used to examine reduction stages in an assemblage; the early stages are characterized by high percentages of flakes with high amounts of dorsal cortex, while the opposite suggests later reduction stages.

Reduction is divided into two main stages: core reduction and tool manufacture. Flakes are removed for use or further modification during core reduction. *Primary* core reduction includes initial core platform preparation and removal of the cortical surface. *Secondary* core reduction is the removal of flakes from core interiors. This difference is rarely as obvious as these definitions may make it seem. Both procedures often occur simultaneously and rarely is all cortex removed before secondary reduction begins. In essence, they represent opposite ends of a continuum, and it is difficult to exactly determine where one ends and the other begins. In this analysis primary core flakes are those with 50 percent or more of their dorsal surfaces covered by cortex, and secondary core flakes are those with less than 50 percent of their dorsal surfaces covered by cortex. These distinctions provide data on the condition of cores reduced at a site. For example, a lack of primary flakes suggests that initial reduction occurred elsewhere, while the presence of few secondary flakes can suggest that cores were carried off for further reduction.

Tool manufacture refers to the purposeful modification of debitage into a specialized form. As discussed earlier, flakes produced during tool manufacture (biface flakes) were defined using a polythetic set of variables that includes platform attributes as well as flake morphology characteristics. Primary core flakes represent early stage reduction, while secondary core flakes and biface flakes represent late stage reduction.

Table 20 shows dorsal cortex percentages for debitage. Overall, well over half of the debitage had no dorsal cortex, and 84 percent had 0 to 49 percent dorsal cortex. This suggests that the later stages of reduction predominated, but some primary core reduction also occurred. It is interesting that all of the exotic debitage had dorsal cortex, while debitage of possible exotic origin were mostly noncortical. The reason for this distribution is unknown, but if distance from source was a factor the opposite would be expected. Only three materials--undifferentiated cherts, limestone,

Table 18. Material Type by Quality, Frequencies and Row Percentages

Material Type	Unflawed	Flawed	Total
Chert	144 68.9	65 31.1	209 6.7
Pedernal chert	2 100.0	0 0.0	2 0.1
San Andreas chert	1 100.0	0 0.0	1 0.03
Obsidian	5 100.0	0 0.0	5 0.2
Igneous undiff.	12 92.3	1 7.7	13 0.4
Basalt	2 100.0	0 0.0	2 0.1
Rhyolite	11 91.7	1 8.3	12 0.4
Chertic rhyolite	2 100.0	0 0.0	2 0.1
Limestone	48 87.3	7 12.7	55 1.8
Sandstone	16 94.1	1 5.9	17 0.5
Silicified siltstone	2428 86.7	372 13.3	2800 89.6
Quartzite	1 100.0	0 0.0	1 0.03
Quartzitic sandstone	6 85.7	1 14.3	7 0.2
Totals Percent	2678 85.7	448 14.3	3126 100.0

Table 19. Artifact Class by Quality, Frequencies and Row Percentages

Artifact Class	Unflawed	Flawed	Total
Debitage	2610 85.9	428 14.1	3038 97.2
Cores	27 71.1	11 28.9	38 1.2
Formal tools	17 100.0	0 0.0	17 0.5
Informal tools	21 72.4	8 27.6	29 0.9

Artifact Class	Unflawed	Flawed	Total
Cobble tools	4 100.0	0 0.0	4 0.1
Total Percent	2678 85.7	448 14.3	3126 100.0

Table 20. Debitage Cortex Percentages

Material Type	0%	1-49%	50-100%	Percent of Total
Chert	73.6	14.7	11.7	6.4
Pedernal chert	0.0	100.0	0.0	0.03
San Andreas chert	0.0	100.0	0.0	0.03
Obsidian	0.0	50.0	50.0	0.1
Igneous undiff.	75.0	8.3	16.7	0.4
Basalt	50.0	50.0	0.0	0.1
Rhyolite	75.0	16.7	8.3	0.4
Chertic rhyolite	100.0	0.0	0.0	0.1
Limestone	83.6	9.1	7.3	1.8
Sandstone	70.6	5.9	23.5	0.6
Silicified siltstone	62.4	21.1	16.5	89.9
Quartzite	100.0	0.0	0.0	0.03
Quartzitic sandstone	71.4	14.3	14.3	0.2
Percent of Total	63.6	20.4	16.0	100.0

and silicified siltstone--comprised 1 percent or more of the assemblage. Of these materials, silicified siltstone is by far the most common and had higher percentages of debitage with dorsal cortex. This suggests that silicified siltstone cores may not have been reduced to the same extent as cores of other materials.

As angular debris cannot be assigned to a reduction stage, it is eliminated from Table 21, which shows flakes by reduction stage for each material type. Overall, about 18 percent of the flakes were produced during primary core reduction and over 81 percent originated during secondary core reduction. Less than half a percent of the flake assemblage was produced during tool manufacture. Most of the material categories contain both primary and secondary core flakes, the exceptions being Pedernal chert, basalt, chertic rhyolite, and quartzite. Thus, most materials seem to have been carried onto the site as unreduced or only partially reduced nodules. The exceptions may have been transported to the site as already reduced cores or individual flakes. Very little tool manufacture seems to have occurred at LA 71276, and only silicified siltstone appears to have been modified into formal tools on-site. This is discussed in more detail later.

Flake Platforms. As noted earlier, the polythetic set used to define manufacturing flakes only identifies ideal examples, and some manufacturing flakes were probably included in the core flake category. Flake platform modification can often be used as supplementary evidence of tool manufacture, even when flakes do not fit the polythetic set. Platforms are modified to facilitate flake removal. By retouching or abrading a platform it is possible to reduce the risk that pressure applied to remove a flake will shatter the edge of a core or tool. It also provides the flintknapper with greater control over the shape, size, and direction of flakes that are removed. While core platforms are sometimes modified, this usually occurs when they are being reduced in a deliberate manner to maximize the amount of edge produced from a single nodule. Blade manufacture is an example of this type of reduction, and blade core platforms are carefully prepared so that reduction can be controlled, producing flakes with a uniform shape and size. Platforms on tools are modified for the same reasons--control over flake removal, and prevention of edge shattering.

Table 21. Flakes by Reduction Stage, Frequencies and Row Percentages

Material Type	Primary Core Flake	Secondary Core Flake	Manufacturing Flake	Totals
Chert	17 12.5	118 86.8	1 0.7	136 5.7
Pedernal chert	0 0.0	1 100.0	0 0.0	1 0.04
Obsidian	1 50.0	1 50.0	0 0.0	2 0.08
Igneous undiff.	2 25.0	6 75.0	0 0.0	8 0.3
Basalt	0 0.0	2 100.0	0 0.0	2 0.08
Rhyolite	1 10.0	9 90.0	0 0.0	10 0.4
Chertic rhyolite	0 0.0	1 100.0	0 0.0	1 0.04
Limestone	3 9.4	29 90.6	0 0.0	32 1.3
Sandstone	3 27.3	8 72.7	0 0.0	11 0.5
Silicified siltstone	404 18.5	1767 81.0	10 0.5	2181 91.2
Quartzite	0 0.0	1 100.0	0 0.0	1 0.04
Quartzitic sandstone	1 14.3	6 85.7	0 0.0	7 0.3
Totals Percent	432 18.1	1949 81.5	11 0.4	2392 100.0

Table 22 tabulates all flake platforms by material type. Cortical platforms are mostly indicative of early stage core reduction. Overall this category comprises nearly 17 percent of the total assemblage, and closely replicates the percentage of primary flakes identified. This is illusory, however, as not all flakes with cortical platforms were primary core flakes. The breakdown of flakes by morphology and dorsal cortex is shown in Table 23. Only one manufacturing flake had a cortical platform, and only 23 percent of the flakes with cortical platforms were removed during primary core reduction. Most of the secondary core flakes with cortical platforms (52 percent) had no dorsal cortex. There appears to have been no platform preparation on the cores from which these flakes were removed, and primary reduction was probably minimal. That is, only a few flakes were struck to remove cortex, and the remaining cortical surface was used as a platform. While a few cortical platforms appear to have been abraded, this type of modification is usually not necessary on cortical surfaces and may simply be evidence of natural stream-rolled battering. Thus, abraded cortical platforms are probably not purposeful modifications.

Table 22. Platform Type by Material Type, Frequencies and Row Percentages

Material type	Cortical	Cortical, Abraded	Single Facet	Single Facet, Abraded	Multifacet	Multifacet, Abraded	Retouched
Chert	11 8.1	0 0.0	56 41.2	1 0.7	21 15.4	1 0.7	0 0.0
Pedernal chert	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Obsidian	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Igneous undiff.	3 37.5	0 0.0	0 0.0	0 0.0	1 12.5	0 0.0	0 0.0
Basalt	0 0.0	0 0.0	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0
Rhyolite	0 0.0	1 10.0	4 40.0	0 0.0	1 10.0	0 0.0	0 0.0
Chertic rhyolite	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0
Limestone	1 3.1	0 0.0	15 46.9	0 0.0	4 12.5	0 0.0	0 0.0
Sandstone	0 0.0	0 0.0	2 18.2	0 0.0	3 27.3	0 0.0	0 0.0
Silicified siltstone	377 17.4	3 0.1	700 32.4	12 0.6	404 18.7	27 1.2	3 0.1
Quartzite	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0
Quartzitic sandstone	1 14.3	0 0.0	2 28.6	0 0.0	1 14.3	0 0.0	0 0.0
Totals Percent	393 16.6	4 0.2	780 32.9	13 0.5	438 18.4	28 1.2	3 0.1

Table 22. (Continued)

Material Type	Retouched, Abraded	Abraded	Collapsed	Crushed	Absent (Snap)	Absent (BIM[1])	Obscured	Totals
Chert	0 0.0	3 2.2	12 8.8	5 3.7	17 12.5	9 6.6	0 0.0	136 5.7
Pedernal chert	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.03
Obsidian	0 0.0	0 0.0	0 0.0	1 50.0	0 0.0	1 50.0	0 0.0	2 0.1
Igneous undiff.	0 0.0	0 0.0	1 12.5	0 0.0	2 25.0	1 12.5	0 0.0	8 0.3
Basalt	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.1
Rhyolite	0 0.0	1 10.0	3 30.0	0 0.0	0 0.0	0 0.0	0 0.0	10 0.4
Chertic rhyolite	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 0.03
Limestone	0 0.0	1 3.1	2 6.3	1 3.1	6 18.8	2 6.3	0 0.0	32 1.3
Sandstone	0 0.0	0 0.0	2 18.2	0 0.0	3 27.3	1 9.1	0 0.0	11 0.5
Silicified siltstone	2 0.1	27 1.2	146 6.7	97 4.5	248 11.5	114 5.3	3 0.1	2163 91.1
Quartzite	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.03
Quartzitic sandstone	0 0.0	0 0.0	1 14.3	0 0.0	2 28.6	0 0.0	0 0.0	7 0.3
Totals Percent	2 0.1	32 1.3	167 7.0	105 4.4	278 11.7	128 5.4	3 0.1	2374 100.0

[1] Broken in manufacture.

Table 23. Flake Type by Dorsal Cortex for Flakes with Cortical Platforms, Frequencies and Row Percentages

Flake Type	0%	10-49%	50-100%	Totals
Core flakes	206 52.0	99 25.0	91 23.0	396 99.7
Manufacturing flakes	1 100.0	0 0.0	0 0.0	1 0.3
Totals Percent	207 52.1	99 24.9	91 22.9	397

Slightly more than a third of the flakes had single facet platforms, and most were not modified to facilitate removal. Multifacet platforms were the next most common type, comprising nearly 20 percent of the total. A number of these platforms were modified by abrasion. Single facet platforms usually occur on flakes removed from cores that were partially reduced before that flake was removed. Multifacet platforms occur on flakes removed from partially reduced cores, but are also common on flakes removed from tool edges. Retouched platforms are rare in this assemblage and are mostly associated with tool manufacture. While abrasion is generally considered a modification of one of the platform types that have already been discussed, it is also a separate category because some platforms were obviously ground but are too small to be more accurately classified. This category comprises slightly more than 1 percent of the total assemblage.

Collapsed and crushed platforms were altered by material failure during reduction. When platforms collapse they separate from the main body of the flake when force is applied. Crushed platforms were shattered by the force used to remove a flake, but did not detach separately. Platforms can also be damaged by use or noncultural processes like trampling, and these examples are simply classified as obscured. Platforms on flake fragments other than proximal ends are classified as absent. Only about 17 percent of the flakes are fragments without platforms, suggesting that there was not a large amount of breakage in this assemblage. Fragments with missing platforms are not included in Table 24, which shows general platform categories by morphology and material type. While platforms were modified on 20 percent of the manufacturing flakes, only 3.9 percent of the core flakes had modified platforms.

Of 76 core flakes with modified platforms, 49 (64.5 percent) had no dorsal cortex, 13 (17.0 percent) had 1 to 49 percent dorsal cortex, and 14 (18.4 percent) had 50 percent or more of their dorsal surface covered by cortex. While some of these flakes may have been misclassified because they were removed during early tool manufacture and resembled core flakes, it is unlikely that all are incorrectly classified. Opposing dorsal scars are often used as evidence of biface manufacture, and only 4.1 percent of these flakes have opposing scars. Also, only 25 percent have lipped platforms, which are usually evidence of soft hammer percussion (Crabtree 1972). Five of these flakes combine lipped platforms with opposing dorsal scars and no dorsal cortex. These flakes were probably removed during early tool manufacture, but most of the rest, particularly those with more than 50 percent dorsal cortex, are undoubtedly core flakes. Thus, there is evidence for platform modification during core reduction as well as tool manufacture.

Table 24. Platform Categories by Material and Flake Type, Frequencies and Row Percentages

Material Type	Core Flakes			Manufacturing Flakes			Totals
	Unmodified	Modified	Obscured	Unmodified	Modified	Obscured	
Chert	87 79.1	5 4.6	17 15.5	1 0.9	0 0.0	0 0.0	110 5.6
Pedernal chert	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.05
Obsidian	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 0.05
Igneous undiff.	4 80.0	0 0.0	1 20.0	0 0.0	0 0.0	0 0.0	5 0.3
Basalt	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.1
Rhyolite	6 60.0	1 10.0	3 30.0	0 0.0	0 0.0	0 0.0	10 0.5
Chertic rhyolite	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 0.03
Limestone	20 83.3	1 4.2	3 12.5	0 0.0	0 0.0	0 0.0	24 1.2
Sandstone	5 71.4	0 0.0	2 28.6	0 0.0	0 0.0	0 0.0	7 0.4
Silicified siltstone	1479 82.2	69 3.8	243 13.5	4 0.2	2 0.1	3 0.2	1800 91.5
Quartzite	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.03
Quartzitic sandstone	4 80.0	0 0.0	1 20.0	0 0.0	0 0.0	0 0.0	5 0.3
Totals Percent	1609 81.8	76 3.9	272 13.8	5 0.3	2 0.1	3 0.2	1967

Reduction Stages. A few attributes have already been used to suggest which reduction stages are represented in the assemblage. Dorsal cortex percentages suggested that secondary core reduction dominated, though primary reduction is also well represented. Low percentages of modified platforms and the presence of few manufacturing flakes suggested that little tool production occurred. Other attributes such as debitage ratios and flake breakage patterns can also be used as indicators of reduction stages, and are expected to confirm these conclusions.

Low flake to angular debris ratios suggest core reduction while the opposite is indicative of tool manufacture. Flake removal during tool production is usually accomplished by soft hammer

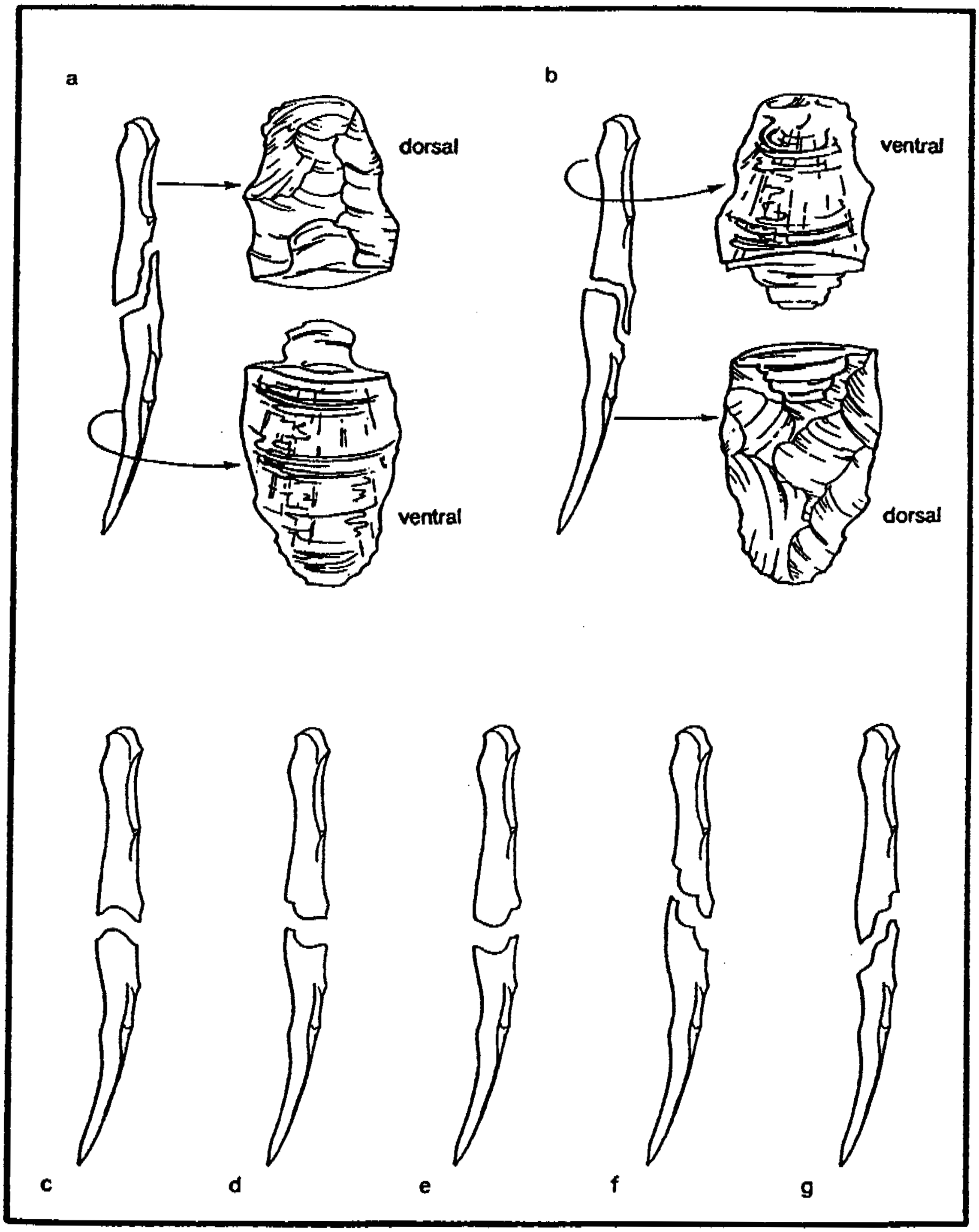

Figure 14. Manufacturing break patterns of flake fragments; (a-b) pieces à languette; (c) negative proximal hinge, positive distal hinge; (d) positive proximal hinge with small step off ventral surface, negative distal hinge; (e) positive proximal hinge, negative distal hinge; (f) proximal step, distal step off distal surface; (g) reverse proximal step, distal step off ventral surface. Note that proximal fragments of (e) and (f) resemble natural core terminations and would usually be defined as such.

percussion or pressure flaking. These techniques are more controlled than hard hammer percussion and produce less angular debris. Cores are generally reduced by hard hammer percussion, which produces comparatively large amounts of angular debris.

Though reduction techniques are more controlled during tool manufacture, flake breakage increases because debitage gets thinner as the reduction sequence proceeds. Much of this breakage is by secondary compression, in which outward bending during removal causes flakes to snap (Sollberger 1986). Certain characteristics of the distal ends of proximal or medial fragments and the proximal ends of distal or medial fragments can be used to determine whether breakage occurred during or after flake removal. Characteristics diagnostic of manufacturing breakage include *pieces a languette* (Sollberger 1986:102), and unnatural breaks on flake fragments (Fig. 14). On proximal fragments these include negative hinges, positive hinges curving up into small negative step fractures on the ventral surface, and step fractures on the dorsal rather than ventral surface. On distal or medial fragments they include step fractures and positive or negative hinges at the proximal end. Fragments with snap fractures could have fragmented during or after removal. Applying conservative standards, this pattern was considered evidence of post-removal breakage.

Debitage is divided into flakes and angular debris by material type in Table 25. Analysis of chipped stone assemblages from Archaic sites near San Ildefonso where tool manufacture was important produced flake to angular debris ratios of 7.0 or more (Moore n.d.a). Pueblo sites and associated scatters in the Rio Grande del Rancho Valley near Taos had flake to angular debris ratios between 2.42 and 3.12 (Moore n.d.b). Two of these sites, LA 2742 and LA 70577, contained pithouses and had flake to angular debris ratios of 3.10 and 3.12, respectively. Core reduction dominated those assemblages. The overall flake to angular debris ratio at LA 71276 is 3.54, which is rather low and indicative of core reduction.

Only chert, limestone, and silicified siltstone comprised 1 percent or more of the assemblage. These materials had flake to angular debris ratios of 2.23, 1.39, and 3.78, respectively. While these ratios are all indicative of core reduction, the ratios for chert and limestone are much lower than that for silicified siltstone. Material quality may be responsible for the difference between chert and silicified siltstone; chert is finer-grained and more brittle and thus more prone to shattering. Chert is also better suited for formal tool production, and it is possible that more flakes of this material were modified into other forms. The low flake to angular debris ratio for limestone could be due to the softness of that material in comparison with the others, which may have caused it to shatter more easily. Thus, two factors may be responsible for these differences--comparative brittleness and softness. Unfortunately, this is conjectural as no comparative data have been gathered.

No angular debris was recovered for five materials. These included Pedernal chert, obsidian, basalt, quartzite, and quartzitic sandstone. It is possible that these materials were not reduced on-site, but were carried in as flakes removed from cores reduced elsewhere, were collected from earlier sites, or were obtained from other persons. This phenomenon has been observed elsewhere. At Homol'ovi II, it appears that debitage was struck from cores in gravel deposits adjacent to the village, and then carried inside for use or manufacture into formal tools (Sullivan and Madsen 1991:80). Transport over very short distances is indicated in this example.

Table 25. Material Type by Debitage Type, Frequencies and Row Percentages

Material Type	Angular Debris	Flakes	Totals	Flake to Angular Debris Ratio
Chert	61 31.0	136 69.0	197 6.4	2.23
Pedernal chert	0 0.0	1 100.0	1 0.03	no angular debris
San Andreas chert	1 100.0	0 0.0	1 0.03	no flakes
Obsidian	0 0.0	2 100.0	2 0.1	no angular debris
Igneous undiff.	4 33.3	8 66.7	12 0.4	2.00
Basalt	0 0.0	2 100.0	2 0.1	no angular debris
Rhyolite	2 16.7	10 83.3	12 0.4	5.00
Chertic rhyolite	1 50.0	1 50.0	2 0.1	1.00
Limestone	23 41.8	32 58.2	55 1.8	1.39
Sandstone	6 35.3	11 64.7	17 0.6	1.83
Silicified siltstone	577 20.9	2181 79.1	2758 89.9	3.78
Quartzite	0 0.0	1 100.0	1 0.03	no angular debris
Quartzitic sandstone	0 0.0	7 100.0	7 0.2	no angular debris
Totals Percent	675 22.0	2392 78.0	3067 100.0	3.54

Table 26. Material Type by Portion for Flakes, Frequencies and Row Percentages

Material	Indeterminate Fragment	Whole	Proximal	Medial	Distal	Lateral	Collapsed Platform	Totals
Chert	0 0.0	87 64.0	22 16.2	3 2.2	22 16.2	2 1.5	0 0.0	136 5.7
Pedernal chert	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.04
Obsidian	0 0.0	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	0 0.0	2 0.1
Igneous undiff.	0 0.0	5 62.5	0 0.0	0 0.0	3 37.5	0 0.0	0 0.0	8 0.3
Basalt	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0	2 0.1
Rhyolite	0 0.0	9 90.0	0 0.0	0 0.0	0 0.0	1 10.0	0 0.0	10 0.4
Chertic rhyolite	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.04
Limestone	1 3.1	19 59.4	5 15.6	1 3.1	6 18.8	0 0.0	0 0.0	32 1.3
Sandstone	0 0.0	6 54.5	1 9.1	0 0.0	4 36.4	0 0.0	0 0.0	11 0.5
Silicified siltstone	0 0.0	1490 68.3	272 12.5	36 1.7	328 15.0	51 2.3	4 0.2	2181 91.2
Quartzite	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.04
Quartzitic sandstone	0 0.0	5 71.4	0 0.0	0 0.0	2 28.6	0 0.0	0 0.0	7 0.3
Totals Percent	1 0.04	1625 67.9	302 12.6	41 1.7	365 15.3	54 2.3	4 0.2	2392 100.0

Table 26 shows flake portion by material type. Only one fragment was not identified. About two-thirds of the flake assemblage is whole, and percentages of proximal and distal fragments are very similar. The similarity between these percentages could be an indication that most breakage was caused by post-removal processes like trampling. Much smaller percentages of the flake assemblage were made up of medial and lateral fragments, and collapsed platforms. The latter category consists of platforms that separated from the main body of a flake when it was struck. Lateral fragments are portions of flakes that split along the platform-to-termination axis.

Table 27 illustrates flake type by portion. There is little difference in whole flake percentages between the core and manufacturing categories. Significant differences do occur in the various fragment categories, but this is probably due to sample error as there are very few manufacturing flakes. Only broken flakes are included in Tables 28 and 29, which show distal and proximal breakage patterns. About two-thirds of the distal breaks on proximal and medial fragments were snap fractures suggesting post-removal breakage (Table 28). Nearly a third, however, had breaks

Table 27. Flake Type by Portion, Frequencies and Column Percentages

Flake Portion	Core Flake	Manufacturing Flake	Totals
Indeterminate fragment	1 0.04	0 0.0	1 0.04
Whole	1618 68.0	7 63.6	1625 67.9
Proximal	299 12.6	3 27.3	302 12.6
Medial	41 1.7	0 0.0	41 1.7
Distal	364 15.3	1 9.1	365 15.3
Lateral	54 2.3	0 0.0	54 2.3
Collapsed platform	4 0.2	0 0.0	4 0.2
Totals Percent	2381 99.5	11 0.5	2392 100.0

Table 28. Distal Termination Type by Flake Type for Proximal and Medial Fragments, Frequencies and Row Percentages

Flake Type	Snap Fracture	Obscured	Broken in Manufacture	Totals
Core flakes	230 67.8	1 0.3	108 31.9	339 99.1
Manufacturing flakes	0 0.0	0 0.0	3 100.0	3 0.9
Totals Percent	230 67.3	1 0.3	111 32.5	342 100.0

Table 29. Proximal Termination Type by Flake Type for Distal and Medial Fragments, Frequencies and Row Percentages

Flake Type	Snap Fracture	Broken in Manufacture	Obscured	Totals
Core flakes	270 68.9	121 30.9	1 0.3	392 99.7
Manufacturing flakes	1 100.0	0 0.0	0 0.0	1 0.3
Totals Percent	271 69.0	121 30.8	1 0.3	393 100.0

Table 30. Thickness Data for Whole and Broken Flakes

Flake Type	Whole and Broken Flakes			
	No.	Mean Thickness (mm)	Range (mm)	Standard Deviation
Whole flakes	1625	5.48	1-37	3.67
Broken flakes	708	4.70	1-22	3.18
Flake Type	Proximal, Medial, and Distal Fragments			
	No.	Mean Thickness (mm)	Range (mm)	Standard Deviation
Snap fractures	470	4.82	1-22	3.29
Manufacturing breaks	234	4.44	1-18	2.96

suggesting they fragmented during removal. A similar pattern occurs for proximal breaks on medial and distal fragments (Table 29). This suggests that two processes caused breaks in this assemblage--material failure during removal and post-removal damage.

As noted above, flake fragments with snap fractures at their proximal or distal ends could have been broken either during or after removal. Conservative standards were applied, and snap fractures have been considered evidence of post-removal breakage. This assignment should be testable, as manufacturing breakage should increase as flakes become thinner. Figure 15 graphs whole and broken flake thicknesses. The curves are similar, and peak at the same thickness. However, broken flakes have a slightly smaller mean thickness than whole flakes, as seen in Table 30. They also have a smaller thickness range and standard deviation. Only proximal, medial, and distal fragments are included in Figure 16. Fragments with snap fractures and manufacturing breaks have similar thickness curves. While fragments with manufacturing breaks have a slightly smaller mean thickness, thickness range, and standard deviation than those with snap fractures, there is little difference between categories.

Flake thicknesses at LA 71276 were compared with those from three other sites to further test these ideas. LA 2742 and LA 70577 are Valdez phase (A.D. 1100 to 1225) pithouses near Taos, and LA 65006 is a late Archaic site near San Ildefonso dating ca. 1400 to 900 B.C. Only the medial and distal portions of broken flakes were considered. Proximal fragments were omitted because their thicknesses were more a measure of the platform or bulb of percussion than the area of the break. Population data and the results of T-tests are shown in Table 31. In only one case (LA 65006) does the T-test suggest that fragments with snap fractures are a different population than those with manufacturing breaks. It may be significant that this is an Archaic site where reduction focused on large biface manufacture while the other sites were Anasazi residences where an expedient core-flake reduction strategy was used. However, obsidian dominated the assemblage at LA 65006 but was rare at the other three sites. Thus, this distinction could also be related to material type, as obsidian is very brittle.

