MUSEUM OF NEW MEXICO

OFFICE OF ARCHAEOLOGICAL STUDIES

Living on the Northern Rio Grande Frontier: Eleven Classic Period Pueblo Sites and an Early Twentieth-Century Spanish Site near Gavilan, New Mexico

Volume 2: Artifact Analysis and Interpretations

James L. Moore

with contributions by

Jeffrey L. Boyer
Linda J. Goodman
Richard G. Holloway
Pamela McBride
Susan Moga
Mollie S. Toll
Natasha Williamson
C. Dean Wilson

Timothy D. Maxwell, Ph.D.
Principal Investigator

ARCHAEOLOGY NOTES 315

SANTA FE 2009 NEW MEXICO

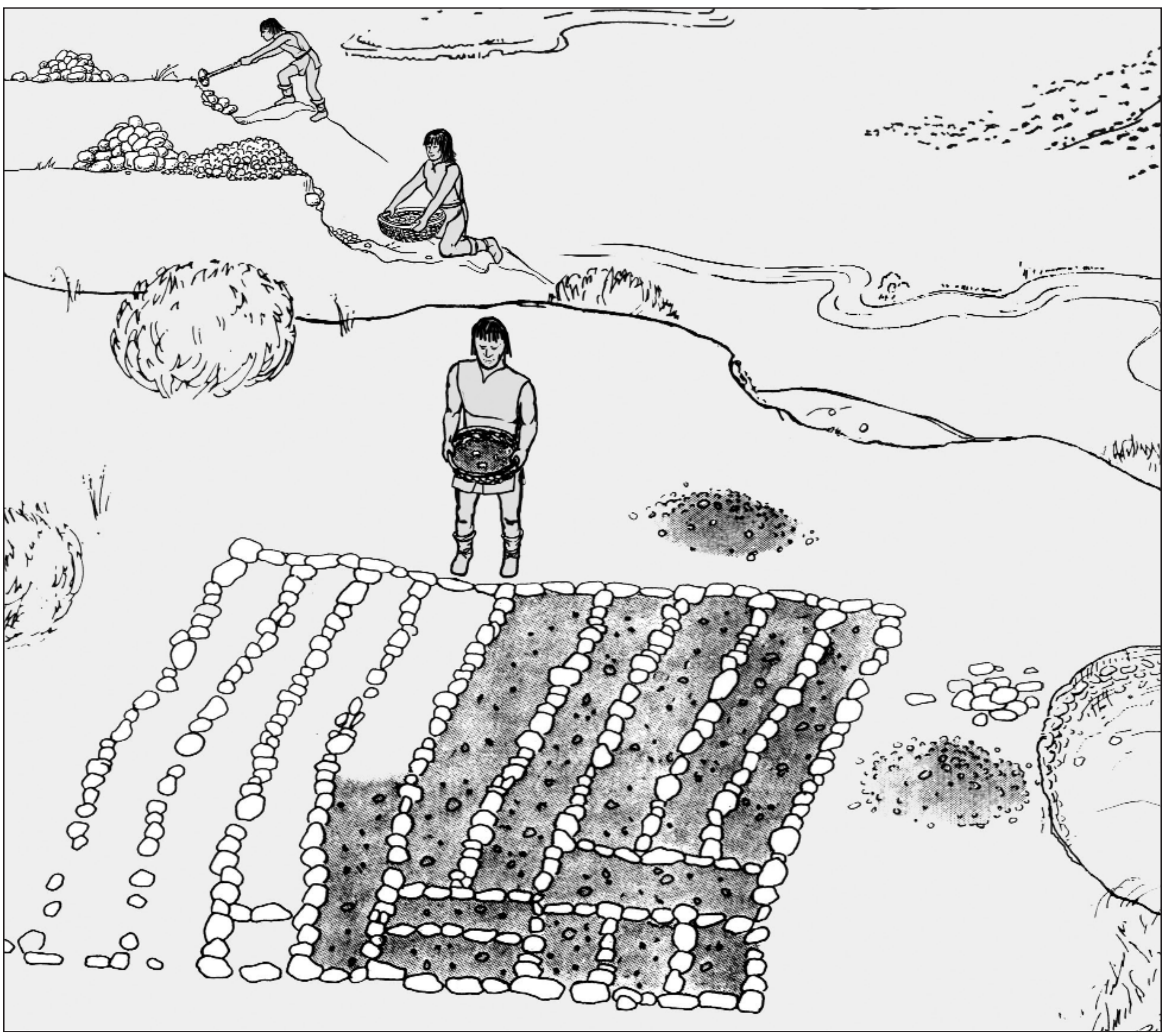
Contents

Figures

Tables

Part 3

Artifact Analysis



Chapter 18. Chipped Stone Artifacts

James L. Moore

Analytic Methods

Chipped stone artifacts were analyzed using a standardized format developed by the Office of Archaeological Studies (OAS 1994). The OAS chipped stone analysis includes a series of mandatory attributes that describe material type, artifact type and condition, cortex, striking platforms, and dimensions. In addition, several optional attributes have been developed that can be used to examine specific questions. Both mandatory and optional attributes were examined in this analysis.

The main areas that the intensive analysis is designed to explore are material selection, reduction technology, and tool use. These topics provide information about ties to other regions, mobility patterns, and site function. While material-selection studies cannot reveal *how* materials were obtained, they can usually provide some indication of *where* they were procured. By studying the reduction strategy employed at a site, it is possible to determine how its occupants approached the problem of producing usable chipped stone tools from raw materials, and how the level of residential mobility affected reduction strategies. The types of tools recovered from a site can be used to assign a function, especially to artifact scatters that lack features. Tools can also be used to assess the range of activities that occurred at a locale. In some cases chipped stone tools provide temporal data, but unfortunately they are usually less time-sensitive than other artifact classes like pottery and wood.

Each chipped stone artifact was examined using a binocular microscope to aid in defining morphology and material type, examine platforms, and determine whether it was used as a tool. However, surface artifacts were not examined for evidence of tool use, because traffic across the sites combined with high surface densities of gravel resulted in a considerable amount of edge damage that was totally unrelated to tool use. Virtually every chipped stone artifact recovered from the surface was damaged in this way. Since this level of noncultural damage would have rendered any definition of cultural edge damage suspect, we opted to simply eliminate this part of our analysis for surface artifacts. The level of magnification used to examine artifacts varied between 15x and 80x, and higher magnification was used to identify wear patterns and platform modifications. Utilized and modified edge angles were measured with a goniometer; other dimensions were measured with a sliding caliper.

General Analytic Methods and Chipped Stone Attributes

Four classes of chipped stone artifacts were recognized in this analysis: flakes, angular debris, cores, and tools. Flakes are debitage exhibiting one or more of the following characteristics: definable dorsal and ventral surfaces, bulb of percussion, and striking platform. Angular debris are debitage that lack these characteristics. Cores are nodules from which debitage has been struck and on which three or more negative flake scars originating from one or more platforms are visible. Tools are debitage or cores whose edges were damaged during use or were modified to create specific shapes or edge angles for use in certain tasks. Attributes recorded for all artifacts included material type and quality, artifact morphology and function, amount of surface covered by cortex, portion, evidence of thermal alteration, edge damage, and dimensions. Platform information was recorded for flakes only.

Material type. This attribute was coded by gross category unless specific sources or distinct varieties were recognized. Codes are arranged so that major material groups fall into specific sequences of numbers, progressing from general material groups to specific varieties.

Material texture and quality. Texture was used as a subjective measure of grain size within rather than across material types. Texture was scaled from fine to coarse for most materials. Fine textures exhibit the smallest grains and coarse the largest. Obsidian was classified as glassy by default, and this category was applied to no other material. *Quality* refers to the presence of flaws that could affect flakeability and included crystalline inclusions, fossils, visible cracks (incipient fracture planes), and voids. Inclusions that would not affect flakeability, such as specks of different colored material or dendrites, were not considered flaws. These attributes were recorded together.

Artifact morphology and function. Two attributes were used to provide information about artifact form and use. The first was morphology, which categorized artifacts by general form. The second was function, which categorized artifacts by inferred use. These attributes were coded separately.

Cortex. Cortex is the chemically or mechanically weathered outer rind on nodules. It is often brittle and chalky and does not flake with the ease or predictability of unweathered material. The amount of cortical coverage was estimated and recorded in 10-percent increments for each artifact—for flakes the percentage of the dorsal surface covered by cortex was estimated, while for all other artifact classes the percentage of the total surface area that was covered by cortex was estimated (since other artifact classes lack definable dorsal surfaces).

Cortex type. The type of cortex on an artifact can be a clue to its origin. Waterworn cortex indicates that a nodule was transported by water and that its source was probably a gravel or cobble bed. Nonwaterworn cortex suggests that a material was obtained where it outcrops naturally. Cortex type was identified for artifacts on which it occurred; when identification was not possible, cortex type was coded as indeterminate.

Portion. All artifacts were coded as whole or fragmentary; when broken, the portion was recorded if it could be identified.

Flake platform. This attribute refers to the shape and modifications to the striking platform on whole flakes and proximal fragments.

Platform lipping. The presence or absence of a lip at the ventral edge of a platform provides information on reduction technology and can often be used to help determine whether a flake was removed from a biface or core. Platform lipping was coded as present or absent.

Platform width. This attribute refers to reduction strategy. The maximum distance between the ventral and dorsal edges of platforms is measured.

Thermal alteration. Chert can be modified by heating at high temperatures, improving its flakeability. This process can realign the crystalline structure and sometimes heals minor flaws like microcracks. Heat treatment can be difficult to detect unless mistakes are made. When present, the type and location of evidence of thermal alteration was recorded to determine whether an artifact was purposely altered.

Wear patterns. Use of a piece of debitage or core as an informal tool can result in edge damage, producing patterns of scars that may indicate the way it was used. Cultural edge damage denoting use as an informal tool was recorded and described when present on subsurface debitage. A separate series of codes was used to describe formal tool edges.

Edge angles. The angles of modified formal and informal tool edges were measured. Edges lacking cultural damage were not measured.

Dimensions. Maximum length, width, and thickness were measured for all artifacts. On angular debris and cores, length was the largest measurement, width was the longest dimension perpendicular to the length, and thickness was perpendicular to the width and the smallest measurement. On flakes and formal tools, length was the distance between the platform (proximal end) and termination (distal end), width was the distance between edges paralleling the length, and thickness was the distance between dorsal and ventral surfaces.

Flake Categories

Several types of flakes may be present in an assemblage, and one analytic goal was to distinguish between flakes removed from cores and bifaces. Flakes were divided into these categories using a polythetic set of variables (Fig. 18.1). A polythetic framework is one in which fulfilling a majority of conditions is both necessary and sufficient for inclusion in a class (Beckner 1959). The polythetic set contains an array of conditions that model an idealized biface flake and includes data on platform morphology, flake shape, and earlier removals from the parent artifact. To be considered a biface flake, an artifact needed to fulfill at

Whole Flakes

1. Platform:
   a. has more than one facet.
   b. is modified (retouched and 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, or flake has a waisted appearance.

7. Flake is less than 5 mm thick.

8. Flake thickness is relatively even from proximal to distal end.

9. Bulb of percussion is weak (diffuse).

10. There is 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 thickness is relatively even from proximal to distal end.

6. Bulb of percussion is weak.

7. There is 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.

Figure 18.1. Polythetic set for distinguishing biface flakes from core flakes.

least 70 percent of these conditions in any combination. Those that did not match that percentage of conditions were classified as core flakes by default. This percentage was considered high enough to isolate flakes produced during the later stages of biface production from those removed from cores, while at the same time it was low enough to permit flakes removed from a biface that did not fulfill the entire set of conditions to be properly classified. While not all flakes removed from bifaces could be identified in this way, those that were can be considered definite evidence of biface reduction. Instead of rigid definitions, the polythetic set provided a flexible means of categorizing flakes and helped account for some of the variation in flake form and attributes that has been observed during flintknapping experiments.

Other flake types were identified by certain distinguishing characteristics. Two subvarieties of biface flakes were categorized separately. Notching flakes were produced when the hafting elements of bifaces were notched. This type of flake generally exhibits a recessed, U-shaped platform and a deep, semicircular scallop at the juncture of the striking platform and dorsal flake surface. Resharpening flakes were removed from formal tool edges that became dull from use and usually fit the polythetic set for biface flakes. They are often impossible to separate from other biface flakes but can sometimes be identified by an extraordinary amount of damage on the platform and the dorsal surface adjacent to the platform. Bipolar flakes, the only subvariety of core flakes that was separately categorized, are evidence of nodule smashing. They usually exhibit signs of having been struck at one end and crushed against an anvil at the other.

Other flake categories are evidence of removals from tools or indicate inadvertent damage during thermal processing—ground stone flakes are debitage struck from a broken piece of ground stone, hammerstone flakes are debitage that were detached from a hammerstone by use, and potlids are debitage that were blown off the surface of a chipped stone artifact during thermal alteration.

Core and Tool Categories

Cores are nodules of raw lithic material that were modified by the removal of debitage during reduction. Some cores were efficiently reduced in a standardized fashion, while flakes were removed from others in a more haphazard manner. Core shape and size are often clues to the relative availability of materials. Materials represented by small, carefully reduced cores may have been uncommon or highly desired. Materials represented by large cores, often with haphazard or badly planned flake removals, tend to be common and not highly prized.

Cores were classified by the direction of removals and in rare circumstances by shape. Unidirectional cores have a single platform from which flakes were removed in one direction or along one continuous surface. Blade cores are pyramidal in shape, with specially prepared platforms that allow the consistent removal of long, narrow flakes (blades). This category tend to only occur in Paleoindian assemblages in the Southwest. Pyramidal cores are a subdivision of the unidirectional category and resemble blade cores in form but lack evidence of the platform preparation that typically occurs on them. This type represents an attempt to maximize the number of flakes removed from a core by reducing it systematically from one platform. Bidirectional cores have two opposing platforms or a single platform from which flakes were removed from two opposing surfaces. Multidirectional cores exhibit multiple platforms, and flakes are struck from any suitable edge. Bipolar cores tend to be rare and result from the smashing of small or exhausted cores or nodules between a hammerstone and an anvil. This is usually done when materials are rare or highly prized, or nodules of high-quality materials are small and difficult to flake in other ways.

Tools are separated into two basic categories—formal and informal. Formal tools are debitage or cores that were intentionally altered to produce specific shapes or edge angles. Alterations take the form of unifacial or bifacial retouch, and artifacts were considered intentionally shaped when retouch scars obscured their original shape or significantly altered the angle of at least one edge. Informal tools are debitage that were used in various tasks without being purposely altered to produce specific shapes or edge angles. This class of tool was defined by the presence of marginal attrition caused by use.

Evidence of informal use was further divided into two general categories—wear and retouch. Retouch scars were at least 2 mm long, while wear scars were shorter than 2 mm. While informal tools can also provide direct evidence of the reduction process, formal tools tend to provide indirect evidence unless they were discarded before being finished.

Formal tools were divided into three basic categories—cobble tools, unifaces, and bifaces. Cobble tools were usually massive in size and unmodified or shaped. The former included tools that did not require modification for use, such as hammerstones. The latter exhibited unifacial or bifacial flaking along one or more edges while retaining enough unflaked surface that their original form remained recognizable. Unifaces were pieces of debitage that had one or more edges modified by flaking across a single surface. Bifaces were pieces of debitage that were flaked across two opposing surfaces. In all three of these tool categories, flaking was purposely done to alter edge shape or angle into a needed or desired form.

Cores and formal tools represent nuclei from which flakes were removed, but they differ in the reason for those removals. Flakes were struck from cores for use as informal tools or to be modified into formal tools. Flakes were removed from formal tools to create desired shapes or edge angles. Thus, cores were classified with debitage as by-products of the reduction process. Formal tools were considered separately because they are usually evidence of other unrelated tasks. Since all chipped stone artifacts result from similar reductive processes, this division is in many ways artificial, and some formal tools can also be used to provide evidence of reduction strategy.