An interesting trend is visible when means for each breakage category are compared by site. Flakes with snap fractures tend to be thinner than those exhibiting manufacturing breaks on three of the four sites. Only at LA 71276 are they thicker. This is impossible to accurately interpret from such a small sample of assemblages, but some possible reasons can be posited. First, of course,

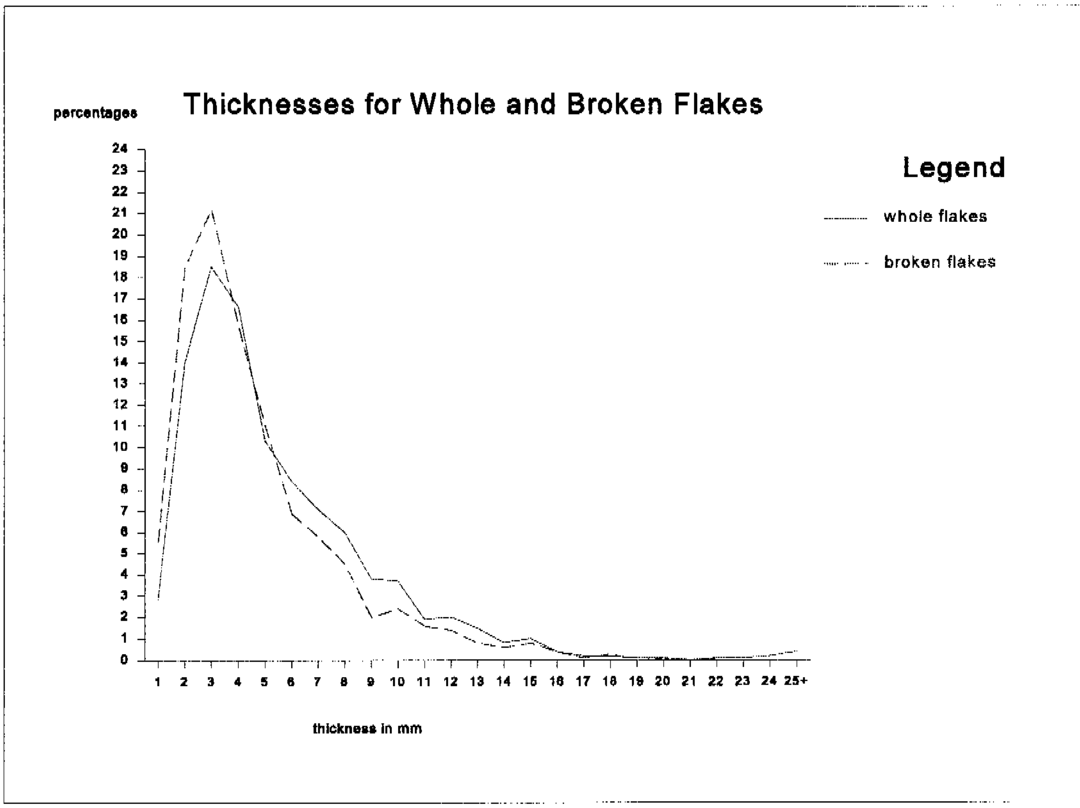

Figure 15. Comparison of thicknesses for whole and broken flakes.

it is possible that this trend is simply sample error as large assemblages are available from only two sites, LA 65006 and LA 71276. If sample error is not responsible, two patterns of flake breakage may be visible in these data. Post-reduction impact may be responsible for most of the snap fractures at LA 2742, LA 65006, and LA 70577, while fracture during manufacture may be responsible for most of the breakage at LA 71276. Whatever the cause, however, it appears that our assumption that manufacturing breakage increases as flakes become thinner may be incorrect. While flakes are prone to fracture by secondary compression as they become thinner, post-reduction impact seems to affect flakes that are marginally thinner (on the average) than those that were broken during manufacture. This appears to conflict with our assumption that manufacturing breakage increases with decreasing flake thickness unless most of the snap fractures also originated during reduction.

Thus, this portion of the analysis is inconclusive. While about two-thirds of the broken flake assemblage exhibited snap fractures and only one-third were broken during manufacture, comparisons with other assemblages suggest that post-removal processes may not have been responsible for the former type of break at LA 71276. Debitage patterns at LA 2742 and LA 70577 suggested that most breakage was attributable to post-removal impact (Moore n.d.b). The assemblage from LA 65006 has not yet been fully analyzed, but a preliminary examination of data suggests that post-reduction impact was responsible for most breakage represented by snap fractures. LA 71276 only partially matches the pattern exhibited by these sites. While one measure has statistically shown that both categories of broken flakes from three of the four sites derive from the same populations, other variables that have not been measured may also have affected flake breakage. Flake thickness may not be an appropriate measure, and more experimentation is in

Table 31. Results of T-tests on Flake Breakage Patterns

Population Data

Site No.	Breakage Type	No. of Cases	Mean (mm)	Standard Deviation	Standard Error
LA 2742	snap fracture	25	4.920	3.718	.744
	manufacturing break	41	5.878	3.743	.585
LA 65006	snap fracture	1040	1.999	1.384	.043
	manufacturing break	1376	2.203	1.358	.037
LA 70577	snap fracture	73	2.959	2.003	.234
	manufacturing break	172	3.105	2.000	.153
LA 71726	snap fracture	274	4.139	2.745	.166
	manufacturing break	119	4.059	2.559	.235

T-Test Results

Site No.	F Value	2-Tail Prob.	Pooled Variance Estimate			Separate Variance Estimate		
			t Value	df[1]	2-Tail Prob.	t Value	df[1]	2-Tail Prob.
LA 2742	1.01	.996	-1.01	64	.316	-1.01	51.11	.316
LA 65006	1.04	.513	-3.62	2414	.000	-3.61	2215.06	.000
LA 70577	1.00	.967	-.52	243	.603	-.52	135.61	.603
LA 71726	1.15	.384	.27	3.91	.787	.28	239.55	.781

[1] degrees of freedom

order. All that can be said at this point is that we don't know what caused the snap fractures on broken flakes at this site, though limited experimentation suggests that core reduction could be responsible for many of these breaks.

Though ambiguous as far as the origin of much of the flake breakage, this analysis also supports the conclusion that core reduction dominated at this site. Slightly over two-thirds of the flake assemblage was whole, and slightly more than two-thirds of the broken flakes had snap fractures. A different pattern of flake breakage is visible at LA 65006, where tool manufacture dominated the reduction sequence. Only a third of the flakes in that assemblage were whole, and nearly two-thirds of the broken flakes exhibited manufacturing breaks. Both of these figures are opposite those derived for LA 71276, and suggest that a different reduction pattern occurred there. Thus, core reduction appears to be indicated. While breakage during reduction and post-reduction impact are probably both responsible for the snap-fractured fragments at LA 71276, limited evidence suggests that the former may have been a major cause of breakage at this site as opposed to LA 2742 and LA 70577 (Moore n.d.b).

Core reduction dominated the reduction sequence at this site, though limited tool manufacture did occur. While debitage removed during the secondary stage of core reduction appears to prevail in the assemblage, a relatively high percentage of primary flakes suggests that early-stage core reduction was also an important reduction activity at this site. Core type and core flake modification data might provide further clarification.

Table 32 shows core type by volume. Cores were categorized by the direction of removals and number of platforms. Tested cobbles had only one flake removed to determine material quality. Undifferentiated cores could not be accurately identified as to type. Flakes were removed from one surface on unidirectional cores, and from two surfaces on bidirectional cores; both categories had only one platform. Multidirectional cores had flakes removed from more than one surface and exhibited multiple platforms. Pyramidal cores were triangular in cross section, and had flakes struck from one platform on multiple surfaces.

Most cores were multidirectional, suggesting that they were expediently reduced as far as possible before being discarded. The pyramidal core was the only example of a type that suggests efficient reduction aimed at producing the maximum amount of useable edge. Eliminating the tested cobble and undifferentiated cores from consideration, 10 (28.6 percent) of the cores were uni- or bidirectional, suggesting they were discarded before being exhausted. Mean core volume confirms this. The mean volume of multidirectional cores is nearly 200 cubic centimeters less than the unidirectional cores, and over 2,000 less than the bidirectional cores. Though only one example was found, the pyramidal core was one of the smallest recovered, with only two smaller cores occurring in the assemblage.

Table 32. Core Type by Volume in Cubic Centimeters, Frequencies and Row Percentages

Volume (cm^3)	Tested Cobble	Core Undiff.	Unidirect.	Bidirect.	Multidirect.	Pyramidal	Totals
1-500	1 8.3	1 8.3	3 25.0	0 0.0	6 50.0	1 8.3	12 31.6
501-1000	0 0.0	1 6.3	1 6.3	2 12.5	12 75.0	0 0.0	16 42.1
1001-1500	0 0.0	0 0.0	1 33.3	0 0.0	2 66.7	0 0.0	3 7.9
2001-2500	0 0.0	0 0.0	1 33.3	0 0.0	2 66.7	0 0.0	3 7.9
2501-3000	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.6
3501-4000	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	1 2.6
4001-4500	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.6
7501-8000	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	1 2.6
Totals Percent	1 2.6	2 5.3	7 18.4	3 7.9	24 63.2	1 2.6	38 100.0
Mean	360.0	621.1	1221.7	3112.9	1039.5	188.0	1174.4

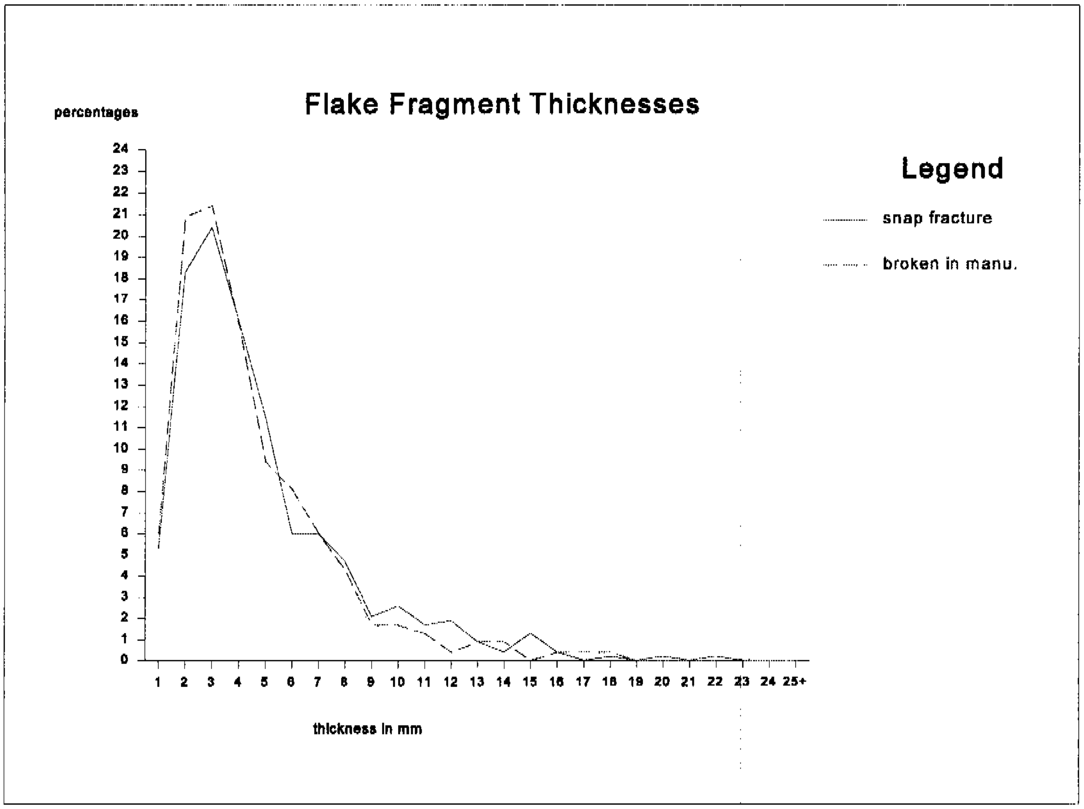

Figure 16. Comparison of the thickness of flakes with manufacturing breaks versus snap fractured flakes.

Material types are illustrated for each core category in Table 33. Silicified siltstone was by far the most common, with only single examples of chert and an undifferentiated igneous material occurring in the core assemblage. Most of the cores (35, 92.1 percent) are fine-grained, only a few (3, 7.9 percent) are medium-grained, and none were coarse-grained. While debitage was also predominantly fine-grained, there was a larger percentage of medium and a small percentage of coarse-grained materials in that artifact class. Figure 17 illustrates material quality by core volume. Most cores with a volume of less than 501 cubic centimeters were fine-grained and without visible flaws. Equal numbers of unflawed and flawed fine-grained cores occurred between 501 and 1,000 cubic centimeters, and a few cores in this category were unflawed and medium-grained. In general, only fine-grained materials were reduced to the smallest size category (less than 501 cubic centimeters), and flaws seem to have usually been discovered before cores were reduced to this extent. Medium-grained cores were abandoned before they were exhausted, particularly if flaws were encountered.

Both the chert and undifferentiated igneous core were fine-grained, multidirectional, and reduced to a volume of under 501 cubic centimeters (Table 34). This suggests that these materials were desirable and were reduced as far as possible. While silicified siltstone was the most common material at LA 71276, cores of this material were discarded at larger sizes than were those of other materials. Being locally available, it was not as necessary to conserve silicified siltstone as it was materials that were obtained at a distance from the site. Thus, silicified siltstone cores were discarded at larger sizes, probably whenever they became difficult to reduce or enough flakes had

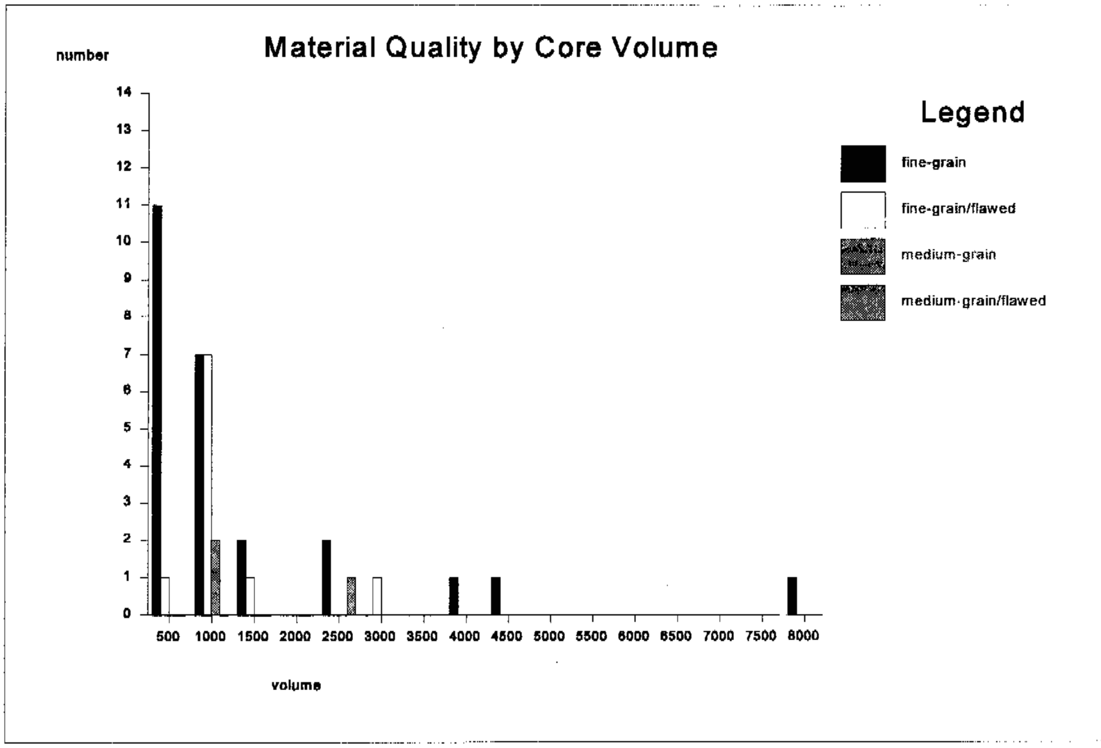

Figure 17. Material quality graphed against core volume.

been removed for the task at hand.

This is partially confirmed by Table 35, which shows the percentage of cortical-covered surface by core type. Only eight (21.1 percent) had no cortex, and this category included both the chert and undifferentiated igneous cores. About 63 percent of the cores had between 10 and 49 percent of their surfaces covered by cortex, and about 16 percent had more than 50 percent cortical surfaces. Most of the silicified siltstone cores retained at least some cortex; only a small percentage were reduced to the point of exhaustion, and few had all of their cortical rind removed. Thus, many of the silicified siltstone cores appear to have been discarded earlier in the reduction sequence than were those of chert or undifferentiated igneous material.

Expedient reduction dominates the core assemblage, and only one core type (pyramidal) suggests an attempt at maximizing the amount of edge produced. This is also suggested by core flake platform data. Though platform modification is more likely to occur during tool manufacture, core platforms can also be modified to increase control over flake length and shape and to prevent platform shattering. This is more likely to occur in the later stages of core reduction when continued flake removal has created steeply angled platforms that may shatter when struck. Table 24 showed platform types for the various flake categories, and only 3.8 percent of the core flakes had modified platforms. Thus, platform modification was only rarely used to control flake removal and platform shattering during reduction. Evidence for material conservation during core reduction is very limited.

Table 33. Material Type by Core Type, Frequencies and Row Percentages

Material Type	Tested Cobble	Core Undiff.	Unidirect.	Bidirect.	Multidirect.	Pyramidal	Totals
Chert	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.6
Igneous undiff.	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 2.6
Silicified siltstone	1 2.8	2 5.6	7 19.4	3 8.3	22 61.1	1 2.8	36 94.7
Column Total	1 2.6	2 5.3	7 18.4	3 7.9	24 63.2	1 2.6	38 100.0

Table 34. Core Volume by Material Type, Frequencies and Column Percentages

Core Volume (cm³)	Chert	Igneous Undiff.	Siltstone	Totals
1-500	1 100.0	1 100.0	10 27.8	12 31.6
501-1000	0 0.0	0 0.0	16 44.4	16 42.1
1001-1500	0 0.0	0 0.0	3 8.3	3 7.9
2001-2500	0 0.0	0 0.0	3 8.3	3 7.9
2501-3000	0 0.0	0 0.0	1 2.8	1 2.6
3501-4000	0 0.0	0 0.0	1 2.8	1 2.6
4001-4500	0 0.0	0 0.0	1 2.8	1 2.6
7501-8000	0 0.0	0 0.0	1 2.8	1 2.6
Totals Percent	1 2.6	1 2.6	36 94.7	38 100.0

In summary, expedient core reduction dominated the reduction sequence at this site. For those cores with definable flaking patterns, all but one were reduced expediently. Manufacturing flakes comprised only a small percentage of the assemblage, and few core flakes exhibited platform modification. The flake to angular debris ratio for this site is consistent with core reduction rather than tool manufacture, and is comparable to ratios derived for similar sites near Taos. While the removal of secondary flakes dominated the core reduction sequence, there was also a relatively high percentage of primary flakes. This seems to be related to the local availability of silicified siltstone, which allowed cores to be discarded before they were reduced to the point of exhaustion.

Table 35. Percentage of Cortex-Covered Surface by Core Type, Frequencies and Column Percentages

Cortex	Tested Cobble	Core Undiff.	Unidirect.	Bidirect.	Multidirect.	Pyramidal	Totals
0	0 0.0	1 50.0	1 14.3	1 33.3	5 20.8	0 0.0	8 21.1
10	0 0.0	0 0.0	1 14.3	1 33.0	4 16.7	0 0.0	6 15.8
20	0 0.0	0 0.0	1 14.3	0 0.0	3 12.5	1 100.0	5 13.2
30	0 0.0	0 0.0	2 28.6	0 0.0	5 20.8	0 0.0	7 18.4
40	0 0.0	0 0.0	1 14.3	1 33.3	4 16.7	0 0.0	6 15.8
50	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 2.6
70	0 0.0	0 0.0	1 14.3	0 0.0	2 8.3	0 0.0	3 7.9
80	0 0.0	1 50.0	0 0.0	0 0.0	1 4.2	0 0.0	2 5.3
Totals Percent	1 2.6	2 5.3	7 18.4	3 7.9	24 63.2	1 2.6	38 100.0

Tool Use

Both formal and informal tools were recovered from LA 71276. Formal tools are debitage whose shape was significantly altered to produce a certain shape or edge angle. Flaking patterns are unifacial or bifacial, and artifacts are classified as early, middle, and late stage tools based on the extent of flaking and edge condition. Early stage tools have an irregular edge outline and widely and variably spaced flake scars that often do not extend completely across their surfaces. Middle stage tools have a semiregular outline and closely or semi-regularly spaced flake scars that sometimes extend completely across surfaces. Late stage tools have a regular outline and closely or regularly spaced flake scars that usually extend completely across surfaces. While these categories may reflect manufacturing stages, this is not always true. For example, flaking is often confined to margins on late prehistoric projectile points, suggesting the early or middle stages of the manufacturing process, though the points are finished tools. Thus, tools cannot be judged as finished or unfinished on the basis of morphology alone.

Informal tools are pieces of debitage that were used without modification, or with modification limited to marginal retouch. Very conservative standards were applied when defining edge damage as evidence of use. This was necessary because trampling and erosional movement can cause damage that might be mistaken for cultural use. Only when scar patterns were consistent along an edge, and the edge margin was regular (no extreme scoops or projections) were artifacts categorized as informal tools.

Table 36. Tools by Material Types, Frequencies and Row Percentages

Tool Type	Chert	Pedernal chert	Obsidian	Silicified Siltstone	Totals
Informal tools	6 18.2	0 0.0	0 0.0	27 81.9	33 57.9
Hammerstones	0 0.0	0 0.0	0 0.0	4 100.0	4 7.1
Core-choppers	0 0.0	0 0.0	0 0.0	1 100.0	1 1.8
Core-hammerstones	0 0.0	0 0.0	0 0.0	2 100.0	2 3.5
Scrapers	0 0.0	0 0.0	0 0.0	2 100.0	2 3.5
Bifaces	1 100.0	0 0.0	0 0.0	0 0.0	1 1.8
Projectile points	10 71.4	1 7.1	3 21.4	0 0.0	14 24.6
Totals Percent	17 32.7	1 1.9	3 5.8	32 61.5	57 100.0

Table 36 shows the array of formal and informal tools recovered from LA 71276. Over half were informally used debitage or cobbles. Though four cobbles were informally used as hammerstones and three cores were informally used as choppers or hammerstones, they are included in the discussion of formal tools.

A total of 35 edges were used as informal tools on 33 pieces of debitage; 2 had a pair of used edges apiece, while the others had only 1 (Table 37). Five basic wear patterns were found: utilization, retouch, battering, abrasion, and rounding. Utilized edges exhibit unidirectional or bidirectional scars that are less than 2 mm long, and retouched edges have unidirectional or bidirectional scars that are more than 2 mm long. As the distinction between utilization and retouch is based on the length of attritional flake scars it is a rather subjective attribute. Battered edges are crushed and abraded from contact with hard materials, and abrasion occurs when edges are ground against hard materials. Light battering may be impossible to distinguish from abrasion in some cases. Rounding is an extreme form of abrasion that is sometimes accompanied by polish.

Utilization is the most common wear pattern, occurring on fourteen edges. Unidirectional use occurred on nine edges, one edge combined unidirectional utilization with abrasion, and four were used bidirectionally. Marginal retouch is less common, with nine edges exhibiting unidirectional scarring. However, two other edges combined unidirectional retouch with battering or unidirectional utilization. Four edges were rounded, four were battered, and two were abraded. Since very conservative standards were used to define evidence of informal tool use, it is unlikely that all informally used pieces of debitage were identified. While wear patterns such as rounding, abrasion, and battering are usually obvious and difficult to mistake for noncultural damage, the same is not true for attritional flake scars. Trampling, erosional movement, contact with excavation tools, and bag wear can all damage debitage edges. Thus, inconsistent scarring was considered to be evidence of noncultural impact.

Table 37. Wear Pattern by Artifact Morphology for Utilized and Retouched Debitage, Frequencies and Column Percentages

Wear Pattern	Angular Debris	Core Flakes	Totals
Unidirectional utilization	0 0.0	9 30.0	9 25.7
Bidirectional utilization	1 20.0	3 10.0	4 11.4
Unidirectional retouch	0 0.0	9 30.0	9 25.7
Rounding	0 0.0	4 13.3	4 11.4
Battering	2 40.0	2 6.7	4 11.4
Unidirectional retouch and utilization	0 0.0	1 3.3	1 2.9
Unidirectional retouch and battering	1 20.0	0 0.0	1 2.9
Abrasion	1 20.0	1 3.3	2 5.7
Unidirectional utilization and abrasion	0 0.0	1 3.3	1 2.9
Totals Percent	5 14.3	30 85.7	35 100.0

The types of scars that occur along an edge can vary with the way in which a tool was used as well as the material upon which it was used. Experiments by Vaughan (1985:20) showed that longitudinal use (cutting) caused mostly bidirectional scarring (65 percent), though a significant number of specimens were scarred on only one surface (17 percent). Transverse use (scraping, whittling) produced bidirectional scars in 46 percent of his experiments, and unidirectional scars in 54 percent. Thus, it is difficult to assign a specific function to these patterns. Similarly, rounding occurred when tools were used in both longitudinal and transverse directions (Vaughan 1985:26). While retouch may represent an attempt to resharpen an edge dulled by use, this is unlikely in most cases. It is probable that most informal tools were discarded when they became dull, and new flakes were selected as replacements. Striking a new flake from a core requires less effort than retouching a dulled edge. Most of what were identified as marginal retouch scars were undoubtedly caused by use. Scar length is probably a function of several factors including the type of material being processed, the brittleness of the material used as a tool, the amount of pressure exerted on the tool, and the angle at which it was used.

Material hardness, both that of the object being processed and the tool, are also important factors in scarring. Vaughan's (1985:22) experiments showed that consistent scarring along the utilized portion of an edge was almost always the result of contact with a hard material. However, nearly half of the edges used on hard materials and 80 percent of those used on medium-hard materials (such as fresh or soaked wood or soaked antler) were not consistently scarred. These conclusions are similar to those reached by Schutt (1980). In her experiments, consistent scarring also only occurred when hard materials were contacted. Scarring also varies with the type of material used as a tool. Brittle materials, such as obsidian, scar more easily than tough materials like chert or basalt. Further, scars are easier to define on glassy and fine-grained materials than on medium- and coarse-grained materials like silicified siltstone or quartzite.

Inconsistent scarring along an edge could either be the result of tool use, particularly against a soft or medium-hard material, or noncultural impact. This pattern of damage was noted on one or more edges of 49 pieces of debitage. As it was impossible to determine whether cultural or noncultural processes were responsible for this damage, the latter was assumed. Unfortunately, since the processing of soft materials rarely creates visible scars, and the processing of hard or medium-hard materials also may not always cause consistent scarring, it is likely that only a small part of the informal tool assemblage was identified. Thus, while we can conclude that informal tool use occurred at this site, it is impossible to determine how many pieces of debitage actually functioned in that way.

As noted in the discussion of material type and quality, glassy and fine-grained materials are best suited for cutting tasks and coarser-grained materials are better for heavy-duty chopping or pounding. As shown in Table 38, only two materials evidenced use as informal tools--chert and silicified siltstone. Both of these materials produce sharp edges when flaked, though chert is a finer-grained material and has somewhat sharper edges than does silicified siltstone. Twenty percent of the informal tools are chert and 80 percent are silicified siltstone. In contrast, chert made up 6.5 percent of the debitage assemblage as a whole, while silicified siltstone constituted

Table 38. Wear Pattern by Material Type for Informal Tools, Frequencies and Column Percentages

Wear Pattern	Chert	Silicified Siltstone	Totals
Unidirectional utilization	3 42.9	6 21.4	9 25.7
Bidirectional utilization	1 14.3	3 10.7	4 11.4
Unidirectional retouch	2 28.6	7 25.0	9 25.7
Rounding	0 0.0	4 14.3	4 11.4
Battering	0 0.0	4 14.3	4 11.4
Unidirectional retouch and utilization	0 0.0	1 3.6	1 2.9
Unidirectional retouch and battering	0 0.0	1 3.6	1 2.9
Abrasion	1 14.3	1 3.6	2 5.7
Unidirectional utilization and abrasion	0 0.0	1 3.6	1 2.9
Totals Percent	7 20.0	28 80.0	35 100.0

89.9 percent. This suggests that while chert comprised only a small part of the debitage assemblage it was more desirable for informal tool use than was silicified siltstone. Unfortunately, this conclusion is tentative because of the small number of artifacts that exhibited recognizable use-wear patterns.

Though several wear patterns were identified, it is difficult to assign most to specific functions. The presence of obvious signs of wear suggests that these tools were used to cut or scrape hard materials such as wood, bone, or antler. As the suitability of edges for certain tasks is partly determined by their sharpness, wear patterns are grouped by edge angles in Table 39. Most edges used in Schutt's (1980) experiments that measured over 40 degrees were found to be poorly suited for cutting. Thus, we assume that edge angles smaller than 40 degrees were best for longitudinal use (cutting), and those larger than 40 degrees were better for transverse use (scraping). Only about a quarter of the informal tool edges were smaller than 40 degrees, suggesting that most were used for scraping.

Several wear patterns are only associated with steeper edges including unidirectional retouch and utilization, battering, unidirectional retouch and battering, and unidirectional utilization and abrasion. Using the experimental criteria cited earlier it is likely that most of these tools were used against hard materials. It is also possible that the battering and abrasion on steeper edges was

Table 39. Wear Patterns by Edge Angles in Increments of 10 Degrees, Frequencies and Row Percentages, Two Values Missing

Wear Pattern	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	Totals
Unidirectional utilization	1 11.1	3 33.3	1 11.1	3 33.3	1 11.1	0 0.0	0 0.0	0 0.0	9 27.3
Bidirectional utilization	1 25.0	0 0.0	2 50.0	0 0.0	1 25.0	0 0.0	0 0.0	0 0.0	4 12.1
Unidirectional retouch	0 0.0	1 12.5	1 12.5	3 37.5	2 25.0	1 12.5	0 0.0	0 0.0	8 24.2
Rounding	0 0.0	1 25.0	2 50.0	0 0.0	1 25.0	0 0.0	0 0.0	0 0.0	4 12.1
Battering	0 0.0	0 0.0	1 33.3	0 0.0	1 33.3	0 0.0	0 0.0	1 33.3	3 9.1
Unidirectional retouch and utilization	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	1 3.0
Unidirectional retouch and battering	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	1 3.0
Abrasion	0 0.0	1 50.0	0 0.0	1 50.0	0 0.0	0 0.0	0 0.0	0 0.0	2 6.1
Unidirectional utilization and abrasion	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 3.0
Totals Percent	2 6.1	6 18.2	8 24.2	8 24.2	6 18.2	1 3.0	1 3.0	1 3.0	33 100.0

purposely done to dull parts of tools to prevent damage to the user's hand. Thus, some of the damaged edges may not have been used as tools; rather they were dulled to allow more efficient use of other edges. However, this is difficult to demonstrate because none of the informally used pieces of debitage possessing these wear patterns had more than one utilized edge.

Formal tools were relatively rare, as shown by Table 40. Only 0.8 percent of the total assemblage consists of formal tools, which, as noted earlier, also includes utilized cores and utilized but otherwise unmodified cobbles. Morphologically, all of the formal tools used for pounding were unmodified cobbles or cores. Unmodified cobbles were used as hammerstones, while cores were used as choppers or hammerstones. While it is likely that the hammerstones made from unmodified cobbles were used in lithic reduction, the utilized cores may have functioned differently. Though these tools may have been used for lithic reduction, they could also have been used to peck and sharpen the surfaces of ground stone tools.

Two scrapers were recovered; both were unifacial tools, and were probably used to process materials such as hides or wood. The tough, steep edges on these tools are suited to either purpose. Hafted scrapers are still used to process cow hides by the Gurage of Ethiopia (Gallagher 1977) and for working wood by the Ngatjara of Australia (Gould et al. 1971).

Only two types of bifacial tools were recovered--projectile points and a generalized biface. The latter may have been an all-purpose tool used for cutting, chopping, whittling, and scraping; essentially any task for which a sharp, durable edge was needed. It is unlikely that it was used as a core as were those produced during the Archaic period. The remaining bifaces were all projectile points (Fig. 18). Only one of these tools was a middle stage biface; the rest (including the generalized biface) were late stage tools.

Table 40. Tool Morphology by Function, Frequencies and Row Percentages

Morphology	Hammerstone	Core-Hammerstone	Core-Chopper	Scraper	Biface	Proj. Point	Totals
Cobble tool	4 100.0	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	4 16.7
Core tool	0 0.0	2 66.7	1 33.3	0 0.0	0 0.0	0 0.0	3 12.5
Early stage uniface	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	1 4.2
Middle stage uniface	0 0.0	0 0.0	0 0.0	1 100.0	0 0.0	0 0.0	1 4.2
Middle stage biface	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 4.2
Late stage biface	0 0.0	0 0.0	0 0.0	0 0.0	1 7.1	13 92.9	14 58.3
Totals Percent	4	2	1	2	1	14	24

Table 41. Experimental Projectile Point Debitage Data (weight in grams)

Material Type	Total Weight	% ¼-inch Mesh	% ⅛-inch Mesh	% Window Screen	Amount of Percussion
Obsidian	6.409	11.1	47.2	80.2	some
Obsidian	3.162	0.0	32.5	66.0	none
Obsidian	4.426	19.6	35.1	76.0	none
Obsidian	4.763	0.0	40.0	73.3	none
Obsidian	3.201	0.0	27.5	69.5	none
Chert	30.560	39.7	69.4	86.1	much
Chert	25.687	42.3	75.4	88.5	much
Obsidian	8.690	0.0	48.9	75.8	none
Obsidian	15.610	1.1	47.6	73.8	none
Obsidian	7.491	11.2	34.6	67.3	none
Obsidian	4.465	0.0	34.8	67.5	none
Obsidian	8.936	0.0	37.1	69.8	none
Obsidian	2.637	0.0	20.9	63.9	none
Obsidian	5.009	0.0	40.4	73.5	none
Obsidian	7.199	0.0	37.8	71.0	none
Obsidian	2.955	0.0	26.1	64.7	none
Obsidian	2.281	0.0	25.3	62.0	none
Obsidian	8.67	10.8	49.3	76.2	some
Obsidian	4.497	0.0	35.7	69.7	none
Obsidian	7.439	6.1	45.6	76.6	none
Obsidian	3.538	0.0	23.1	64.6	none
Obsidian	5.327	4.3	37.7	67.7	none
Obsidian	8.664	0.1	49.5	75.8	none
Obsidian	4.659	0.0	41.2	70.9	none
Obsidian	2.275	0.0	23.9	68.9	none
Obsidian	4.128	2.2	36.4	72.2	none
Obsidian	8.722	8.5	48.7	75.7	none

Projectile points were primarily used for hunting, and all of the specimens recovered were of a size suitable for use as arrow points. One was corner-notched, one was missing its hafting element, and twelve were side-notched. One of the latter had three side-notches. Most of the side-notched points were very similar to one another, and were probably produced by the same person. It is interesting that while chert and obsidian comprise rather small percentages of the chipped

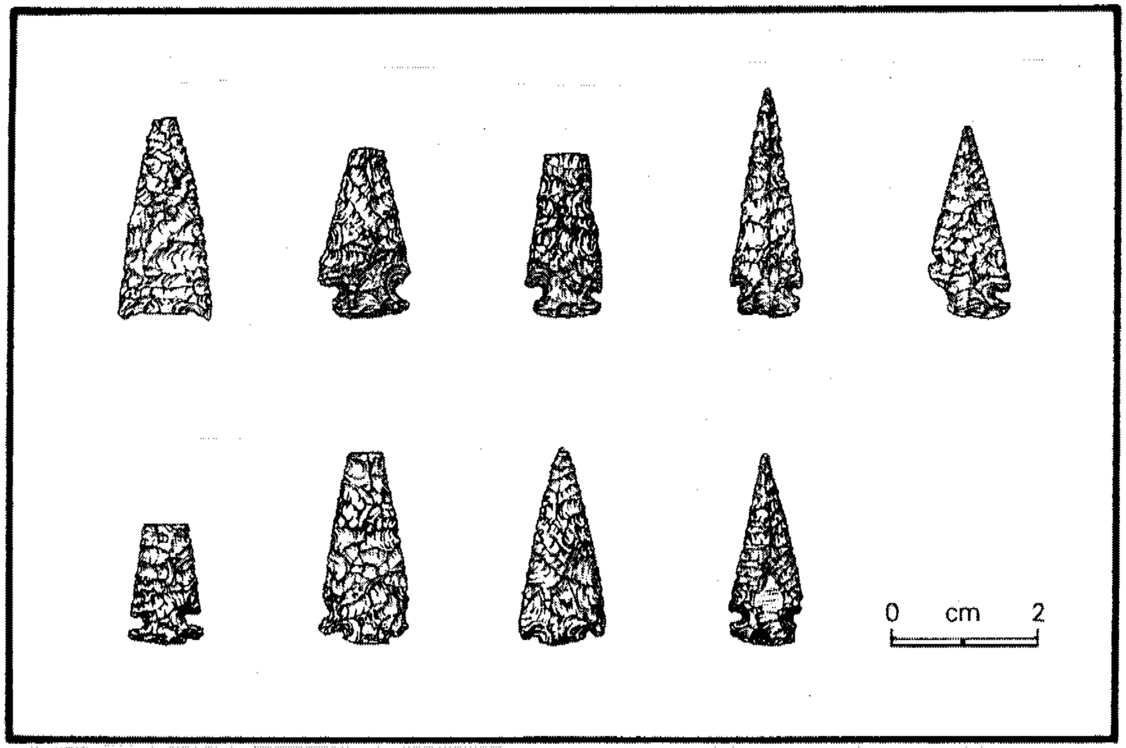

Figure 18. Projectile points from LA 71276.

stone assemblage, all of the projectile points were made from these materials. The relative rarity of these materials in the assemblage as a whole and the lack of debitage that would demonstrate that these tools were manufactured on-site suggests that projectile points were produced at another location. Experimental data may help address this possibility. Table 41 illustrates data from experimental projectile point manufacture. Only information from the manufacture of small arrow points is presented. It includes (from left to right) material type, total weight of debitage recovered from manufacture of the tool, cumulative percentages of total weight recovered by screening through a series of meshes of varying size, and the relative amount of percussion used to make each tool. Pressure flaking was the predominant method used to manufacture the experimental points. All flaking was conducted over a drop-cloth, and debitage produced during manufacture was recovered and stored in plastic bags.

Debitage from the manufacture of 27 points is included in Table 41. Flakes were recovered by ¼-inch screen in 12 cases (44.4 percent). At least a few flakes were removed by percussion in 4 of these cases, and pressure flaking was the only method used to manufacture the other 8. Of 23 points produced solely by pressure, debitage were recovered by ¼-inch screen in 8 cases (34.8 percent). In 2 of these cases the only pieces of debitage recovered were large fragments of the original flake that snapped early in the reduction process. Eliminating these examples, only 28.6 percent of the cases manufactured entirely by pressure yielded debitage recoverable by ¼-inch screen.

The number of flakes recovered by ¼-inch screen in these 6 cases ranged between 1 and 4, and averaged 1.5. In the 4 cases in which percussion was used to remove flakes, between 3 and 38 (average of 18) pieces of debitage were recovered by ¼-inch screen. By weight, an average of about 26 percent of the debitage from points produced by percussion in addition to pressure flaking was recovered by ¼-inch screen. In contrast, a maximum of only 11.3 percent (1 flake) was recovered when only pressure flaking was used and no major mistakes were made.

What this experimental data tells us is that unless percussion is used or a major mistake is made during projectile point manufacture, little evidence of this process is recoverable by ¼-inch screen. In most cases the flakes recovered by ¼-inch screen were produced early in the reduction sequence, and few possess the classic characteristics of a biface flake. In contrast, between 20.9 and 49.5 percent of the debitage (by weight) was recoverable by 1/8 inch screen. Cursory examination of these flakes showed that many were identifiably the result of tool manufacture.

Two factors are important when looking for evidence of the manufacture of small bifaces. First is the specific technique used in manufacture, and second is the size of screen used to recover materials from a site. When percussion is used during tool manufacture, larger flakes are produced and it is more likely that evidence of this process will be recovered by ¼-inch screen. When pressure is the sole technique used, the likelihood that evidence of this process will be recovered by ¼-inch screen decreases significantly. Thus, the recovery of only a few pieces of debitage removed during tool manufacture at LA 71276 does not necessarily imply that most of the bifaces were produced elsewhere as was concluded earlier. The projectile points from this site are small and seem to have been mostly or solely manufactured by pressure flaking. Since ¼-inch screen was used during excavation it is likely that most of the recognizable evidence for the on-site manufacture of these artifacts was too small to be recovered.

The similarity of most of these tools to one another suggests that much of the projectile point assemblage was manufactured by a single craftsman. It seems likely that these artifacts were produced on-site rather than procured from elsewhere. As the experimental data demonstrate, the lack of debitage from the manufacture of these tools is not necessarily an indication that they were made elsewhere. It is probable that most, if not all, of the debitage produced during the manufacture of these tools was not recoverable by the size of screen used during excavation. A second possibility is that they were manufactured in areas of the site outside project limits. In any case, we can conclude that negative information is not enough to suggest exchange or trade into the site; in situ manufacture must also be considered.

Ground Stone Artifacts

A total of 16 ground stone artifacts were recovered during excavation at LA 71276. Fifteen of these ground stone tools were recovered from the pit structure, 2 from the ventilator shaft and 13 from the trash-filled interior of the structure. Only 1 ground stone tool was recovered from a provenience outside the pit structure, and it was from the site surface. With one exception, all ground stone artifacts from the pit structure are fragmentary. The only unbroken ground stone artifact is a shaped slab used to cover the interior opening of the ventilator shaft, which was left in place when the pit structure was abandoned. None of the other ground stone tools are related to residential use of the structure. They were found in the trash-filled interior of the pit structure and ventilator shaft, and appear to represent broken tools that were discarded after the structure fell into disuse.

Table 42 illustrates function by material type for these tools. Sandstone is by far the dominant material, comprising 81.3 percent of this small assemblage. Undifferentiated igneous materials make up 18.7 percent, and were only used for manos. Sandstone was used to manufacture shaped slabs, manos, and metates. The functions of four sandstone tools were not identified. The sandstone from which most of the ground stone tools were made is fine grained, while the undifferentiated materials are all coarse grained.

The only economic activity represented by identifiable tool fragments is food preparation. Seven ground stone tools (43.8 percent) were used in food preparation, including four mano and three metate fragments. Four tools (25.0 percent) are too fragmentary to be functionally identified, but are undoubtedly also pieces of broken manos and metates. The five remaining tools (31.3 percent) are shaped slabs that were probably used as covers. One of the latter was used to seal the interior ventilator opening, as noted earlier. Specific functions cannot be assigned to the other shaped slab fragments, but they probably served similar purposes.

Table 42. Frequencies of Ground Stone Artifacts, Material Type by Artifact Function

Material Type	Indeterminate	Shaped slab	Mano	Metate	Totals
Igneous undifferentiated	0	0	3	0	3
Sandstone	4	5	1	3	13
Totals	4	5	4	3	16

Table 43. Ground Stone Tool Function by Preform Morphology

Function	Indeterminate	Rounded Cobble	Thin Slab	Very Thin Slab	Totals
Indeterminate	2	0	0	2	4
Shaped slab	0	0	1	4	5
Mano	2	1	1	0	4
Metate	2	0	0	1	3
Totals	6	1	2	5	16

Table 44. Ground Stone Tool Function by Production Input

Function	Indeterminate	None	Slightly Modified	Mostly Modified	Fully Shaped	Totals
Indeterminate	3	0	1	0	0	4
Shaped slab	0	0	5	0	0	5
Mano	1	1	0	1	1	4
Metate	3	0	0	0	0	3
Totals	7	1	6	1	1	16

Table 43 illustrates ground stone tool function by preform morphology. About 56 percent of the assemblage was manufactured from thin to very thin slabs. These categories are distinguished by thicknesses of 5 to 10 cm and less than 5 cm, respectively. Only one tool (6.3 percent) was made from a rounded cobble. Preform morphologies could not be determined for six tools (37.5 percent), which were represented by very small fragments.

Table 44 shows the amount of labor used to produce each functional category. Production input could not be determined for seven tools (43.8 percent) because only small fragments were recovered. About two-thirds of the other tools were slightly modified, including all five shaped slabs and one indeterminate fragment. One mano was unshaped, and two others were mostly or fully shaped. Unfortunately, since these tools were represented by fragments it was impossible to determine whether the shaping was purposeful or a consequence of use. The former was presumed, but the latter is also possible. Three methods were used to shape ground stone tools--pecking, flaking, and grinding. Only one tool of unknown function was shaped by pecking, and only its edge was modified. Flaking was exclusively used to shape two slabs, and in combination with grinding to shape three slabs. Grinding was the only visible method used to shape two manos.

Because of the incomplete nature of the ground stone tools, none of the mano or metate fragments could be differentiated by type. A study of grinding surface cross sections provided more specific information on the types of tools represented by these fragments. The grinding surfaces of two mano fragments were convex, and the cross-section shape of one could not be determined. The fourth fragment had two grinding surfaces--one flat and one convex. Two metate fragments had flat grinding surfaces and one was faceted. These data, particularly those furnished by the manos, suggest that two combinations of grinding stones were used. One was composed of tools that had flat grinding surfaces and includes the mano and metate fragments with flat cross sections. The second was composed of tools with curved grinding surfaces, and includes two mano fragments with convex surfaces. The faceted metate fragment may also fit into this category, but it is too small to be absolutely certain.

Only three pieces of ground stone evidenced pecking of the working surface for the purpose of resharpening. They included fragments of a mano, a metate, and an unidentified tool (probably a mano or metate). Secondary wear patterns were found on only one tool, the mano, with flat and convex grinding surfaces on opposing faces. Though none of the other ground stone fragments appear to have been recycled as tools when no longer suitable for their original purpose, many seem to have been recycled in other ways. At least five were oxidized or heat fractured and seem to have been reused as heating elements. Two others were blackened by charcoal, but only one was also partially oxidized and thus almost certainly burned. The other could have been used as a heating element, but it is more likely that it was simply stained by charcoal from the trash deposits. Thus, at least 37.5 percent of the ground stone assemblage appears to have functioned as heating elements after being broken or becoming otherwise unsuitable for their original purpose.

With the exception of the slab used to cover the interior opening of the ventilator shaft, none of the ground stone tools represent site furniture. With the same exception, none of these tools are whole and many show evidence of having been recycled as heating elements after being broken. Thirteen individual tools are represented among the fifteen fragments recovered from the pit structure. Two tools are represented by multiple fragments including a shaped slab (two fragments) and a metate (two fragments). Both pieces of the slab were found in the pit structure fill; one of the metate fragments was from pit structure fill and the other was from the ventilator shaft. The broken condition of most of this assemblage coupled with the reuse of a significant portion of it as heating elements suggest that most of these tools were purposely discarded. The only exception was the slab used to seal the interior ventilator opening, which was simply abandoned with the pit structure.

Conclusions

A total of 3,126 chipped and 16 ground stone artifacts was recovered during excavation at LA 71276. The chipped stone assemblage is dominated by local materials. Silicified siltstones are most common, comprising nearly 90 percent of the total. Over 96 percent of the cortical silicified siltstone debitage was procured at or near the source, and only a small percentage was obtained from secondary gravel deposits.

Only 0.3 percent of the chipped stone artifacts are from demonstrably exotic sources. Two materials are included in this category--Pedernal chert and obsidian. Other possible exotics include undifferentiated igneous materials, rhyolite, and basalt, and comprise 0.9 percent of the assemblage. In addition, the cherts used to manufacture 10 of the projectile points are finer and differently colored than those found locally, and may also have been obtained from nonlocal sources. Thus, about 1.5 percent of the assemblage does not appear to have been obtained locally (within 15 to 20 km of the site). It is probably significant that cortex on the few artifacts of demonstrably exotic origin indicates that they were obtained at or near their sources. This suggests contact with regions to the north of the study area, though it is impossible to determine whether those ties were direct or indirect from these limited data.

While most of the materials from this site are fine grained, there was a tendency to select high-quality cryptocrystalline materials for formal tool production. In particular, high-quality cherts and obsidians were used for the manufacture of bifacial tools, especially projectile points. Lower-quality noncryptocrystalline materials like silicified siltstones were used for hammerstones, scrapers, and informal tools that required little or no modification. This pattern was not unexpected. Davis et al. (1985) noted similar tendencies at early Anasazi sites on White Mesa in Utah. There, higher quality materials were used for projectile points and bifaces, while lower quality materials were used for informal and some formal tools (Davis et al. 1985). They note that ". . . the finer the raw material, the greater tendency for it to be used for extensive retouching of formal tools" (Davis et al. 1985:486).

Similar tendencies were also seen at ceramic period sites on Black Mesa in Arizona. There, materials are divided into local, intermediate, and distant categories based on the distance of sources from the study area (Parry 1987). Local materials were available within the study area, intermediate materials could be found as close as 15 km north of the study area, and distant materials were from more than 100 km away (Parry 1987). Local materials are predominantly coarse grained and not well suited to reduction (Parry 1987:23). This is similar to the situation at LA 71276, where local materials are also predominantly unsuitable for extensive retouching. Cameron (1987:131) noted that over 80 percent of the high-input tools from Black Mesa were made from nonlocal materials, while only 40 percent of the medium-input and 20 percent of the low-input tools were made from nonlocal materials. Again, high quality, nonlocal materials were used to manufacture tools requiring extensive retouching.

As expected, expedient core reduction dominates at LA 71276. While some evidence of tool manufacture was found, 99.6 percent of the flake assemblage probably originated during core reduction. These conclusions were supported by flake morphology, flake to angular debris ratios, flake breakage patterns, and core analysis. Most cores were reduced rather haphazardly, and only one was flaked in a way that suggested standardized reduction. This pattern is one of the hallmarks of an expedient reduction strategy (Parry and Kelly 1987:287).

Flakes removed during primary core reduction constitute 18.1 percent of the flake assemblage, and 81.5 percent were produced during secondary core reduction. Of the latter, over 75.4 percent have no dorsal cortex. These percentages suggest that most materials came onto the site as unreduced nodules or only partially reduced cores. Exceptions to this include Pedernal chert, obsidian, basalt, and rhyolite. These exotic materials are represented by only a few examples apiece, and probably arrived at the site as already reduced cores or individual flakes.

Analysis of flake platforms suggests that modification by abrasion occurred during both core reduction and tool manufacture. When other attributes such as dorsal scar pattern, cortex, and platform lipping are combined with platform data, 5 of 79 core flakes with modified platforms can be classified as possible early stage manufacturing flakes. This increases the number of possible manufacturing flakes to 16, or 0.7 percent of the flake assemblage. Thus, even with the addition of these artifacts, evidence for the manufacture of facially flaked tools remains uncommon at this site.

Both formal and informal tools were recovered. Only slightly more than half the tool assemblage was comprised of informally used debitage, which is less than might be expected. However, the use of very conservative standards for identifying informal tools coupled with a tendency for debitage used on all but the hardest of materials to lack consistent edge damage suggest that a large part of the informal tool assemblage was not identified. Most of the informally used debitage was probably used on hard materials such as antler, bone, or wood. Battering and abrasion on some of the steeper edges may be evidence of intentional dulling to protect the hand of the user rather than direct evidence of use.

As discussed earlier, it is difficult to assign informal tools to a specific use on the basis of wear pattern alone. The predominant selection of cherts and silicified siltstone for use, however, suggests that cutting edge sharpness was more important than durability. The dominance of utilized edge angles greater than 40 degrees may indicate that most of these tools were used for scraping. The tools with edge angles less than 40 degrees were probably used for cutting.

Formal chipped stone tools were also rare in the assemblage, and many were not facially flaked. This category includes unmodified cobbles and cores used as hammerstones or choppers, which comprise nearly 30 percent of the tool assemblage. Of the 17 remaining tools, 15 are bifaces (14 projectile points and 1 generalized biface). Thus, facially flaked tools were rather rare, and primarily comprised of a single specialized type. While evidence for projectile point manufacture was generally lacking in the area investigated, experimental data indicate that this negative evidence is not strong enough to allow us to conclude that the projectile points were manufactured elsewhere. The similarity of many of these points suggests that they were produced by the same craftsman, and it is more likely that they originated on-site than off.

Analysis of the ground stone assemblage provided several important pieces of information. The nature of this assemblage supports the conclusion that materials removed from Structure 1 were trash deposits. Only one whole ground stone tool was recovered, and this artifact was a piece of site furniture that was left in place when the structure was abandoned. All of the other ground stone tools are broken, and a large percentage were recycled as heating elements before being discarded. Only two general categories of ground stone tools are present--food grinding stones and shaped slabs.

While these analyses proceeded under the assumption that the artifacts were representative of the site as a whole, it must be kept in mind that most materials were retrieved from trash deposits in Structure 1. Thus, the artifacts had been discarded as no longer useful. Nearly 91 percent of the chipped stone artifacts came from the trash-filled interior of the pit structure and ventilator shaft. This assemblage included most of the debitage, all but 1 of the bifaces, 1 of 2 unifaces, all 3 cobble tools, 33 of 36 cores, all 11 manufacturing flakes, all of the informally used debitage and cores, and all but 1 piece of ground stone. Only 3 chipped and ground stone tools were not discarded with other trash in the pit structure.

It is probable that the chipped stone artifacts are representative of activities performed with that part of the assemblage. Most of the tools produced by an expedient reduction strategy are low maintenance. Using ethnographic data, Parry and Kelly (1987:287) suggest that there is no distinction made between tools and waste material in expedient technologies, and tools are seldom modified. Thus, all debitage are viewed as potential tools, and tend to be discarded rather than resharpened when no longer usable. Cobble and core tools were whole when discarded at LA 71276. Like the informally used debitage, these tools were made with minimum effort or were wholly unmodified before use, and were expendable when the task for which they were selected was finished. However, much more effort was put into the production of facially flaked tools, which should not occur in trash deposits unless broken, exhausted, or lost. Eleven of 17 facially flaked tools are broken, and were probably discarded for that reason. Unbroken facially flaked tools include both scrapers and 4 projectile points. The use-lives of the scrapers were probably exhausted at the time of discard, but the projectile points are another matter; perhaps they were lost or discarded by accident.

The manufacture of ground stone tools represents a further increment in production input. Where a projectile point can be flaked in as little as twenty to thirty minutes, a metate might require many hours of shaping and grinding before it is suitable for use. Thus, there is even less likelihood that these tools would be casually discarded while still usable. This was demonstrated by the ground stone assemblage that, except for the slab used to seal the ventilator shaft, consists of broken fragments. It is unlikely that these artifacts were broken after discard. If that was the case most, if not all, of the fragments should have been recovered during excavation. In addition, a fragment of one metate was found in the pit structure, and a second piece was recovered from the ventilator shaft. Since the interior ventilator shaft opening was sealed, these fragments were disposed of individually, and the tool had to have been broken at the time of discard.

Thus, while the debitage and cores are probably representative of the site assemblage as a whole, the formal chipped and ground stone tools are not. Missing from the trash deposits (for the most part) are serviceable facially flaked and ground stone tools, which would have been transported elsewhere when the site was abandoned, cached for future use, or discarded at another location when worn out or broken.

Several conclusions have been made concerning the chipped and ground stone assemblages from LA 71276. First, an expedient core-flake reduction strategy was used at this site. A core was the sole example of standardized reduction. Second, local materials seem to have been unsuitable for the production of facially flaked tools, which appear to have been mostly made from exotic materials. While possible that many of the facially flaked tools (mostly projectile points) were imported as finished tools, the similarity of most of these artifacts to one another coupled with experimental data indicate that it is more likely that they were made on-site. Finally, it is likely that the tool assemblage is not representative of activities occurring at the site as a whole; rather they represent a part of the assemblage that was broken and discarded or lost while the site was still occupied.

ANALYSIS OF BOTANICAL REMAINS

by Mollie S. Toll

Introduction and Methods

Excavations at LA 71276 produced a compact but informative plant assemblage. Six flotation samples document a single agricultural crop, corn, an impressive array of wild plant products, and utilized wood species from pit structure fill and features, and an extramural hearth (Table 45). Wood samples collected during excavation provide further information about roofing materials and larger size fuel remains. Macrobotanical specimens of *Zea mays* provide a small number of morphometric cases for placing Bingham corn in a regional perspective.

Bingham is located on the eastern margin of the broadly defined Rio Grande Valley, characterized in the low-elevation flatlands by Chihuahuan desert scrub (shrubs and small trees such as mesquite, creosote bush, tarbush, saltbush, and yucca, with an understory of grasses and various annuals and perennials; Brown 1982). The contact between desert scrub and Chihuahuan semidesert grassland is complex, occurring at elevations between 1,100 and 1,400 m and providing "alternating landscape mosaics over many miles" (Brown 1982:123). In the prehistoric era, perennial bunch grasses separated by intervening bare ground produced a purely grass landscape over much of the semidesert grassland zone; today, grazing has induced a shift to either sod grasses or annuals, depending on local rainfall. Bingham is situated in an area of rapidly increasing elevation. At 1,908 m, Great Basin conifer woodland (largely composed of piñon and juniper with grass and shrub understory) surrounds the site, but the grassland zone is not far away. The conifer woodland zone provides all wood taxa of the predominantly coniferous assemblage recovered, and all wild seed taxa. Wild plant remains include juniper twigs, seeds of two cacti (hedgehog, prickly pear), and charred (goosefoot, mallow) and uncharred (tobacco, pigweed, purslane, spurge) annual weed seeds.

Tajo phase ceramics place the site between A.D. 800 and 1000, reiterated by an archeomagnetic date of A.D. 930-1010. The only truly comparable site nearby is Taylor Draw, from which a collection of 78 maize cobs found in burned granaries is reported by Brugge (1976); no flotation analysis was undertaken (Table 46). To the north in the Salinas area, analyses in progress from the Kite site focus specifically on subsistence and paleoenvironmental data (Rautman 1991). Excavated sites from the early Pueblo period in the central Rio Grande Valley are few and far between. Work prior to the 1970s generally did not include flotation analysis (Peckham 1957; Skinner 1965; Vivian and Clendenen 1965), while more recent projects have suffered from abstemious sampling and meager recovery of botanical materials (Struever 1980; Toll 1981, 1986).

The soil samples were processed at the Office of Archaeological Studies by the simplified "bucket" version of flotation (see Bohrer and Adams 1977). Samples consisted of 2 liters of soil, with the exception of a smaller, 1 liter sample from the extramural hearth, Feature 6. Each sample was immersed in a bucket of water, and a 30-40 second interval allowed for settling out of heavy particles. The solution was then poured through a fine screen (about 0.35 mm mesh) lined with a square of "chiffon" fabric, catching organic materials floating or in suspension. The fabric was

Table 45. Bingham Botanical Materials

Provenience	Flotation	Wood	Macrobotanical
Pit Structure Features			
Hearth 8	FS 67	FS 67 [flotation] FS 67 [macro] FS 67 [C-14]	
Posthole 9	FS 76	FS 76 [flotation] FS 76 [macro] FS 76 [C-14]	
Pit Structure Fill			
Level 4, TP 5			FS 29 *Zea*
Level 9		FS 18 [macro]	FS 18 *Zea*
Level 10	FS 21	FS 19 [macro]	
"full cut"	FS 41	FS 37 [C-14] FS 38 [macro]	FS 41, 48 *Zea* FS 38 *Yucca*
Extramural Features			
Hearth 6	FS 56	FS 56 [flotation]	
Ventilator 5	FS 65	FS 65 [flotation] FS 62 [C-14]	FS 62 *Zea*
Burial 4		FS 49 [macro]	

Table 46. Plant Remains Reported from Early Pueblo Sites in Central New Mexico

Site	Location	Date	Reference	Flotation Samples	Macrobotanical Remains
Desert Scrub and Grassland					
Sevilleta Shelter LA 20896	Palo Duro Canyon 8 km E of Rio Grande at La Joya	PII shelter	Struever 1980	5	4 *Zea* cob fragments, *Quercus* root
Sevilleta LA 29412 LA 29416	low ridges along Arroyo los Alamos 5 km E of Rio Grande, S of Socorro	late PI/early PII A.D. 850-1050	Toll 1981	2	none
Fite Ranch LA 45884	dunal ridge near San Antonio	PI/II pithouse village A.D. 955 ± 31	Toll 1986	4	none
Denison	low hill W of Rio Grande, 5 km N of Isleta Pueblo	PI/II pithouse village	Vivian and Clendenen 1965:17	none	2 *Zea* cobs (no measurements)
Sedillo	first terrace W of Rio Grande, Albuquerque	PI/II pithouse village A.D. 800-1150	Skinner 1965:17	none	*Zea* cobs (no measurements)

Site	Location	Date	Reference	Flotation Samples	Macrobotanical Remains
River's Edge	terrace just W of Rio Grande, W of Corrales	BMIII/PI A.D. 650-900	Brandt 1991	114 scan	morphometrics on 33 *Zea* cobs; wood
Artificial Leg	terrace just W of Rio Grande, W of Corrales	BMIII/PI	Frisbie 1967, table 20	none	morphometrics on 2 *Zea* cobs (Galinat)
LA 45995 LA 45996 LA 45997	9 km W of Rio Grande, near Albuquerque	PI (pithouses at 45995, extramural features at others)	Brandt 1990	#?	?
LA 3289 LA 3290 LA 3291	first terrace E of Rio Grande, 5 km S of Sandia Pueblo	BMIII/PI(II) pithouses	Peckham 1957:47	none	roof material = charred grass *(Phragmites?)* and cottonwood
Conifer Woodland					
Bingham LA 71276	conifer woodland, E margin of Rio Grande Valley	PI/PII pithouse A.D. 930-1010	[this study]	6	4 *Zea* cob fragments, 25 *Yucca* seeds, wood
Taylor Draw LA 6565	conifer woodland, E margin of Rio Grande Valley	PI/PII pithouse	Peckham 1976 Brugge 1976	none	78 *Zea* cobs [14 measured in detail]
Kite Site LA 38448	juniper woodland/ grassland at base of Chupadera Mesa	PI/II pithouse village A.D. 979-1257	Rautman 1991 Moore 1990	42	none reported

lifted out and laid flat on coarse mesh screen trays, until the recovered material had dried. Each sample was sorted using a series of nested geological screens (4.0, 2.0, 1.0, 0.5 mm mesh), and then reviewed under a binocular microscope at 7-45x. The large size of the "floated" samples required subsampling of the smallest screen sizes in each sample. For each taxon in a sample, an estimated number of seeds per liter was calculated, taking into account subsampling and the original volume of soil.