Analysis of the Chipped Stone Assemblages

For the most part, this analysis focuses on the artifacts that were collected from the Gavilan sites, but at times the more limited data from assemblages recorded outside the right-of-way is used to amplify this information. Only LA 105713 is not directly represented in this analysis because no chipped stone artifacts were collected from that site. The overall assemblage can also be broken into three basic subsets: artifacts recovered from habitation sites, artifacts recovered from the surface of farming sites, and artifacts recovered from subsurface deposits at farming sites. The first category includes materials from LA 66288 and the north section of LA 105710, which appear to reflect the redeposition of trash eroding down the slopes adjacent to Hilltop Pueblo. These materials are combined in the following discussion. Artifacts from the south section of LA 105710 may also be related to this habitation site, but it is more likely that they were derived from quarrying activities on the nearby terrace slope below the farming features at LA 105709. Artifacts recovered from subsurface deposits at farming sites may reflect activities that occurred in the fields while they were in use. Examination of these artifacts may show whether they were created by raw-material quarrying or if they reflect the agricultural function of these sites. Artifacts recovered from the surface of farming sites were discarded while the fields were in use or after they were abandoned. Field observations suggest that most of these artifacts were created by raw-material quarrying. Since none of the living areas observed at several of these sites extended into the right-of-way, none of those materials were available for detailed analysis. However, some contrasting data are available from the field inventories.

Material Type and Quality Selection

Information on the range of materials used at these sites is shown in Tables 18.1 and 18.2. It should be remembered that chipped stone artifacts from the north part of LA 105710 are included with the LA 66288 assemblage. Both rhyolite categories combine aphanitic and nonaphanitic varieties because specimens were not consistently assigned to the former by all analysts. Most varieties of rhyolite are aphanitic, and the nonaphanitic varieties are almost invariably fine-grained. Most specimens of red aphanitic rhyolite visually resemble rhyolitic tuff from the Picuris Mountains. Similarly, most of the andesite visually resembles types from the Taos Plateau. Unfortunately, we were unable to substantiate these comparisons.

Though not all of the collected assemblages

Table 18.1. Material type by site in the collected assemblage (count and column percentage)

Material Type	LA 66288	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105710	LA 118547	LA 118549	Total
Chert	64	4	-	-	-	-	1	21	1	3	1	95
	9.7%	0.4%	-	-	-	-	0.8%	1.0%	4.0%	0.5%	1.2%	1.9%
Pedernal chert	93	3	-	-	-	1	2	5	1	3	1	109
	14.1%	0.3%	-	-	-	3.0%	1.6%	0.2%	4.0%	0.5%	1.2%	2.2%
Silicified wood	1	-	-	-	-	-	-	-	-	-	-	1
	0.2%	-	-	-	-	-	-	-	-	-	-	0.0%
Obsidian	12	1	-	-	-	-	-	4	-	2	-	19
	1.8%	0.1%	-	-	-	-	-	0.2%	-	0.3%	-	0.4%
Igneous undifferentiated	3	1	-	-	-	-	-	-	-	3	-	7
	0.5%	0.1%	-	-	-	-	-	-	-	0.5%	-	0.1%
Gabbro	1	-	2	-	-	-	2	-	1	-	-	6
	0.2%	-	10.5%	-	-	-	1.6%	-	4.0%	-	-	0.1%
Red rhyolite	51	26	2	6	2	4	16	126	2	38	6	279
	7.8%	2.3%	10.5%	24.0%	28.6%	12.1%	12.9%	5.7%	8.0%	5.9%	7.2%	5.6%
Gray rhyolite	218	1,055	12	10	2	28	90	1,399	14	466	72	3366
	33.1%	93.0%	63.2%	40.0%	28.6%	84.8%	72.6%	63.5%	56.0%	71.8%	86.7%	67.8%
Andesite	174	18	1	5	-	-	11	543	4	113	2	871
	26.4%	1.6%	5.3%	20.0%	-	-	8.9%	24.6%	16.0%	17.4%	2.4%	17.6%
Welded tuff	-	4	-	-	-	-	-	6	-	1	-	11
	-	0.4%	-	-	-	-	-	0.3%	-	0.2%	-	0.2%
Limestone	1	-	-	-	-	-	-	-	-	-	-	1
	0.2%	-	-	-	-	-	-	-	-	-	-	0.0%
Quartzite	19	13	1	4	-	-	-	22	-	17	1	77
	2.9%	1.1%	5.3%	16.0%	-	-	-		-	2.6%	1.2%	1.6%
Massive quartz	21	10	1	-	3	-	2	77	2	3	-	119
	3.2%	0.9%	5.3%	-	42.9%	-	1.6%	3.5%	8.0%	0.5%	-	2.4%
Total	658	1,135	19	25	7	33	124	2,203	25	649	83	4961
Percent	13.3%	22.9%	0.4%	0.5%	0.1%	0.7%	2.5%	44.4%	0.5%	13.1%	1.7%	100.0%

Table 18.2. Material type by site in the field-inventoried assemblages (count and column percentage)

Material Type	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105713	LA 118547	Total
Chert	1	-	-	-	2	3	28	-	4	38
	0.2%	-	-	-	0.5%	0.3%	4.9%	-	1.3%	1.0%
Pedernal chert	1	-	1	1	7	21	7	1	3	42
	0.2%	-	0.3%	1.5%	1.7%	1.9%	1.2%	0.2%	1.0%	1.1%
Silicified wood	-	-	1	-	-	-	-	-	-	1
	-	-	0.3%	-	-	-	-	-	-	0.0%
Obsidian	-	-	1	-	-	10	4	-	3	18
	-	-	0.3%	-	-	0.9%	0.7%	-	1.0%	0.5%
Red rhyolite	32	-	18	5	11	22	7	12	12	119
	5.5%	-	5.4%	7.6%	2.7%	2.0%	1.2%	2.9%	3.8%	3.1%
Gray rhyolite	508	8	244	52	347	742	342	378	198	2819
	86.8%	61.5%	73.7%	78.8%	85.0%	67.9%	59.3%	91.5%	63.1%	74.2%
Andesite	18	1	59	3	31	292	182	13	94	693
	3.1%	7.7%	17.8%	4.5%	7.6%	26.7%	31.5%	3.1%	29.9%	18.2%
Quartzite	4	4	1	3	2	1	6	4	-	25
	0.7%	30.8%	0.3%	4.5%	0.5%	0.1%	1.0%	1.0%	-	0.7%
Massive quartz	21	-	6	2	8	2	1	5	-	45
	3.6%	-	1.8%	3.0%	2.0%	0.2%	0.2%	1.2%	-	1.2%
Total	585	13	331	66	408	1,093	577	413	314	3800
Percent	15.4%	0.3%	8.7%	1.7%	10.7%	28.8%	15.2%	10.9%	8.3%	100.0%

are statistically comparable because of the large disparity in their sizes, several observations can be made. When combined, rhyolites are the most common material in all assemblages and comprise less than 60 percent of only two—LA 66288 and LA 105706 (Table 18.1). The former is the only habitation site, and the latter yielded the smallest assemblage. Thus, LA 66288 would be expected to deviate from the pattern recognized in the farming sites and trail. The collected assemblage from LA 105706 probably deviates from this pattern because of sample error caused by small sample size—rhyolites made up over 86 percent of the much larger field inventory assemblage from this site (Table 18.2), showing that they are also dominant there. Though no artifacts were collected from LA 105713, rhyolites also dominated the field-inventoried artifacts from that site, comprising over 94 percent of that assemblage.

Andesite is usually the second most common material in the collected assemblages, comprising at least 15 percent of five assemblages. In five cases where andesite either does not occur or comprises less than 15 percent of the total, assemblage size is less than 124 artifacts, so sample error may be responsible for this deviation. The sixth case is LA 105703, which yielded over 1,100 artifacts but contained only 1.6 percent andesite. In the latter case, this discrepancy may be due to landform variability. LA 105703 was the only farming site that was not situated along the edge of a series of related gravel terraces. Thus, the gravel beds under LA 105703 may have been deposited at a different time, resulting in a somewhat different lithic makeup, which is perhaps reflected by the very small percentage of andesite used there. Andesite is also the second most common material in six of nine field-recorded assemblages (Table 18.2). When collected and field-recorded assemblages are combined, andesite is the second most common material in ten cases, and the third most abundant in the remaining two.

Other materials comprise smaller percentages of these assemblages. Cherts and obsidians tend to be uncommon except at LA 66288 and in habitation areas on farming sites. Silicified wood is particularly rare and is therefore combined with the cherts. Only a single example of limestone was identified, at LA 66288.

Except for LA 66288, imported materials are fairly rare or nonexistent. Though observations made in the field suggested that most of the gravels at these sites were composed of quartzite and various igneous materials, a few unworked chert nodules were also seen. Thus, the only exotic materials documented were Pedernal chert and obsidian. Exotics comprise nearly 16 percent of the LA 66288 assemblage. Nonlocal materials were much rarer in the overall assemblages from the farming sites and trail—none occurred in two assemblages (LA 105704 and LA 105705), less than 1 percent occurred in three assemblages (LA 105703, LA 105709, and LA 105713), and less than 2 percent occurred in four assemblages (LA 105706, LA 105707, LA 118547, and LA 118549). Only two of the overall assemblages contained more than 2 percent exotic materials—LA 105708 had 2.7 percent, and LA 105710 had 4 percent.

Of the six assemblages that contained more than 1 percent exotic materials, sample error is probably responsible for comparatively high proportions in three cases—LA 105706, LA 105710, and LA 118549—each of which contained only a single exotic specimen. Two of the three remaining assemblages (LA 105708 and LA 105709) are from sites that contain occupational areas, which is where most of the exotic materials were observed. Thus, with the exception of sample error, sites containing more than 1 percent exotic materials tend to be habitations or farming sites with associated occupational zones. The only exception to this is LA 118547, which could indicate the presence of undefined occupational zones at that site, though this is unlikely.

Slightly more than 80 percent of the overall collected assemblage consisted of glassy and fine-grained materials, indicating a clear selection preference for the better grades of materials. Medium-grained materials comprised another 18.7 percent of this assemblage. Glassy and fine-grained materials, and medium-grained materials to a certain extent, are best suited for activities involving cutting and scraping because they can produce very sharp edges when fractured. Glassy and fine-grained materials are also best suited for the manufacture of formal tools by soft hammer percussion and pressure flaking.

Coarse-grained materials account for only 1.2 percent of the overall collected assemblage: over 75 percent of these artifacts are massive quartz, 14.5 percent are nonaphanitic rhyolites, and 4.8 percent are quartzite. Nearly half (48.4 percent) of the artifacts made from coarse-grained materials were recovered from LA 105709. Since LA 105709 also accounts for more than 44 percent of the overall collected assemblage, this high percentage is in proportion to the collected assemblage from that site. However, 25.8 percent of the artifacts made from coarse-grained materials were recovered from LA 66288, which comprises only 11.3 percent of the overall collected assemblage. In this case, coarse-grained materials are more common than expected and may have been purposely selected. About two-thirds of the coarse-grained materials from LA 66288 are massive quartz and quartzite, which may have been selected because large grain size made them durable for chopping or pounding.

Reduction Strategy

Debitage assemblages were examined to determine whether there was evidence of efficient or expedient reduction. Efficient reduction usually entailed manufacture of tools in anticipation of need, allowing them to be transported from camp to camp until required. In the Southwest, this strategy usually involved the manufacture of large bifaces that could be used for multiple purposes. Kelly (1988:731) defines three types of bifaces: those used as cores as well as tools, long use-life tools that can be resharpened, and bifaces made to replace parts of existing composite tools. Specialized bifaces can be added to this list. They were made for a single purpose and mostly associated with the expedient strategies used by sedentary peoples, where efficiency and conservation of weight were not important. Bifaces with multiple functions or long use-lives were usually associated with mobile lifestyles, where efficiency was critical. However, these categories were not exclusive: mobile people made and used specialized bifaces, while sedentary people manufactured general-purpose bifaces. The difference is a matter of degree. There was less use of specialized bifaces by mobile people, and less use of general-purpose bifaces by sedentary people. Thus, it is not necessarily the amount of evidence of biface manufacture in an assemblage that is indicative of reduction strategy and lifestyle, but the types of bifaces that were made and used.

Bifaces in the first two categories defined by Kelly (1988) were large by necessity. Bifaces functioning as cores, general-purpose tools, and blanks for the replacement of broken or lost tools had to be large to be useful. Similarly, bifaces made with long use in mind had to be large enough to be resharpened. Specialized bifaces needed to be no larger than required by the task at hand. Projectile points provide a good contrast between these categories. In an efficient tool kit, broken projectile points can be replaced with the blanks that also served as cores and general-purpose tools. Large projectile points could be used as knives, since they possess a fairly long edge and were usually set into detachable foreshafts. When broken they could often be reworked into a new form. Small projectile points are evidence of a different focus. They were not very useful as cutting tools because their edges were short and therefore awkward and inefficient, even when set into foreshafts. The thinness of these tools and the point of weakness created by notching often caused them to break during use, and because of their small size and the location of most breaks they usually could not be resharpened. Thus, small projectile points were effectively limited to a single function, and quite often to only one use.

Therefore, we differentiate between the manufacture of large bifaces and small bifaces in this analysis. Archaic hunter-gatherers tended to use large projectile points and large general-purpose bifaces. We know little of later peoples who may also have been hunter-gatherers. However, we can suggest that hunter-gatherers in the Northern Rio Grande probably adopted the bow and arrow when it was introduced. If so, large projectile points would no longer have been produced, but large general-purpose bifaces should have continued in use. Thus, late hunter-gatherers would use a combination of large general-purpose bifaces and small specialized bifaces, the latter as tips for projectiles.

Efficient and expedient debitage assemblages modeled. Several attributes can be used to assess an assemblage and determine whether the reduction strategy was efficient, expedient, or a combination of both. Unfortunately, no single indicator can provide this information, so a range of attributes must be used.

Debitage assemblages reflecting a purely expedient strategy should contain lower percentages of noncortical debitage than those in which a purely efficient strategy was employed. Cortex is usually brittle and chalky and does not flake with the ease or predictability of unweathered material. This can cause problems during tool manufacture, so cortex is usually removed during the early stages of tool production. The manufacture of large bifaces is rather wasteful, and quite a bit of debitage must be removed before the proper shape is achieved. These flakes are carefully struck and are generally smaller and thinner than flakes removed from cores. Thus, as bifaces are manufactured, large numbers of interior flakes lacking cortical surfaces are removed, and the percentage of noncortical debitage increases. Cortex removal is not as high a priority in expedient reduction, so the chance that a given piece of debitage will possess a cortical surface is higher.

The presence of biface flakes is good evidence that tools were manufactured at a site, though it is usually impossible to determine absolute number or type. Biface flake length is indicative of the size of the tool being made, and lengths of 15–20 mm or more suggest that large bifaces were manufactured. However, when only small biface flakes are found, the reverse is not necessarily true. While the presence of small biface flakes may be evidence of the manufacture of small specialized bifaces, the possibility that they are debris produced by retouching large biface edges must also be considered. High percentages of biface flakes in an assemblage suggest that tool production was an important activity. When those flakes are long, it is likely that large bifaces were made or used, and this in turn suggests an efficient reduction strategy. Though a lack of these characteristics is not definite proof of an expedient strategy, it does suggest that reduction did not focus on tool manufacture.

While platform modification is used by the polythetic set to help assign flakes to core or biface categories, it can also be used as an independent indicator of reduction strategy. This is because the polythetic set only identifies ideal examples of flakes removed during tool production. Many flakes produced during initial tool shaping and thinning are difficult to distinguish from core flakes. However, even at this stage of manufacture, platforms were usually modified to facilitate removal. While core platforms were also modified on occasion, this technique was not as common because the same degree of control over size and shape were unnecessary unless a core was being systematically reduced. Since this rarely occurred in the northern Southwest, a large percentage of modified platforms in an assemblage is indicative of tool manufacture, while the opposite implies core reduction. When there is a high percentage of modified platforms but few definite biface flakes, an early stage of tool manufacture may be indicated.