From each flotation sample, a sample of 20 pieces of charcoal was identified (10 from the 4 mm screen, and 10 from the 2 mm screen). Each piece was snapped to expose a fresh transverse section, and identified at 45x. Charcoal specimens examined prior to submission for radiocarbon dating were examined in the same fashion, but selection was adapted to securing a minimal sufficient sample (the objective was 5 g) with the fewest pieces, rather than aiming to examine both large and small pieces. Low-power, incident light identification of wood specimens does not often allow species- or even genus-level precision, but can provide reliable information useful in distinguishing broad patterns of utilization of a major resource class.

Corn cob fragments, and the single kernel, were measured with dial calipers according to basic attributes described by Nickerson (1953).

Results

Pit Structure Features

Economic plant remains in the pit structure hearth and a posthole included corn cob and kernel fragments, and seeds of two cacti (hedgehog and prickly pear; Table 47). Unburned weedy annual seeds, ambiguous as to whether they are cultural or intrusive, included pigweed, goosefoot, and groundcherry (all possible food sources) and spurge (likely present as a contaminant). Some shrubby wood (saltbush/greasewood and sage) showed up in the small charcoal pieces recovered from the posthole flotation sample, though the vast majority of flotation wood was juniper (Table 48). Larger pieces of wood recovered from these features was entirely juniper, regardless of whether it was carbonized or unburned (Table 49). As is often the case, plant remains recovered by flotation from the posthole seem to represent general room trash, likely deriving ultimately from food processing activities centering around the hearth.

Pit Structure Fill

Pit structure fill netted the greatest density and diversity of economic plant remains (Table 47), including several food species (goosefoot, prickly pear and hedgehog cacti, ricegrass, and corn), and two likely correlates of medicinal/ceremonial activities (tobacco and mallow). A small ceramic pipe or cloudblower recovered from the fill (see Fig. 10) provides a nice correlate to the presence of *Nicotiana* seeds; chemical analysis of the dottle lining the pipe would confirm whether it was actually used to smoke tobacco. Each flotation sample contained small numbers of tiny carbonized cob fragments; larger corn remains collected during excavation included a charred kernel (FS 41; 108N/101E) and four cob fragments (only two of which were measurable: FS 48; 108N/100E). Also present were 25 charred yucca seeds (FS 38; 107N/101E). These were neatly stacked up in two rows, just as seeds are arranged in a mature yucca fruit pod.

Charred juniper twigs or scale leaves found in flotation samples may relate to fuel, roofing, or bedding. Flotation wood was all juniper, while the larger pieces of macro and C-14 wood included a sizeable contingent of piñon (25 percent by number, 31 percent by weight; Table 49). Dendrochronological samples, all piñon, derived from pit structure fill, either just above floor fill (FS 53), or from roof fall (FS 40; William Robinson, letter dated June 19, 1992).

Extramural Features

An extramural hearth contained no flotation remains (Table 47) and a strictly juniper wood assemblage (Table 48). Ventilator fill was much like low-density pit structure fill. Two of the most prominent pit structure constituents were present in lower frequency: tobacco seeds and corn cob parts (FS 65 and FS 62). As in the pit structure posthole, the predominantly coniferous wood assemblage from the vent shaft included a small amount of shrubby material (sage; Table 48). Wood accompanying the burial (Feature 4) was all juniper (Table 49).

Table 47. Flotation Results, LA 71276 (Bingham)

Taxa	Pit Structure Features		Pit Structure Fill		Extramural Features	
	Hearth 8 FS 67	Posthole 9 FS 76	Level 10 FS 21	Full cut FS 41	Hearth 6 FS 56	Vent 5 FS 65
Weedy Annuals						
*Chenopodium** goosefoot				1.0		
Nicotiana tobacco			15.0	5.0		1.0
Malvaceae* mallow family				1.0		
Perennials						
*Opuntia**		1.5		1.5		
Opuntia prickly pear cactus		1.5	1.0			
Echinocereus hedgehog cactus	.05		1.0			
*Juniperus** juniper			+tw	+tw		
Grasses						
*Oryzopsis** ricegrass			0.5			
Cultivars						
*Zea mays** corn	0.5k	+c	+c	+c		+c
Unknowns						
9131*				0.5		
Unidentifiable*			0.5	1.0		
Total Probable Economic Species						
Total taxa	2	2	6	8	0	2
Total burned taxa	1	2	3	7	0	1
Total seeds	0.5	3.0	18.0	10.0	0	1.0
Taxa with Uncertain Role						
Amaranthus pigweed		10.0	2.0			
Chenopodium goosefoot	0.5		1.5			

Taxa	Pit Structure Features		Pit Structure Fill		Extramural Features	
	Hearth 8 FS 67	Posthole 9 FS 76	Level 10 FS 21	Full cut FS 41	Hearth 6 FS 56	Vent 5 FS 65
Portulaca purslane			4.5			
Physalis groundcherry	8.0					
Malvaceae mallow family			1.0	0.5		
Total Uncertains						
Total taxa	2	1	4	1	0	0
Total seeds	8.5	10.0	9.0	0.5	0	0
Probable Contaminants						
Euphorbia spurge	2.5		0.5	1.0		
Total Contaminants						
Total taxa	1	0	1	1	0	0
Total seeds	2.5	0	0.5	1.0	0	0

Seed frequencies expressed as an estimated number of seeds per liter of soil sample (taking into account any subsampling, and soil sample size other than the standard 1 liter
* = carbonized; c = cupule; k = kernel; tw = twig

Table 48. Species Composition of Wood from Flotation Samples, LA 71276

	Pit Structure Features		Pit Structure Fill		Extramural Features	
	Hearth 8 Floor 2 FS 67	Posthole 9 FS 76	Level 10 FS 21	Fill FS 41	Hearth 6 FS 56	Vent shaft FS 65
Conifers						
Juniperus juniper	20 .99g	17 .23g	20 .42g	20 1.31g	20 2.05g	18 .39g
Undetermined		1 .05g				1 .09g
Total Conifer	20 .99g	18 .28g	20 .42g	20 1.31g	20 2.05g	19 .48g
Nonconifers						
Atriplex/Sarcobatus saltbush/greasewood		1 .02g				

	Pit Structure Features		Pit Structure Fill		Extramural Features	
	Hearth 8 Floor 2 FS 67	Posthole 9 FS 76	Level 10 FS 21	Fill FS 41	Hearth 6 FS 56	Vent shaft FS 65
Artemesia sage		1 <.01g				1 .04g
Total Nonconifers	0	2 .02g	0	0	0	1 .04g
Total sample	20 .99g	20 .30g	20 .42g	20 1.31g	20 2.05g	20 .52g

Table 49. Species Composition of Charcoal and Unburned Wood, Collected as Macrobotanical Samples or for C-14 Dating: LA 71276

Provenience	Juniper	Piñon	Undet. conifer	Total
Pit Structure Features				
Hearth 8				
FS 67 macro	8 [5.57g]			8 [5.57g]
FS 67 C-14*	10 [5.20g]			10 [5.20g]
Posthole 9				
FS 76 macro	20 [29.61g]			20 [29.61g]
FS 76 C-14*	5 [2.10g]			5 [2.10g]
Pit Structure Fill				
Level 9 FS 18 macro*	17 [2.45g]	3 [0.50g]		20 [2.95g]
Level 10 FS 19 macro*	11 [5.11g]	9 [4.70g]		20 [9.81g]
Full cut				
FS 37 C-14*		3 [7.70g]		3 [7.70g]
FS 38 macro	19 [20.38g]		1 [0.62g]	20 [21.00g]
Extramural Features				
Vent 5 FS 62 C-14*	9 [5.00g]	1 [0.90g]		10 [5.90g]
Burial 4 FS 49 macro	6 [0.16g]			6 [0.16g]
Total	105 [75.58g] 86% [84%]	16 [13.8g] 13% [15%]	1 [0.62g] 1% [1%]	122 [90.00g] 100%[100%]

* Carbonized wood

Discussion

Utilized Wild Plants: Significant Presence of Perennials

Keeping in mind that the Bingham flotation sample is small (six samples), the assemblage appears to correspond nicely with the pattern seen in other sites in the Rio Abajo and associated upland locations (Table 50). The array of utilized annuals is relatively compact; only charred goosefoot and mallow family, and unburned tobacco seeds are surely cultural (unburned pigweed, purslane, and groundcherry seeds are possible additions to the collection). Several perennials, found in *very* low frequency in prehistoric contexts in wide-ranging parts of New Mexico, put in a significant appearance at Bingham and other southern sites (this pattern is most evident at later, larger sites with better preservation, see Toll 1988:42-43). Four out of six flotation samples contained hedgehog or prickly pear cactus seeds, and yucca seeds were also found in pit structure fill (FS 38). The Chihuahuan Desert floristic community appears to provide a resource base with some distinctive qualities. In cooler deserts to the north, many perennial resources are restricted to specialized soil and drainage conditions that tend to occur towards the upper altitudinal limits for these species. In south-central New Mexico, greater profusion of gravelly outwashes and other coarse-textured soils, together with warmer winters, longer growing season, and lower elevation, favors denser and more widely distributed populations of several cacti species and broad-leafed yucca. The observed emphasis on these perennial species, at Bingham and other southern sites where they were obtainable in quantity, suggests that the large carbohydrate or oil reserves in fruit or root tissues offered a greater nutritive return for energy expended.

Lack of piñon nut debris is indeed curious, given the proximate availability of this tasty crop, high in protein, carbohydrate, and fat (Botkin and Shires 1948). Either of two factors may be at work here: short-term site occupation (in any given area, nut crops are produced at three to five-year intervals; Barger and Folliott 1972:39), or systematic bias against nutshell preservation. Ricegrass, found in the pit structure fill, is a crop of coarse-grained soils filling a handy niche in the annual subsistence round. *Oryzopsis* uses winter and spring moisture to produce relatively large (3-4 mm) and nutritious seeds in late May to early June, coming at a "critical time of the year for the hunter-gatherer and the agriculturalist" (Bohrer 1975:199), when most wild food plants are not yet available and cultivated crops are far from ready for harvest. Ricegrass is a common component of several southern flotation assemblages from various prehistoric periods: for instance, in 14 percent of samples (37 percent of feature samples) at a PIII pit structure village in Belen (Toll 1988, table 11), in 47 percent of samples at a PIII pithouse site in Albuquerque (Toll 1987a, table 6), and in 56 percent of samples at Qualacu pueblo (Toll 1987b). This stands in considerable contrast to its spotty appearance in sites of the Colorado Plateau.

Tobacco

Our knowledge of prehistoric tobacco usage is in a curious and rapidly changing state. At magnification levels commonly used for flotation analysis (less than 15x), the distinctive surface sculpturing of tiny tobacco seeds is inevident; without the proper search image, the seeds look like yellow sand grains, or bits of amorphous organic material. Analysts are now alert to check out these yellow rectangular bits, or to work at higher magnification in the smaller screen sizes, but it is altogether possible that many *Nicotiana* seeds have gone unrecognized in the past.

Table 50. Economic Plant Taxa at Early Pueblo Sites in the Rio Abajo

Site	Flotation and Macrobotanical [n of flotation samples]
Desert Scrub and Grassland	
Sevilleta Shelter Struever 1980	[5] A: *Chenopodium, Amaranthus, Portulaca, Cleome, Sphaeralcea* P: *Rhus, Echinocereus, Juniperus* twigs G: Gramineae C: *Zea*
Sevilleta (Arroyo los Alamos) Toll 1981	[2] A: cheno-am, *Portulaca* C: *Zea*
Fite Ranch Toll 1986	[4] no seeds
Conifer Woodland	
Bingham (this study)	[6] A: *Chenopodium, Nicotiana*, Malvaceae P: *Opuntia, Echinocereus, Yucca, Juniperus* twigs G: *Oryzopsis* C: *Zea*
Taylor Draw Peckham 1976	C: *Zea*
Kite site Rautman 1991:7 H. Moore 1990	[42] A: *Chenopodium, Portulaca* P: *Yucca, Opuntia* G: *Oryzopsis* C: *Zea*

A = annuals; P = perennials; G = grasses; C = cultivars

In the period A.D. 750 to 950, corresponding roughly to Anasazi Pueblo I, sites with tobacco remains have been identified solely on the basis of flotation. More dramatic and informative recoveries have so far been relegated to well-preserved assemblages from Basketmaker caves (*Nicotiana* stems in reedgrass cigarettes, Grange 1952; stems, leaves, flowers, and seeds filling a vessel, and yucca quids with tobacco seeds and capsules, Jones and Morris 1960) or later pueblos (vessel filled with seeds, Yarnell 1977). PI tobacco seeds have been found at numerous sites in southwestern Colorado and the Totah region of northwestern Colorado; other occurrences in this period are rare, and scattered far and wide across the Southwestern landscape (central Rio Grande area, west-central New Mexico, southern Arizona; Toll and Adams 1991). Early Pueblo tobacco occurrences in central New Mexico are rare (Table 51), and poor preservation together with poor flotation coverage are surely to blame for this record. The recovery of pipes at excavations antedating routine flotation suggests tobacco use in this era may have been more widespread.

Wood

When we look at wood use in the central Rio Grande Valley, our view is tempered greatly by distribution of available data sets in time and space: mostly what we have are large, late pueblos

Table 51. Tobacco and Pipes at Sites in Central New Mexico

Site/Location	Period	Reference	*Nicotiana*	Pipes
Bingham, LA 71276 E of San Antonio in PJ woodland	PI/PII pithouse	[this study]	36 seeds [pit structure hearth, vent, fill and posthole]	cloudblower [pit structure fill]
LA 3290 Rio Grande Valley 3 mi. S of Sandia Pueblo	BMIII/PI pithouse village	Peckham 1957:66,67	--	cloudblower [Room 1 fill]
Sedillo, LA 3122 first terrace of Rio Grande, Albuquerque	PI/II pithouse village	Skinner 1965:17	--	8 cloudblowers
River's Edge	BMIII/PI pithouse villages	Brandt 1991	seeds [Pithouse 1, LA 59617]	?
LA 45996	PI pithouse village	Brandt 1990	2 charred seeds [pit structure hearth]	?
Sevilleta Shelter LA 20896 Rio Grande Valley Socorro Co.	PII shelter	Struever 1980	10 seeds [ash pocket]	--
Belen Bridge LA 53662 Rio Grande Valley Belen	PIII pithouse village	Toll 1988	57 seeds [Pithouse 10 hearth]	--

and pithouse villages on the first or second terraces of the valley, where wood use is predominantly a mix of riparian and shrubby woods (Toll 1992, table 11). Bingham falls into the early sedentary era, from which comparative data sets are few and small (Table 52). Situated in the piñon-juniper upland margins of the Rio Grande Valley, Bingham and its neighbor, Taylor Draw, draw from immediate, highly desirable wood resources available to river corridor occupants only by considerable effort.

Elsewhere in New Mexico (Toll 1983, 1992), Archaic wood use was based close to home, with taxa taken strictly from the immediate site environs, and typically a large shrub component. In the early sedentary period, shrubs are still a strong element, but wood use branches out to the highly desirable (higher heat value) coniferous species, and riparian woods are more prominent. During the Puebloan era, greater diversity of wood use develops. The complete array of utilized wood broadens, and, as population density rises and construction needs increase dramatically, there is clearer differentiation in woods selected for different uses. Riparian woods attain their highest use during the Puebloan era; rapid replacement rate may have outweighed the drawbacks of poorer heat value and strength.

Maize Farming in the Rio Abajo

Corn exhibits considerable sensitivity, expressed in measurable morphological variability, to factors useful to understanding how people made their living. Physical characteristics of *Zea* vary with genetics (clearly linked to political and economic communication between geographic groups) and growing conditions (a vital key to agricultural success, over time and across the landscape). Unfortunately, carbonization and post-depositional erosion add significant wrinkles to measurable attributes of cobs and kernels. Corn morphometrics, while tied to some informative variables, are sufficiently complex that substantial sample sizes are needed to sort out overlapping layers of variability. Yet what we have more often to work with are samples of a few cob fragments (Table 53). A regional view helps a great deal.

In all periods in the Rio Abajo the majority (61-100 percent) of cobs are 10- or 12-rowed, with the principal event being an increase in cobs with 14 or more rows in PIII, and a further increase in PIV. Cobs with some of their glumes intact are hardest to compare *between* observers; clearer trends are visible in the department of completely eroded cobs, where analysts are more likely to be measuring the same thing. Here we see that the most significant change is between the early Pueblo era and PIII, with PIV cobs showing no significant change in dimensions. Brugge's (1976) measurements at Taylor Draw are a good example of the reasonable concern that different analysts may have different ideas about where to measure a given attribute; I suspect his "cob diameter" includes kernels, and I wonder whether his cupule dimensions might be "inside" rather than "outside."

Summary

Botanical remains at a Pueblo I/Pueblo II pit structure site on the eastern, upland margin of the Rio Grande Valley point to a farming economy bolstered by local wild plants. The brief selection of annuals documented includes goosefoot, tobacco, and mallow family, and possibly pigweed, purslane, and groundcherry (the latter recovered only as unburned seeds). More extensive flotation sampling might well broaden this array. Hedgehog and prickly pear cactus, appearing in four out of six samples, were relatively abundant, and yucca and ricegrass were also utilized. The flotation assemblage fits a pattern observed throughout southern New Mexico of wild plant procurement leaning more heavily towards perennial taxa.

Tobacco seeds put in a significant appearance at Bingham, occurring in 67 percent of flotation samples, and reiterated nicely by a cloudblower in pit structure fill. This unambiguous evidence is the earliest case to date of tobacco use in the Rio Abajo, and provides a useful contribution to our understanding of the temporal and geographic extent of tobacco utilization.

Wood used at Bingham was highly tuned to the surrounding conifer woodland. When compared with similar and lower elevation sites of the broadly defined Rio Grande Valley, we see that wood utilization exhibits greater correspondence to immediate resources than observed with other wild plants used.

The few Bingham cobs fit generally with the few other known examples of early Pueblo corn from this area. The early corn has mostly 10 or 12 rows, while later PIII and PIV corn has more cobs with 14 or more rows, and is generally more robust (larger cobs, larger kernels).

Future botanical analyses at other early pit structure sites in central New Mexico will help sort out the relationship between geography and subsistence adaptation, over time. Assemblages of corn and other cultivars are badly needed to explore the early role of farming in this area.

Table 52. Wood Use in Early Pueblo Sites, Central New Mexico

Site	Zone	Sample n [grams]	Conifers	Shrubs	Mesquite	Riparian
Bingham [this study]	PJ	120 [5.59g] dendro	99% of trash (mostly juniper) roof beams = 100% piñon	1% of trash (saltbush, sage)	none	none
Taylor Draw Peckham 1976	PJ	dendro	roof beams = 100% piñon	none	none	none
Kite site	PJ					
Fite Ranch Toll 1986	F	?	most of trash (mostly juniper)	fraction of trash (sage)	fraction of trash	
LA 3290 Peckham 1957:47	F, near RC	?				Roof fall in Room 1 = "cottonwood timbers"

Zone: RC = river corridor; F = flats (desert scrub or grassland); PJ = Piñon-juniper woodland

Table 53. Corn Morphometrics in the Puebloan Era, Rio Abajo

Site	n	Percent Row Number				Partially Eroded Cobs			Completely Eroded Cobs		
		8	10	12	14+	Mean diam.	Mean cupule width	Mean RSL	Mean diam.	Mean cupule width	Mean cupule height
PI/PII											
LA 71276 Bingham	4		50	50		13.0	7.3	3.4	9.3	4.8	3.4
LA 6565 Taylor Draw Brugge 1976	78	5	13	72	10	19.0		2.0		3.4	1.3
LA 20896 Sevilleta Shelter Struever 1980	3		67	33		11.4	7.4		9.4	4.3	
PIII											
LA 15260 Coors Road Toll 1987a	5			80	20				11.1	5.3	3.2
LA 53662 Belen Bridge Toll 1988	27	15	33	30	22	16.6	7.2	3.3	11.9	5.7	3.3

Site	n	Percent Row Number				Partially Eroded Cobs			Completely Eroded Cobs		
		8	10	12	14+	Mean diam.	Mean cupule width	Mean RSL	Mean diam.	Mean cupule width	Mean cupule height
PIV											
LA 282 Las Huertas Toll 1987c	100	2	18	43	37	12.7	7.4	3.1	11.2	5.4	3.1
LA 757 Qualacu Toll 1987b	28		25	29	47	15.0	6.7	3.3	11.4	5.6	3.3

All dimensions in mm; RSL = rachis segment length

Note: Deborah Johnson sorted the six flotation samples and measured corn cobs. Mollie Toll is responsible for other macrobotanical and wood identifications.

ANALYSIS OF FAUNAL REMAINS

by Susan M. Moga

Introduction

The upper Sonoran life zone (Bailey 1913) offers a wide variety of plant and animal resources that could be utilized by a hunting and gathering subsistence economy. The faunal assemblage for LA 71276 represents the diversity of species at this locale, both intrusive and utilized, by the former occupants.

Methodology

Identification of the faunal remains from the Bingham Project was accomplished using comparative osteological collections housed at the Museum of New Mexico, Office of Archaeological Studies, Santa Fe, and the University of New Mexico, Museum of Southwest Biology, Albuquerque. Preliminary identification was done with the aid of *Gilbert's Mammalian Osteology* (1980), *Avian Osteology* (Gilbert 1981), and Olsen's osteology of mammals and the turkey (Olsen 1964, 1968). All bone fragments were identified to the most specific level possible given the state of preservation and the size of each fragment.

Faunal remains were identified at least to the class level with bone fragments separated into small, medium, and large categories according to the thickness of the compact tissue. Each bone was then identified to element, side, completeness, portion, age, and development. Further evaluation included environmental or animal alterations, the degree of burning, butchering, and human modifications. The summary of these attributes provided the information for this report.

Overview of Faunal Remains at LA 71276

During the excavation of LA 71276, 455 bones, including bone tools (1.1 percent), and shell (2.4 percent), were recovered from a trash-filled pit structure and adjacent ventilator shaft, thus providing a small but diverse sample for this report. Table 54 presents a summary of the species identified at LA 71276. This table includes bone that could only be identified as small, medium, or large mammal, representing 44.5 percent (212 bone fragments) of the overall sample recovered from the site. The remaining fauna (55.5 percent) could be identified to eight species, three genera, four families, and two orders.

Order Rodentia

Unidentifiable to a specific species, a fragmented metapodial, one cranial fragment, and the proximal portion of a juvenile right tibia were recovered from the pit structure trash fill.

Table 54. Summary of Faunal Taxon Identified from LA 71276

TAXON	FREQUENCY	PERCENT
Mammal	11	2.4
Small mammal	180	39.6
Medium mammal	14	3.1
Large mammal	8	1.8
Order Rodentia	3	.7
Family Sciuridae (Chipmunks,squirrels,marmots)	1	.2
Cynomys sp. (Praire dog)	2	.4
Cynomys ludovicianus (Black-tailed prairie dog)	4	.8
Thomomys bottae (Botta's pocket gopher)	1	.2
Neotoma albigula (White-throated woodrat)	1	.2
Neotoma mexicana (Mexican woodrat)	2	.4
Family leporidae (Rabbits)	3	.7
Syvilagus audubonii (Desert cottontail)	120	26.4
Lepus californicus (Black-tailed jackrabbit)	83	18.2
Canis sp. (Dog, coyote, wolf)	1	.2
Vulpes vulpes (Red fox)	1	.2
Artiodactyla (Even-toed, hooved mammals)	2	.4
Odocoileus sp. (Deer)	1	.2
Aves (Birds)	2	.4
Phasianidae (Quails, partridge, pheasants)	1	.2
Callipepla squamata (Scaled quail)	1	.2
Meleagris gallopavo (Turkey)	1	.2
Colubridae (Nonvenomous snake)	1	.2
Shell	11	2.4
Total	455	99.8

Family Sciuridae (Chipmunks, Squirrels, and Marmots)

A nondistinctive proximal portion of a right tibia, displaying a snap break at midshaft, could only be identified to this family.

***Cynomys* sp. (Prairie Dog).** Two mature metacarpals were identified to this genus. These specimens recovered from the trash fill exhibited heavy burning over the entire elements. This suggests that disposal was either into a fire or in a context hot enough to thermally alter the bone.

***Cynomys ludovicianus* (Black-Tailed Prairie Dog).** Three of the four specimens assigned to this species were recovered from the pit structure trash fill, and one right mature scapula fragment was located on Floor 2.

Black-tailed prairie dogs inhabit shortgrass plains, but are also reported in marginal habitats of the semi-desert regions of the southwestern part of New Mexico (Findley et al. 1975). Becoming very fat in fall in preparation for several months of hibernation, the prairie dog provided a good source of protein for local populations.

***Thomomys bottae* (Botta's Pocket Gopher).** A left mature mandible fragment with carnivore puncture marks was recovered from Feature 5, the ventilator shaft. Though this species was often a food source, the carnivore impact would suggest that it may be intrusive in this context.

Located throughout New Mexico, *Thomomys bottae's* size will vary depending upon the depth and friability of soils. The Sierra Blanca region with its shallow, rocky soil has produced the smaller variety of pocket gopher (Findley et al. 1975).

***Neotoma albigula* (White-Throated Woodrat).** This common and widespread species, represented by a single fragmented left mature mandible, is found from desert to mixed coniferous forest (Findley et al. 1975).

***Neotoma mexicana* (Mexican Woodrat).** Only an immature proximal portion of a humerus and a fragmented mature mandible were assigned to this species, which is as abundant as *Neotoma albigula,* but characteristically distinguishable (Findley et al. 1975).

Family Leporidae (Rabbits)

Three bone fragments could be identified to the family Leporidae, but could not be assigned to the species level.

***Sylvilagus audubonii* (Desert cottontail).** One hundred and twenty bones (26.4 percent) were identified to this species, which clearly dominated the faunal sample. Elements included cranial, long bone, innominate, vertebra, and scapula fragments. The majority of long bones, especially tibias, were either split longitudinally or displayed snap breaks at midshaft to possibly extract the minor amounts of bone marrow. As a protein source, the hind limbs produce a greater meat source than forelimbs (Driver 1985).

Sylvilagus audubonii is one of the three species of cottontail found throughout New Mexico (Findley et al. 1975) that has been hunted both historically and prehistorically.

***Lepus californicus* (Black-Tailed Jackrabbit).** *Lepus californicus* is the most common jackrabbit observed in New Mexico (Findley et al. 1975) and it accounted for 18.2 percent of this faunal sample. These 83 bones included fragments of cranium, scapula, rib, metacarpals, portions of an innominate and vertebra, and numerous long bone fragments. Only two tibias (0.4 percent) display heavy burning and almost all the long bones exhibited either longitudinal or midshaft splits.

The same practice of marrow extraction noted on the desert cottontail was also observed on the jackrabbit long bones. Figure 19 provides a comparison of the lagomorph (rabbit) elements recovered from LA 71276. The cranial elements of *Sylvilagus audubonii* double in number compared to that of *Lepus californicus.* It was probably a common practice to detach the cranium from the body with a twisting motion, slipping the whole hide off with it, before throwing the rabbit into the stewpot. The cranial elements were tossed aside, lacking evidence of thermal alterations. The high frequency of lagomorph innominates, femurs, and tibias represents a preference for the meaty hind limbs as compared to the lower frequency of forelimbs. The variety of lagomorph elements recovered from LA 71276 (Fig. 19) indicates that the entire rabbit was either totally consumed or the bones utilized in some other manner.

Canis *sp. (Dog, Coyote, Wolf)*

Only one element, a left immature mandible fragment from a dog, coyote or wolf was recovered and could not be identified to the species level.

Vulpes vulpes *(Red Fox)*

One right immature humerus was assigned to this species. The red fox is usually limited to the northern mountains of New Mexico with isolated occurrences in other parts of the state (Findley et al. 1975). Kelley (1984) has also recorded evidence of red fox during her Sierra Blanca research.

Artiodactyla (Even-Toed, Hooved Mammals)

Two tooth fragments could not be specifically identified, but they displayed the general characteristics of this group, which include peccary, cervids, antilocapra, and bovids.

Odocoileus sp. *(Deer)*

A slightly weathered right orbital fragment was assigned to this genus and since both mule deer *(Odocoileus hemionus)* and white-tailed deer *(Odocoileus virginianus)* are present in the Sierra Blanca region, speciation was not possible.

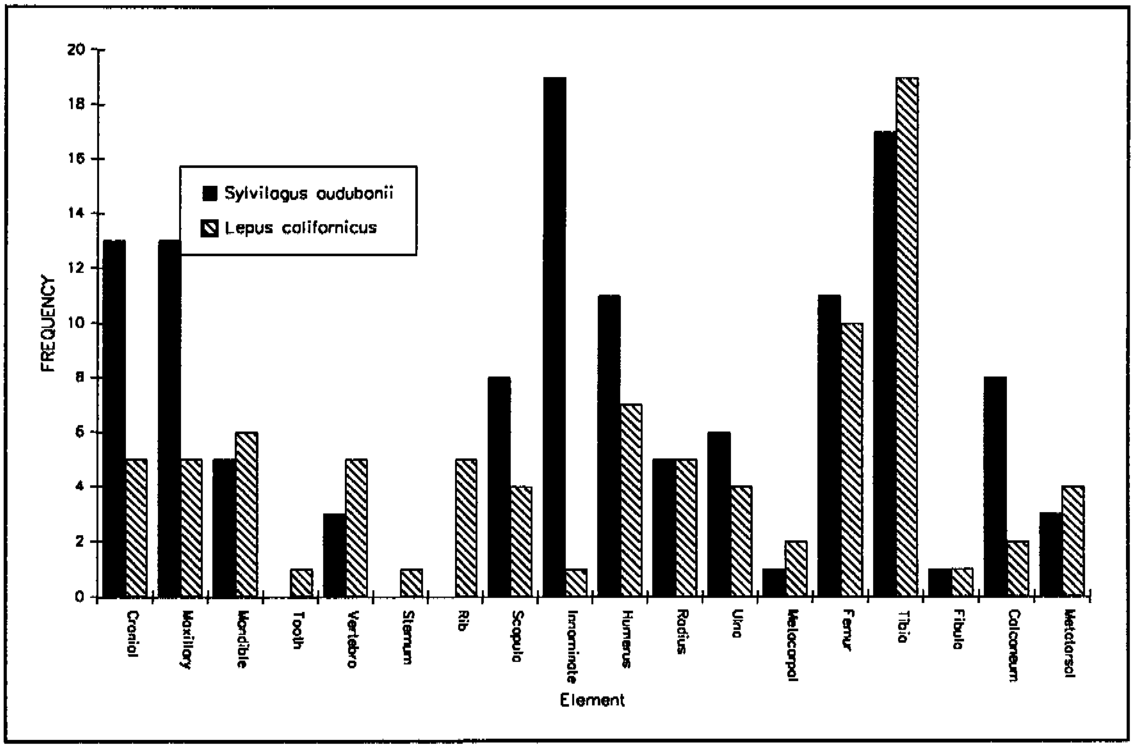

Figure 19. Element distribution of lagomorphs at LA 71276.

Aves (Birds)

Only two small bone fragments were recognized as bird.

Family Phasianidae (Quails, Partridge, Pheasants). A fragmented right tibiotarsus is attributed to this bird family, which dwells in fields or open country (Robbins et al. 1966).

***Callipepla squamata* (Scaled Quail).** A portion of a right humerus was identifiable to this species which resides in dry, semi-desert country and is usually found in flocks of up to 100 birds (Robbins et al. 1966). Preferring to run, instead of flying, these birds may have been readily captured for foodstuff.

***Meleagris gallopavo* (Turkey).** Feature 5, the ventilator shaft, produced only a drilled phalanx. Turkey, the largest game bird in North America, was of considerable dietary importance and has been hunted both historically and prehistorically. The turkey was also utilized for its plummage and awls were produced from the long bones.

Family Colubridae (Nonvenomous Snakes)

A dorsal portion of a snake vertebra was recovered from the trash-filled pitstructure. Forty-four of the forty-eight genera of North American snakes are nonvenomous (Levitan 1970). The vertebra exhibited evidence of heat treatment suggesting that the snake may have been a food source, or possibly just an intrusive creature that ended up in the firepit.

Shell

Eleven fragments of shell (2.4 percent of the sample) were recovered. The sample included fresh-water shell and complete snail shells.

Summary

These summaries of individual species identified from LA 71276 provide us with evidence for animal usage and information on which animals inhabited the environment during the early Pueblo period. Even though deer were present, their utilization was extremely rare, in comparison to small mammal useage, particularly lagomorphs (Table 54). Turkeys, as well as lagomorphs, are attracted to agricultural plots, but surprisingly only one turkey bone (.2 percent) was recovered in comparison to 203 rabbit bones (45.0 percent). It appears that the inhabitants of LA 71276 had a diverse and readily available food resource.

Worked Bone Assemblage

Evidence of cultural modification was observed on only five pieces (1.1 percent) of the 455 bones analyzed from LA 71276. All five pieces were recovered from the trash fill of the pit structure. They will be discussed by type and function.

Awl

Only one awl fragment was identified from the trash fill (Fig. 20a). Manufactured from an artiodactyl diaphysis, this heavily weathered artifact was in extremely poor condition. Both the tip and handle were broken, but it still showed evidence of human modification.

Gaming Pieces

A single oblong gaming piece was produced from a longitudinally split section of a large mammal long bone (Fig. 20b). These pieces were often found in sets, matching in size, shape, and thinness and were used for either games of chance or ceremonial purposes. Gaming proved extremely popular at the Bonnell site in the Sierra Blanca region, which produced 53 gaming pieces (Kelley 1984).

Bone Ornament

This fragmented ornament, visually very similar to a gaming piece, possesses a drill hole impression on one side and several incised lines on the other (Fig. 20c). Incised lines, but not drilled holes, are commonly found on gaming pieces, placing this piece in the ornament category. It should also be noted that this piece was thermally altered almost to the point of being calcined.

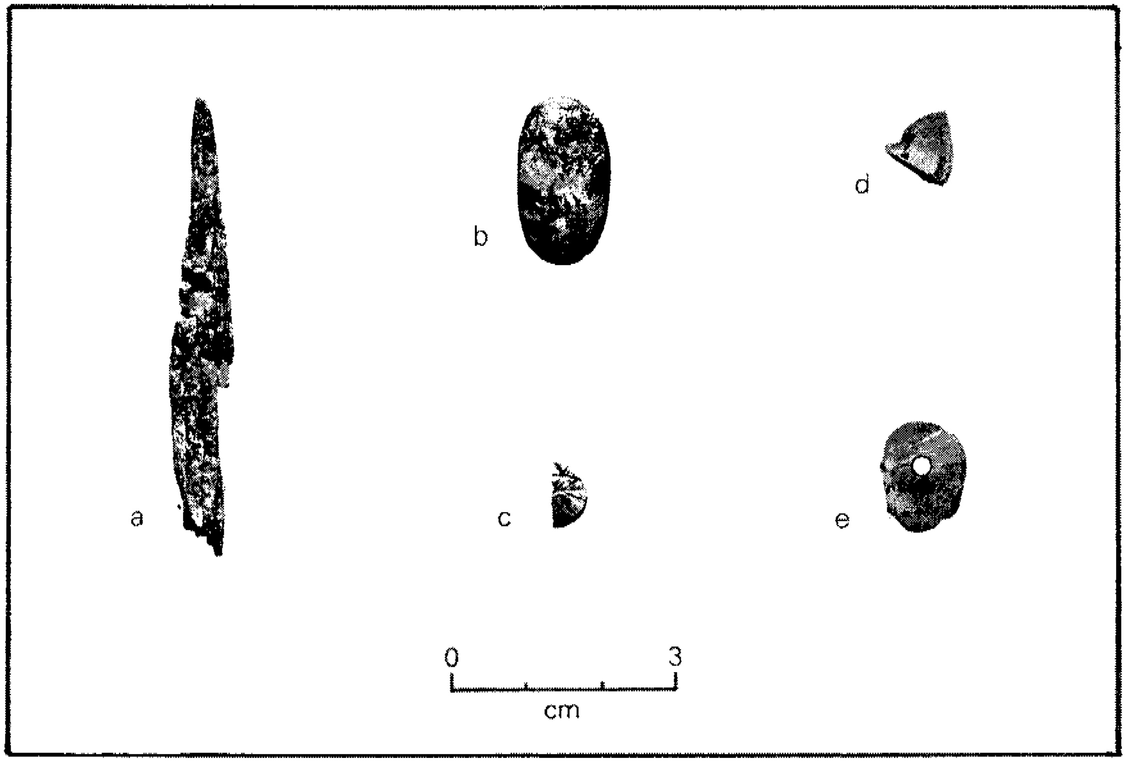

Figure 20. Worked bone assemblage.

Shell

Two modified pieces of shell were recovered from the pit structure trash fill (Fig. 20d, e). The exact species could not be determined because of the extreme modification of the artifacts. One minute fragment classified as an ornament displayed only evidence of abrasion on one edge. The second piece, a small pendant, was intact with rough edges, a drill hole near center, and numerous incised lines on the backside, which probably occurred during the manufacturing of the piece. The pendant measures 15 mm by 112 mm.

Taphomomic Processes

The faunal assemblage was observed for evidence of postdepositional effects that may have taken place subsequent to the processing and disposal of animal remains by the inhabitants of LA 71276.

Carnivore activity affected only 0.2 percent of the total sample. A small mammal mandible displayed evidence of a carnivore puncture mark.

The sample was totally void of cut marks, but butchering, which involved snap breaks and longitudinal splits on diaphysis, was common. As mentioned earlier, practically all the lagomorph (rabbit) long bones provided evidence of breakage, primarily for carcass segmentation and possibly for the extraction of bone marrow.

Thermal alterations were minimal with only 28 bones (6.1 percent) showing a range of light roasting to heavy burning with a few calcined fragments. The amount of burning may suggest that meat was cooked or roasted and heavy burning provides evidence of discarding the bones into an ash pit or fire.

Sixty-eight bones (15.0 percent) showed evidence of weathering or cracking from exposure, seven with erosion (1.5 percent) or root-pitting and only one (0.2 percent) with solutional staining. The small percentage of weathering may indicate rodent activity. As rodents rummaged through the trash fill, bone was environmentally exposed and eventually reburied by the inhabitants of the community as they deposited more trash into the pit structure.

Review by Excavation Areas

The major portion of the fauna produced for the sample came from the pit structure trash fill (Table 55). The structure was excavated by stratigraphic and arbitrary levels and split into four quadrants. Desert cottontail, jackrabbit, and indeterminate small mammal fragments were the most abundant species throughout the levels.

A trash-filled ventilator shaft was located approximately 0.5 m east of the pit structure. Producing only five bones, this small but diverse assemblage included a medium mammal long bone, a drilled turkey phalanx, a small mammal phalange, a cottontail calcaneum and a pocket-gopher's mandible with a puncture mark. All of these elements were void of thermal alterations.

Only four bone fragments were recovered from Floor 1 and seven from Floor 2. Of the five posthole features within the pit structure, Features 9, 10 and 13 produced minor amounts of small mammal bones, including one artiodactyl tooth fragment from Feature 9.

Table 55. Distribution of Taxon by Primary Excavation Units at LA 71276

Taxon	Pit Structure Fill		Pit Structure Floor	
	Frequency	Percent	Frequency	Percent
Mammal	9	2.4		
Small mammal	137	36.5	22	45.8
Medium mammal	12	3.2	1	2.0
Large mammal	8	2.1		
Order Rodentia	3	.8		
Family Sciuridae (chipmunks, squirrels, marmots)	1	.3		
Cynomys sp. (prairie dog)	2	.5		
Cynomys ludovicianus (black-tailed prairie dog)	2	.5	2	4.1

Taxon	Pit Structure Fill		Pit Structure Floor	
	Frequency	Percent	Frequency	Percent
Thomomys bottae (Botta's pocket gopher)			1	2.0
Neotoma albigula (white-throated woodrat)	1	.3		
Neotoma mexicana (Mexican woodrat)	2	.5		
Family leporidae (rabbits)	3	.8		
Sylvilagus audubonii (desert cottontail)	98	26.1	7	14.6
Lepus californicus (black-tailed jackrabbit)	67	18.0	11	23.0
Canis sp. (dog, coyote, wolf)	1	.3		
Vulpes vulpes (red fox)	1	.3		
Artiodactyla (Even-toed, hooved mammals)	1	.3	1	2.0
Odocoileus sp. (deer)	1	.3		
Aves (birds)	2	.5		
Phasianidae (quail, partridge, pheasants)	1	.3		
Callipepla squamata (scaled quail)	1	.3		
Meleagris gallopavo (turkey)			1	2.0
Colubridae (nonvenomous snake)	1	.3		
Shell	10	2.7	1	2.0
Total	375	100.0	48	100.0

Conclusions

The faunal assemblage from LA 71276 suggests the preferential consumption of small mammals over large mammals. The expansion of horticulture in the Southwest attracted small mammals and turkeys to garden plots, thus providing a readily available food source for the local community. Expanding settlement could have depleted the large game, which increased the reliance on smaller mammals.

The large mammal category provided us with only three artiodactyl fragments, suggesting either minimal usage or discard into another area.

Sites within the Sierra Blanca region have produced similar faunal assemblages. The Bonnell site to the east of LA 71276 recovered a substantial number of cottontail and jackrabbit bones in their refuse along with other small mammals (Kelley 1984). Fifty-one percent of Bonnell's cottontail long bones displayed spiral fractures (Driver 1985), evidence for carcass division, and marrow extraction, a process also exhibited in LA 71276's faunal assemblage.

The Phillip's site to the north of LA 71276 recorded a relatively low number of lagomorphs and a higher percentage of artiodactyl remains, probably due to the higher elevations (Driver 1985). This evidence represents the similar species diversity within the Sierra Blanca region.

In summary, many of the same species, such as deer, cottontail, and jackrabbit were utilized in the same fashion and were a substantial part of the subsistence diets of the surrounding communities within the Sierra Blanca region.

ANALYSIS OF HUMAN REMAINS

by

Linda S. Mick-O'Hara

One burial was found during backhoe testing at the site. The remains were located near present-day ground surface, approximately 2 m north of the pit structure. No apparent grave preparation could be determined, but numerous pieces of charcoal were recovered around the bones that remained in situ. The backhoe removed and scattered most of the remains with only the pelvis and left femur remaining in the ground. The position or orientation of the burial is unknown because of the degree to which the remains were disturbed prior to excavation. The elements remaining in the ground were excavated using the guidelines set forth by the Office of Archaeological Studies (OAS) and all remains were returned to OAS for cleaning and analysis.

The remains that were recovered from the backhoe testing were extremely fragmentary due to the impact, but all remains were also eroded and friable. Preservation, overall, would be considered poor even without the impact of the backhoe.

Methodology

The bone was cleaned and sorted in the laboratory but the fragmentary nature of much of the bone prevented the further identification of numerous bone fragments that are most likely what remains of elements that are absent from the skeletal inventory. After sorting, all remains were identified and fragments were refitted where possible. Elements were identified using comparative materials housed at OAS and anatomical guides by both Bass (1987) and White (1991). All possible measurements were also taken using the guidelines from Bass (1987). After the inventory and analysis were completed the remains were returned to OAS secured storage for final transfer to the Museum of New Mexico repository.

Results

The remains were heavily eroded and fragmentary but all pieces were evaluated for level of identification and possible refitting. The inventory that follows this report is the result of that evaluation.

From the measurements of both the femur and the tibia, this individual was a female. The two maxillary molars suggest that she was between 35 and 45 years of age at death. The fragmentary nature of the remains precluded any estimation of her stature or ethnic affiliation. The proximity of these remains to the pit structure and the charcoal found around the excavated bone would suggest that the burial was associated with the occupation of the site as a whole, and thus prehistoric Puebloan in origin.

Almost all of the epiphyses were eroded away along with vertebrae and a few long bones. The skull and mandible were extremely fragmentary and could not be refitted at all. Most of the refitting was accomplished with the long bones. Though this did not allow for any estimates of the individual's height, it enabled measurements that could be used in evaluating the sex of the burial.

Discussion and Conclusions

The burial seems typical of those found in the region. Kelley (1984:118, 436) states that the most usual burial location was in the sheet trash outside of or between structures in rather shallow graves usually without grave goods. This description fits the interment at LA 71276 very well. Its location was in probable sheet trash close to the ground surface, outside of the pit structure. Grave preparation would be difficult to determine for any of these shallow graves in sheet trash.

This individual was of an age at death common for females in the region and throughout the Puebloan Southwest. At 35 to 45 years, most females in the prehistoric Puebloan periods had worked hard for many years and produced several offspring, depleting their reserves against disease or infection.

Burial 1 exhibited no apparent pathologies, though heavy erosion of the bone would make observations of any anomalies or pathologies problematic. The remains appear to be a typical interment for a female member of this prehistoric community.

ORNAMENTS AND MINERALS

One bone and one shell ornament were found, and are discussed in the Faunal Analysis chapter. Other types recovered include two turquoise pendants (Fig. 21), a quartz crystal, and three pieces of raw turquoise in matrix. Numerous pieces of a chalky white mineral were found.

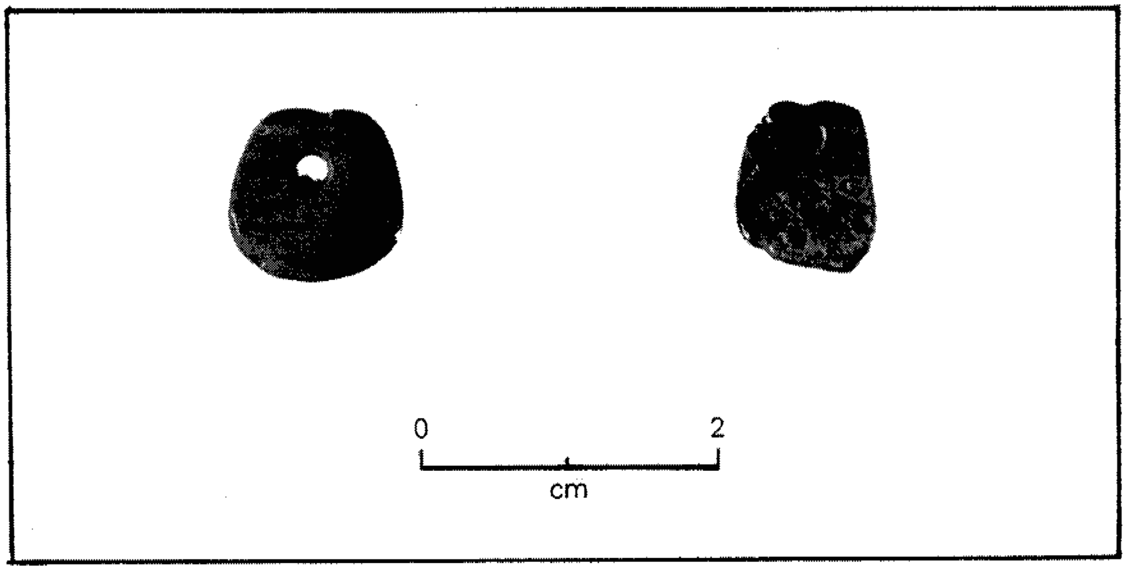

Figure 21. Turquoise pendants from LA 71276.

DISCUSSION

Phase Sequences

In order to evaluate an appropriate phase designation for LA 71276, an outline of phase sequences from the surrounding areas is presented. Lehmer (1948) first defined the Jornada Branch of the Mogollon, splitting it into northern and southern variants. Differences were based primarily on ceramics and architecture. Lehmer's sequence is shown below.

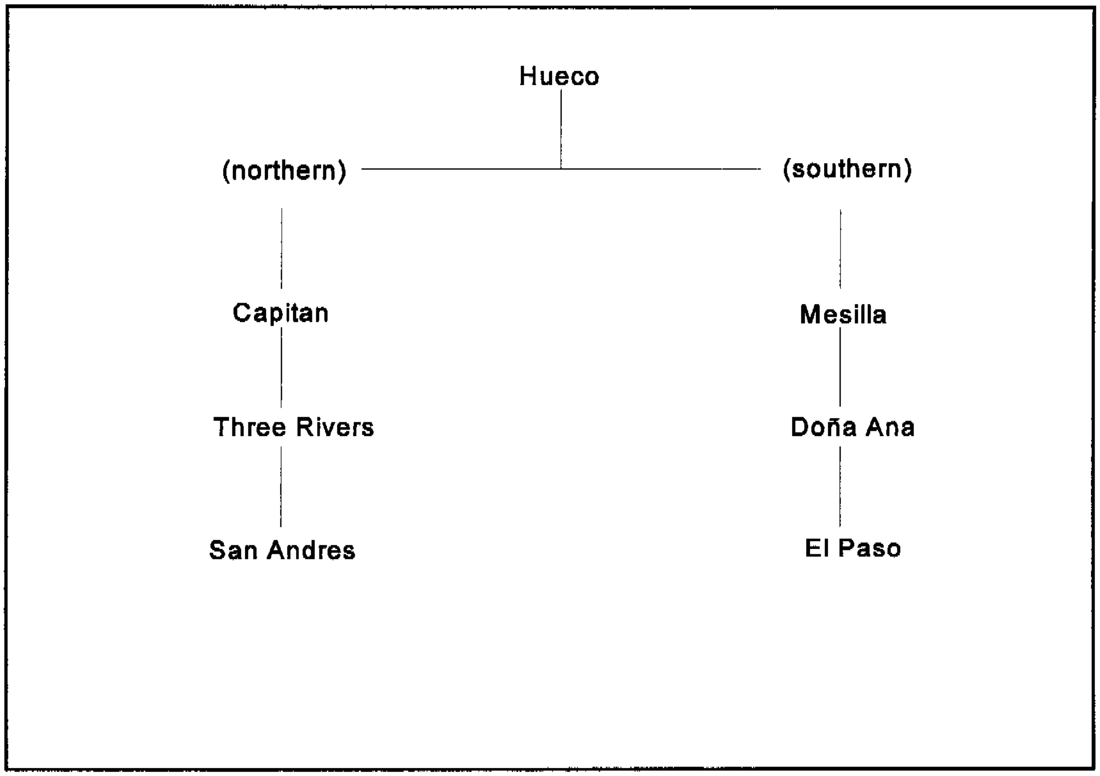

Figure 22. Lehmer's cultural sequence.

Lehmer defined a pear-shaped area in southeastern New Mexico as the limits of the Jornada Branch of the Mogollon (Fig. 22). His northern boundary was above Carrizozo and the southern extreme was Villa Ahumada in Mexico. At the widest point, the limits were given as 75 miles west and 150 miles east of El Paso. This has recently been revised to include the area between the Rio Grande Valley and the eastern slopes of the Black Range, and the northern end of the Jornada del Muerto Basin. These additional areas represent boundaries between the Jornada Mogollon and the Anasazi (Kirkpatrick et al. 1992:2-3). Following the extended boundaries, the project area is situated in the northern end of the Jornada Mogollon region.

The Jornada Branch of the Mogollon evolved from the Hueco phase, an aceramic period originally defined by Sayles (1935), though some pottery has been found in later Hueco sites. Beckett (1993:13-15), however, believes that the Hueco phase needs to be redefined since there is more than one preceramic horizon in the Jornada Mogollon area. The Mesilla phase was defined

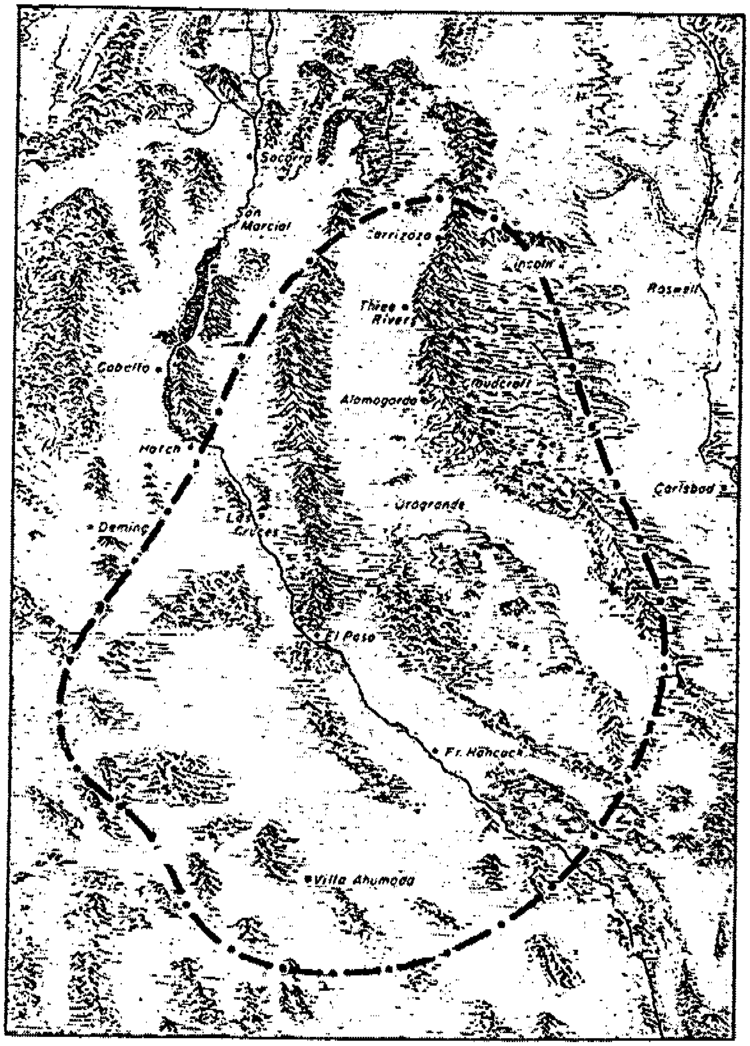

Figure 23. Map of the Jornada Mogollon boundaries (after Lehmer 1948).

from excavations at Los Tules (LA 16315), a pithouse site along the Rio Grande near the Mesilla Diversion Dam. Mesilla phase pithouses are rectangular with eastern or southeastern entries, or circular with roof entrances. Lehmer (1948) noted that round pithouses in the Mesilla phase resembled those from early Anasazi horizons, and that it was likely that they were derived from the northern San Marcial phase. Rectangular pithouses were probably introduced into the northern Jornada area from Mimbres sites along the Rio Grande south of Socorro (Kelley and Peckham 1962:10-11). The dominant pottery in the Mesilla phase is El Paso Brown; intrusive types include Mimbres Black-on-white (Boldface and Classic), Mimbres Corrugated, San Francisco Red, and Alma Plain (Lehmer 1948:76). Lehmer dated the Mesilla phase from A.D. 900 to 1100.

The Doña Ana phase is a short transitional period, dating from A.D. 1100 to 1200. It was characterized by Lehmer (1948:78-80) as having both adobe surface structures and pithouses. Mesilla phase pottery persists, with some modifications. El Paso Brown comprises about half of a Doña Ana phase assemblage, with the remainder being El Paso Polychrome. Intrusives are similar to those in the preceding Mesilla phase, with the addition of Chupadero Black-on-white, Three Rivers Red-on-terracotta, and St. Johns Polychrome. Ceramic types indicate continued contact with the Mimbres area to the west, and new contacts with the Western Anasazi (indicated by the presence of St. Johns Polychrome) and the northern Jornada area (represented by Chupadero Black-on-white). There is disagreement as to whether to retain this phase, the rationale being that it was only a transitional period between the two other phases (LeBlanc and Whalen 1977:139-140).

The El Paso phase, dated by Lehmer as A.D. 1200 to 1400, is characterized by adobe pueblos. El Paso Polychrome was the dominant ceramic type, and typically had everted, thickened, or thickened-everted jar rims. Many intrusive ceramics are present, such as Chupadero Black-on-white, an "unnamed smudged corrugated ware from the Mogollon area," Three Rivers Red-on-terracotta, Lincoln Black-on-red, Gila Polychrome, Agua Fria Glaze-on-red, Ramos Polychrome, Heshotauthla Glaze Polychrome, Arenal Glaze Polychrome, St. Johns Polychrome, and Playas Red Incised. The most common found types were Chupadero Black-on-white, Lincoln Black-on-red, Three Rivers Red-on-terracotta, and the unnamed smudged corrugated ware.

The northern sequence correlates chronologically with the southern phases. The northern sequence, however, was based on survey and the examination of local collections, not excavations. The Capitan phase dates from A.D. 900 to 1100, paralleling the Mesilla phase. Pithouses are both rectangular and circular. Jornada Brown is the dominant pottery, associated with Mimbres Boldface, Chupadero Black-on-white, and a "locally made Broad-line red-on-terracotta" (Lehmer 1948:85), probably San Andres Red-on-terracotta. Conspicuously absent is Red Mesa Black-on-white, which falls within the temporal range for the Capitan phase. LA 2000, excavated by Jennings (1940), is the type site for the Capitan phase, as well as for Jornada Brown. Few Capitan phase sites have been excavated; LA 5377 and LA 5378, two pithouse sites excavated in 1971, were designated as belonging to the Capitan phase (Broilo 1973:9). Rectangular pithouses were found at both sites, and ceramic assemblages consisted of Jornada Brown, Alma Plain, and Chupadero Black-on-white.

The Three Rivers phase is a brief transitional period, as is the Doña Ana phase. Surface structures and pithouses co-existed during this time. Ceramics indicative of this phase are Jornada Brown, El Paso Polychrome, and Three Rivers Red-on-terracotta. Intrusive types include Mimbres Black-on-white, Mimbres Corrugated, Chupadero Black-on-white, and rarely, St. Johns Polychrome. Continued contact with western groups is indicated by the ceramics, paralleling development during the Doña Ana phase to the south.

The San Andres phase is characterized by adobe pueblos, as is the El Paso phase. The ceramic assemblage consists of El Paso Polychrome, Three Rivers Red-on-terracotta, and Lincoln Black-on-red. Intrusive types are similar to those found on El Paso phase sites in the south, including Chupadero Black-on-white, Gila Polychrome, Ramos Polychrome, Playas Red Incised, Agua Fria Glaze-on-red, Arenal Glaze Polychrome, St. Johns Polychrome, Heshotauthla Glaze Polychrome, and the same Mogollon smudged ware as that found in the south (Lehmer 1948:86).

Recent researchers in the Jornada Mogollon area have proposed revisions in Lehmer's phase sequence. Whalen (LeBlanc and Whalen 1980) uses the terms Pithouse period, divided into early and late; the Transitional Pueblo period; and the Pueblo period. The pithouse period corresponds to Lehmer's Mesilla phase, though Whalen begins this period at A.D. 1, with the separation of early and late occurring at A.D. 600. The Pithouse period ends at A.D. 1100, as does the Mesilla phase. Whalen's Transitional Pueblo period corresponds to the Doña Ana phase, and the Pueblo period corresponds to the El Paso phase. The division between Early and Late Pueblo period is at A.D. 1300.

Wiseman (1985:11-14)) suggests combining Lehmer's and Whalen's schemes into a framework that still uses Lehmer's phase names but has Whalen's finer temporal control. Since the two phase sequences were essentially the same, Wiseman objects to eliminating the original names.

Wiseman also proposes dropping Lehmer's northern sequence of the Capitan, Three Rivers, and San Andres phases (1985:15-17). He believes that Kelley's phases, described below, characterize the northern area much more concisely, particularly the eastern side of the Sierra Blancas. Kelley's work was based on extensive survey and excavation, resulting in a detailed chronology of the mountainous area. Since Lehmer's northern sequence was not based on as detailed a study, Wiseman's suggestion is a reasonable one. If the Capitan-Three Rivers-San Andres phases are still to be used, Wiseman feels that they should only be applied to sites on the western side of the Sierra Blancas (pers. comm. 1993).

Kelley's pioneering work in the Sierra Blanca region defined the Glencoe, Corona, and Lincoln phases (1984). This area is east of the study area, in and north of the northern Jornada area (Fig. 24). The Glencoe phase, divided into Early and Late, applies to the southern Sierra Blanca region. The Corona and Lincoln phases refer to the northern Sierra Blanca region, though there is some overlap in the case of the Lincoln phase. All three of these phases refer to Pueblo III settlement and are therefore not relevant to LA 71276. There is no defined phase sequence for the Pueblo I and II periods in the Sierra Blanca area.

The ceramic complex for Kelley's Early Glencoe phase is almost identical to Lehmer's description of the Capitan phase; however, Kelley felt that there were sufficient differences to warrant a new phase designation (1984:44-46). The differences revolve around a mountain adaptation, where change seems to have occurred at a slower pace than in the main Jornada area. She includes LA 2000, which Lehmer had placed in the Capitan phase, in her list of Glencoe phase sites. Glencoe phase architecture consisted of square and round pithouses.