Since tool manufacture is usually more controlled than core reduction, fewer pieces of recoverable angular debris are produced in that process. Thus, a high ratio of flakes to angular debris is considered indicative of tool manufacture, while a low ratio implies core reduction. Unfortunately, this is a bit simplistic, because the production of angular debris also depends on material type, the reduction technique used, and the amount of force applied. Brittle materials shatter more easily than elastic materials, and hard hammer percussion tends to produce more recoverable pieces of angular debris than do soft hammer percussion or pressure flaking. Use of excessive force can also cause materials to shatter. In general, though, as reduction proceeds the ratio of flakes to angular debris should increase, and late-stage core reduction as well as tool manufacture should produce high ratios.

Flake breakage patterns are also indicative of reduction strategy. Experimental data suggest that there are differences in fracture patterns between flakes struck from cores and tools (Moore 2001b). Though reduction techniques are more controlled during tool manufacture, flake breakage increases because debitage get thinner as reduction proceeds. Thus, there should be more broken flakes in an assemblage in which tools were made than in one that simply reflects core reduction. However, trampling, erosional movement, and other post-reduction impacts can also cause breakage and must be taken into account.

Much flake breakage during reduction is caused by secondary compression, in which outward bending causes flakes to snap (Sollberger 1986). Characteristics of the broken ends of flake fragments can be used to determine whether breakage was caused by this sort of bending. When a step or hinge fracture occurs at the proximal end of distal or medial fragments, they were broken during manufacture. Characteristics diagnostic of manufacturing breaks on proximal fragments include "pieces à languette" (Sollberger 1986:102), negative hinge scars, positive hinges curving up into small negative step fractures on the ventral surface, and step fractures on dorsal rather than ventral surfaces. Breakage by processes other than secondary compression causes snap fractures. This pattern is common on debitage broken by trampling or erosion, but it also occurs during reduction. Core reduction tends to create a high percentage of snap fractures, while biface reduction creates a high percentage of manufacturing breaks. But since snap fractures can also indicate post-reduction damage, this may be the weakest of the attributes used to examine reduction strategy.

The presence of platform lipping is indicative of reduction technique and is marginally related to strategy. Platform lipping usually implies pressure flaking or soft-hammer percussion, though it sometimes occurs on flakes removed by hard hammers (Crabtree 1972). The former techniques were usually used to manufacture tools, so a high percentage of lipped platforms suggests a focus on tool manufacture rather than core reduction.

The pattern of scars left by earlier removals on the dorsal surface of a flake can also help define reduction strategy. Since bifacial reduction removes flakes from opposite edges, some scars originate beyond the distal end of a flake and run toward its proximal end. These opposing scars indicate reduction from opposite edges. Opposing dorsal scars are indicative of biface manufacture but can also occur when cores are reduced bidirectionally (Laumbach 1980:858). Thus, this attribute is not directly indicative of tool production, but it can help define the reduction strategy used.

The ratio of flakes to cores on a site is another potential indicator of reduction strategy. As the amount of tool manufacture increases, so does the ratio between flakes and cores. The opposite should be true of assemblages in which expedient core reduction dominated; in that case the ratio between flakes and cores should be relatively low. A potential problem, of course, is that cores were often carried to another location if still usable while debris from their reduction was left behind. This would inflate the ratio and suggest that tool manufacture rather than core reduction occurred. The systematic reduction of cores can also produce high flake to core ratios.

Few of the attributes examined during this study are accurate independent indicators of reduction strategy. However, when combined, they allow us to fairly accurately characterize how materials were reduced at a site. A purely efficient debitage assemblage should contain high percentages of noncortical debitage, biface flakes, modified platforms, manufacturing breaks, lipped platforms, and flakes with opposing dorsal scars, and they should have high flake to angular debris and flake to core ratios. Purely expedient debitage assemblages should contain lower percentages of noncortical debitage and low percentages of biface flakes, modified platforms, manufacturing breaks, lipped platforms, and flakes with opposing dorsal scars. They should also have low flake to angular debris and flake to core ratios. Unfortunately, "pure" assemblages are rare, and most can be expected to combine tool manufacture and core reduction.

Dorsal cortex and reduction stage. Cortex is the weathered outer rind on nodules, and it is rarely suitable for flaking or tool use. Outer sections of nodules transported by water often contain microcracks created by cobbles striking against one another, producing a zone with unpredictable flaking characteristics. Chemical weathering can change the structure of the outer surface of a nodule, making it more brittle or powdery and unsuitable for flaking. Because of these factors, cortical zones are typically removed and discarded because they flake differently than nodule interiors and may be flawed. Flakes have progressively less dorsal cortex as reduction proceeds, so dorsal cortex data can be used to examine reduction stages. Early stages are characterized by high percentages of flakes with much dorsal cortex, while the opposite suggests the later stages of reduction.

Reduction can be divided into two basic stages—core reduction and tool manufacture. Flakes are removed for use or modification during core reduction. Primary core reduction includes initial core platform preparation and removal of the cortical surface. Secondary core reduction entails removal of flakes from core interiors. This difference is rarely as obvious as these definitions make it seem. Both processes often occur simultaneously, and rarely is all cortex removed before secondary reduction begins. They represent opposite ends of a continuum, and it is difficult to determine where one stops and the other begins. In this analysis, primary core flakes have 50 percent or more of their dorsal surfaces covered by cortex, and secondary core flakes have less than 50 percent dorsal cortex. This distinction can provide data on the condition of cores used at a site. For example, a lack of primary flakes suggests that initial reduction occurred elsewhere, while the presence of few secondary flakes may indicate that cores were carried off for further reduction. Primary core flakes represent the early stage of reduction, while secondary core flakes and biface flakes represent the later stages.

Table 18.3 shows percentages of dorsal cortex on flakes from the collected assemblages. Four assemblages can be discounted from the outset because of small sample size: LA 105704, LA 105705, LA 105706, and LA 105710 each contain fewer than 20 flakes and are too small to provide reliable results. Even so, percentages of cortical flakes are very high for LA 105704 and LA 105706, and are comparatively low for LA 105705 and LA 105710.

Table 18.3. Dorsal cortex on collected flakes by site (count and row percentage)

Site	0%	1-49%	50-100%	Total
LA 66288	360	52	64	476
	75.6%	10.9%	13.4%	100.0%
LA 105703	420	124	170	714
	58.8%	17.4%	23.8%	100.0%
LA 104704	2	6	-	8
	25.0%	75.0%	-	100.0%
LA 105705	11	3	-	14
	78.6%	21.4%	-	100.0%
LA 105706	2	2	-	4
	50.0%	50.0%	-	100.0%
LA 105707	17	6	3	26
	65.4%	23.1%	11.5%	100.0%
LA 105708	39	27	22	88
	44.3%	30.7%	25.0%	100.0%
LA 105709	1073	184	169	1426
	75.2%	12.9%	11.9%	100.0%
LA 105710	12	3	1	16
	75.0%	18.8%	6.3%	100.0%
LA 118547	21.4	86	91	198.4
	10.8%	43.3%	45.9%	100.0%
LA 118549	18	13	10	41
	43.9%	31.7%	24.4%	100.0%

Considering the other assemblages, LA 66288 contains the highest percentage of noncortical flakes, and LA 105709 is a close second. Cortical flakes comprise about 35 percent or more of the six remaining assemblages. These percentages are very high and suggest that early-stage core reduction dominated these assemblages. This is especially true of LA 105703, LA 105708, LA 118547, and LA 118549, because primary flakes comprise 20 percent or more of each of these assemblages.

Flake platforms. Platforms are remnants of core or tool edges that were struck to remove flakes. Various types of platforms can be distinguished, providing information about the condition of the artifact from which a flake was removed and reduction technology. Cortical platforms are usually evidence of early-stage core reduction, especially when dorsal cortex is also present. Single-facet platforms can occur at any time during reduction but are most often associated with flakes removed from cores. Multifacet platforms are evidence of previous removals along an edge; they occur on both core and biface flakes, and they suggest that the parent artifact was subjected to a considerable amount of earlier reduction.

Platforms were often modified to facilitate flake removal. Two types of modification were used—retouch and abrasion. While abrasion occurs on all types of platforms (except cortical), retouch is a distinct platform type. Both modifications result from rubbing an abrader across an edge—movement perpendicular to the edge removes microflakes and retouches it, while parallel movement causes abrasion. These techniques increase the exterior angle of a platform, strengthening it and reducing the risk of shatter. Stronger platforms also increase control over the shape and length of flakes.

Platform types could not be defined in many instances. The most common reason was breakage, in which the proximal fragment was absent. Two other processes also obscure platforms during reduction. An unmodified or poorly prepared platform will sometimes crush when force is applied. Though the impact point may still be visible on a crushed platform, its original configuration is impossible to determine. Platforms can also collapse when force is applied, detaching separately and leaving a scar on the dorsal or ventral surface. Part of the platform is sometimes preserved on one or both sides of the scar. While these remnants are usually too small to allow identification of the original platform, they show where impact occurred and indicate that even though the platform is missing, flake dimensions may be complete. Platforms damaged by use or impact from natural processes were recorded as obscured.

The distribution of platform types for each site is shown in Table 18.4. Cortical platforms comprise 10 percent or more of six assemblages, 1–10 percent of three assemblages, and do not occur in two assemblages. Since the latter are some of the smallest assemblages represented, the lack of cortical platforms in those cases is probably due to sample error. Except for LA 105706, which contained only four flakes, single-facet platforms are the most common type or are tied for the most common type with cortical platforms. Multifacet platforms also tend to be common, especially in assemblages containing more than 20 artifacts. Modified platforms are very rare overall and were found in only four assemblages. It is probably significant that those assemblages came from the habitation site (LA 66288) or from farming sites with associated occupational zones (LA 105707, LA 105708, and LA 105709). Platforms were missing from large percentages of flakes in each assemblage, primarily through collapse or breakage.

These distributions suggest that core reduction dominated all of the collected assemblages. Platform types indicative of tool manufacture or resharpening were found in only four assemblages and are rare when they occur. Discounting missing and obscured platforms, modified platforms occur on only 4.0 percent of the flakes from LA 66288 (n = 11), 4.5 percent of the flakes from LA 105707 (n = 1), 1.6 percent of the flakes from LA 105708 (n = 1), and 1.0 percent of the flakes from LA 105709 (n = 9). Thus, only single examples occur in two of four cases. Though cherts comprise 31.8 percent of the modified platforms, most are on rhyolite or andesite flakes (40.9 percent and 27.3 percent, respectively). Thus, while flakes made from exotic materials might be expected to dominate the small assemblage of modified platforms, this is not the case. Over two-thirds are on flakes made from locally available igneous materials.

Debitage type and condition. Table 18.5 shows the distributions of debitage types by material types for the overall assemblage of collected chipped stone artifacts. Core flakes and angular debris predominate, especially when considering that bipolar and ground stone flakes are simply specialized types of core flakes. While biface flakes were identified in three material categories, they are very rare. Surprisingly, even though rhyolite was the most abundant material category (and some rhyolite flakes had modified platforms), no rhyolite biface flakes were identified.

The distribution of debitage types by site is shown in Table 18.6. While flakes with modified platforms were recovered from four sites, biface flakes were identified at only LA 66288 and LA 105709. Since the former contained deposits from the only prehistoric habitation site investigated during this project, and the latter contained the largest chipped stone assemblage, this is no great surprise. Freehand removal of debitage from cores dominated chipped stone reduction at these sites. Bipolar reduction was very uncommon and in two of three cases was performed on high-quality materials that were of exotic origin (Pedernal chert) or locally uncommon (chert). The single ground stone flake recovered from LA 105709 may reflect artifact recycling at a farming site that also contained a temporary occupational zone.

The ratio between flakes and angular debris can also be a good indicator of reduction strategy. Flake to angular debris ratios are generally low to very low for these sites, except for three of the four assemblages that contain less than 60 artifacts. In those cases, sample error associated with small assemblage size is probably responsible for comparatively high ratios. Thus, none of these small assemblages are further considered in this section.

The flake to angular debris ratio for the composite assemblage is 2.10:1—very low. The highest ratio for the larger assemblages was derived for LA 105708, while the lowest was derived for LA 118549. Perhaps not coincidentally, these are also the smallest assemblages of those being considered. Flake to angular debris ratios in Table 18.6 contrast greatly with those in Table 18.7, which presents artifact morphology data for the

Table 18.4. Flake platform type by site for the collected assemblage (count and row percentage)

Site	Cortical	Single Facet	Multifacet	Multifacet and Abraded	Retouched	Retouched and Abraded	Collapsed	Crushed	Absent	Broken in Manufacture	Obscured	Total
LA 66288	42	155	65	3	6	2	68	30	79	25	1	476
	8.8%	32.6%	13.7%	0.6%	1.3%	0.4%	14.3%	6.3%	16.6%	5.3%	0.2%	100.0%
LA 105703	61	263	166	-	-	-	65	2	100	55	2	714
	8.5%	36.8%	23.2%	-	-	-	9.1%	0.3%	14.0%	7.7%	0.3%	100.0%
LA 105704	1	2	3	-	-	-	1	1	-	-	-	8
	12.5%	25.0%	37.5%	-	-	-	12.5%	12.5%	-	-	-	100.0%
LA 105705	4	4	1	-	-	-	5	-	-	-	-	14
	28.6%	28.6%	7.1%	-	-	-	35.7%	-	-	-	-	100.0%
LA 105706	-	1	2	-	-	-	-	-	1	-	-	4
	-	25.0%	50.0%	-	-	-	-	-	25.0%	-	-	100.0%
LA 105707	-	11	10	-	1	-	1	1	2	-	-	26
	-	42.3%	38.5%	-	3.8%	-	3.8%	3.8%	7.7%	-	-	100.0%
LA 105708	10	31	19	-	1	-	8	4	13	2	-	88
	11.4%	35.2%	21.6%	-	1.1%	-	9.1%	4.5%	14.8%	2.3%	-	100.0%
LA 105709	95	532	273	-	8	1	149	49	235	80	4	1426
	6.7%	37.3%	19.1%	-	0.6%	0.1%	10.4%	3.4%	16.5%	5.6%	0.3%	100.0%
LA 105710	5	5	2	-	-	-	2	-	-	2	-	16
	31.3%	31.3%	12.5%	-	-	-	12.5%	-	-	12.5%	-	100.0%
LA 118547	40	161	87	-	-	-	22	4	54	23	-	391
	10.2%	41.2%	22.3%	-	-	-	5.6%	1.0%	13.8%	5.9%	-	100.0%
LA 118549	5	8	8	-	-	-	8	-	9	3	-	41
	12.2%	19.5%	19.5%	-	-	-	19.5%	-	22.0%	7.3%	-	100.0%

Table 18.5. Debitage type by material for the collected assemblages (count and row percentage)

Material Type	Angular Debris	Core Flake	Biface Flake	Bipolar Flake	Ground Stone Flake	Total
Chert	29	63	1	1	-	94
	30.9%	67.0%	1.1%	1.1%	-	100.0%
Pedernal chert	22	76	1	1	-	100
	22.0%	76.0%	1.0%	1.0%	-	100.0%
Obsidian	7	3	-	-	-	10
	70.0%	30.0%	-	-	-	100.0%
Undifferentiated igneous	7	12	-	-	1	20
	35.0%	60.0%	-	-	5.0%	100.0%
Rhyolite	1135	2323	-	1	4	3463
	32.8%	67.1%	-	0.0%	0.1%	100.0%
Andesite	258	589	7	-	-	854
	30.2%	69.0%	0.8%	-	-	100.0%
Limestone	-	1	-	-	-	1
	-	100.0%	-	-	-	100.0%
Quartzite	10	61	-	-	-	71
	14.1%	85.9%	-	-	-	100.0%
Massive quartz	57	59	-	-	-	116
	49.1%	50.9%	-	-	-	100.0%
Total	1,525	3,187	9	3	5	4729
Percent	32.2%	67.4%	0.2%	0.1%	0.1%	100.0%

Table 18.6. Debitage type by site for the collected assemblages (count and row percentage)

Site	Angular Debris	Core Flakes	Biface Flakes	Bipolar Flakes	Ground Stone Flakes	Total	Flake/Angular Debris Ratios
LA 66288	154	464	6	2	4	630	3.09:1
	24.4%	73.7%	1.0%	0.3%	0.6%	100.0%	
LA 105703	346	713	-	1	-	1060	2.06:1
	32.6%	67.3%	-	0.1%	-	100.0%	
LA 105704	1	8	-	-	-	9	8.00:1
	11.1%	88.9%	-	-	-	100.0%	
LA 105705	6	14	-	-	-	20	2.33:1
	30.0%	70.0%	-	-	-	100.0%	
LA 105706	1	4	-	-	-	5	4.00:1
	20.0%	80.0%	-	-	-	100.0%	
LA 105707	4	26	-	-	-	30	6.5:1
	13.3%	86.7%	-	-	-	100.0%	
LA 105708	23	88	-	-	-	111	3.83:1
	20.7%		-	-	-	100.0%	
LA 105709	731	1,422	3	-	1	2157	1.95:1
	33.9%	65.9%	0.1%	-	0.0%	100.0%	
LA 105710	5	16	-	-	-	21	3.2:1
	23.8%	76.2%	-	-	-	100.0%	
LA 118547	227	391	-	-	-	618	1.72:1
	36.7%	63.3%	-	-	-	100.0%	
LA 118549	27	41	-	-	-	68	1.52:1
	39.7%	60.3%	-	-	-	100.0%	
Total	1,525	3,187	9	3	5	4,729	2.10:1
Percent	32.2%	67.4%	0.2%	0.1%	0.1%	100.0%	

Table 18.7. Morphology of field-inventoried assemblages by site (count and column percentage)

Artifact Type	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105713	LA 118547	Total
Core flakes	370	10	254	53	299	831	324	295	221	2,657
	62.9%	76.9%	75.6%	81.5%	72.2%	76.2%	82.2%	71.4%	71.5%	73.4%
Angular debris	160	1	48	4	89	213	46	71	61	693
	27.2%	7.7%	14.3%	6.2%	21.5%	19.5%	11.7%	17.2%	19.7%	19.1%
Cores	52	-	32	8	19	28	19	45	25	228
	8.8%	-	9.5%	12.3%	4.6%	2.6%	4.8%	10.9%	8.1%	6.3%
Tested cobbles	6	1	-	-	-	10	1	-	2	20
	1.0%	7.7%	-	-	-	0.9%	0.3%	-	0.6%	0.6%
Projectile points	-	-	1	-	4	5	3	-	-	13
	-	-	0.3%	-	1.0%	0.5%	0.8%	-	-	0.4%
Bifaces	-	1	-	-	2	2	1	-	-	7
	-	7.7%	-	-	0.5%	0.2%	0.3%	-	-	0.2%
Hoes	-	-	-	-	-	-	-	1	-	1
	-	-	-	-	-	-	-	0.2%	-	0.0%
Drills	-	-	-	-	1	-	-	-	-	1
	-	-	-	-	0.2%	-	-	-	-	0.0%
Scrapers	-	-	-	-	-	1	-	-	-	1
	-	-	-	-	-	0.1%	-	-	-	0.0%
Choppers	-	-	-	-	-	-	-	1	-	1
	-	-	-	-	-	-	-	0.2%	-	0.0%
Total	588	13	336	65	414	1,090	394	413	309	3,622
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Flake/angular debris ratio	2.31:1	10.00:1	5.29:1	13.25:1	3.36:1	3.90:1	7.04:1	4.15:1	3.62:1	3.83:1

field inventoried assemblages. Flake to angular debris ratios for the field inventories correspond closely to those for the collected assemblages in only two cases—LA 105703 and LA 105708. In all other cases they are wildly divergent. This is probably the result of field inventory methods, which apparently led to an undercounting of angular debris in most cases. Thus, ratios for the field inventories can probably be discounted.

The flake to angular debris ratios for collected assemblages are consistent with a sedentary lifestyle when compared with other sites around New Mexico. Vierra (1990:67) provides flake to angular debris ratios for sites in northwest New Mexico, where the average ratio for Archaic sites is 4.34:1; Pueblo residential sites have a mean ratio of 2.52:1, while Pueblo limited-use locales have a mean ratio of 3.40:1. Ratios of 2.42:1 and 3.12:1 were derived for Valdez phase residential sites near Pot Creek Pueblo (Moore 1994) and are similar to those presented by Vierra. A study of assemblages from 25 Archaic through late Pueblo sites in the Mogollon Highlands provided flake to angular debris ratios of 4.71:1 for the Late Archaic, a range of 3.35:1 to 3.78:1 for the early Pithouse through early Pueblo periods, and 1.40:1 for the late Pueblo period (Moore 1999b). When a very brittle material (Luna Blue agate) was removed from consideration in that study, the late Pueblo period ratio was 2.78:1, more in line with those from Pueblo sites in other areas. Flake to angular debris ratios for late Archaic components at the San Ildefonso Springs site range from 6.68:1 to 14.55:1 (Moore 2001a). Two sites from the Taos area in which quarrying and initial core reduction were dominant activities had flake to angular debris ratios of 1.50:1 and 1.29:1 (Moore 2001b).

Three of the Gavilan sites had very low flake to angular debris ratios, consistent with those from the Taos quarries (LA 105709, LA 118547, and LA 118549). A slightly higher ratio was derived for LA 105703, but that assemblage probably should be included with the potential quarries. Three assemblages have ratios consistent with those from Pueblo habitation sites: LA 66288, LA 105708, and LA 105710. None of the flake to angular debris ratios for assemblages with at least 60 artifacts were consistent with Archaic habitation or workshop sites.

Platform lipping and dorsal scar orientation. These data are shown in Table 18.8. Lipped platforms are fairly common in six of the collected assemblages, though the three in which they are most common each contain fewer than 60 artifacts. Lipped platforms are uncommon or do not occur in five assemblages, and with the exception of the LA 105706 assemblage, which contains only five pieces of debitage, these are the assemblages with the lowest flake to angular debris ratios. Platform lipping usually occurs when flakes are struck from cores by soft hammer percussion or are removed from tool edges by pressure flaking (Crabtree 1972). Thus, much of the reduction at LA 66288, LA 105704, LA 105705, LA 105707, LA 105708, and LA 105710 may have been accomplished using soft hammer percussion, though in each case the majority of flakes were probably removed by hard hammer percussion. Little or no soft hammer percussion appears to have been used at LA 105703, LA 105706, LA 118547, and LA 118549. Some soft hammer percussion seems to have been used at LA 105709, but hard hammer percussion was by far the most common method used there. Platform lipping occurs in only four material type categories: cherts, Pedernal chert, rhyolite, and andesite. Coarser-grained materials all appear to have been reduced by hard hammer percussion.

As Table 18.8 illustrates, opposing dorsal scars are common in three assemblages: LA 66288, LA 105705, and LA 105707. They are absent or rare in three other assemblages: LA 105703, LA 118547, and LA 118549. Otherwise,

Table 18.8. Percentage of flakes with platforms and those with opposing dorsal scars by site for the collected assemblages

Site	Lipped Platforms	Opposing Dorsal Scars
LA 66288	31.7%	48.1%
LA 105703	2.2%	1.4%
LA 105704	33.3%	25.0%
LA 105705	33.3%	57.1%
LA 105706	0.0%	25.0%
LA 105707	40.9%	69.2%
LA 105708	29.5%	36.4%
LA 105709	11.1%	24.3%
LA 105710	25.0%	25.0%
LA 118547	0.7%	1.5%
LA 118549	0.0%	0.0%

opposing dorsal scars are moderately common. While this attribute can be indicative of biface reduction, opposing dorsal scars also occur during intense core reduction, where flakes are removed from multiple platforms on cores. Since biface flakes and modified flake platforms are quite uncommon in the same assemblages, it is unlikely that the moderate to high percentages of opposing dorsal scars are indicative of tool manufacture. Rather, they suggest that cores were often reduced to a high degree from multiple platforms. However, it is again interesting to note that three assemblages with the lowest flake to angular debris ratios also contain the lowest percentages of flakes with opposing dorsal scars.

Flakes to cores. Frequencies and percentages of core flakes and cores are shown in Table 18.9. Only whole flakes and proximal fragments are considered, providing a minimum number of individual removals. Biface flakes and bifaces are not considered because few of either were recovered. These data are difficult to interpret. The highest core flake to core ratios occur at LA 66288, LA 105709, and LA 118547, and cores seem to have been more intensively reduced at these sites. Low core flake to core ratios for the other sites probably suggest that cores were reduced and selected debitage was removed for use or modification elsewhere. Thus, rather than testing cobbles and transporting those that met the knappers' requirements to other sites for further reduction, most cores were reduced and abandoned, and usable debitage was transported away.

Table 18.9. Core flakes and cores by site for the assemblages (count and row percentage)

Site	Core Flakes	Cores	Total	Core Flakes/ Cores
LA 66288	241	15	256	16.07:1
	94.1%	5.9%	100.0%	
LA 105703	479	73	552	6.56:1
	86.8%	13.2%	100.0%	
LA 105704	8	10	18	0.80:1
	44.4%	55.6%	100.0%	
LA 105705	12	5	17	2.40:1
	70.6%	29.4%	100.0%	
LA 105706	2	2	4	1.00:1
	50.0%	50.0%	100.0%	
LA 105707	16	3	19	5.33:1
	84.2%	15.8%	100.0%	
LA 105708	50	13	63	3.85:1
	79.4%	20.6%	100.0%	
LA 105709	809	43	852	18.81:1
	95.0%	5.0%	100.0%	
LA 105710	5	4	9	1.25:1
	55.6%	44.4%	100.0%	
LA 118547	270	29	299	9.31:1
	90.3%	9.7%	100.0%	
LA 118549	29	15	44	1.93:1
	65.9%	34.1%	100.0%	

Cores

The types and conditions of cores can provide corroborative data concerning reduction strategy. Table 18.10 shows numbers of cores by morphology for the complete assemblage from each site. Tested cobbles are nodules with one or two flakes struck from them, unidirectional cores had flakes removed from only one platform, bidirectional cores had removals from two opposing platforms, and multidirectional cores had removals from two (nonopposing) or more platforms. Pyramidal cores reflect systematic reduction.

Multidirectional cores are the most common type in all 11 assemblages. Overall, unidirectional cores are the second most abundant type; they are the second most common type in five assemblages and are absent from five. Tested cobbles are the third most common type, though they comprise less than 10 percent of this assemblage; they rank second in one assemblage, third in four, and are absent from six. Bidirectional cores are fairly rare, occurring in only six assemblages. This type ranks second in three cases and fourth in three. The pyramidal type is represented by a single example from LA 105709.

Most cores (n = 180; 84.9 percent) are rhyolite, which is dominated by the multidirectional variety (63.3 percent), followed by unidirectional (22.8 percent), tested cobbles (8.9 percent), bidirectional (4.4 percent), and pyramidal (0.6 percent). Andesite cores are next in abundance but comprise only 7.5 percent of the core assemblage (n = 16). This material category is dominated by multidirectional cores (75.0 percent), followed by unidirectional (12.5 percent), tested cobbles (6.3 percent), and bidirectional (6.3 percent). Quartzite cores are next in abundance, comprising 2.8 percent of the core assemblage (n = 6). Types include unidirectional (33.3 percent), tested cobbles (33.3 percent), bidirectional (16.7 percent), and multidirectional (16.7 percent). Cores

Table 18.10. Core type by site (count and row percentage)

Site	Tested Cobble	Unidirectional Core	Bidirectional Core	Multidirectional Core	Pyramidal Core	Total
LA 66288	-	-	1	14	-	15
	-	-	6.7%	93.3%	-	100.0%
LA 105703	8	24	3	38	-	73
	11.0%	32.9%	4.1%	52.1%	-	100.0%
LA 105704	2	1	3	4	-	10
	20.0%	10.0%	30.0%	40.0%	-	100.0%
LA 105705	-	-	2	3	-	5
	-	-	40.0%	60.0%	-	100.0%
LA 105706	-	-	-	2	-	2
	-	-	-	100.0%	-	100.0%
LA 105707	-	1	-	2	-	3
	-	33.3%	-	66.7%	-	100.0%
LA 105708	-	-	-	13	-	13
	-	-	-	100.0%	-	100.0%
LA 105709	1	8	1	32	1	43
	2.3%	18.6%	2.3%	74.4%	2.3%	100.0%
LA 105710	-	-	-	4	-	4
	-	-	-	100.0%	-	100.0%
LA 118547	4	10	1	14	-	29
	13.8%	34.5%	3.4%	48.3%	-	100.0%
LA 118549	5	4	-	6	-	15
	33.3%	26.7%	-	40.0%	-	100.0%
Total	20	48	11	132	1	212
Percent	9.4%	22.6%	5.2%	62.3%	0.5%	100.0%

of various igneous materials make up 1.9 percent of this assemblage and include one specimen apiece of the multidirectional, unidirectional, bidirectional, and tested cobble varieties. Three massive quartz cores were recovered, including 2 (66.7 percent) multidirectional and 1 (33.3 percent) unidirectional. Cherts are represented by only three specimens; two (66.7 percent) are multidirectional, and one (33.3 percent) is unidirectional.

We assume that tested cobbles were reduced the least amount, followed by the unidirectional, bidirectional, multidirectional, and pyramidal types. We also assume that the most desirable materials were reduced to the greatest degree. Finally, we expect that cores on sites where people lived were reduced to a smaller size than on sites where they simply farmed. Table 18.11 presents information on cortical coverage and mean size for the collected assemblage that can be used to test these expectations.

Tested cobbles have the largest mean size and retain the most cortex, indicating that they were reduced the least amount of any of the core types. However, while unidirectional cores have the next largest mean size, they retain the same average amount of cortex as the multidirectional type. Though bidirectional cores have a smaller mean size than both the unidirectional and multidirectional varieties, they retain about twice as much cortex. Thus, the amount of reduction does not seem to directly increase with number of striking platforms. Reducing cores from single platforms or multiple platforms appear to be equally efficient, and deciding on which way a core should be reduced was probably more dependent on nodule shape than anything else. Bidirectional reduction seems to have been applied to smaller nodules and allowed removal of fewer flakes. The pyramidal type falls where predicted in both size and amount of retained cortex, but since only a single specimen of this type was recovered, not much reliance can be placed on this.

Table 18.11. Core data by morphology, material type, and site for the collected assemblages

Morphology

Attribute	Tested Cobbles	Unidirectional Cores	Bidirectional Cores	Multidirectional Cores	Pyramidal Cores
Percentage of cortical coverage	69.0%	24.8%	49.1%	24.8%	10.0%
Mean size (cu cm)	320.1	256.4	223	243	63

Material Type

Attribute	Chert	Pedernal Chert	Igneous Undifferentiated	Rhyolite	Andesite	Quartzite	Massive Quartz
Percentage of cortical coverage	30.0%	15.0%	50.0%	29.9%	20.0%	55.0%	33.3%
Mean size (cu cm)	39	12.5	443.5	260.8	75.6	456.3	204.7

Site

Attribute	LA 66288	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105710	LA 118547	LA 118549
Percentage of cortical coverage	24	27.4	51	54	20	40	34.6	20.5	27.5	35.2	42
Mean size (cu cm)	76.3	297	371.6	210.4	111.5	78.7	119.5	128	52.8	331	558.9

Reducing cores from multiple platforms was obviously the most favored technique; 62.3 percent of the core assemblage was reduced in this way. Reducing cores from a single platform was the second most common method selected; 22.6 percent of the assemblage was reduced in this way. These methods were probably considered the most efficient ways in which to reduce cores and may have been applied to larger nodules, with essentially the same sizes of nodules considered amenable to these reduction techniques. Bidirectional reduction was much less common, and bidirectional cores comprise only 5.2 percent of the assemblage. As noted above, smaller nodules seem to have had this reduction technique applied to them. Though nearly 10 percent of the core assemblage is comprised of tested cobbles, they can probably be considered rejects. Removal of one or two flakes presumably allowed a knapper to judge whether a nodule was of the requisite texture and relatively free of flaws. If not, it would have been rejected and another selected for testing.