The Corona phase, dating to the early Pueblo III period, is at the northern end of the Sierra Blanca region, contemporaneous and similar to the Three Rivers phase. The geographical extent includes the upper Gallo drainage, the upper Macho drainage, and along the north and southeast

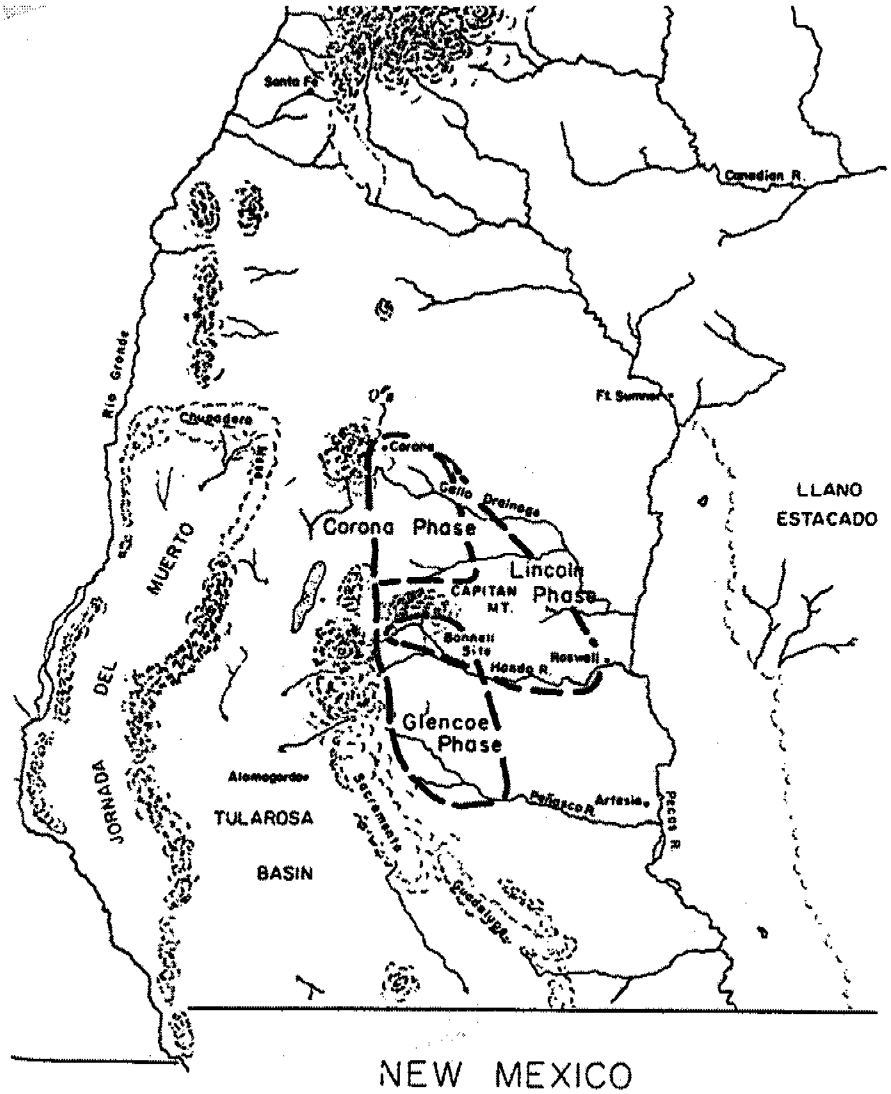

Figure 24. The Sierra Blanca region (after Kelley 1984).

slopes of Capitan Mountain. This phase is characterized by shallow pithouses with jacal superstructures.

The geographic boundaries of the Lincoln phase overlap those of the Corona phase, but also extend southeast into the Bonito and Hondo valleys. The Lincoln phase correlates temporally with the San Andres phase and the same ceramic types occur. Architecture is characterized by coursed adobe and masonry pueblos.

The Chupadera Mesa region to the north of the project area is briefly described by Caperton (1981) from a 1967 survey of the area surrounding Gran Quivira. Occupations (not designated as phases or periods) are similar to those proposed by Whalen (Le Blanc and Whalen 1980): Pithouse, Jacal, and Masonry Pueblo. The pithouse occupation dates from A.D. 800 to 1200. Jornada Brown is the predominant ceramic type; decorated types varied between northern and southern sites. At the southern sites, Puerco Black-on-white, Socorro Black-on-white, Chupadero Black-on-white, and Casa Colorada Black-on-white were found. Small amounts of Mimbres Bold Face and San Andres Red-on-terracotta were also present. Sites on Jumanes Mesa to the north also had Puerco, Socorro, Chupadero, and Casa Colorada Black-on-white. In addition, these sites also had Red Mesa Black-on-white, San Marcial Black-on-white, Kiathuthlana Black-on-white, and Mimbres Black-on-white. Minor amounts of Wingate Black-on-red, Lino Gray, Corona Plain, and early glazewares were found (Caperton 1981:3-4). Sites were situated on sandy wooded slopes, flat land, or low ridges.

During a survey of Gran Quivira Monument, Beckett (1981) located at least eight pithouses or pithouse villages. The large number of pithouses within the monument, combined with the pithouse village on the adjoining Kite property (discussed below), indicates a sizable early population for the area. In addition, the amount of early brown ware sherds eroding from trash areas associated with major mounds suggests that these later structures may have been built on top of earlier pithouses (Beckett 1981:45).

Fenenga (1956:226-233) was one of the first researchers to excavate a site dating to the early pithouse occupation. LA 2579 is near Gran Quivira, and consists of a series of pithouse depressions and storage pits. The ceramic assemblage was comprised mainly of Jornada Brown, followed in frequency by Lino Gray. Decorated types included Three Rivers Red-on-terracotta, San Marcial Black-on-white, and Tabira Black-on-white. The frequency of Lino Gray suggests that the northern Chupadera Mesa region experienced more Anasazi contact than did the southern and eastern areas.

Toulouse and Stephenson (1960:40-41) also established a chronological framework for the Chupadera Mesa region, though their system deals with puebloan sites from the early Pueblo III to the historic period and does not include the pithouse period. They defined six foci based on survey in the Gran Quivira vicinity. The term "foci" was revised by Kelley (1984:22-25) into "phases."

Although LA 71276 is near the northern boundary of the Jornada Mogollon culture area, the ceramic assemblage from this site does not fit with the Capitan phase assemblage described by Lehmer as characteristic of the northern Jornada Mogollon. Being situated in the northwestern corner of the Jornada area (slightly outside Lehmer's boundaries) seems to have given the inhabitants more of an affiliation with the Rio Grande Anasazi rather than with the Jornada Mogollon culture to the south.

Although seemingly far from the project area and described as a riverine environment rather than rolling uplands, the Rio Abajo area to the west has more similarities to LA 71276 than do any of the Jornada Mogollon subareas closer to LA 71276. The ceramic assemblage identified for the Tajo phase is comparable to that of LA 71276. As described by Marshall and Walt (1984:49), the ceramics include mainly plain and ribbed Mogollon Brown Wares, with Red Mesa Black-on-white occurring frequently. This is an intrusive Cibola Ware from the north and northwest; there appears to be no native white ware industry during this phase. Minor amounts of Cibola Gray Ware, Mimbres White Ware, and Elmendorf White Ware are found on some late Tajo sites. Red Mesa Black-on-white is found more often on early Tajo phase sites, while Puerco and Gallup Black-on-white (Cibola White Wares) occur in the late Tajo phase, though always in association with Red Mesa Black-on-white. The occurrence of Cibolan ceramics indicates a blending of Anasazi and Mogollon populations during this time. Traces of red-slipped brown ware, red-on-brown, and smudged interior plain wares also occur.

One of the only excavated Tajo phase pithouse sites in the Rio Abajo area, LA 45884, exhibited a ceramic complex similar to that at LA 71276 (Baldwin et al. 1986, but revised during this analysis). As discussed in earlier, the only excavated site in the project area is a late Tajo phase settlement excavated by Peckham (1976). This site, LA 6565, is the largest of a cluster of 25 sites along Taylor Draw, near the southern end of Chupadera Mesa. LA 6565 consists of 4 pithouses, a kiva, and 22 slab-lined surface rooms. Plain brown ware comprised over 90 percent of the ceramic assemblage, with small amounts of Red Mesa Black-on-white present.

Most of the ceramic sites recorded during survey of the White Sands Missile Range just south of the project area fall temporally within the Tajo phase, indicated by brown wares and Red Mesa Black-on-white. So far, over 20 sites of this phase have been recorded (site lists in Sale 1988; Shields 1987; Laumbach 1986; Clifton 1985; Laumbach and Kirkpatrick 1985). Recently, a possible pit structure with associated surface rooms and Tajo phase ceramics were recorded during survey (Karl Laumbach and Mark Seachrist, pers. comm. 1991). With numerous Tajo phase sites in the woodland and mountainous regions south of Chupadera Mesa (the White Sands sites, LA 71276, and LA 6565), the Tajo phase definition and geographic boundaries need to be expanded from that of a riverine adaptation to include upland environments.

The Tajo phase is preceded by the San Marcial phase and followed by the Elmendorf phase, discussed in the Cultural Overview.

Site Comparisons

The closest excavated pit structure site to LA 71276 in distance and age is LA 6565, the Taylor Draw site. This site is only [redacted]) to the east of LA 71276, on a long, low ridge near the southern end of Chupadera Mesa. The Taylor Draw excavation consisted of 22 slab-lined surface rooms, one-story high, arranged in straight or arced rows, four pithouses and a kiva (Peckham 1976:42). Most of the surface rooms had jacal superstructures, though one had masonry walls. No dedrochronological samples were obtained from the surface structures, and it was not clear whether they were contemporaneous with the pit structures on the site.

Variations were observed in all four pithouses, with no two alike. Two were round and two were oval/rounded rectangular. Two were shallow (less than 1 m deep) and two were over 1 m deep. All had a four-post roof support systems (square pattern centered in structure), and all had a central hearth. None of the pit structures had subfloor storage pits. Three had an eastern or southeastern orientation to the ventilator (no ventilator was present in the fourth), and all three had a damper slab. Ladder holes were present in two of the pithouses. The two shallower structures had ramp entries, one to the northwest and one to the south. Floor area varied from 11.1 to 15.2 sq m.

There are several similarities between the Taylor Draw pithouses and the structure at LA 71276. Table 56 presents a comparison of attributes. The most obvious similarities are size, depth, shape, hearth location, ventilator orientation, and presence of damper slab. The roof support system is the most striking difference. The lack of a four-post system combined with the possible postholes leaning inwards towards the center of the structure at LA 71276 is an aberrant configuration when compared to the Taylor Draw pithouses. All of the pithouses there had four support posts, with the only variation being the addition of a supplemental post in one of the houses. The location of both sites is also similar, both being at roughly the same elevation at the base of Chupadera Mesa and

Table 56. Attribute Comparison, LA 6565 and LA 71276

ATTRIBUTE	TD-3	TD-7	TD-15	TD-17	LA 71276
Shape:					
Round		x		x	x
Oval or rounded-rectangular	x		x		
Depth:					
0.5 to 0.75 m	x		x		
1.0 to 1.5 m		x		x	x
Floor area (sq m)	14.2	15.2	11.1	13.2	11.9
Four-post support system	x	x	x	x	?
Central hearth	x	x	x	x	x
East/southeast ventilator	x	x		x	x
Damper slab	x	x		x	x
Ladder entry	x			x	
Ramp entry		x	x		?

Adapted from Peckham 1976; TD designation is Taylor Draw, followed by a feature number.

Table 57. Attribute Comparison, LA 45884 and LA 71276

ATTRIBUTE	FR-A	FR-C	FR-D	FR-E	LA 71276
Shape:					
Round	x	x		x	x
Oval			x		
Depth of fill (m)	1.3	0.87	0.57	0.32	1.06
Max. original depth (m)	0.67	0.65	0.20	?	0.91
Floor area (sq m)	12.6	4.5	5.3	6.2	11.9
Postholes	Probable 4-post pattern; 27 holes; 7 sloping to center	1, against wall	0	?	1, off-center; 4 slanting in
Hearth	Burn stain, center of floor	round, near east wall, adobe collar	stains, probably surface hearth	?	central
Ventilator	?	?	?	?	east

Adapted from Oakes 1986; FR designation is Fite Ranch, followed by a feature number along major draws. Because of their proximity and similar physiographic locations, soil type, amount of precipitation, and vegetation are almost identical. The locational similarities suggest that the lower slopes and base of Chupadera Mesa, near perennial water sources, was a desirable location to settle during the Tajo phase. It is likely that there are more clusters of structures similar to the Taylor Draw site in the area, which future surveys should indicate. It is also probable that more pit structures existed at LA 71276 before the construction of U.S. 380; pit structures may also exist outside of the highway right-of-way.

Peckham found only three extramural features: two hearths and a storage pit near one of the masonry structures. The scarcity of extramural features is similar to the situation at LA 71276.

At the time of Peckham's work at Taylor Draw, there were no similar excavated sites from which to draw comparisons. Peckham (1976:62) felt that limited knowledge at the time precluded "determination as to whether or not LA 6565 is an isolated, marginal, or normal development relative to earlier, contemporary, and later sites in south-central New Mexico." Now, 39 years after the Taylor Draw excavation, there are still very few excavated, similar, and contemporary sites. Although this sample is small, it is obvious that LA 6565 is not a case of isolated development; this is further supported by the number of Tajo phase sites found during survey on the White Sands Missile Range to the south. Unfortunately, at this point, it is still not clear whether Tajo phase sites in the Chupadera Mesa region represent marginal or typical development.

Five pit structures were excavated at LA 45884, the Fite Ranch site, three of which were definite habitation units, while two may have been used for habitation or storage. Habitation units were determined by artifact diversity, internal hearths, and associated surface debris. A possible storage function was indicated by lack of internal features and low artifact density, though these same factors could also indicate a summer occupation (Oakes 1986:19). At this site, the three habitation units were round and the two possible storage units were oval. Dimensions varied from 2 to 4 m in diameter, and depth varied from 0.3 m to 1.3 m. Following is a comparison between the Fite Ranch pit structures and LA 71276 (Table 57). Pit structure B was a storage feature and has been omitted from Table 57; the function of Structure D, whether habitation or storage, was questionable; and Structure E was only tested.

Both similarites and differences are apparent between the structures at the Fite Ranch site and the one at LA 71276 on Table 57. The pit structures that have been identified as habitation at Fite Ranch are round, as is the structure at LA 71276, and depth is similar. However, only Pit Structure A is similar in floor area to the LA 71276 pit structure, which are both on the low end for floor area at the Taylor Draw sites. The posthole pattern in Structure A is intriguing because of the presence of holes slanting towards the center, which also occurred at LA 71276 (but was not found at Taylor Draw). No two structures at Fite Ranch had identical hearth placement; variation included central location, against the wall, and surface staining. Again, only the hearth placement in Feature A is similar to that of LA 71276, particularly the hearth on the upper floor, which was only a burn stain (the lower floor at LA 71276 had a basin-shaped hearth).

Similarities are also seen in pit structure construction. At Fite Ranch, all of the structures were dug into the native fill and walls were unprepared. The only structure with a prepared floor was Pitstructure A, which had a floor of well smoothed white caliche. All other floors were compacted sand and caliche, some burned and some unburned; LA 71276 had a floor of compacted sand. Structure D had multiple floors, as did the LA 71276 structure.

All of the structures at Fite Ranch had surface burn areas associated with them. Again, this situation occurred at LA 71276. LA 71276 had one extramural hearth, and three surficial burned features. One of these, Feature 2, was across the highway and may have been associated with a structure that existed prior to highway construction. As mentioned above, Taylor Draw had a scarcity of extramural features, with two of the three being hearths.

A few pithouses have been excavated in the area to the north, in the Salinas area around Gran Quivira. Although there is limited information on the site excavated by Fenenga (1956) near Gran Quivira, similarities are apparent between the pithouse at LA 2579 and the sites discussed above. The pithouse at LA 2579 was round, with four support posts in a square pattern centered in the floor. The hearth was central, and the ventilator was to the southeast. No damper slab was present, but the ventilator opening into the structure was sealed with an adobe cap. The ventilator "flue" was a bell-shaped pit, an attribute also present at LA 71276. Floor area was 13.3 sq m; depth was 1.6 m. Walls were unprepared, but the floor had a layer of smoothed adobe. Another pithouse was excavated near LA 2579 by Fred Wendorf (Green 1955). It also was round with four central support posts and a central hearth. Floor area was 15.9 sq m.

Two pithouses were excavated in 1986 at the Kite site, LA 38448, about [redacted] northwest of Gran Quivira. The site is on a sandy alluvial fan at the base of Chupadera Mesa, in an area of mixed juniper forest and grasslands (Rautman 1991:1-8). Structure 1 had been damaged by arroyo erosion and was previously tested in 1982. It was round, 4.1 m in diameter (floor area was 13.2 sq m), with a central hearth, plastered floor, and a ventilator shaft to the northeast. Subfloor pits were present. The ceramic assemblage consisted of Jornada Brown, Red Mesa Black-on-white, and "several different black-on-white types" (Rautman 1991:2). Ceramically, the structure was dated to A.D. 900-1100. Structure 2 was about 1 m deep and was also round; however, it was very small, with a diameter of only 1.5 m. The ventilator shaft, which was almost as large as the structure itself, indicates a habitation rather a storage feature. A C-14 date of A.D. 979 was obtained. Two shallow extramural burial pits were near Structure 2.

Tajo 2 (LA 49786) is an excavated pithouse site on the east bank of the Rio Grande ne[redacted] south of Socorro (Weber 1973). This site dates to the Pueblo II-III period (late Elmendorf phase) and is therefore later than the Tajo phase sites discussed above. However, several similarities that cannot be overlooked exist between the two structures at Tajo 2 and those at LA 71276, Taylor Draw, and Fite Ranch. Similar attributes may indicate the longevity of desirable traits, or may simply be indicative of continuing ties with the Rio Grande Anasazi rather than with the Mogollon or the Jornada Mogollon.

Both of the structures at Tajo 2 are round with a four-post support system. Ventilators are to the east; one ventilator had a rectangular sandstone damper slab in place. Hearths were central, and ladder holes were present. Floor area was 11.9 and 13.8 sq m. This description, and the map of Pithouse 1 (Weber 1973:16), could easily be defining a Taylor Draw pit structure.

Table 58 compares the mean floor areas of the northern Jornada area pit structures discussed above. The Fite Ranch figures are affected by the three small structures at that site, which were not definitely classified as habitations. Omitting these structures in the last line of the table, it is clear that there is actually very little deviation in pit structure size at all of these sites. Therefore, the smaller features at Fite Ranch may not have funtioned as habitations.

Table 58. Mean Floor Area Comparison of Northern Jornada Area Pit Structures (sq m)

Site	No. of Structures	Mean	Std. Dev.
Taylor Draw	4	13.4	1.49
Fite Ranch	4	7.2	3.44
Bingham	1	11.9	-
LA 2579	1	13.3	-
Wendorf's	1	15.9	-
Kite Site	1	13.2	-
Tajo 2	2	12.9	-
All sites	14	11.6	3.28
All sites, without small structures at Fite Ranch	11	13.1	1.36

Significantly more work has been done in the Tularosa Basin and in the southern Jornada Mogollon region than in the northern perimeter area in which the sites described above are located. A few sites fitting Lehmer's description of the Capitan phase have been excavated in the northern Tularosa Basin. The Temporal site, located [redacted] north of the town of Tularosa, consisted of a single square pit structure, trash pit, and an external hearth. Several other pit structures are reported in the area (Marshall 1973:62). The roof support system was four posts in a central square pattern with a number of secondary posts set inside the perimeter of the room. The hearth was circular and located east of center. This structure was extremely large, with a floor area of 36 sq m. Jornada Brown was the dominant ceramic type, with smaller amounts of El Paso Brown and Alma Plain; decorated types included San Andres Red-on-terracotta and Three Rivers Red-on-terracotta (Marshall 1973:62)

The Hatchet site (LA 13495) is another Capitan phase site, located near Three Rivers. Four pithouses were excavated--two were square, one was subrectangular, and one was roughly circular. The circular room had a two-post roof support system; the square and rectangular structures had four posts. Floor area ranges from 13.0 to 44.8 sq m. The smallest structure was one of the square pithouses (13.0 sq m), followed by the circular structure (15.6 sq m). The subrectangular and the other square pithouse were the largest (21.8 and 44.8 sq m). The Hatchet site is the type site for San Andres Red-on-terracotta pottery (McCluney 1962).

Los Tules, the type site for the Jornada Mogollon and the Mesilla phase (Lehmer 1948), is located on the west bank of the Rio Grande about [redacted] north of the Mesilla Diversion Dam. Los Tules consisted of 11 pit structures and two extramural storage pits. Five structures were rectangular, four were circular, and one was oval. The rectangular structures had ramp entries to the east and southeast; other strucures had roof entries. Most had four or six support posts, although two had two large support posts and one structure had only one, in the center. Other posts may have been present outside the pit walls. This pit structure was the smallest at Los Tules (10.5 sq m), and though rectangular rather than round, may bear resemblance to the odd post configuration at LA 71276. No ventilators were reported, though where ramp entryways are present, they would have served as ventilators. Great variation in size is seen at Los Tules. The oval and rectangular structures are smaller than the round structures, ranging from 4.4 to 14.7 sq m; the round structures range from 16.0 to 50.2 sq m (this largest structure may have been a kiva; it is the only structure with a bench).

Two other excavated Mesilla phase sites are the Rincon site (LA 5599) and the Hatch site (LA 3135). Four pit structures were excavated at the Rincon site, two round with two main support posts and two rectangular with rounded corners and four support posts (Hammack 1962). No ventilator shafts were reported. Floor area ranged from 7.1 to 24.5 sq m; both the smallest and the largest structure were circular.

The Hatch site is a multicomponent site, with an Archaic, Mesilla phase, and Doña Ana phase component (Schaafsma 1990). The Mesilla phase component comprises the most substantial part of the site. Three of the 17 Mesilla phase structures were excavated. Two were round and one was rectangular. The rectangular structure was only partially excavated and the only floor feature identified was a central hearth. All of the structures were relatively large--the two round rooms were 15.4 and 17.0 sq m, while the rectangular structure had 33.3 sq m of floor area. One of the round structures had numerous postholes with no pattern evident; the other was intriguing in that it had only one posthole, as did the pit structure at LA 71276. Only one structure (round) had a ventilator shaft, to the northeast.

The most striking differences between what will be referred to here as the "Jornada perimeter" sites and the Tularosa Basin and southern Jornada Mogollon sites are size and shape; notably absent are ventilator shafts. Of the sites discussed above, nine are round, six are rectangular, three are subrectangular, three are square, and one is oval. At Taylor Draw, two structures were round and two were "oval or rounded-rectangular." Fite Ranch had three round structures and one oval. LA 71276 and LA 2579 each had one round pit structure. None of the sites had any square or rectangular structures. Table 59 lists pit structure shape by area.

The southern pit structures are, on the average, substantially larger than those on the northern perimeter. The mean floor area for the northern structures (LA 71276, Taylor Draw, Fite Ranch, LA 2579, Kite site, and Wendorf's) is 13.1 sq (standard deviation of 1.36); the mean for the southern sites (Hatchet, Los Tules, Rincon, and Hatch) is 22.8 sq m, even omitting the possible kiva at Los Tules, which had a floor area of 50.2 sq m.

Though considerable work has been done in the Sacramento Mountains (Kelley 1984; Vierra and Lancaster 1987; Farwell and Oakes 1992), these pit structure sites all date to a later period than does LA 71276 (see Phase Sequences discussion, above). However, because they are also in the northern Jornada Mogollon region, a brief discussion of attributes will be presented.

House shape was not standardized in the early Glencoe phase, though later in the phase most structures had square sides. Corona and Lincoln phase structures were also square (Kelley 1984:63-64). Most pithouses in the Sierra Blanca region lacked both ventilators and deflectors, with the exception of the Block Lookout site (LA 2112), which had a ventilator in the east wall (Kelley 1984:67). Central circular hearths were common. The four central post pattern was the most common type of roof support used, particularly in the larger, deeper structures. Occasionally six posts were used, four large central supports and an additional two support posts against the wall. One structure at the Bonnell site (LA 612) had only two posts, suggesting a gable or shed roof (Kelley 1984:79).

Anasazi influence is not evident in these later mountain settlements, in contrast to settlements to the west near Chupadera Mesa area and along the Rio Abajo. The Sierra Blanca region seems to have been influenced by the southern Jornada Mogollon area; though, as mentioned by Kelley (1984:71), change was slower in the mountain regions than elsewhere.

In contrast, the perimeter area (the southern slopes and perimeter of Chupadera Mesa, including LA 71276, LA 6565, and the Sargeant York survey area) clearly shows influence from the Rio Grande Anasazi to the west. Both Peckham (1976:58-59), at Taylor Draw, and Laumbach and Kirkpatrick (1985) noted that sites exhibited a blending of Mogollon and Anasazi traits, with an obvious link to the Middle Rio Grande region. The similarity in ceramic assemblages from all of

Table 59. Pit Structure Shape by Area

Area	Round	Rectangular	Subrectangular	Square	Oval or Rounded-Rectangular	Oval
Jornada perimeter	9	-	-	-	2	1
Northern Tularosa Basin	1	-	1	3	-	-
Southern Jornada	8	6	2			1
Total	18	6	3	3	2	2

these sites, when compared to Tajo phase sites along the Rio Abajo (as defined by Marshall and Walt 1984), are striking. Also apparent is the lack of similarity to the ceramic assemblage defined for the Capitan phase of the Jornada Mogollon. Whether the population originated in the Rio Grande Valley is unclear, but ties to the area are indicated by the consistent presence of nonlocally made Red Mesa Black-on-white, an Anasazi white ware that became popular during the Pueblo II period. Anasazi influence is blended with that of the Jornada Mogollon, strongly evident in the high number of locally made brown ware pottery.

Architectural Comparisons: Jornada Mogollon vs. Anasazi

The geographic area in question experienced a blending of Anasazi and Jornada Mogollon traits. Anasazi influence is not only apparent in the ceramic assemblage, but in pit structure architecture as well. Bullard (1962) examined pithouse architecture in the Southwest prior to A.D. 900. During this time, Eastern Anasazi pithouses were generally rectangular with rounded sides and almost always had a four-post roof support system. The earliest pithouses throughout the Southwest tended to be circular; a shift towards a rectangular shape occurred in most of the Mogollon area and in much of the Anasazi area between about A.D. 500 and 800 (Bullard 1962:117). During the Pueblo I period in the Chaco and Red Mesa Valley regions, pithouses were categorized as "medium" sized--12 to 21 sq m (average Eastern Anasazi size was 17 sq m)--and "medium" depth (0.75 to 1.29 m below prehistoric ground surface) (Bullard 1962:118-125).

The four-post method of roof support was widely used throughout the Anasazi region, and in the Southwest in general. The four posts were placed in a square pattern centered in the floor of the structure. Stringers joined the tops of the posts forming a rectangular surface on which to lay the horizontal roof timbers. The sides of the roof were formed by small poles that leaned against the stringers or eaves of the flat part of the roof, their butts placed on the ground surface around the edge of the pit or occasionally on the floor at the base of the walls. The framework was covered with smaller sticks or thatch and the entire roof covered over with earth, presenting the appearance of a low mound or a truncated pyramid. An opening was left over the hearth, serving as a smoke hole and as an entrance (Bullard 1962:128).

Gable roofs occurred during the Three Circle phase in the Mogollon area (contemporary with the early Pueblo II period). Postholes were configured to indicate a ridge pole crossing the center of the house at right angles to the direction of the entrance passage. Prior to A.D. 900, gable roofs were restricted to the Mogollon and Hohokam areas (Bullard 1962:131-132). Pithouses with the gable roof configuration were found at Los Tules in the Jornada Mogollon area, which dates to the Mesilla phase (PII period).

In the Mogollon area, passage entrances were common. They were slightly inclined from the house floor up to the ground surface, and also served as fresh air inlets. In the Anasazi region, antechambers served these same purposes. In the Eastern Anasazi area, antechambers developed into ventilators, which were accompanied by a ladder entry into the house (Bullard 1962:140-143).

Hearths, prior to A.D. 900, were predominantly round or oval. They were either centrally located or slightly off-center. Ash pits, an Anasazi trait, often were associated with hearths.

During the BMIII-PI period, deflectors were found only in the Anasazi area. They were common in northern San Juan pithouses, but were generally absent in the Red Mesa Valley and the Northern Rio Grande during the PI period. Their absence in the Mogollon and Hohokam areas may be due to the larger openings of entry passages, which would not have concentrated drafts such as a ventilator tunnel (Bullard 1962:162-163).

In the Pueblo II period in the Albuquerque District, the Rio Grande Anasazi built round pithouses with central hearths and ventilator shafts oriented to the east; a two- or four-post roof support system, ladder holes, and ash pits were common, as in the preceding period. Interior and exterior storage pits also occur (Cordell 1978:42-44). A few sites dating to the PI-PII period have been excavated in the Rio Grande Valley in the Albuquerque area. Strong similarites are evident when comparing these sites to the contemporary Tajo phase sites.

The Denison site (LA 49993), near Isleta Pueblo, consisted of four excavated pithouses dating from the PI through the PIII period (Vivian and Clendenen 1965). All of the houses were round and had central rectangular fire pits. Size varied, but three of the four structures fell with Bullard's (1962) "medium" size: 16.9, 17.5, and 20.1 sq m. Pithouse 3 had a floor area of 9.2 sq m. Average floor area for the site is 15.9 sq m. Ventilators to the east or northeast were present in three of the four structures; the ventilator for Pithouse 3 may have been destroyed during construction of Pithouse 2, which cut into the east wall of the first structure (Vivian and Clendenen 1965:5-10).

Pottery at the Denison site was from both Anasazi and Mogollon sources. Red Mesa Black-on-white was the most common white ware. Both gray and brown wares were present (57 percent and 40 percent). The brown wares were described as being from two areas of production: the Mogollon area and the Acoma (Cebolleta) area. The Jornada area was not mentioned; if Jornada Brown was present it may have been lumped with Alma Brown; or it simply was not found at the site and contact was only from the southwest and west, not the southeast.

Peckham (1957) excavated three sites (LA 3289, LA 3290, and LA 3291) ranging in age from BMIII to PI or early PII, near Sandia Pueblo on the east side of the Rio Grande. Nine pithouses were excavated, both round and rounded rectangular. Ventilators were oriented to the east, and hearths were centrally located. In some cases, damper slabs were indicated by a long, shallow groove in the floor across the mouth of the ventilator opening, referred to as a "damper notch." Other features include ash pits, subfloor pits and burials, sipapus, and ladder holes. Considerable variation in size was seen. Floor area ranged from 3.7 to 27.5 sq m; three structures were in the 26-27 sq m range, five were 9-20 sq m, and one was 3.7 sq m. Average floor area, within this broad range, was 16.4 sq m.

There was a considerable amount of Mogollon Brown Ware at LA 3290, comprising 27 percent of the assemblage. Again, no Jornada Brown was listed. Red Mesa Black-on-white was the major decorated pottery at all three sites (Peckham 1957:57).

At the Sedillo site (LA 3122), along the Rio Grande near Albuquerque, 10 pithouses were excavated; a total of 20 pithouses and two kivas were estimated at the site (Skinner 1965). The pithouses were round, with ventilators oriented to the east. They all had a four-post roof support pattern and central hearths. Occasional ladder holes and sipapus were present. Two fragmentary damper slabs were found, both rectangular with rounded corners. Skinner suggests that damper slabs may have been used in place of deflectors to control the air flow into the pithouses (1965:14). The absence of true deflectors is considered a characteristic of the Rio Grande region through PI (Bullard 1962:162), and evidence from the Sedillo site shows that this absence continues into the PIII period (Skinner 1965:21).

Brown wares are present in the ceramic assemblage, but there is no indication of Mogollon contact. Instead, they point to the Cebolleta region (Pilares Banded) and the Jornada area (though the Jornada Brown is mostly from one vessel and only constitutes a minor percentage of the total assemblage). Red Mesa Black-on-white, made of a local Rio Grande paste (Skinner 1962:19), is common in the white ware assemblage, along with both earlier and later white wares.