Pedernal chert is the only exotic material in the core assemblage. As might be expected, the Pedernal chert cores have the smallest mean size and retain the least cortex of any of the materials in this assemblage. Surprisingly, though other chert cores have the second smallest mean size, they retain more cortex than andesite and about the same amount as rhyolite, though they have a mean size that is less than half that of the former, and less than a fifth that of the latter. This suggests that chert nodules, rare in the gravel deposits that most of the sites are on, tended to be much smaller than nodules of other materials selected for reduction. Andesite nodules also seem to have been smaller than rhyolite nodules, on the average, and perhaps represented a slightly more desirable material since they tend to retain less cortex. Most coarse-grained materials, such as the igneous undifferentiated category and quartzites, were usually reduced to a lesser extent than fine-grained materials. Massive quartz may be an exception to this, since it retains slightly more cortex than rhyolite and has a smaller mean size. Nodules of this material were probably smaller, on the average, than those of rhyolite and may have been considered more desirable than other coarse-grained materials. In general, these patterns tend to reflect our expectations—the most desirable materials were reduced to the greatest extent.

The expected pattern can also be seen in the distribution of these attributes by sites. Cores from LA 66288 and LA 105710 have the smallest mean sizes and among the lowest mean percentages of cortex. Cores from sites with occupational zones also tend to have comparatively small mean sizes. The largest mean core sizes occur in assemblages from sites with no associated occupational zones, including LA 105703, LA 105704, LA 118547, and LA 118549. The distribution of retained cortex percentages is not as well patterned but generally follows similar lines. Except in a few cases, where small sample size may have introduced some degree of error, the sites that lack associated occupational zones tend to have large percentages of cortex, while those with occupational zones usually have smaller percentages. LA 105703 is an exception to this and has a comparatively small percentage of retained cortex but lacks an occupational zone. However, as noted earlier, this site does not sit on the same series of gravel terraces as the other farming sites, and the gravel deposits in that area may have a different lithology. Since the average size of cores from LA 105703 is fairly large, it is possible that larger nodules occur in that area, which could be efficiently reduced to a greater extent than is the case for the other sites. LA 105705 and LA 105707 do not follow the predicted pattern for sites with associated occupational zones, and LA 105706 does not follow the pattern for sites that lack them. These assemblages contain only five, three, and two cores, respectively, so sample error is probably responsible for this deviation.

Tool Use

Both formal and informal tools are discussed in this section, because few of either category were recovered from these sites. Tools were collected from four sites (Table 18.12) and field inventoried at three of those sites as well as four additional sites (see Table 18.7). LA 66288 and LA 105708 are the only sites for which informal debitage tools were recorded. As discussed earlier, debitage from farming sites was not assigned to this category if it was found on the surface because of the high degree of incidental damage caused by traffic across site surfaces that are primarily com-

Table 18.12. Formal and informal tools by site (count)

Tool Type	LA 66288	LA 105703	LA 105708	LA 105709	LA 118547
Hoes	-	2	-	-	-
Unifaces	1	-	-	-	-
Bifaces	12	-	-	2	-
Projectile points	-	-	-	1	2
Utilized debitage	58	-	2	-	-
Utilized cores	2	-	-	2	-
Total	73	2	2	5	2

posed of gravels. Informal tools were found in subsurface contexts at only these two sites.

As might be expected, most of the tools in the collected assemblage are from LA 66288 and are primarily biface fragments and informal tools. The only formal tools collected from LA 105703 were two small hoes, both of which were very crudely shaped. Two informal tools were recovered from subsurface contexts at LA 105708. Five tools were collected from the surface of LA 105709, including a complete biface whose function could not be defined, and an unidentifiable biface fragment. The projectile point from LA 105709 is a medial section of a small dart or large arrow point. Both projectile points from LA 118547 are fragments of small corner-notched arrow points.

Nearly all formal tools in the collected assemblage are made from materials that are locally rare or imported. The exceptions are two rhyolite hoes from LA 105703 and an andesite biface from LA 105709. Other bifaces in the collected assemblage are made from Pedernal chert (six), obsidian (six), and chert (one). Two of three projectile points are obsidian, and the third is Pedernal chert. The only unifacial tool recovered was made from obsidian.

As Table 18.7 indicates, more formal tools were recorded during field inventory on the farming sites than were recovered during surface collection and excavation. A quartzite biface of undetermined function was the only tool noted on the surface of LA 105704. Similarly, part of a Pedernal chert projectile point was the only tool found at LA 105705. Seven tools were identified at LA 105707, including two obsidian arrow point tips, two obsidian corner-notched arrow points, an obsidian drill base, a Polvadera obsidian retouched tool discarded after it was broken during manufacture, and a Pedernal chert biface fragment. Tools inventoried on the surface of LA 105708 included five obsidian arrow points (three corner-notched, one side-notched, one tip), an obsidian biface, a Pedernal chert drill, and a Pedernal chert scraper. Formal tools noted at LA 105709 included a Pedernal chert side-notched arrow point, a Polvadera obsidian medium-sized corner-notched dart point, a Polvadera obsidian arrow point tip, and an obsidian biface fragment. Both the hoe and chopper noted on the surface of LA 105713 were made from andesite.

Considering the formal tools from both the collected and field inventoried assemblages, the distribution of material types is quite striking. Except for a quartzite biface from LA 105704, an andesite biface from LA 105709, and a chert biface fragment from LA 66288, all of the bifacial tools and the only uniface fragment recovered are made from exotic materials—either Pedernal chert or obsidian. Conversely, the cobble tools (three hoes and one chopper) are made from rhyolite or andesite—dense, durable materials that are locally available.

Material-selection parameters were somewhat different for the informal tools. More than half (51.6 percent) of the informal tools from LA 66288 and LA 105708 were made from locally available and abundant materials, and another 11.3 percent were made from generic cherts that were probably available locally but were comparatively rare. Only 35.5 percent of the informal tools were made from imported materials—Pedernal chert in 20 cases and obsidian in 2. Both utilized cores from LA 66288 are andesite, so locally available materials comprise 63.3 percent of the informal tools in those assemblages. Wear patterns on the edges of informal tools are consistent with cutting or scraping activities except for the edges of three core flakes from LA 66288 that are rounded, probably from working soft, pliable materials such as leather.

Material selection for formal and informal tools in the Gavilan assemblages is very interesting because of the high degree of reliance on materials imported from outside the Ojo Caliente Valley. In particular, 94.9 percent of the bifaces and unifaces were manufactured from Pedernal chert or obsidian. Though local materials dominate the informal tool assemblage, exotic materials still comprise slightly more than a third of those tools as well. Conversely, the cobble tools that would have been used in tasks requiring durable edges were made from locally available igneous rocks. This distribution suggests several possibilities. Materials amenable to careful shaping into desired tool forms by soft hammer percussion and/or pressure flaking seem to have been rare locally, leading to heavy reliance on imported materials for these purposes. If local materials, such as aphanitic rhyolite, were heavily used as informal tools, those materials were much tougher than cherts and obsidians, and consistent edge damage is more difficult to define on them. The presence of very small percentages of exotic materials in the farming site assemblages suggests that the formal tools made from imported materials at those locations were probably not made on-site. Instead, they were probably produced at residential sites and transported to farming sites for use and eventual discard.

What It All Means: Summaries, Conclusions, and Speculations

The array of sites investigated during this study can be divided into three basic groups. The first consists of habitation sites and contains only LA 66288 and probably LA 105710. Farming sites with associated occupational zones make up the second group and include LA 105707, LA 105708, LA 105709, and probably LA 105705. Farming sites that lack associated occupational zones are the third group and include LA 105703, LA 105704, LA 105705, LA 105706, LA 105713, and LA 118547. LA 118549 can probably be added to the third group because the activities reflected along the trail are much the same as those seen in the chipped stone assemblages from the sites that lack occupational zones.

Several topics remain to be discussed that can all be approached by structuring the array of sites in this way. The first question concerns the range of activities that occurred at these sites and how activities might have differed between groups. The second concerns the relationship between surface materials and the small numbers of subsurface materials recovered from several farming sites. Finally, we need to ask what relationship there was between the chipped stone artifacts found on the surface and the use of most of these sites for farming.

Activities Reflected in the Assemblages

By using data provided by analysis of reduction-related debris and tools, it is possible to define the range of activities involving chipped stone that occurred at these sites. However, it should be remembered that this will only be part of the story. In many instances, formal tools used in the fields were carried back to camps or villages unless they were broken or worn out during use and discarded. Many informal tools may not have been recognized at these sites because of difficulties involved in distinguishing between cultural and natural edge damage. In addition, the assemblage recovered from LA 66288 represents only a minute percentage of the artifacts present at that site, most of which are in deposits outside the right-of-way and thus outside our excavation areas. Indeed, only a small percentage of the artifacts from that site within the right-of-way were recovered because the strata that contained them were not culturally deposited, so more extensive studies were not pursued. Also, occupational zones defined at farming sites were outside the right-of-way and could not be investigated in detail. Thus, only the most obvious of the chipped stone using activities performed at these sites can be defined.

Core-reduction. The types of materials selected for reduction can be indicative of functional differences between sites. Materials that are well suited to pressure flaking should be more abundant at habitation sites, where formal tools were produced and used. They should be less common at sites used for temporary habitations and rare at sites that mostly served as loci for raw-material acquisition.

LA 66288 was the only definite habitation site investigated during this project, but materials recovered in and around the García store foundations at the south end of LA 105710 might also have been associated with the occupation of LA 66288, rather than LA 105709, which sits above that area. Thus, LA 105710 is tentatively also considered a habitation site.

Material-selection parameters at LA 66288 differed greatly from those observed at the farming sites and trail, and differ slightly for LA 105710 (Table 18.13). Cherts and obsidians comprise just over a quarter of the LA 66288 assemblage. In contrast, LA 105710 contains only 8.0 percent cherts and no obsidians, and the next highest percentage is in the LA 105707 assemblage, which contains 3.0 percent cherts. LA 66288 also contains the highest percentage of andesite and the lowest percentage of rhyolite. Though LA 105710 does not replicate this pattern, the comparatively high percentage of cherts in that assemblage may set it apart from the farming sites.

Table 18.13 shows that the assemblages from these sites mostly fit the expected pattern, especially when data from both the field-inventoried and -collected assemblages are combined into composite assemblages. The presumed habitation sites contain the largest percentages of cherts and obsidians, the materials that are best suited for formal tool manufacture. Composite assemblages from the farming sites with occupational zones contain very similar percentages of cherts and obsidians, ranging from 2.3 to 3.0 percent. Farming sites without occupational zones consistently contain the lowest percentages of cherts and obsidians, ranging from 0.0 to 1.9 percent. Interestingly, the percentage of these materials recovered along LA 118549 is consistent with percentages from the farming sites with occupational zones, which is contrary to the predicted pattern.

Since cores are expected to have been reduced to a greater extent at habitation sites than at farming sites, habitation site assemblages should contain higher percentages of flakes that lack dorsal cortex. Assemblages from farming sites with occupational zones should contain somewhat smaller percentages of noncortical flakes, and farming sites without occupational zones should contain the smallest percentages of noncortical flakes. Unfortunately, since dorsal cortex was not monitored during the field inventory, only the collected assemblage can be examined for this attribute. This reduces sample size significantly in several cases and eliminates LA 105713 from consideration.

As Table 18.13 shows, these tendencies are reflected at most of our sites. Overall, assemblages from habitation sites contain the highest proportion of noncortical flakes, an average of 75.3 percent. Assemblages from farming sites with occupational zones have the next highest mean, 65.9 percent. Farming sites without occupational zones have the smallest mean percent-

Table 18.13. Material-selection parameters by site category (composite assemblages)

Site Category	Site	Cherts and Obsidians (%)	Noncortical Flakes (%)	Modified Platforms (%)
Habitation sites	LA 66288	25.8	75.6	4.0
	LA 105710	8.0	75.0	0.0
Farming sites with occupational zones	LA 105705	0.0 (2.5)	78.6	0.0
	LA 105707	3.0 (2.3)	65.4	4.5
	LA 105708	2.4 (3.0)	44.3	1.6
	LA 105709	1.4 (2.5)	75.2	1.0
Farming sites without occupational zones and the trail	LA 105703	1.2 (0.8)	58.8	0.0
	LA 105704	0.0 (0.0)	25.0	0.0
	LA 105706	0.0 (1.4)	50.0	0.0
	LA 105713	0.2	-	-
	LA 118547	1.2 (1.9)	54.7	0.0
	LA 118549	2.4	43.9	0.0

age, 46.5 percent including LA 118549. Since the percentage only increases to 47.1 percent when LA 118547 is eliminated, the assemblage from the trail seems to fit with the farming sites without occupational zones for this attribute.

Platforms are often modified by abrasion during biface manufacture. While some platform modification can occur during core reduction, it generally takes a different form and is rarely extensive enough to be identified. Thus, the presence of modified platforms in an assemblage is an indication that some biface manufacture or modification may have occurred there. Since platforms were not monitored during field inventories, our assemblage size is again limited, and no data are available for LA 105713 when this attribute is considered.

We expect habitation site assemblages to contain the highest percentages of modified platforms, followed by farming sites with occupational zones. Farming sites without occupational zones should have the lowest percentages. As Table 18.13 shows, the sites essentially follow these predictions. Only flakes with intact platforms were used to calculate percentages. LA 66288 has one of the highest percentages of modified platforms, though none were found at LA 105710. Three of four farming sites with occupational zones yielded flakes with modified platforms, but no modified platforms were found at the farming sites without occupational zones or the trail.

Since the polythetic set used to define biface flakes took several other attributes into account, not all of these flakes were considered removals from bifaces. Definite biface flakes were only recovered from LA 66288 and LA 105709 (Table 18.6), constituting 1.0 and 0.1 percent of those assemblages, respectively. Combining both of these attributes, the reduction of bifaces large enough to produce recoverable flakes seems to have occurred only at habitation sites and farming sites with occupational zones, but it was quite rare when it occurred at all.

The ratio of flakes to angular debris is indicative of both reduction strategy and reduction technique, and it can also be affected by material characteristics. Reduction strategies that focus on efficiency tend to produce much larger flake to angular debris ratios than do strategies that focus on expediency. Hard hammer percussion produces much higher percentages of recoverable angular debris than does soft hammer percussion, and hence lower flake to angular debris ratios. In the same way, pressure flaking produces less recoverable angular debris and consequently higher flake to angular debris ratios. Materials that are brittle tend to produce more shatter than materials that are more elastic and less brittle; thus they have smaller flake to angular debris ratios as well.

Flake to angular debris ratios for the collected assemblages are shown in Table 18.6. Even though the use of only these data results in smaller assemblage sizes, dramatically so in some cases, the field inventories are considered less reliable for this attribute because much of the angular debris may have been missed since rocks that were broken by cultural means and those that were naturally fractured could not always be differentiated by cursory examination. Both habitation sites have flake to angular debris ratios that are larger than 3:1. However, ratios for the other sites are scattered all over the place because of a large variation in sample size. The largest ratios all occur in assemblages that contain 30 or fewer artifacts. To even this out, assemblages were combined for the three site categories to produce more accurate ratios. When combined, the habitation sites have a flake to angular debris ratio of 3.09:1, the farming sites with occupational zones have a ratio of 2.03:1, and the farming sites without occupational zones plus the trail have a ratio of 1.92:1. There is no appreciable change in the latter when LA 118549 is eliminated from consideration. In general, all three of these ratios are low, but as might be expected, the ratio for farming sites with occupational zones is about a third lower than the ratio for habitation sites, and the farming sites without occupational zones have the lowest ratio.