Traits that occurred consistently at all of these Rio Grande sites were round to rounded-rectangular shape; central firepits, both round and rectangular; ventilators, with an eastern orientation; damper slabs or damper notches; similarity in size (floor area); and presence of brown wares mixed with Red Mesa Black-on-white. The average size of the Denison site structures was 15.9 sq m, and the Sandia sites averaged 16.4 sq m. Dimensions for the Sedillo site houses were not given, and only three of the 10 structures were illustrated. Measuring the diameters from the illustations, which can only give an estimate of size, floor areas were 7.1 sq m, 9.6 sq m, and 16.6 sq m, with an average of 14.5 sq m for three of the 10 structures.

Similarities are apparent between the Rio Grande Valley sites and the Tajo phase/Jornada perimeter sites discussed above. Round to rounded rectangular shape, "medium" size, presence of ventilators and dampers, and central firepits are common to both areas. In contrast, the Jornada area structures have more shape variation, including rectangular and square, they are larger, and they do not have ventilators. This would indicate a stronger connection between the Jornada perimeter and the Rio Grande Valley than with the actual Jornada Mogollon area. The only obvious Jornada Mogollon characteristic in the Perimeter sites is the presence of Jornada Brown Wares. It is possible that the presence of brown wares is the result of brown-firing clay as opposed to gray-firing clay in the area. Thus, brown pottery might indicate available resources, rather than a choice or a cultural affiliation. Clay sourcing studies would be necessary to address this question.

Subsistence and Seasonality

Propositions to test the model from the Research Design relating to differentiating between a permanent and a seasonal occupation of a site are repeated below:

1. Food storage facilities, such as subsurface pits, surface rooms, and large storage vessels would be found at sites occupied on a year-round basis. A seasonally occupied site would not need extensive storage facilities.

2. Extensive food-processing facilities, such as mealing bins, would be expected at sites occupied year round.

3. Sites occupied only during the summer would have outdoor hearths and activity areas, while year-round sites would have indoor hearths.

4. A greater amount and diversity of artifacts would be expected at a year-round site. Artifacts would reflect a broader range of activities, such as axes or mauls, hoes, bone awls, a variety of chipped and ground stone artifacts, and ritual objects. In addition, larger and more varied trash deposits would be expected.

5. Floral and faunal remains reflect the season of occupation at a site. Therefore, a seasonally occupied site would yield evidence only of remains that could have been collected during the season the site was occupied. A site occupied year-round would have a greater diversity of remains.

Contrary to the above listed expectations, Gilman (1987) has proposed that pit structures were used only as winter habitations, and were always accompanied by some type of storage facilities. Traditionally accepted views include the idea that pit structures represent year-round sedentism with a major dependency on agriculture (Berry 1982; Lightfoot and Feinman 1982; Martin and Plog 1973; Woodbury and Zubrow 1979), or that while pit structures may not have been inhabitated year-round, the population still depended heavily on agriculture (Gillespie 1976; Gumerman 1969; Hayes 1964; Lightfoot 1984; Martin 1939). Gilman believes that the presence or absence of agriculture is not directly related to the use of pit structures. Pit structures were used if three critical conditions were met: cold season use, minimally a biseasonal settlement pattern, and stored food reliance during the season of use. Therefore, the presence of pit structures can not be used to differentiate between hunter-gatherer and agricultural economies.

Gilman's perspective is based on an ethnographic study of populations in South America and Africa, where she found that the vast majority of groups used pit structures as winter-only habitation structures. The main reason was better thermal efficiency--heat is retained better in pithouses than in above-ground buildings, and the house is not subject to heat loss by wind (Gilman 1987:541-542; Farwell 1981). Although the thermal qualities of pit structures would also be advantageous in the summer months, Gilman found that ethnographically most groups did not live in them in the summer. She believes this phenomenon relates to two other propositions of pit structure use: the presence of at least a biseasonal settlement pattern and the use of stored food. A group dependent on stored food, or food that can be gathered in one locale, will be residentially sedentary while they are using that food source and will live in pit structures. If a group's subsistence strategy is more mobile, other less permanent habitations will be used. Her studies suggested that people living in pit structures were tied to their food stores and were sedentary during the season of pit structure use (Gilman 1987:542).

Population is another important factor in settlement patterns. Ethnographically, most pit structure settlements had less than 100 people. Generally, population was less than at other types of settlement. Pithouse communities that had dense population had access to large and fairly predictable food resources.

According to Gilman (1987:552-553), prehistoric Southwestern pit structures were sedentary winter habitation structures. She proposes that the population used other types of structures during the warmer growing season months. These structures could be at the same site, and thus the structure, rather than the site, would be used biseasonally; the site could then experience year-round use. However, in spite of Gilman's proposal, the labor investment in building a new structure on the same site as the "winter pitstructure" does not necessarily make sense, particularly when the thermal properties of pithouses are almost as beneficial in the summer as in the winter. Furthermore, seasonal use would leave the pithouse unmaintained for months, thus increasing the possibility of water damage and insect infestations. As Cameron (1990), Schlanger (1985, 1986), and Ahlstrom (1985) have demonstrated, lack of maintenance leads to quick deterioration of a structure. Schlanger has suggested an estimated use-life of 10-12 years, after which repairs could extend the life of the structure to about 30 years. Ahlstrom's estimate is repair after 7 years, extending the life of the structure to 15-20 years. When a unit does eventually become structurally unsound or infested with insects, this can lead to short distance relocation and reuse of structural materials (Cameron 1990:160). Trash filled structures, such as that at LA 71276, can be the end result of short distance relocation--as deterioration renders a structure uninhabitable, it becomes the dump for the succeeding pithouse.

Gilman further proposed that storage facilities would reflect winter sedentism. These may be smaller, less formal, and less obvious in the archaeological recorded under conditions of less winter sedentism and low stored food bulk (baskets, pottery, hide containers). Further subsistence intensification would be reflected in more storage features: pits, storerooms, cists, and pottery (Gilman 1987:553-554).

Gilman's model is difficult to test at LA 71276 since there was only one excavated pithouse, and no storage facilities were found. The simple presence of the pithouse, by her model, would represent winter habitation, which is further supported by the presence of an interior hearth. The absence of storage features is problematic, but these may either have been ephemeral, as discussed above, or may no longer exist due to construction of U.S. 380. Another problem is that the structure was trash-filled, indicating that the artifacts and the botanical remains recovered may not relate to that pithouse.

The same difficulties outlined in the preceding paragraph are encountered when using Lancaster's (Vierra and Lancaster 1987) model. No outdoor hearths or activity areas, indicative of summer-only habitation, were found. According to Criterion 4, artifacts should reflect a broad range of activities at a year-round site, and may include the presence of ritual objects. The artifact assemblage from Bingham may fulfill this criterion. A bone awl, worked sherds, bone gaming pieces, shell and turquoise pendants, and the one quartz crystal all suggest more than a temporary settlement. Lithic artifacts, however, indicate only food processing and hunting, and ceramic artifacts were generally too small to determine if any large storage vessels were present.

The botanical remains from Bingham indicate a farming economy bolstered by local wild plants (Toll, this volume). Annuals documented include goosefoot, tobacco, and mallow, and possibly pigweed, purslane, and groundcherry. Perennial plants found include abundant samples of hedgehog and prickly pear cactus, as well as yucca and ricegrass. Common plant taxa from the pollen samples include cheno-am, sunflower, cholla and corn; corn pollen, however, was found only in samples from outside the pithouse, such as the ventilator shaft and activity surface, and not in those samples from the interior of the pithouse (Dean, this volume). The presence of corn in both macrobotanical and pollen samples is evidence of farming in the site vicinity. The types of wild plants present in the botanical sample span the growing season, from ricegrass (late spring) to the various species of cactus (late summer-early fall) (Toll, pers. comm. 1993). The faunal assemblage indicates a diverse and readily available food resource, with an abundance of small mammals (Moga, this volume). The location of the site, situated between perennial drainages in a hilly piñon-juniper zone, would have provided water (at least in the summer), firewood, and wild plant and animal resources to supplement agricultural crops. The presence of lithic tools including numerous projectile points indicates that hunting was part of the subsistence base. Without evidence of storage features, however, it is not possible to determine whether plant gathering was for winter storage or for immediate use. However, available evidence points to a mixed agricultural and hunting-gathering subsistence economy.

Peckham (1976:62-63) also postulates a mixed agricultural and hunting economy for the residents of nearby Taylor Draw. Summer run-off in the area was apparently sufficient for farming the valley bottoms. The numerous surface granaries and their contents indicated environmental conditions conducive to production of surplus crops. Locally available wild foods included piñon nuts, yucca fruit, and prickly pear. The frequency of projectile points indicates the importance of hunting. Peckham estimated the population of Taylor Draw at not more than 100, and believed that the area was satisfactory for settlement as long as precipitation was consistent and run-off sufficient for agriculture. An interesting observation was that with the exception of small quantities of ceramics and lithic materials, there seemed to have been few introductions from the outside. The type of corn recovered suggested that Taylor Draw and the surrounding area was isolated from stimuli that led to more rapid growth in the northern Chupadera Mesa region (Peckham 1976:63).

Of the five pithouses excavated at LA 45884 (Fite Ranch), one was postulated to be a storage feature and one was "residence/storage." By Gilman's model, this makes Fite Ranch a year-round settlement. In addition, both of the fully excavated pithouses had internal hearths. The site was situated between riverine and hilly zones, providing various wild food resources (Oakes 1986:18). This allowed for alternative subsistence strategies in times of low resource availability, such as poor farming seasons. No corn was recovered from this site. LA 45884 was thought to represent a wild food gathering and hunting subsistence economy with some dependence on stored goods (Oakes 1986:110).

Ceramic period sites located during the Sargeant York survey (on the White Sands Missile Range) were consistently located near or within areas of the La Fonda loamy soils. In contrast, Archaic sites were mainly restricted to the Rocklands (Laumbach and Kirkpatrick 1985:67).

Laumbach and Kirkpatrick believe that the area was only inhabited for a short time, with an agricultural population present from about the A.D. 900s to around A.D. 1050.

Examining other contemporary sites in surrounding areas, it is apparent that year-round occupation by small agricultural populations occurred during this time. Storage areas--both subfloor and extramural pits or cists--were common at PI-PII sites along the central Rio Grande. One of the three sites excavated by Peckham (1957) near Albuquerque had two small extramural storage areas associated with a pithouse. Another of these sites had interior undercut pits, which were not specifically described as storage features. Storage features were common at the Sedillo site, also near Albuquerque (Skinner 1965). Exterior bell-shaped storage cists were present at this site, as well as subfloor pits; the exterior features were deeper and wider than those in the interior. One circular extramural cist was present at a BMIII-PI pithouse site near Santa Ana (Allen and McNutt 1955). To the north of Bingham, Fenenga's (1956) Gran Quivira pithouse site had one exterior bell-shaped storage cist and one interior cylindrical pit. At the Kite site, also near Gran Quivira, no storage features were found, but analysis of materials from the midden indicate evidence of a mixed agricultural and hunting-gathering economy, with cultivation of domesticated plants such as maize and beans and utilization of wild plants such as yucca, *Chenopodium,* and *Portulaca.* The importance of hunting in the economy is indicated by the presence of numerous projectile points (Rautman 1991). Both the Hatchet site (McCluney 1961) and the Hatch site (Schaafsma 1990) to the south had storage features present, as did LA 2000 to the east (Jennings 1940). Thus, during this period in the Jornada Mogollon region and in surrounding areas, agricultural or at least year-round settlements (indicated by food storage features) were present, even if only briefly in the project area as postulated by Laumbach and Kirkpatrick (1985).

Conclusion

Data recovery at LA 71276 revealed a single Tajo phase pithouse and associated extramural features archaeomagnetically dated A.D. 930-1010. The site appears to represent a year-round settlement. Artifactual, botanical, and faunal evidence points to a mixed agricultural and hunting-gathering subsistence base, indicated by the presence of corn, wild plants, projectile points, and a variety of fauna. In this respect, Bingham is similar to the nearby contemporary Taylor Draw site and the Fite Ranch site 30 miles to the east.

In pithouse construction and ceramic assemblage, LA 71276 is also similar to these two Tajo phase sites. However, it is also similar to Middle Rio Grande pithouses of the same period. It is situated in a boundary area where there is an intermixing of Anasazi and Jornada Mogollon traits. Anasazi contact is indicated by the presence of Red Mesa Black-on-white, nonlocal lithic material from the north and west, and pithouse style. A comparison of contemporary sites in the Chupadera Mesa region to the north indicates that the pithouses at LA 71276 and at the surrounding sites more closely resemble PI-PII Rio Grande structures than Mesilla or Capitan phase pithouses to the south and east. Pithouse size and shape is consistently similar between Tajo phase and Rio Grande structures; most are round or rounded-rectangular with ventilator shafts, and vary from around 12 to 14 sq m in floor area with very little deviation. Red Mesa Black-on-white is always present at these sites. In contrast, contemporary Capitan and Mesilla phase pithouses to the south, in and near the Tularosa Basin, are much larger and are generally square. They are shallower and rarely have ventilator shafts. Red Mesa Black-on-white does not occur on these southern sites. Sites to the east, in the Sierra Blanca region, also generally have square pithouses, and the white wares are from the Mimbres area to the west, rather than from the Anasazi region.

The Tajo phase was originally defined from survey as a riverine adaptation. However, evidence from this study suggests that it extends into the piñon-juniper uplands to the east of the Rio Abajo, along the southern edge of Chupadera Mesa. Thus, elevation ranges from about 4,900 ft to about 6,700 ft for Tajo phase sites. Of the few excavated Tajo phase sites (six, including LA 71276), all except the Fite Ranch site are located on or near Chupadera Mesa. This is an area in which resources--plant, animal, wood, water--were apparently abundant. Sites in this region had definite ties to the Anasazi region, and, to a much lesser extent, possible contact with the Mimbres area. This is significantly different from other sites and phases of the Jornada Mogollon and is the result of being a peripheral zone between the Jornada Mogollon and the Anasazi regions.

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APPENDIX 1. POLLEN ANALYSIS OF SEVEN SAMPLES FROM A TAJO PHASE PITHOUSE AT LA 71276 NEAR BINGHAM, SOCORRO COUNTY, NEW MEXICO[1]

Glenna Dean, Ph.D.

INTRODUCTION

Archaeological excavations were conducted at LA 71276 near Bingham, Socorro County, New Mexico, by the Office of Archaeological Studies (OAS), Museum of New Mexico, Santa Fe in advance of construction activities on U.S. 380. A pit structure and several extramural features were present at the site.

The pit structure was large (3.9 m in diameter) and prehistoric remodeling of its interior was indicated by the presence of two floors separated by about 10 cm of sterile orange fill. Hearths were present in both floors, the upper hearth situated directly above the lower. The opening of a ventilator shaft was covered by a large sandstone slab in the pit structure interior. Occupation of the site was dated by ceramics to the Pueblo I Tajo phase (A.D. 800-1000; Daisy Levine, general site information). I have not visited the project area.

Seven pollen samples taken from various features within and near the pit structure were submitted by Daisy Levine, project director, to the Castetter Laboratory for Ethnobotanical Studies (CLES), University of New Mexico, for pollen analysis. One of the samples was washed from ground stone by OAS personnel; the remaining six were sediment samples. Sample proveniences are given in Table 1.1. The pollen types identified are listed in Table 1.2.

Table 1.1. Proveniences of Archaeological Pollen Samples from LA 71276 near Bingham, Socorro County, New Mexico

CLES No.	OAS No	Provenience
92168	FS 66	Pollen sample taken from modern ground surface SE of site.
92169	FS 45b	Pit structure, SE quadrant, activity surface 15-20 cm below present ground surface (bpgs).
92170	FS 58	Pit structure, NW quadrant, upper floor 75 cm BPGS.
92166	FS 73	Pit structure, NW quadrant, pollen wash from ground stone (mano fragment) on lower floor.
92167	FS 45a	Pit structure, SE quadrant, ventilator cover slab, pit structure face 50-55 cm bpgs.
92172	FS 71	Pit structure, SE quadrant, ventilator cover slab, ventilator shaft face.
92171	FS 49	Feature 4, human burial, pelvic area 15 cm bpgs.

[1] Castetter Laboratory for Ethnobotanical Studies Technical Report no. 337. University of New Mexico, Albuquerque.

Table 1.2. Pollen Types Identified in Samples from LA 71276 near Bingham, Socorro County, New Mexico

Taxon	Common Name
Pinaceae	Genera of the Pine family producing saccate pollen
Pinus	Pine
Juniperus	Juniper
Juniperus/Populus	Indistinguishable pollen grains of *Juniperus* and Cottonwood/Aspen *(Populus)*
Quercus	Oak
Cheno-Am	Indistinguishable pollen grains of genera of the Goosefoot (Chenopodiaceae) family and Pigweed *(Amaranthus)*
Sarcobatus	Greasewood
Ephedra	Mormon Tea
Gramineae	Genera of the Grass family
Zea	Corn
Low-spine composite	Wind-pollinated genera of the Sunflower family
Artemisia	Sagebrush
High-spine composite	Insect-pollinated genera of the Sunflower family
Cylindropuntia	Cholla Cactus
Sphaeralcea	Globemallow
Eriogonum	Wild Buckwheat
Nyctaginaceae	Genera of the Four O'Clock family
Onagraceae	Genera of the Evening Primrose family

Laboratory Techniques

Sediment Samples

Chemical extraction of the sediment samples from LA 71276 was performed by CLES personnel using the CLES procedure designed for arid Southwest sediments. This process avoids the use of reagents such as nitric acid, bleach, and potassium hydroxide, which are potentially destructive to pollen grains (Gray 1965:545-547, 555-557, 566). The details of the process are as follows:

1. The dry samples were screened through a tea strainer (mesh openings of about 2 mm) into numbered beakers, to a total screened weight of 25 g. The samples were "spiked" with three tablets of pressed Lycopodium (clubmoss) spores (batch 414831, Dept. Quat. Geol., Lund, Sweden), for a total addition of 36,300 marker grains to each sample.

2. Concentrated hydrochloric acid (38 percent) was added to remove carbonates, and the samples were allowed to sit overnight.

3. Distilled water was added to each sample, and the acid and dissolved carbonates were removed by siphoning the supernatant off the sediment after a settling period of at least three hours. More distilled water was added, the water-sediment mixture swirled, allowed to sit no longer than five seconds, and the fine fractions were decanted off of the settled heavier residue through a 195 μm mesh into another beaker. This process, essentially similar to bulk soil flotation, differentially floated off light materials, including pollen grains, from heavier nonpalynological matter. After three such "flotations" of the sediment, the fine fractions were concentrated by centrifugation at 2,000 rpm, and the heavy fraction remaining in the beakers was discarded.

Rinsing of the recovered fine fractions was accomplished by mixing them with distilled water, followed by centrifugation, three times.

4. The fine fractions were mixed with 49 percent hydrofluoric acid and allowed to sit in beakers overnight to remove smaller silicates. The next day, distilled water was added to dilute the acid-residue mixture. Centrifugation and washing of the compacted residue with distilled water was repeated as above to remove acid and dissolved siliceous compounds.

5. Trisodium phosphate (2.5 percent solution) was mixed with the residues and centrifuged. Repeated centrifuge-assisted rinses with distilled water subsequently removed much fine charcoal and small organic matter. The residues were washed with glacial acetic acid to remove remaining water in preparation for acetolysis.

6. The residues were mixed with a saturated solution of zinc chloride (specific gravity 2.0) and centrifuged for 8.5 minutes to concentrate mechanically the lighter pollen fractions at the top of the heavy liquid. The liquid was poured into numbered beakers and diluted with hydrochloric acid and distilled water to drop the specific gravity. The compacted heavy residues in the centrifuge tubes were checked under the microscope for stray pollen grains before being discarded. The diluted heavy liquid was centrifuged, poured off the compacted pollen residues, and the residues were then washed with distilled water several times.

7. Acetolysis mixture (9 parts acetic acid anhydride to 1 part concentrated sulfuric acid) was added to the residues in the centrifuge tubes to destroy small organic particles. The tubes were heated in a boiling water bath for 5 minutes, followed by a 5-minute cool-down. The residues were compacted by centrifugation and the acetolysis mixture was poured off. Following a rinse with glacial acetic acid, multiple centrifuge-assisted washes with distilled water removed remaining traces of acid and dissolved organic compounds. Total exposure of the residues to acetolysis mixture was about 15 minutes.

8. The sample residues were rinsed with methanol, stained with safranin O, and transferred to 1-dram storage vials with tertiary butyl alcohol (butanol). The vials were centrifuged to settle the residue, the supernatant butanol was decanted, and the pollen residues were mixed with 1,000 CKS silicon fluid. After evaporation of the butanol, the storage vials were closed. These vials are in permanent storage at CLES; the unused sediment samples were returned to OAS.

Pollen Wash

Extraction of the pollen washed from the ground stone was performed by CLES personnel using a highly abbreviated subset of the above laboratory process. Chemical dissolution of carbonates (Steps 1 and 2) and concentration of pollen grains by heavy-liquid centrifugation (Step 6) were the only extractive processes employed. Organic material and silicates were allowed to remain in the sample to maximize the possibility of pollen recovery. The details of the extraction process are as follows:

1. The pollen wash had been collected by OAS personnel by washing the artifact over a filter paper circle which retained particles 5 μm and larger in size. The filter paper was dried and packaged in a sterile plastic bag. In the CLES laboratory, the filter paper was thoroughly washed with distilled water over a beaker to remove the collected pollen grains. The pollen wash was

acidified with hydrochloric acid and spiked with one tablet of pressed *Lycopodium* (clubmoss) spores (batch 414831, Dept. Quat. Geol., Lund, Sweden). The spike tablet added 12,100 marker grains to help "bulk up" what was expected to be a very small volume of pollen grains, and to allow some statistical considerations of the pollen content.

2. Extraneous water was removed by repeated centrifugation above 2,000 rpm, followed by three distilled-water rinses of the compacted pollen residue.

3. The sample was suspended in a saturated solution of zinc chloride (specific gravity 2.0) and centrifuged above 2,000 rpm for 8.5 minutes. The supernatant, containing spike and pollen grains, was collected in a beaker and diluted with 10 volumes of distilled water and hydrochloric acid to drop the specific gravity. The heavy fraction remaining in the bottom of the centrifuge tube was examined microscopically for any stray pollen grains and then discarded. The pollen fraction was concentrated by centrifugation above 2,000 rpm, washed with distilled water and methanol, stained with safranin O, and transferred to a 1-dram storage vial with butanol. The vial was centrifuged to settle the residue, the supernatant butanol was decanted, and the pollen residue was mixed with 1000 CKS silicon fluid. After evaporation of the butanol, the storage vial was closed. This vial is in permanent storage at CLES; there was no unused portion of the sample to return to OAS.

Microscopy

Microscope slides were made from droplets of the pollen residues using 1000 CKS silicon oil as the mounting medium under 22-by-22 mm cover slips sealed with fingernail polish. The liquid mounting medium allowed the grains to be turned over during microscopy, facilitating identifications. Slides were examined at a magnification of 400x until a total of at least 200 pollen grains was achieved, with the exception of the pollen wash sample. Ten percent of the slide made from this sample was examined at 400x and yielded only seven pollen grains. The uncounted portion of all slides was scanned at a magnification of 200x in search of the larger pollen grains of cultivated plants (corn and squash), two kinds of cactus (cholla and prickly pear), and other large pollen types; smaller pollen types were not noted during scans. Each slide was completely examined during the scan, even after a given rare pollen type was found, to compensate for the uneven distribution of rare pollen types on the slides.

The finding of pollen grains from cultivated plants often requires a different approach than the standard 200-grain count, because these and other pollen types are usually rare in archaeological samples. Previous attempts by myself and other workers to concentrate the pollen grains of cultivated plants from features such as suspected agricultural fields have generally focused on physical methods, typically screening of the pollen residue to separate the pollen types by size (Dean 1989), but these methods do not give results that can be manipulated statistically. Recently, I developed a regimen of intensive systematic microscopy to search for rare pollen types at 200x magnification. As a result, very low concentrations of cotton and corn pollen grains were detected in pollen samples from high-altitude prehistoric field features in northern New Mexico (Dean 1991). A refinement of this approach was used for the Bingham pollen samples reported here.

The number of pollen and spike grains were tallied at 400x during the 200-grain count, as usual. Then, the remainder of each slide was examined at 200x, but only the spike grains, any cultigen grains, and the number of transects were tallied. These figures were used to estimate the potential abundance of a rate pollen type (say, corn) that might be present in a given sample but which happened to be absent from the particular slide chosen for examination. This estimate made use of pollen concentration equations (1) and (2) discussed in the next section. The potential abundance was calculated by assuming that a corn pollen grain would be the first pollen grain seen on the subsequent slide; solving the pollen concentration equation using the value 1 for the "number of pollen grains counted" and the total number of spike grains counted on the previous slide for the "number of spike grains counted" portions of the equation yielded the maximum *potential* concentration for the unseen pollen type. This maximum potential concentration is discussed as appropriate for each sample in the Results.

During the 200-grain counts, all identifications were made to the family or genus level, as possible. Grains which could not be identified despite well-preserved morphological details were tallied as "Unknowns." Pollen grains too degraded (corroded or crumpled) to identify further were tallied as "Unidentifiable." Any grain that could not be positively identified as either pollen or a spore was not counted.

The artificial category Cheno-Am, as used here, combines the indistinguishable pollen grains of several genera in the families Chenopodiaceae (goosefoot) and Amaranthaceae (pigweed; Martin 1963:31). These genera also share many aspects of habitat and life cycle. All members of the Cheno-Ams are prolific producers of windborne pollen. In sediment samples from the Southwest, the Cheno-Ams typically dominate the nonarboreal portion of the pollen spectrum.

Pollen of the sunflower (Compositae) family was classified as "High-Spine Composite" and "Low-Spine Composite" on the basis of microscopic spine length. A grain with spines greater than 2.5 μm in length was classified as a high-spine composite, while a grain with spines less than 2.5 μm in length was classified as a low-spine composite. Compositae taxa producing pollen grains with long spines are usually showy, such as the sunflowers and asters, and are primarily insect-pollinated. Compositae taxa producing pollen grains with short spines are usually more weedy, such as ragweed, and are prolifically wind-pollinated.

Unfortunately, at least three taxa of some prehistoric economic importance (Stevenson 1915; Whiting 1939) produce pollen with spines right at 2.5 μm in length, but are primarily insect-pollinated. The spines of the pollen of snakeweed *(Xanthocephalum/Gutierrezia),* rabbitbrush *(Chrysothamnus),* and *cota* or Navajo tea *(Thelesperma)* are about 2.5 μm in length on undegraded pollen grains. Any shortening of the spines as a result of degradation causes these primarily insect-transported grains to be counted as low-spine, wind-transported grains. It is therefore highly probable that the pollen of these and similar taxa appear in the low-spine composite category. Low-spine composites are typically recovered from Southwest sediments in numbers second only to the Cheno-Ams.

Pollen grains from the grass family (Gramineae) are not identifiable to genus with one general exception, corn *(Zea).* All grass pollen grains, including corn, bear but a single pore for an aperture, are spherical, appear to have simple wall architecture at 400x magnification, and lack much surface ornamentation. The medium size of noncorn pollen grains make their identification as "grass" pollen especially dependant on the preservation of the single distinctive pore. In the Bingham pollen analysis, no identification of a "corn" or "grass" pollen grain was made unless the pore was clearly identifiable. All grass family grains that might have been pollen, but for which no pore was identifiable, were considered possible spores and were not counted. Isolated corn pores were counted and noted as "pore only," and possible corn grains from which the pore had been torn were not counted. The windborne pollen of corn has been shown to adhere to kernels, shucks, and tassels, to cling to grinding slabs, and to appear in human feces following the ingestion of corn products (Bohrer 1968:36, 47; Hevly 1964:89-91; Williams-Dean and Bryant 1975:105-106). Isolated pores and torn grains of corn pollen have been found indicative of grinding activities in other studies (Williams-Dean 1986:199).

Clumps of three or more pollen grains seen during the counts were tallied as a single grain in order to avoid skewing the 200-grain count. Their presence is indicated in the pollen tables with "*." Notes were kept of the numbers of grains comprising the clumps and these data are presented as appropriate in the Results. Clumped pollen grains from wind-pollinated taxa were given analytical weight in combination with estimates of pollen concentration (the number of pollen grains/g of sample). Clumps of pollen from insect-pollinated taxa such as High-spine composites and beeweed *(Cleome)* were assumed to reflect the presence of unopened buds or opened flowers, because clumping is advantageous in the pollination biology of those taxa and could be expected to occur often.

In the following analysis, pollen abundance is expressed as the estimated numbers of pollen grains/g of sample (pollen concentration). Although the resulting numbers are often small for the rarer pollen types, the description of pollen abundance in terms of pollen grains/g of sample allows the direct comparison of these types from sample to sample. This is a distinct advantage over the more traditional use of relative percentages, in which pollen abundance is expressed in relation to a fixed sum (200 grains), and rare pollen types always comprise 1 percent or less of the total spectrum. The advantages of scale gained by calculating pollen concentration are considerable.

For example, 100 grains of taxon X may be 10 percent of the estimated total of 1,000 pollen grains/g in one sample, and 1,000 grains of taxon X may be 10 percent of the estimated total of 10,000 pollen grains/g in another sample. Both samples yielded abundances of 10 percent for taxon X, but the description of that abundance as a percentage obscures the differences in scale between the two pollen samples. Why are there 1,000 total grains/g in one sample and 10,000 total grains/g in the other? Why are there 100 grains of taxon X in one sample, but 1,000 grains of taxon X in the other? What are the implications for pollen dispersal, or prehistoric human behavior, in the differences in estimated pollen abundance?

Insight into behavioral implications is impossible when pollen data are expressed solely as percentages. Should, however, the reader wish to convert the Bingham archaeological pollen data to relative percentages, simply divide the raw count for each taxon by the total number of pollen grains counted (Total Pollen) and multiply by 100.

Theoretical Considerations

Limitations of Pollen Data

Two statistical considerations should be explored in order to evaluate pollen data. The first consideration is the routine "200-grain count" derived from the work of Barkley (1934), and augmented by Dimbleby (1957:13-15) and Martin (1963:30-31). Counting pollen grains to a total of 200 per sample allows the microscopist to inventory *the most common* taxa present in the sample. My calculations using the data presented by Dimbleby (derived from counts of slides containing about 20 pollen taxa) reveal that from 70 percent to 85 percent of the total population of taxa can be seen during a 200-grain count. Taking a different approach, Barkley (1934:286) reported from 72 percent to 94 percent agreement (average 85 percent) in comparing the first 100 grains counted from a sample to the second 100 grains counted from the same sample (total grains counted: 200). Barkley's (1934:287) statistical consideration of these data, from three slides of a single sample, indicated that comparison of two 161-grain counts (a total of 322 counted grains) would be required to yield 90 percent agreement between the two counts. He concluded that the 5 percent average increased accuracy ("0.5 coefficient of reliability") did not warrant the work of counting 122 additional grains, and that a 200-grain count was sufficient.

Counting fewer than 200 grains results in a less accurate assessment of even the most common pollen taxa. Counting more than 200 grains increases the accuracy of the analysis in terms of recognizing rarer taxa, but at the expense of greatly increased time at the microscope. Instead, rarer taxa are usually assayed by means of specialized counts, as done for the Bingham samples, sometimes in combination with specialized laboratory processing.

The second consideration is the "1,000 grains/g" rule summarized by Hall (1981:202), which he used to assess the degree of pollen destruction in his study of samples from a rockshelter. This technique has subsequently been adopted by many palynologists, working with samples from other contexts, as a guide for deciding which pollen samples warrant attention at the microscope. In practice, an estimate of the number of pollen grains present in a unit of sample is made possible by the addition of known numbers of marker grains ("spike") to the sample at the beginning of the processing procedure (Benninghoff 1962; Maher 1981). Separate tallies are then kept of the spike grains and pollen grains counted under the microscope, allowing the abundance of pollen grains in the sample to be estimated by means of the equation:

$$\text{\# Pollen Grains/unit sample} = \frac{\text{\# fossil pollen counted}}{\text{\# spike grains counted}} \times \frac{\text{\# of spike grains added}}{\text{weight (or vol) of sample}} \quad (1)$$

Pollen abundance for samples without a weight or volume (such as the pollen wash of ground stone reported here from the Bingham project) is estimated using the equation

$$\text{\# Pollen Grains on artifact} = \frac{(\text{\# fossil pollen counted})\ (\text{\# of spike grains added})}{\text{\# spike grains counted}} \quad (2)$$

Without the use of spike, pollen abundance is often subjectively judged by the ease (or difficulty) with which the microscopy can be accomplished--few pollen grains seen per unit of slide or per unit of time translates as "poor pollen abundance." Objectively calculating pollen concentration removes the goal of 200 pollen grains from the influence of poor laboratory extraction or slide preparation. Given a chance to be seen in a preparation, pollen grains can be recovered in the tens or hundreds of thousands/g in well-preserved sediments. To Hall (1981), amounts fewer than 1,000 grains/g were a signal that the forces of degradation may have been at work. For archaeological samples from certain contexts, amounts fewer than 1,000 grains/g can signal that the potential natural pollen rain was restricted in some (cultural) way. For example, archeological samples taken from pit features or from floors within enclosed rooms commonly yield fewer than 1,000 estimated pollen grains/g as the result of a pit covering or the walls and roof of the structure. By the same token, the pollen grains recovered from such contexts can often be interpreted largely as the result of human activities.

Complementary to the calculation of pollen concentration is a description of the degree of degradation seen in the pollen grains which do remain for analysis in a sample. It is known that the pollen grains from different taxa do not degrade at the same rate; degradation is differential (Holloway 1981, and references cited therein). Some pollen taxa are relatively resistant to destruction, remaining part of the pollen record long after other types have disappeared altogether. Many pollen types readily degrade beyond recognition, while others are so distinct in shape that they remain identifiable even when degraded to transparent "ghost grains" lacking sufficient structure to take up stain. Thus, differential pollen degradation is compounded by differential pollen recognition, leading to varying assessments of pollen diversity from sample to sample.

Pollen grains in perfect condition are uncommon in archaeological samples from open contexts. Pollen grains in excellent or pristine condition are noteworthy when they do occur, and are often indicators of disturbance and recent introduction to such samples. A description of the condition of a sample's pollen grains gives an important clue as to how much the pollen spectrum has been affected by post-depositional disturbance and the continuing processes of degradation.

Cushing (1967) devised a six-step scale for observations of degradation; Hall (1981) refined this to a four-step scale. The utility of such scales is that they provide quantifiable evidence of degradation independent of the goals of 200-grain counts or 1,000 grains/g. The obvious limitation of such scales is that they can assess only those grains which remain in the sample. The amounts and degrees of degradation have direct implications for the representativeness of the pollen counted by the analyst, but it must be recognized that most sediment samples have completely lost some pollen types. For all practical purposes, the original pollen spectrum can never be known for most sediment samples, regardless of the condition of the remaining pollen grains.

In my work, the assessment of the degree of pollen degradation involves relatively subjective consideration of (1) the number of pollen taxa able to be identified during microscopy (pollen diversity), (2) the number of pollen grains unable to be identified even to family (Unidentifiable grains), and (3) the estimated total number of pollen grains/g of sample (pollen concentration). A sample from the modern surface usually provides an idea of the pollen diversity, as well as an idea of the concentration of pollen grains/g, that might be expected from well-preserved sediments.

Pollen grains still recognizable as such, but in the final stages of disintegration, constitute Unidentifiable grains in my work. Only grains exhibiting either three furrows, with or without pores, or complex wall architecture are classified as Unidentifiable pollen grains. Small, poorly-preserved pollen grains with simple wall architecture and no furrow apertures cannot be distinguished from spores with confidence. These constitute a set of unrecognized degraded pollen grains excluded from my usual counts, and this set is of unknowable size. I consider the Unidentifiables to reflect "minimum degradation," that is, the proportion of the pollen spectrum in the final stages of disintegration but still recognizable as pollen. It should be understood from the foregoing considerations, however, that this estimate of degradation is artificially low.

Larger percentages of Unidentifiable grains indicate increasingly altered pollen spectra; the higher the percentage of Unidentifiable grains, the lower the fidelity of the remaining pollen spectrum to the original. Because degraded grains may still be identifiable to family or genus, the number of degraded grains as measured by the Unidentifiables is a low estimate of the total.

Therefore, I consider Unidentifiables above 10 percent to indicate increasingly poor preservation generally; counts of pollen spectra containing 20 percent or more Unidentifiables are terminated and the remainder of each slide is scanned for target taxa as described earlier. Specific research questions will determine whether such poorly preserved pollen samples retain analytical utility. Research questions can concern the general pollen abundance from various intrasite or intersite sampling loci, for example, or the simple presence of cultivated plants.

In sum, three considerations must be weighed simultaneously for pollen spectra: statistical validity (200-grain count), relative abundance (1,000 grains/g), and representativeness (amount of degradation, usually measured by the Unidentifiable grains). Lower diversity of pollen taxa can also be used as a preliminary indicator of pollen preservation, although some loss of diversity and abundance is to be expected as the result of natural pollen degradation. Consideration of the number of pollen grains/g of sample and the percentage of Unidentifiable grains can indicate an unusual sample to the analyst in a way not possible by the mere accomplishment of a 200-grain count alone.

Implications of Sampling Loci

Practically speaking, greater or lesser numbers of pollen grains are recoverable from probably any context. Given this, it follows that the archaeological and geomorphological implications of the sampled context become paramount for the interpretation of the recovered pollen spectrum. Just as one example, a pollen sample from pit fill provides information on the fill of the pit. If research questions are directed at events connected with the filling of the pit, the recovered pollen spectrum probably will be appropriate. If, however, research questions are directed at the original function(s) of the pit before it filled, then the recovered pollen spectrum from this sample will probably not be appropriate.

Another example is a pollen sample from a burned feature such as a hearth. Because pollen grains are destroyed by heat (Ruhl 1986) as well as by exposure to fire, it is logical to assume that the pollen grains recovered from such a burned context do not relate to the use of the feature as a firepit. On the other hand, indoor hearths are likely depositories for floor sweepings, and outdoor hearths similarly accumulate ambient site-area pollen between uses as firepits. Questions aimed at identifying the plants that were present in the area of a hearth are more reasonable and can justify the pollen analysis of hearthfill. Well-considered research questions are required, and are most defensible for samples in which the goal of the research is simply finding evidence of cultivated plants. Research questions aimed at identifying vegetal foods cooked in hearths are the classic provenience of flotation analyses.

Pollen samples scraped from horizontal surfaces, such as floors and elevated benches, are the best source of information on plants once present in a structure. Environmental pollen brought in on plants or on the site inhabitants' clothing will also be present in the recovered pollen spectra. This is just one instance where the use of estimated pollen abundance/g of sample will allow real differences in amounts of individual pollen taxa to be seen, in turn allowing inferences to be made regarding prehistoric human behavior.

To summarize, location-specific archaeological considerations usually dictate where pollen samples will be taken. Research questions formulated by the archaeologist must be tested at the time of sampling to take into account the anticipated recovery of pollen grains from a sampling locus (Why are pollen grains expected from this sampling locus?), and the implications of those recovered grains for site formation processes (How did the pollen get there? What will that tell us?). In all instances, pollen data should be integrated with flotation data, since each data set is usually preserved by different conditions.

RESULTS

All six sediment samples yielded high estimated concentrations of pollen grains/g of sample. Degradation as measured by the Unidentifiable grains was generally low in these six samples (range 7-19 percent; median 10 percent). The pollen wash from ground stone was poorly preserved, with 29 percent degradation as measured by the Unidentifiable grains.

Modern Surface Sample

Table 1.3 presents the pollen spectrum of modern surface Sample 66. Degradation as measured by the Unidentifiable grains was low at 8 percent. Pollen was abundant with a total concentration estimated at over 65,000 pollen grains/g of sample, about 75 percent of which (50,000 grains/g) was contributed by windborne sources (pine family, juniper, and Cheno-Ams).

The estimated concentrations of arboreal pollen, along with the sighting of a clump of three pine pollen grains, suggest that piñon/juniper scrub is present in the general vicinity of the project area. As commonly seen in modern surface samples across the state, windborne Cheno-Ams and low-spine composites dominated the nonarboreal portion of the pollen spectrum. Windborne grass and Mormon tea pollen types made up the balance of the spectrum. Insectborne high-spine composite pollen grains were present, but the grains of other insectborne pollen types were absent.

It is interesting to note that while clumps of Cheno-Am pollen were present on the slide, none comprised more than about seven pollen grains. As will be discussed below, the archaeological samples from the pit structure consistently contained clumps comprising from two to many times this number of Cheno-Am pollen grains. This pattern suggests that Cheno-Am pollen sources were artificially concentrated in the archaeological samples as the result of prehistoric human activities. Consideration of the size of pollen clumps, then, can be an important clue to the origin of the recovered pollen grains.

Activity Surface

Sample 45b was taken from an activity surface some 15 to 20 cm below the present ground surface; this activity surface is thought by the archaeologists to be the prehistoric ground surface from which the pit structure was dug. The pollen spectrum is presented in Table 1.3. Degradation as measured by the Unidentifiable grains was low at 7 percent, and pollen was abundant. Arboreal pollen types were estimated to total about 2,400 grains/g.

Estimated pollen concentrations for windborne Cheno-Ams and low-spine composites are nearly identical to those for modern surface Sample 66, just discussed. The estimated pollen concentration for insectborne high-spine composites is nearly double that for the modern surface sample. The

Table 1.3. Pollen Spectra Identified in Samples from LA 71276 near Bingham, Socorro County, New Mexico

Taxon	Modern Surface Control, FS 66		Activity Surface 15-20 cm bpgs FS 45b		NW Quadrant, Pithouse, Upper Floor, FS 58	
	No.	Concentration†	No.	Concentration	No.	Concentration
Pinaceae	1	290	-	0	2	262
Pinus	15*	4,356	4	645	4	528
Juniperus	45	13,068	8	1,291	11	1,452
Junip/Pop	1	290	3	484	2	264
Quercus	1	290	-	0	1	132
Cheno-Am	109*	31,654	174*	28,072	97*	12,804
Sarcobatus	-	0	-	0	1	132
Ephedra	3	871	2	323	3	396
Gramineae	11	3,194	5*	807	15*	1,980
Zea	-	0	+	11	-	0
Low-spine composite	18	5,227	26	4,195	27	3,564
Artemisia	-	0	-	0	1	132
High-spine composite	2	581	7	1,129	2	264
Cylindropuntia	-	0	+	22	-	0
Sphaeralcea	-	0	[1]	22	-	0
Eriogonum	-	0	[2]	22	-	0
Nyctaginaceae	-	0	-	0	-	0
Onagraceae	+	7	-	0	-	0
Unknown	0	0	0	0	0	0
Unidentifiable	18/8%	5,227	18/7%	2,904	39*/19%	5,148
Total Pollen	224	65,050	250	40,333	205	27,060
Spike	5/206		9/130		11/235	

pollen concentration values for individual taxa do not necessarily sum to the total pollen concentration.
† pollen concentration expressed as estimated number of pollen grains/gram of sample.
* one or more clumps of 3 or more grains seen during count.
+ one or more grains seen during scan of slide after count completed.
[n] number of grains seen during 200-grain count; final pollen concentration computed using total number of pollen type: spike grains on slide to compensate for uneven distribution of pollen type on slide.
Spike n/n: number seen during 200-grain count/total number of spike grains on slide.

pollen grains of corn, cholla cactus, globemallow, and wild buckwheat did not appear in modern surface Sample 66, but did appear in Sample 45b. These observations suggest that Sample 45b was indeed taken from a surface which captured an altered pollen rain, that is to say, a pollen rain influenced by the activities of the occupants of the site area.

Several clumps of Cheno-Am pollen comprising up to 25 grains were seen on the Sample 45b slide, and a clump of six grass pollen grains was also seen. Taken together, the pollen data indicate that pollen-bearing portions of corn, chenopods, cholla cactus, and probably grass, globemallow, and wild buckwheat were processed, used, and/or discarded in the immediate site area. The estimated numbers of both composite pollen types are high, and could be interpreted as reflecting sunflower taxa brought to the site for uses including dyes and teas. The lack of clumps of composite pollen grains, however, suggests that the pollen originated from sunflower taxa growing in the disturbed soil in and around the site, and were deposited on the site surface as part of the localized pollen rain.

Pit Structure

Northwest Quadrant, Upper Floor

Sample 58 was taken from the upper floor of the pit structure, some 75 cm below the present ground surface, in the northwest quadrant. The pollen spectrum is included in Table 1.3. Degradation as measured by the Unidentifiable grains was advanced at 19 percent. Arboreal pollen types were estimated to total about 2,600 grains/g.

Numerous clumps of Cheno-Am pollen comprising up to 15 grains were seen on the slide, indicating that pollen-bearing portions of one or more chenopod taxa were once present in the pit structure. A clump of six grass pollen grains was present on the slide along with nearly 2000 grass pollen grains/g of sample. The estimate of low-spine composite pollen was nearly as high as for the prehistoric ground surface Sample 45b just discussed, and similarly lacked clumped pollen grains. The sampling context, however (from the floor of an enclosed pitstructure), suggests that at least some of the low-spine composite pollen grains originated from sunflower taxa brought into the pit structure for some use such as dye or tea. A clump of ten pollen grains was too degraded for identification, but indicates that pollen-bearing portions of other plants were once brought into the pit structure as well.

Corn or other cultigen pollen was absent from the slide examined. Examination of additional slides from this sample might yield cultigen pollen in estimated amounts of only six grains/g or less. These considerations suggest that corn, while present at the site as indicated by Sample 45b, was not abundant at the Sample 58 sampling locus in the pit structure during the time the upper floor was occupied.

Northwest Quadrant, Lower Floor

Sample 73 was washed by OAS personnel from a mano fragment found on the lower floor in the northwest quadrant of the pit structure. Although CLES laboratory processing was deliberately minimal, pollen grains were not recovered in abundance. Degradation as measured by the

Unidentifiable grains was advanced (29 percent). Table 1.4 presents the results of the examination of one slide made from the pollen wash.

A total of 10 percent of the slide was examined at 400x, with the sighting of only seven pollen grains as the result. The figures given in Table 1.4 are based on this 10 percent examination at high power. The remainder of the slide was examined at lower power (200x), and only large pollen grains were tallied as noted by "+" in Table 1.4.

No cultigen pollen grains were seen on the slide; examination of additional slides might yield cultigen pollen grains in estimated amounts of 61 grains or less. It should be remembered that this estimate is for the entire surface of the sampled artifact. A potential concentration of only 61 corn pollen grains suggests that the artifact was seldom used to grind corn, or that pollen resulting from prehistoric grinding activities had been removed prior to the archaeological excavations. Poor preservation prevented positive identification of the one clump of pollen grains present on the slide, but the grains were small and resembled beeweed *(Cleome)*. No other clumps of pollen grains were seen.

The grinding of seeds from grass, beeweed, corn, and other plants results in the incorporation of clumps of their pollen grains into the ground product. The presence of clumped pollen grains on ground stone artifacts, then, is good evidence of the grinding of pollen-bearing portions of these plants. The absence of clumped pollen grains weakens behavioral interpretations for the pollen

Table 1.4. Pollen Taxa Identified in Sample 73 Washed from Mano Fragment on Lower Floor, Northwest Quadrant of Pithouse, LA 71276 near Bingham, Socorro County, New Mexico

Taxon	Number	Concentration†
Pinaceae	+	-
Pinus	[1]	61
Cheno-Am	4	272
Low-Spine Composite	+	-
High-Spine Composite	+	-
Eriogonum	+	61
Unknown	0	0
Unidentifiable	[2*]/29%	122
Total Pollen	7	4,033
Spike	21/199	

Figures based on examination of 10 percent of slide at 400x; addenda reflect examination of remainder of slide.
pollen concentration values for individual taxa do not necessarily sum to the total pollen concentration.
† pollen concentration expressed as estimated number of pollen grains on the artifact.
* one clump of at least 20 ?*Cleome* (beeweed) grains seen during examination of the slide.
+ one or more grains seen during scan of slide.
[n] number of grains seen during count; final pollen concentration computed using total number of pollen type:spike grains on slide to compensate for uneven distribution of pollen type on slide.
Spike n/n: number seen during count/total number of spike grains on slide.

types recovered from the Sample 73 mano fragment, and instead suggests that nonpollen-bearing plant parts, or even items other than plants, may have been ground by the artifact.

Ventilator Shaft Upright Slab, Pit Structure Face

Sample 45a was taken from the vertical surface of an upright slab covering the opening of the ventilator shaft, some 50 to 55 cm below present ground surface. The sample was taken from the pit structure face of the slab. Degradation as measured by the Unidentifiable grains was fairly low at 12 percent. Arboreal pollen types were estimated to total some 4,000 grains/g. The pollen spectrum is presented in Table 1.5.

Numerous clumps of Cheno-Am pollen grains comprised up to 20 grains and indicate that pollen-bearing parts of one or more chenopod taxa were once present in the pit structure. The estimated abundance of grass pollen was high at 2,000 grains/g, and high-spine composite pollen, including clumps of up to seven grains, was estimated to be about twice as abundant in Sample 45a than in modern surface Sample 66. Cholla cactus and globemallow pollen grains were also recovered from the upright slab.

Corn or other cultigen pollen types were not seen on the slide examined. Examination of additional slides from Sample 45a might yield cultigen pollen in estimated amounts of only eight grains/g or less. These considerations suggest that corn, while present at the site as indicated by Sample 45b, was not abundant at the Sample 45a sampling locus during the time the pit structure was occupied.

Ventilator Shaft Upright Slab, Shaft Face

Sample 71 was taken from the vertical surface of the same upright slab covering the opening of the ventilator shaft; the sample was taken from the ventilator shaft face of the slab. Degradation as measured by the Unidentifiable grains was more moderate at 8 percent in this sample, and pollen was about half as abundant as on the opposite face (Sample 45a, discussed above). Arboreal pollen types were estimated to total some 2,000 grains/g. The pollen spectrum is presented in Table 1.5.

Compared to the pit structure face of the slab, more evidence of cultural behavior is present in Sample 71 despite its lower estimated total concentration of pollen grains. Numerous clumps of Cheno-Am pollen comprising up to 60 grains were present on the Sample 71 slide along with clumps of grass or high-spine composite pollen grains. These data indicate that pollen-bearing portions of chenopod and insect-pollinated sunflower plants (and probably grass plants), were processed, used, and/or discarded in the immediate site area outside the pit structure; their pollen grains were blown or washed into the ventilator shaft and accumulated at its base. Corn pollen grains were also present on the Sample 71 slide and were estimated to represent 21 grains/g of sediment. Cholla pollen grains were estimated to total nearly 200 grains/g, and at least three clumps of up to six grains of pollen were tentatively identified as from cholla among the Unidentifiable pollen grains. Other clumps comprising up to 15 pollen grains were degraded beyond identification and were included with the Unidentifiables.

These data taken together indicate that pollen-bearing portions of chenopods, sunflower taxa, cholla cactus, and corn were once present on the site surface. Enough pollen-bearing plants or their products were brought to and used at the site for these pollen grains to be blown or washed into the ventilator shaft and to accumulate at its base. The lack of corn pollen from three sampling loci within the pit structure (samples 58, 73, and 45a) suggests that corn products were not common there; the recovery of corn pollen from two samples taken outside the pit structure (samples 45b and 71) suggests that corn products were more common there (perhaps due to seasonal or some specialized use of the pit structure?) or may even post-date the last use of the pit structure.

Feature 4, Burial

Pollen Sample 49 was taken from the pelvic area of a human burial found during backhoe operations at LA 71276. The burial was shallow; Sample 49 was taken only 15 cm below the present ground surface. Preservation of the pollen was generally good (12 percent degradation as measured by the Unidentifiable grains); the pollen spectrum is detailed in Table 1.5. Arboreal pollen types totaled some 6,000 grains/g, or somewhat higher than the pit structure samples (range: about 2,000 to about 3,800 grains/g).

The disturbance of the burial by the backhoe probably introduced some pollen types from surrounding sediments to the sampling locus. The estimated concentration of Cheno-Am pollen resembled other prehistoric spectra from the site, but the four clumps of Cheno-Am pollen present on the Sample 49 slide comprised only eight pollen grains or less. Estimated concentrations of low-spine composites pollen resembled other prehistoric spectra from the site, but lacked pollen clumps altogether. These patterns are identical to those seen in the modern surface sample.

Other portions of the pollen spectrum of Sample 49 generally resembled the spectra of other samples taken from more secure contexts within the pit structure, particularly in the estimated concentrations of sagebrush and cholla cactus pollen. The estimated concentration of grass pollen in Sample 49 slightly exceeded that for the modern surface sample, and the estimated concentration of high-spine composite pollen nearly equaled that for the modern surface sample. Finally, pollen grains from four o'clock plants occurred in burial Sample 49, and estimated concentrations of evening primrose pollen were twice that of the modern surface sample. No pollen grains from corn or other cultigens were seen on the slide; examination of additional slides might yield cultigen pollen in the amounts of 15 grains/g or less.

The context of Sample 49 is not tight enough to support an interpretation of the pollen spectrum as reflecting a last meal. Given that overlying sediments would have settled downward with the decomposition of body tissues, it is likely that the recovered pollen spectrum reflects pollen sources placed on or above the body prior to closure of the grave. In this scenario, pollen-bearing sagebrush, and possibly grass stalks, may have been used to line or close the burial pit, and cholla buds may have been included in the burial as a grave offering along with evening primrose and possibly four o'clock flowers. The lack of sizable clumps of low- or high-spine composite pollen grains suggests that these pollen types may have blown into the grave while it was open, may have already been present in the sediments into which the grave was dug, or were introduced to the grave sediments following disturbance by the backhoe. In support of some noncultural origin of the windborne pollen types is the observation that estimated concentrations of pine family, juniper-type, and grass pollen grains were at least twice as high in burial Sample 49 as estimates made for the other prehistoric samples, yet no clumps of these pollen types were present on Sample 49 slide.

Table 1.5. Pollen Spectra Identified in Samples from LA 71276 near Bingham, Socorro County, New Mexico

Taxon	Pithouse, Ventilator Shaft, Pithouse Face of Upright Slab		Pithouse, Ventilator Shaft, Shaft Face of Upright Slab		Feature 4, Burial Pelvic Area, 15 cm bpgs	
	FS 45a		FS 71		FS 49	
	No.	Concentration	No.	Concentration	No.	Concentration
Pinaceae	-	0	1	85	1	161
Pinus	13	1,888	16	1,367	13	2,097
Juniperus	13*	1,888	7	598	22	3,549
Junip/Pop	-	0	-	0	1	161
Quercus	-	0	-	0	-	0
Cheno-Am	144*	20,909	172*	14,691	123*	19,844
Sarcobatus	-	0	-	0	-	0
Ephedra	4	581	3	256	2	323
Gramineae	14	2,033	7*	598	20	3,227
Zea	-	0	+	21	-	0
Low-spine composite	40	5,808	41	3,502	32	5,163
High-spine composite	8*	1,162	8*	683	3	484
Cylindropuntia	+	51	[1]	177	+	59
Sphaeralcea	+	8	+	7	-	0
Eriogonum	-	0	-	0	-	0
Nyctaginaceae	-	0	-	0	+	15
Onagraceae	-	0	-	0	+	15
Unknown	0	0	1	85	0	0
Unidentifiable	32*/12%	4,646	22*/8%	1,879	29*/12%	4,679
Total Pollen	269	39,059	278	23,744	249	40,172
Spike	10/172		17/213			9/98

pollen concentration values for individual taxa do not necessarily sum to the total pollen concentration.
† pollen concentration expressed as estimated number of pollen grains/gram of sample.
* one or more clumps of 3 or more grains seen during count.
+ one or more grains seen during scan of slide after count completed.
[n] number of grains seen during 200-grain count; final pollen concentration computed using total number of pollen type:spike grains on slide to compensate for uneven distribution of pollen type on slide.
Spike n/n: number seen during 200-grain count/total number of spike grains on slide.

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APPENDIX 2. BINGHAM ARCHAEOMAGNETIC SAMPLE RESULTS

Sample No.: CA822

Site: LA 71276

FS No.: 74

Feature: Feature 8, central hearth

Inclination: 55.3

Declination: 357.9

VGP Latitude: 87.3

VGP Longitude: 214.8

$\alpha_{95:}$ 2.0

$\delta_{p:}$ 2.0

$\delta_{m:}$ 2.9

N: 8/8

Dem Ag: 100

Estimated Date: A.D. 800-1000

Archeomagnetic Date: 930-1010

Col: LW

APPENDIX 3. OFFICE OF ARCHAEOLOGICAL STUDIES HUMAN REMAINS INVENTORY FORM

Project No.: 41.504

Project Name: Bingham

Site No.: LA 71276

Field Specimen No.: 49

Provenience: Backhoe Trench

Feature: Feature 4, Burial 1

Inventoried: LM-O

Sex Estimation: Female

1. Brow ridge:
2. Upper edge of orbital:
3. Posterior zygomatic:
4. Mastoid processes:
5. Occipital muscle ridges: gracile
6. Chin:
7. Pelvis: sciatic notch - intermediate
8. Pelvis:
9. Pelvis: subpubic angle -
10. Sacrum:
11. Femoral head diameter: Female
12. Tibia: circumference at nutrient foreman - Female

Age Estimate: 35-45 years

1. Right 2nd and 3rd maxillary molars worn flat into dentin--35-45yrs.

2. All epiphyses present are fully fused--25+

Racial Estimate: Unknown

Craniometrics: Not possible

Cranial Inventory-

There were only fragmented pieces of the skull which included: the sagittal/posterior posterior part of the right and left parietal along with fragments of the superior occipital; two maxillary molars; and a partial right petrous temporal.

Table 3.1. Burial 1, Maxillary Dentition

Tooth	Comment	Pathology
Left M^3	absent	
M^2	absent	
M^1	absent	
P^2	absent	
P^1	absent	
C	absent	
I^2	absent	
I^1	absent	
Right I^1	absent	
I^2	absent	
C	absent	
P^1	absent	
P^2	absent	
M^1	absent	
M^2	half missing, eroded crown worn into dentin, separate	
M^3	partially eroded, worn flat into dentin, separate	

Mandible:

Only fragments of this element were present among the skull fragments. They included: A partial right condyle along with other fragments of the right ascending ramus; a fragment of the left ascending ramus; and some fragments of the horizontal ramus.

Dentition: none present

Hyoid: Absent

Vertebrae:

A few miscellaneous fragments that could not be further identified.

Sacrum: Absent

Sternum: Absent

Scapula: Only unidentifiable plate or blade fragments present

Clavicle:

Right--Diaphysis present but heavily eroded

Left--Absent

Rib: Nineteen unsided fragments present and heavily eroded. Only two partial rib approximately 140mm long.

Humerus:

Right: Distal diaphysis present, friable and heavily eroded. A fragment of the distal epiphysis is also present.
Left: Distal diaphysis present, friable and heavily eroded.

Radius:

Right: Heavily eroded, partial diaphysis present.
Left: heavily eroded, partial diaphysis present.

Ulna:

Right: Absent
Left: Heavily eroded but fairly complete diaphysis present.

Innominate:

Right: Fragmented; part of ilium, acetabulum, and ischium present, heavily eroded and friable.
Left: Fragmented; part of ilium, ischium, and pubis present, heavily eroded and friable.

Femur:

Right: Majority of diaphysis present and intact with a few fragments though all are heavily eroded. The femur head is also present but separate from rest
Circumference: 75.5 mm Length:\\ mm
Vertical diam. femur head: 41.5 mm
Ant/post. diam.: 26.0 mm Mediolat. diam.: 20.4 mm
Biconylar width:\\ mm

Left: Almost entire femur present but the distal diaphysis and epiphysis are fragmented and the proximal end is heavily eroded. Element is fully fused.
Circumference: 77.0 mm Length:\\ mm
Vertical diam. femur head:\\ mm
Ant/post. diam.: 22.4 mm Mediolat. diam.: 20.7 mm
Bicondylar width:\\ mm

Sex Estimate: vertical diameter of the head: female = < 42.5 mm; indeterminate = 43.5 to 44.5 mm; male = > 45.5 mm (Bass 1987:219).
Femoral circumference: female = < 81mm, male = .81 mm.

Tibia:

Right: Partial diaphysis is present, heavily eroded and friable.
Circumference at nutrient foramen: 77.5 mm Length:\\ mm
Ant/post. diam.: 27.5 mm Mediolat. diam.: 16.6 mm

Left: All diaphysis present with only the epiphyses eroded away.

Circumference at nutrient foramen: 83.84 mm Length:\\ mm
Ant/post. diam.: 29.0 mm Mediolat. diam.: 17.5 mm

Sex Estimate: circumference at the nutrient foramen, Arikara Indians: male mean = 98.58 mm, female mean = 83.84 mm.

Fibula:

Right: Fragments of the diaphysis present, heavily eroded and friable.
Left: Almost all of the diaphysis present but heavily eroded and friable.

Patella:

Right: Superior 2/3 present.
Left: Absent.

Bones of the Hand:

Left capitate present but eroded along one other heavily eroded carpal.

Right second metacarpal, proximal 1/2 present but eroded. Two more metacarpal diaphyses present but eroded and not further identified.

Five 1st phalange diaphyses present, eroded.

Three 2nd phalanges eroded but present.

One 3rd phalange, eroded.

Bones of the Feet:

Left astragalus; medial portion present but heavily eroded.
Left first cuneiform present but eroded.

Additional Comments:

Numerous fragments both dirt encased and cleaned are present but so fragmentary as to make identification impossible. No stature estimate was possible.