In general, flake to angular debris ratios suggest that expediency dominated the reduction strategy used in all three site categories, and that hard hammer percussion was probably the dominant technique used. If soft hammer percussion was used, evidence of this technique should be most common at the habitation sites, followed by the farming sites with occupational zones. The farming sites without occupational zones are expected to demonstrate the least use of this technique. As discussed earlier, platform lipping is generally considered a good indication of soft hammer percussion. These data are shown in Table 18.8, but variance in sample size again partly obscures patterning. By combining data into site categories, this variation can be smoothed. When this is done, the proportion of lipped platforms for habitation sites is 45.7 percent; farming sites with occupational zones contain 15.1 percent lipped platforms, and farming sites without occupational zones contain only 1.9 percent lipped platforms. Thus, quite a bit of soft hammer percussion was performed at the habitation sites, about a third as much was done at the farming sites with occupational zones, and very little was performed at the farming sites without occupational zones.

Opposing dorsal flake scars can be evidence of biface reduction, and in that case they are indicative of flakes removed from opposing tool edges. They can also be indicative of the degree to which materials were reduced at a site. Since there was very little biface reduction performed at any of these sites, the latter is applicable. In general, unless cores were reduced systematically, the further they were reduced, the more platforms were used for striking flakes. Since only one example of a systematically reduced core was identified, core reduction was not specifically structured to produce the maximum number of flakes. Thus, percentages of opposing dorsal scars should increase as cores were more intensively reduced because the likelihood that flakes were struck from opposing platforms increases as the number of platforms increases. Again combining sites into the three categories defined earlier, we find that flakes with opposing dorsal scars comprise 47.4 percent of the habitation site flake assemblages, 26.0 percent of those from farming sites with occupational zones, and only 1.6 percent of those from farming sites without occupational zones.

These data suggest that cores should have been reduced to the greatest extent at the habitation sites, to a lesser degree at farming sites with occupational zones, and the least amount at farming sites without occupational zones. This appears to be the case, as shown in Table 18.14. Habitation site contain the highest percentage of multidirectional cores and no tested cobbles, farming sites without occupational zones are at the opposite extreme, and farming sites with occupational zones fall in between. Cores on habitation sites have the smallest mean size and mean cortical coverage, while farming sites without occupational zones have the largest mean core size and cortical coverage. Again, farming sites with occupational zones fall between these extremes.

The various data presented in this discussion suggest that early-stage core reduction dominated on the farming sites without occupational zones. Overall, these sites had the lowest flake to angular debris ratios, somewhat higher than those derived for quarries near Taos (Moore 2001b). They contained little or no chert and obsidian, and no flakes had modified platforms. Nearly all reduction seems to have been accomplished by hard hammer percussion, with little evidence of the use of soft hammers at these sites. Cortical flakes comprise 53.5 percent of the overall flake assemblage, a very high percentage, which suggests that primary core reduction dominated at these sites. Cores from the farming sites without occupational areas have the largest mean size and remaining cortical coverage, suggesting they were reduced to a lesser extent than those recovered from the other site categories. Cores from farming sites without occupational areas are an average of 4.7 times larger than those from habitation sites and 2.6 times larger than those from farming sites with occupational zones. The evidence presented in this discussion suggests that, besides serving as locations for growing crops, the farming sites without occupational zones were also places where lithic materials were acquired and initially reduced. Quarrying occurred on farming features as well as at the edge of the terraces that these sites sit upon. Many cores were probably transported away for further reduction elsewhere, but there is also evidence that some cores were reduced as far as desired in situ, and usable flakes were probably carried off. This would account for the very low flake to angular debris ratios seen in most of these assemblages.

The habitation sites represent the opposite extreme. Some biface manufacture seems to have occurred at them (LA 66288 in particular), and soft hammer percussion was common, though slightly more than half of the reduction seems to have been accomplished with hard hammers. Cores were reduced to the greatest extent at these

Table 18.14. Core attribute by site category

Attribute	Habitation Sites	Farming Sites with Occupational Zones	Farming Sites without Occupational Zones
Percent multidirectional cores	94.7	78.1	49.6
Percent tested cobbles	0	1.6	14.7
Mean cortical coverage per core (%)	24.70%	26.90%	32.60%
Mean size per core (cu cm)	71.4	130.4	338

sites, and there is no evidence of in situ materials acquisition and initial reduction. The habitation site assemblages contained only 24.7 percent cortical flakes, a moderate percentage, which suggests that secondary core reduction dominated at those sites. This is corroborated by core data, which indicate that cores were reduced further at the habitation sites than they were at the others. The habitation sites were locales where cores (and perhaps nodules) that were obtained elsewhere (presumably nearby) were reduced to produce debitage to use as informal tools or knap into formal tools.

The farming sites with occupational zones fall in between these extremes, but in most cases they seem closer to the habitation sites. This resemblance may be a function of domestic activities requiring chipped stone that were not restricted to the occupational zones, but occurred all across the associated fields. Since we were unable to investigate any of the occupational zones in detail, most of our data reflect support activities that occurred on and around the fields. Thus, there is some evidence of raw-material acquisition and initial reduction, though it is not as strong as it was for the farming sites without occupational zones. There is also evidence of some domestic tasks, as shown by the presence of modified flake platforms on three of the four sites that fall into this category and definite biface flakes on at least one. Other evidence includes the somewhat higher percentages of chert and obsidian in comparison with the farming sites without occupational zones. However, these percentages are much lower than those recorded for the habitation sites.

To summarize, farming sites without occupational zones seem to have been primarily used as quarries. Some initial core reduction occurred at them, but no tool manufacture. Farming sites with occupational zones were also used as quarries, but in addition to this function, there may have been a limited amount of tool manufacture (or modification) occurring at these sites, and there is more of a domestic character to their assemblages than there was to the assemblages from the farming sites without occupational zones. Chipped stone assemblages from the habitation sites have a distinct domestic character to them. There is no evidence of in situ quarrying, and secondary core reduction is dominant. Some formal tool manufacture almost certainly occurred at these sites. Indeed, separating these assemblages may be artificial, and the few chipped stone artifacts recovered from around the García store at LA 105710 may actually represent a trail-off of the artifact scatter associated with Hilltop Pueblo.

Formal and informal tools. Formal tools were recovered during excavation and were recorded during field inventories, allowing us to generate composite assemblages for most of the sites. Table 18.15 presents an inventory of all formal tools for each site. Only three of the composite assemblages contain no tools, and they are three of the four assemblages that contain fewer than 100 artifacts. The LA 105710 assemblage lacks formal tools, but it is probably part of a habitation site; LA 105706 is a farming site without an occupational zone; and LA 118549 is a trail. Farming sites without occupational zones mostly contained the lowest percentages of formal tools, but not always. For instance, LA 105704 had the highest percentage of formal tools, but this is a result of small assemblage size, since only one formal tool was recovered from that site.

Thus, variation in assemblage size may be skewing the picture somewhat, and it can be smoothed by examining sites by category rather than as individuals. When this is done, formal

Table 18.15. Composite formal tool assemblages by site

Tool Type	LA 66288	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105710	LA 105713	LA 118547	LA 118549
Projectile points	-	-	-	1	-	4	5	4	-	-	2	-
Bifaces	12	-	1	-	-	2	2	3	-	-	-	-
Hoes	-	2	-	-	-	-	-	-	-	1	-	-
Drills	-	-	-	-	-	1	1	-	-	-	-	-
Unifaces	1	-	-	-	-	-	-	-	-	-	-	-
Scrapers	-	-	-	-	-	-	1	-	-	-	-	-
Choppers	-	-	-	-	-	-	-	-	-	1	-	-
Total number of formal tools	13	2	1	1	0	7	9	7	0	2	2	0
Percentage of composite assemblage	2.0%	0.1%	3.1%	0.3%	0.0%	1.6%	0.7%	0.3%	0.0%	0.5%	0.2%	0.0%
Field-inventoried assemblage	-	588	13	336	65	414	1,090	394	-	413	309	-
Collected assemblage	658	1,135	19	25	7	33	124	2,203	25	-	649	83
Total assemblage	658	1,723	32	361	72	447	1,214	2,597	25	413	958	83

tools comprise 1.9 percent of habitation site assemblages, 0.5 percent of assemblages from farming sites with occupational zones, and 0.2 percent of assemblages from farming sites without occupational zones. Most formal tools from the farming sites are not directly associated with agricultural pursuits. An exception to this are three hoes from LA 105703 and LA 105713, which would have been used for farming. Thus, formal tools with no direct association with farming were recovered from only two of five farming sites without occupational zones and comprise only 0.1 percent of that composite assemblage. This distribution is consistent with site types and the chipped stone reduction activities discussed in the preceding section. Habitation sites contain the highest percentage of formal tools. Farming sites with occupational zones contain some formal tools that are not directly associated with agriculture, but formal tools are much more common in the habitation site assemblage. Formal tools are rare at farming sites without occupational zones, and when tools associated with farming are discounted, they become even rarer.

Only a few domestic activities are reflected in the LA 66288 assemblage, and by extension, the LA 105710 assemblage. All formal tools in this assemblage are fragmentary, and functions could not be assigned to most of them. The three exceptions are two probable drill fragments and a projectile point preform that is missing its tip and may have been broken and discarded during manufacture. At least two other bifaces were discarded during manufacture because of mistakes. One exhibits a lateral snap, which is indicative of manufacturing breakage, and the second is badly step fractured on one surface, and it was probably discarded because of that. From these data we can suggest that small bifacial tools were made at the habitation site, projectile points were used for hunting and/or defense, and drills were used as perforators. Otherwise, the bifaces and unifaces from LA 66288 reflect generalized cutting and scraping activities.

The formal tools were augmented by an array of informal tools, the large number of which suggests that most activities requiring the use of stone tools were probably accomplished with unmodified debitage. In general, these activities would involve cutting or scraping, and suggest general maintenance and production tasks. However, three pieces of utilized debitage exhibit rounded edges and were probably used to scrape soft materials like leather. A surprising find was two pieces of debitage that might have been used as strike-a-light flints. Both were recovered from subsurface contexts (Levels 3 and 5) from a hand-dug exploratory trench. Since much of this area has also seen fairly heavy use during the historic period by Spanish settlers, the presence of strike-a-light flints is not a complete surprise, though the depths at which they were found is. The damage on the edges of these artifacts is not definitive, only suggestive of such use. Thus, their presence in subsurface deposits indicates a greater degree of sand buildup during the historic period than was expected, deeper mixing of materials than was thought to be the case, or a misidentification of tool function. A few pieces of ground stone were also recovered from LA 66288 and are indicative of vegetal food processing, presumably corn grinding.

Projectile points were identified at all four farming sites with occupational zones and at one of the farming sites without an occupational zone (LA 118547). These tools are evidence of hunting, probably of herbivores tempted by crops growing in nearby fields. Hoes were found at two of the farming sites without occupational zones and are directly indicative of farming. The only other formal tools identified at farming sites without associated occupational zones were a biface on LA 105704 and a chopper on LA 105713. The former could have functioned in a variety of capacities; thus, only a generalized cutting /scraping /core function can be assigned to it. The latter was probably used for collecting plant materials for consumption or as raw materials for the manufacture of other implements made from perishable materials.

Besides the projectile points discussed above, the farming sites with occupational zones also yielded several other types of formal tools. Two bifaces and a drill were identified in the LA 105707 assemblage. All three of these tools were fragmentary; one biface was discarded after being broken during manufacture. These artifacts are indicative of formal tool manufacture and use in maintenance and production tasks. In addition to the chipped stone tools from this site, several pieces of ground stone were also noted, including an andesite mano fragment of undetermined form, a quartzite one-hand rocker mano, and parts of two trough metates (andesite and granite). These tools are indicative of vegetal food processing, the grinding of corn in particular.

Other formal chipped stone tools from LA 105708 included two bifaces, a drill, and a scraper. Specific functions could not be assigned to the bifaces. The drill was used to perforate materials, probably wood. The scraper would have been used to scrape soft to semihard materials, most likely hides. Thus, the formal chipped stone tools in this assemblage (other than projectile points) were probably used in production and maintenance tasks. Four informal tools were also recovered from this site. Two had rounded edges, suggesting that they were used to scrape soft materials like hides. The other informal tools from this site were used for cutting or scraping. A few ground stone tools were also noted at LA 105708, including fragments of a slab metate and a trough metate, both made from quartzite. As discussed above, these tools would have been used for food processing, most likely the grinding of corn.

Only two formal chipped stone tools other than projectile points were identified in the assemblages from LA 105709. These tools are bifaces: a complete small andesite biface and an obsidian tool fragment, both of undetermined function. The presence of these tools at LA 105709 in addition to several biface flakes indicates that some use and manufacture of bifacial tools occurred there. Since the function of neither biface could be identified, they are simply considered part of the tool kit used for general production and maintenance tasks. Since these artifacts were in the collected assemblage, that task was at least partly accomplished outside the occupational zone. No ground stone tools were found at this site.

Table 18.16 illustrates the range of tasks represented in the chipped stone assemblages, including the few ground stone tools that were recovered or inventoried. Sites used for habitation, whether long-term or temporary, had the largest number of tasks performed on them. Farming sites without occupational zones and the trail had the fewest tasks performed on them. In particular, evidence of domestic tasks is lacking from the latter. Other than raw-material quarrying and initial processing, the main tasks evidenced in the chipped stone assemblages from the farming sites without occupational zones are farming and hunting, and perhaps some vegetal material acquisition or processing. One tool that can be considered evidence of general production or maintenance was recovered from these sites, suggesting that such tasks were rarely (if ever) performed on them.

There is evidence of multiple tasks at most of the farming sites with occupational zones. Many of these tasks are of a domestic nature, especially vegetal food processing, and suggest that farmers used the occupational zones for extended periods rather than just resting during the heat of the day and occasional overnight stays. Unfortunately, we lack detailed information from these areas, so a deeper discussion of the type of use they reflect is not possible. However, we should note that a dense chipping area collected at LA 105709 was not in the occupational zone, indicating that some chipped stone reduction occurred elsewhere on these sites. Since this area also contained evidence of biface reduction, tool manufacture was apparently not restricted to occupational zones.

The Relationship between Surface and Subsurface Materials at the Farming Sites

Both surface and subsurface artifacts were recovered from four farming sites: LA 105703, LA 105708, LA 105709, and LA 118547. These are also the farming sites with the largest collected assemblages. Chipped stone artifacts recovered from the surface of farming features at these sites are considered to postdate the period of feature construction and possibly use. Those found in Stratum 1, which is postoccupational buildup, certainly postdate the period of feature construction but may have been deposited while the features were in use. Artifacts found within the gravel mulch (Stratum 2) may relate to the use of an area for quarrying that predates feature construction, but they could also have been deposited while the fields were in use. Finally, artifacts recovered from the base of the gravel mulch almost certainly predate feature construction. It is now necessary to sort the chipped stone artifacts that were found in subsurface contexts into these categories.

Artifacts recovered from excavation units

Table 18.16. Tasks associated with chipped stone and ground stone tools by site

Task	LA 66288 and LA 105710	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105713	LA 118547	LA 118549
Quarrying and initial reduction	-	x	x	x	x	x	x	x	x	x	x
Secondary chipped stone reduction	x	-	?	x	-	x	x	x	-	-	-
Biface manufacture	x	-	-	-	-	x	-	x	-	-	-
Hunting	?	-	-	x	-	x	x	x	-	x	-
Perforating	x	-	-	-	-	x	x	-	-	-	-
Chopping	-	-	-	-	-	-	-	-	x	-	-
Farming	-	x	-	-	-	-	-	-	x	-	-
Vegetal food processing	x	-	-	-	-	x	x	-	-	-	-
General production and maintenance	x	-	x	-	-	x	x	x	-	-	-
Fire making	?	-	-	-	-	-	-	-	-	-	-
Leather working	x	-	-	-	-	-	x	-	-	-	-

comprise fairly large percentages of the collected assemblages for three sites: 6.8 percent for LA 105703, 18.5 percent for LA 105708, and 18.6 percent for LA 118547. Only a few chipped stone artifacts were recovered from excavation units at LA 105709, and they comprise 0.3 percent of that assemblage. However, not all of these artifacts were from farming features, nor were all from subsurface contexts. EU-B at LA 105709 was used to investigate Feature 3, which turned out to be a temporary historic structure. EU-E at LA 105708 was in an area that did not contain a farming feature. Both of these excavation units yielded chipped stone artifacts that cannot be considered with the assemblage from farming features. Thus, they are added to the assemblage of surface artifacts. Also added to the surface assemblage are a few artifacts recovered from the surface of excavation units.

Table 18.17 shows corrected counts for each site by stratum. From 1 to 31 subsurface artifacts were recovered from 12 of 14 excavation units at LA 105703. The greatest number of chipped stone artifacts was recovered from EU-K, which was one of two excavation units used to investigate Feature 22. The second largest number of chipped stone artifacts, 12, came from EU-L, which was one of eight excavation units used to investigate Feature 18.

All subsurface artifacts from LA 105703 are rhyolite. They include 45 core flakes, 28 pieces of angular debris, and 4 cores. Rhyolite was by far the dominant material overall at LA 105703, comprising 92.3 percent of the complete assemblage, so this is not surprising. Twenty artifacts (26.3 percent) were recovered from Stratum 1, and 56 (73.7 percent) were from Stratum 2. The Stratum 1 assemblage contained 8 pieces of angular debris, 10 core flakes, and 2 cores. The Stratum 2 assemblage contained 20 pieces of angular debris, 34 core flakes, and 2 cores. Seventy percent of the flakes from Stratum 1 were noncortical, as were 64.7 percent of those from Stratum 2. Both of these percentages are rather high when compared with the overall percentage for the site (Table 18.13). There are no modified or lipped platforms on these flakes. Flake to angular debris ratios are 1.25:1 for Stratum 1 and 1.70:1 for Stratum 2. Both ratios are a bit low when compared to the overall flake to angular debris ratio for the site (Table 18.6).

When these data are combined, fairly early-stage core reduction is indicated for the chipped stone artifacts from both subsurface strata at LA 105703. Of course, it must be remembered that these artifacts undoubtedly represent numerous reduction episodes. Stratum 1 artifacts represent chipping episodes that occurred after the farming features were built, while they were in use or after they were abandoned. Chipping episodes represented by the Stratum 2 artifacts occurred before the features were built or while they were in use.

From two to six chipped stone artifacts were recovered from all five of the excavation units that were used to examine farming features at LA 105708. Two of the three EUs that were used to examine Feature 9 contained the largest and second largest numbers of artifacts. Six were recovered from EU-A, and five from EU-B. Most sub-

Table 18.17. Chipped stone artifacts recovered from excavation units on farming sites that yielded subsurface artifacts (count and column percentage)

Provenience	LA 105703	LA 105708	LA 105709	LA 118547
Surface	1,059	102	2,198	529
	93.3%	82.3%	99.8%	81.5%
Stratum 1	20	6	3	47
	1.8%	4.8%	0.1%	7.2%
Stratum 2	56	15	2	27
	4.9%	12.1%	0.1%	4.2%
Stratum 3	-	1	-	46
	-	0.8%	-	7.1%
Total	1,135	124	2,203	649

surface artifacts from LA 105708 are rhyolite. The only exceptions are a piece of chert from EU-B and a piece of Pedernal chert from EU-F. At 88.8 percent, the proportion of rhyolite in this small assemblage is nearly equivalent to the percentage in the assemblage as a whole. However, the presence of cherts in subsurface contexts is surprising, since the collected assemblage contained only three chert artifacts. Three artifacts (16.7 percent) were recovered from Stratum 1, 14 (77.8 percent) from Stratum 2, and 1 (5.6 percent) at the top of Stratum 3.

The Stratum 1 assemblage includes 2 core flakes and 1 piece of angular debris. Most of the subsurface artifacts were recovered from Stratum 2, including 11 core flakes, 2 pieces of angular debris, and 1 core. The single artifact found at the top of Stratum 3 was a core flake. Both flakes from Stratum 1 are noncortical, as are 36.4 percent of those from Stratum 2. The only core flake in Stratum 3 is cortical.

Only Stratum 2 contained enough flakes for comparison to the overall assemblage, and the percentage of noncortical flakes from this layer is somewhat lower than it was for the assemblage as a whole. There were no modified platforms on these flakes, and only two (one each from Strata 1 and 3) had lipped platforms. Flake to angular debris ratios are 2.00:1 for Stratum 1 and 5.50:1 for Stratum 2. Neither of these ratios is consistent with the overall flake to angular debris ratio for this site (Table 18.6). One possible utilized flake was recovered from Stratum 2, but the wear on that artifact was questionable since it came from a matrix that contained large amounts of gravel.

The data presented for the subsurface assemblage from LA 105708 are difficult to interpret because the assemblages from each stratum are so small, especially those from Strata 1 and 3. Artifacts from Strata 1 and 3 represent chipping episodes that occurred before (Stratum 3) and after (Stratum 1) the farming features were built. Chipping episodes represented by the artifacts from Stratum 2 occurred before the features were built or while they were in use.

Chipped stone artifacts were recovered from two of three EUs used to examine farming features on LA 105709. Three pieces of debitage were recovered from Stratum 1 in EU-A, and two were found in Stratum 2 in EU-C. All of these artifacts are rhyolite. Stratum 1 contained a core flake and two pieces of angular debris, while Stratum 2 contained a core and a piece of angular debris. This is rather surprising, since rhyolite comprised only about 60 percent of the overall assemblage from this site. The core flake was a noncortical lateral fragment with a crushed platform.

The data presented for the subsurface artifacts from LA 105709 are difficult to interpret because the assemblages from each stratum are so small. Artifacts from Stratum 1 probably represent a single chipping episode that occurred after Feature 1 was built. Artifacts from Stratum 2 may have been present in the gravels used to mulch Feature 4, or they represent the mixing of a few artifacts into the mulch from a chipping episode that occurred after this feature was built.

Between 1 and 50 subsurface artifacts were recovered from all 12 excavation units at LA 118547. The greatest number of chipped stone artifacts was recovered from EU-C, and the second largest number (12) came from both EU-D and EU-K. All excavation units on this site were used to examine Feature 15. Rhyolite was the most common material type in the subsurface assemblage and comprised 87.5 percent of those artifacts. Other materials included chert (1.7 percent), igneous undifferentiated (0.8 percent), andesite (9.2 percent), and quartzite (0.8 percent). These percentages are out of proportion to the makeup of the overall assemblage. Rhyolite is overrepresented, and andesite is underrepresented (Table 18.2).

Forty-seven artifacts (39.2 percent) were recovered from Stratum 1, 27 (22.5 percent) from Stratum 2, and 46 (38.3 percent) from the top of Stratum 3. The Stratum 1 assemblage includes 15 pieces of angular debris, 31 core flakes, and 1 core. The Stratum 2 assemblage contains 9 pieces of angular debris, 16 core flakes, and 2 cores. Stratum 3 contained 12 pieces of angular debris, 31 core flakes, and 3 cores. Noncortical flakes comprise 58.1 percent of the Stratum 1 assemblage, 56.3 percent of the Stratum 2 assemblage, and 41.9 percent of the Stratum 3 assemblage. These percentages for Strata 1 and 2 are similar to the percentage for the overall assemblage, while the percentage for Stratum 3 is somewhat lower (Table 18.13). There are no modified or lipped platforms on these flakes. Flake to angular debris ratios are 2.07:1 for Stratum 1, 1.78:1 for Stratum

2, and 2.58:1 for Stratum 3. The ratio for Stratum 2 is very close to that for the overall assemblage, while the others are a bit higher (Table 18.6).

Subsurface data from LA 118547 are a bit easier to interpret than those from the other sites, because more information on the positioning of artifacts is available from the field notes. In three cases (EU-E, EU-H, and EU-J) the excavator noted that artifacts from Stratum 2 were found near the top of that layer. Though no chipped stone artifacts were recovered from Stratum 2 in EU-H, these data provide a much needed clue. All artifacts from Stratum 1 and most, if not all, of those from Stratum 2 undoubtedly were deposited after the farming features were built. Conversely, the occurrence of a large number of artifacts at the top of Stratum 3 in EU-C shows that this area was also used as a quarry before the farming features were built. Data for all three strata suggest early-stage core reduction consistent with the raw-material quarrying that was considered to be the main activity involving chipped stone for the site as a whole.

While it has not been possible to definitively determine the relationship between surface and subsurface chipped stone artifacts at these sites, several tendencies are clear. Overall, these small assemblages fit, albeit not very neatly, with the complete assemblages from these sites. Though numerous chipping episodes are represented in each assemblage, raw-material quarrying and initial core reduction seem to have been the focus of those episodes. Artifacts in Stratum 1 were deposited after farming features were built. Considering the data from LA 118547, most or all of the chipped stone artifacts recovered from Stratum 2 are probably related to similar chipping episodes, and they were worked down into the gravel mulch by natural processes or prehistoric cultivation techniques. Since most of the gravel used to mulch these features was obtained from borrow pits, the chance that many chipped stone artifacts would be included in those materials is fairly low.

At least two quarrying episodes that occurred before farming features were built were defined. Earlier chipping episodes in areas selected for field construction may also account for some of the chipped stone artifacts in Stratum 2, especially those recovered near the bottom of the mulch layer. In some cases, multiple layers of mulch may have been applied, and material acquisition occurring between applications could also be responsible for some subsurface chipped stone artifacts.

Thus, we conclude that most of the subsurface chipped stone artifacts from these sites resulted from chipping episodes that occurred before and after features were built. Others may have been deposited between applications of mulch, but this possibility is considered to be much less likely in most cases.

Relationship between Surface Artifacts and Farming Activities

Only three artifacts collected from or inventoried at the farming sites were directly related to farming activities—the hoes found at LA 105703 and LA 105713. Assemblages that are spread across farming features or occur at the edges of the gravel terraces that these sites occupy were probably not directly related to farming activities but may represent raw-material acquisition embedded in farming activities. Four of these sites also have occupational zones associated with the farming features. Analysis showed that the assemblages from these sites have a different character than those from the farming sites that lack occupational zones. When occupational zones occur there tend to be more cherts and obsidians in chipped stone assemblages, as well as more formal tools representing a larger variety of activities. The types of pottery found in subsurface contexts mostly tend to match those recovered on the surface of these sites. This suggests that field construction, use, and exploitation of the area for raw chipped stone materials may have occurred at pretty much the same time.

Unfortunately, there is no way to determine whether there is any correspondence between surface and subsurface assemblages. The resemblances between them may be indicative of a close relationship, but this remains uncertain. Undoubtedly, both earlier and later occupants of the Ojo Caliente Valley exploited some of the same material sources, as did the prehistoric pueblo farmers. Indeed, at least some of the chipped stone artifacts on our sites probably derive from quarrying episodes that predated and postdated construction and use of the fields. However, we feel that most of the chipped stone assemblages reflect material acquisition embedded in farming activities, as noted above. Lack of evidence of much primary reduction at the habitation site(s) provides some support for this possibility. Unfortunately, those assemblages were too small to provide any real substantiation.

Summary and Conclusions

This chapter has examined the collected assemblages from 12 sites in the Ojo Caliente Valley, with additional detail from the field-recorded assemblages at those sites and the thirteenth site. Assemblage characteristics allowed us to divide this array of sites into three basic groups: habitation sites (LA 66288 and LA 105710), farming sites with associated occupational zones (LA 105705, LA 105707, LA 105708, and LA 105709), and farming sites without associated occupational zones (LA 105703, LA 105704, LA 105706, LA 105713, and LA 118547). The last site—LA 118549—is a trail, and it was included with the latter group because of assemblage similarities.

Our analysis found that imported materials were fairly rare in all assemblages, and the largest percentages occurred in the habitation site assemblage(s). Though some imported materials were found at both categories of farming sites, they were more common at the farming sites with occupational zones. Analysis of attributes indicative of reduction strategy and techniques showed that chipping on the farming sites without occupational zones focused on material quarrying and initial core reduction. This was almost entirely accomplished by hard hammer percussion, and some data suggest that selected flakes may have been carried off for use elsewhere. Other data suggest that material acquisition was probably embedded in farming activities. Formal tools were rare to nonexistent at the farming sites, and most were related to farming activities or field hunting.

Quarrying and initial core reduction was also common at the farming sites that had associated occupational zones. However, an array of domestic tasks is also reflected in these assemblages. Since none of the occupational zones extended into the right-of-way, those areas were not studied in detail. Even so, differences were noted between collected assemblages from both categories of farming sites, which indicates that domestic tasks associated with temporary habitation were not restricted to occupational zones. Reduction activities that were not strictly related to quarrying and initial core reduction also sometimes occurred on farming features and at the edge of the gravel terraces they occupy. Substantial amounts of reduction at these sites was accomplished by soft hammer percussion, though hard hammer percussion was probably dominant.

The assemblage from the habitation site(s) differed greatly from those recovered from the farming sites. However, it should be remembered that these materials represent a minuscule part of the Hilltop Pueblo assemblage and that none seemed to be in situ. Rather, the artifacts recovered at LA 66288 and in the northern section of LA 105710 appear to have been redeposited, limiting the conclusions that can be drawn from these materials. Even so, there is little evidence of the early stages of core reduction in this assemblage, suggesting that most cores were probably transported to the habitation site in a partly reduced state. Material selection was more focused on imported materials and materials that are rare in local gravel deposits. Soft hammer reduction was very common but may still have been dominated by hard hammer reduction. Evidence of formal tool manufacture and use was more common in this assemblage than in any of those from farming sites.

The differences in these assemblages are fairly easy to explain. LA 66288 and LA 105710 formed parts of a residential site where local farmers and their families lived and performed myriad domestic tasks, many of which used chipped stone. Farming activities seem to have required some people to reside near their fields for at least part of the year, though not every group of farming features seems to have needed this level of tending or protection. Perhaps the distribution of occupational zones is more indicative of the land tenure system than the requirements of agriculture, but this remains uncertain at this time. In any case, the occupational zones that occur near several field systems were a focus of domestic tasks, many of which used stone tools, and those tasks often spilled across the fields to the terrace edge, where lithic raw materials were readily available. Where occupation zones do not occur next to fields, we found the simplest chipped stone assemblages, which were mostly indicative of raw-material acquisition. The farmers that tended these fields probably collected cores and suitable flakes while working in their fields, perhaps for transport back to the main residence or to field structures in occupational zones associated with other fields.

Chapter 19. Pottery Analysis

C. Dean Wilson

During surface collection and excavation at the Gavilan sites, 3,078 sherds were recovered, including 1,864 from LA 66288, 47 from LA 105703, 181 from LA 105708, 35 from LA 105709, 940 from LA 105710, and 11 from LA 118547 (Table 19.1). No sherds were collected from the other seven sites that were examined, which included six farming sites and the trail. Distributions of various pottery forms, as reflected in typological categories and descriptive attribute classes, provide a framework to determine the dates of site occupation and examine a range of issues such as the influence of cultural tradition and resource use on local ceramic technologies, exchange of pottery vessels between different areas, and the use of ceramic vessels and tools in various activities.

Attribute Analysis Categories

Descriptive attribute categories recorded during this study include temper type, pigment, interior and exterior surface manipulation, vessel form, and postfiring modifications. In addition, refired paste color was recorded during analysis of small subsamples of selected sherds.

Temper

Temper categories were recorded by examining freshly broken sherd cross sections through a binocular microscope. *Temper* refers to aplastic particles that were intentionally added to the clay or fragments naturally occurring in the clay that would have served the same purpose. Temper categories were distinguished by combinations of color, shape, size, fracture, and sheen of observed particles. It is often not possible to differentiate rock types based on microscopic analysis of temper fragments, so the categories employed here are best considered groups with similar visual characteristics rather than specific rock and mineral types. Still, recognition of such categories provides information on the basic types of resources used by potters in a particular area.

Almost all of the sherds examined during this study contained some type of igneous rock temper. *Tuff/ash* or *vitric tuff* refers to fine volcanic rock fragments, presumably derived from ash or tuff deposits. This category includes small, clear, dark, vitreous, angular to rod-shaped particles and light-colored dull pumice fragments. The presence of such particles may indicate the use of self-tempered ash-derived clays or the addition of crushed or weathered tuff or ash to the clay. Most examples of this temper occurred along with rounded quartz grains and were classified as fine tuff or ash and sand.

Other tempers include various classes of crushed igneous porphyries. *Granite* refers to crushed leucocratic igneous rock dominated by white to light gray fragments with smaller amounts of black fragments. The minerals visible in this category include quartz, feldspar, brown biotite, and mica, and this type of temper was commonly used in utility wares through much of the Rio Grande Valley. Similar tempers were assigned to categories based on the frequency of mica fragments and included granite with mica, granite without mica, and granite in highly micaceous paste.

Sand refers to rounded or subrounded, well-sorted sand grains that are usually light-colored to transparent. This category was distinguished from the sandstone category by the presence of large, even-sized quartz grains and the absence of a matrix. Similar temper consisting of dark gray to black rounded sand grains was assigned to the dark sand category. Inclusions consisting of dull fragments representing the addition of crushed potsherds to the clay were assigned to the sherd category.

Pigment Type

Pigment categories were recorded for decorated sherds. *Organic paint* refers to the use of vegetal pigments that soak into the surface of a vessel

Table 19.1. Pottery type by site (count and column percentage)

Pottery Type	LA 66288	LA 105703	LA 105708	LA 105709	LA 105710	LA 118547	Total
Unpainted biscuit paste	111	1	124	-	52	-	288
(slipped both sides)	6.0%	2.1%	68.5%	-	5.5%	-	9.4%
Unspecified painted biscuit ware	19	6	-	-	27	-	52
	1.0%	12.8%	-	-	2.9%	-	1.7%
Biscuit A	85	2	-	3	35	8	133
	4.6%	4.3%	-	8.6%	3.7%	72.7%	4.3%
Biscuit B	410	30	7	31	257	3	738
	22.0%	63.8%	3.9%	88.6%	27.3%	27.3%	24.0%
Unpainted biscuit ware	51	5	-	-	45	-	101
(slipped one side)	2.7%	10.6%	-	-	4.8%	-	3.3%
Micaceous utility undifferentiated	857	1	43	1	51	-	953
	46.0%	2.1%	23.8%	2.9%	5.4%	-	31.0%
Sapawi Micaceous-Washboard	324	2	-	-	459	-	785
	17.4%	4.3%	-	-	48.8%	-	25.5%
Potsuwi'i Incised	3	-	-	-	-	-	3
	0.2%	-	-	-	-	-	0.1%
Classic nonmicaceous	1	-	7	-	8	-	16
	0.1%	-	3.9%	-	0.9%	-	0.5%
Tewa Buff undifferentiated	-	-	-	-	1	-	1
	-	-	-	-	0.1%	-	0.0%
Kapo or Tewa Black	-	-	-	-	4	-	4
	-	-	-	-	0.4%	-	0.1%
San Juan Red-on-tan	-	-	-	-	1	-	1
	-	-	-	-	0.1%	-	0.0%
Glaze Red body (unpainted)	1	-	-	-	-	-	1
	0.1%	-	-	-	-	-	0.0%
Largo Glaze Polychrome	2	-	-	-	-	-	2
	0.1%	-	-	-	-	-	0.1%
Total	1864	47	181	35	940	11	3078

rather than remaining unabsorbed on its surface. Thus, streaks and polish are often visible through the paint. The painted surface is generally lustrous from surface polishing, and the pigment may be gray, black, bluish, and occasionally orange in color. Edges of painted designs are often fuzzy when an organic paint was used.

Matte mineral paint refers to the use of ground minerals such as iron oxide as pigments. These are usually powdered compounds applied with an organic binder. This type of pigment forms a physical layer that rests on the vessel surface, often thick enough to exhibit visible relief. Mineral pigments usually cover and obscure surface polish and irregularities. The firing atmospheres to which mineral pigments were exposed affected their color. Mineral pigment categories identified during the present study were classified as mineral black.

Glaze paint refers to the use of lead as a fluxing agent to produce a vitreous paint. Glaze-painted surfaces exhibit a heavy sheen or gloss and are often black or green, but they may be brown, yellow, or red. Glaze pigments are often very thick and runny, and bubbles may protrude through the surface. The glaze paint may weather from the surface of a sherd, leaving a thin organic layer.

Manipulation

Manipulation refers to the type of treatment noted on a sherd surface. *Plain unpainted* refers to surfaces with no evidence of textured treatments, polishing, or painting. *Polish* implies intentional smoothing with a polishing stone to produce a compact and lustrous surface. Evidence of polishing over an unslipped surface was recorded as plain polish. Similar manipulations over a low-iron slip were recorded as polished white slip, while that over a high-iron slip was recorded as polished red slip. Lustrous black surfaces resulting from intentional sooting of a polished surface were classified as polished smudged. Textures reflecting various treatments of coils that were not completely obliterated on corrugated utility wares included narrow coil, clapboarded, smeared indented corrugated, and smeared wide neck-banded.

Vessel Form

Sherds were assigned to vessel form categories based on their shape and the portion of the vessel from which they were assumed to have originated. The consistent placement of all sherds into similarly defined vessel form categories allows basic interpretation of functional trends represented by sherd assemblages. *Indeterminate* refers to cases where the type of vessel from which a sherd originated could not be determined. *Bowl rim* refers to rim sherds exhibiting inward curvature indicative of bowl forms. *Bowl body* refers to body sherds exhibiting polish or painted decoration on the interior surface indicating they were fragments of bowls. Bowl rim sherds exhibiting significant flaring or eversion toward the rim were classified as flared bowl rim.

Most of the sherds examined during this study were unpolished body sherds for which no precise vessel form could be determined. While all unpolished gray body sherds were assigned by default to the jar body category, some could actually have been parts of bowls. *Jar neck* includes sherds with a curvature that indicated they originated somewhere along the upper portion or neck of a jar. *Jar rim* refers to forms with relatively wide rim diameters that could have been used for cooking or storage. *Seed jar rim* refers to sherds from spherical vessels that do not exhibit distinct necks but have small openings near the top. Other vessel forms included dipper with handle and curved pipe.

Modified Sherds

Modified sherd categories indicate the presence of postfiring modifications resulting from shaping, wear, or repair. These categories incorporate information concerning item shape and size as well as processes of shaping and use. While most of the sherds examined did not exhibit postfiring modifications and were coded as none, those that did provide information about the actual use and modification of sherds and vessels. *Drilled hole for repair* refers to the presence of holes drilled along fractures that allowed a broken vessel to be repaired by lacing the fragments together. Repair holes are usually within 2 cm of a break. Sherds exhibiting shaping and wear patterns indicative of use in pottery vessel manufacture were classified as ceramic scrapers. Those exhibiting at least one shaped edged were classified as beveled edge. Those that had been shaped on all sides were assigned to the shaped object category. Another category recognized during this study was large sherds used as scoops or digging tools. Sherds exhibiting spalls or pitting from exposure to repeated cooking cycles were assigned to distinct categories.

Pottery Types

Pottery from the Gavilan sites was overwhelmingly comprised of Northern Rio Grande types typical of Classic period occupations (Cordell 1978; Fallon and Wening 1987; Hibben 1937; Wendorf 1953b). These include sherds assigned to white ware, gray ware, and glaze ware types. Table 19.1 shows distributions of prehistoric pottery types by site, while Table 19.2 illustrates the distributions of ware groups associated with these types.

White wares. Five prehistoric white ware categories were identified during this analysis. Most categories represent Northern Rio Grande pottery types from the Tewa white ware series that date to the Classic period (Fallon and Wening 1987; McKenna and Miles 1990; Wendorf 1953b). During the Classic period, similar Tewa series white wares were produced in the Pajarito Plateau, Tewa Basin, and Chama Valley areas (Mera 1934). Tewa White wares from different time periods are characterized by similar tuff temper, high iron pastes, and painted decorations executed in organic paint. Thus, variations in paste surface treatment and design styles, which are known to have changed through time, were used to place white wares into types.

All of the white wares sherds recovered during this study appeared to be from biscuit ware vessels. Biscuit wares were the dominant types of decorated pottery produced at Classic period sites in the Northern Rio Grande (Mera 1934).

Table 19.2. Ceramic ware group by site (count and column percentage)

Ware Group	LA 66288	LA 105703	LA 105708	LA 105709	LA 105710	LA 118547	Total
Gray ware	1185	3	50	1	518	-	1757
	63.6%	6.4%	27.6%	2.9%	55.1%	-	57.1%
White ware	676	44	131	34	416	11	1312
	36.3%	93.6%	72.4%	97.1%	44.3%	100.0%	42.6%
Glaze ware	3	-	-	-	-	-	3
	0.2%	-	-	-	-	-	0.1%
Historic plain ware	-	-	-	-	6	-	6
	-	-	-	-	0.6%	-	0.2%
Total	1864	47	181	35	940	11	3078

They are often referred to as black-on-gray, apparently because of their dark surface color relative to other white ware types. However, this study follows more recent conventions in identifying biscuit wares as black-on-white types (Lang 1997). Biscuit wares are characterized by the use of bentonitic clays and vitric tuff or ash temper (Fallon and Wening 1987; Kidder and Amsden 1931). Their pastes are very porous and lightweight, and biscuit ware sherds tend to be very soft and weather easily. Surfaces are often white, light gray, tan, or buff. Vessel walls tend to be very thick, particularly when compared to earlier decorated types. Biscuit ware bowl rims exhibit a distinct flare or eversion, and thickness may vary considerably over short distances from the rim.

Biscuit wares were decorated using a sharp black to blue-black organic paint that was applied to a white- to buff-colored slip. Plain bowl rims are generally ticked, and standing rims are embellished with repeating dashes or zigzag lines on the interior below the lip. Painted designs are often organized in bands with panels of repeating hatched or solid geometrical elements that include ticked edges, parallel or rectilinear lines, and stylized Awanyu motifs.

Two biscuit ware types can be distinguished by the presence of painted or slipped surfaces (Kidder and Amsden 1931). The earlier type is known as Biscuit A (Abiquiu Black-on-white) and was defined by the presence of slip and/or painted designs on interior surfaces only. Bowls are the only vessel form that occur in this type. The manufacture of Biscuit B (Bandelier Black-on-white) began somewhat later, and this type is distinguished from Biscuit A by yellowish pastes as well as slip and/or painted decorations on jar exteriors and both surfaces of bowls. The latter type dominated the identifiable decorated ceramic assemblages from our sites (Fig. 19.1). Decorated biscuit ware sherds that could not be assigned to a specific type were categorized as unspecified painted biscuit ware. Unpainted sherds that clearly exhibited traits indicative of biscuit wares were categorized as unpainted biscuit paste slipped on both sides or unpainted biscuit ware slipped on one side.

Prehistoric gray wares. Gray utility wares, also dominated by types produced during the Classic period, were differentiated by paste and textured treatments. *Smeared corrugated* refers to gray wares with partly obliterated coils on exterior surfaces. The corrugations on this type are shallower and more obliterated than they are on earlier corrugated types. This textured treatment generally covered the entire exterior surface of a vessel. Rio Grande gray wares that exhibit this type of treatment have been previously labeled Tesuque Smeared or Tesuque Gray (Habicht-Mauche 1993; Mera 1935). Surface color varies from dark gray, gray, or brown to tan. Pastes are usually gray or dark gray and turn yellow-red and red when refired in an oxidizing atmosphere. Tempers include various types of crushed granite and sand. This type is almost exclusively comprised of jars. Smeared corrugated was the last form of corrugated vessel treatment in the Northern Rio Grande and was most common at about A.D. 1350, remaining popular into the 1400s (Habicht-Mauche 1993; Lang 1997).

Sapawe Micaceous-Washboard was the dominant utility ware at many Classic period sites in the Northern Rio Grande and appears to be the dominant type at most of our sites. This type is

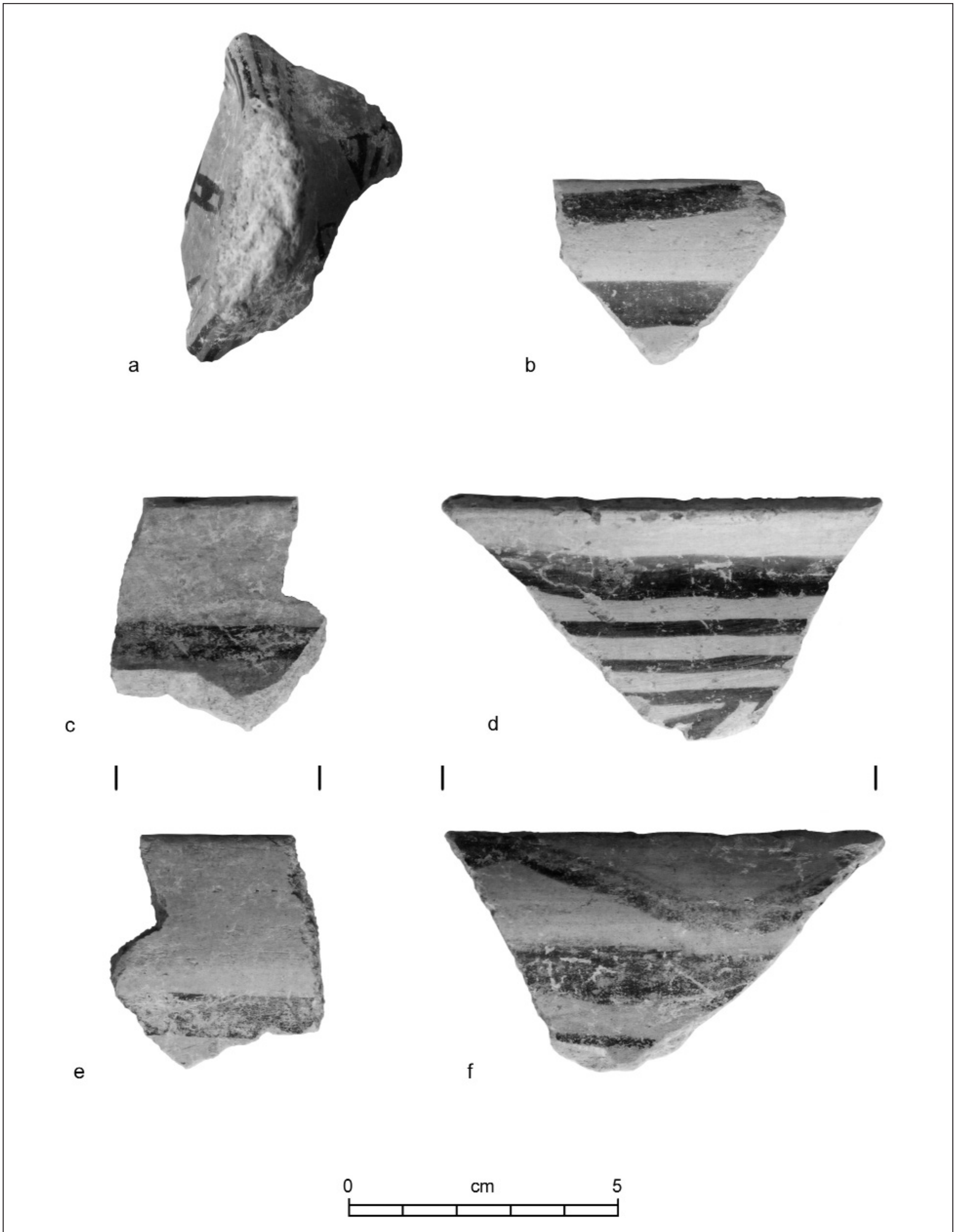


Figure 19.1. Biscuit B sherds from LA 66288: (a) effigy; (b) bowl sherd; (c, d) sherds from same bowl, interior; (e, f) exterior of c and d.

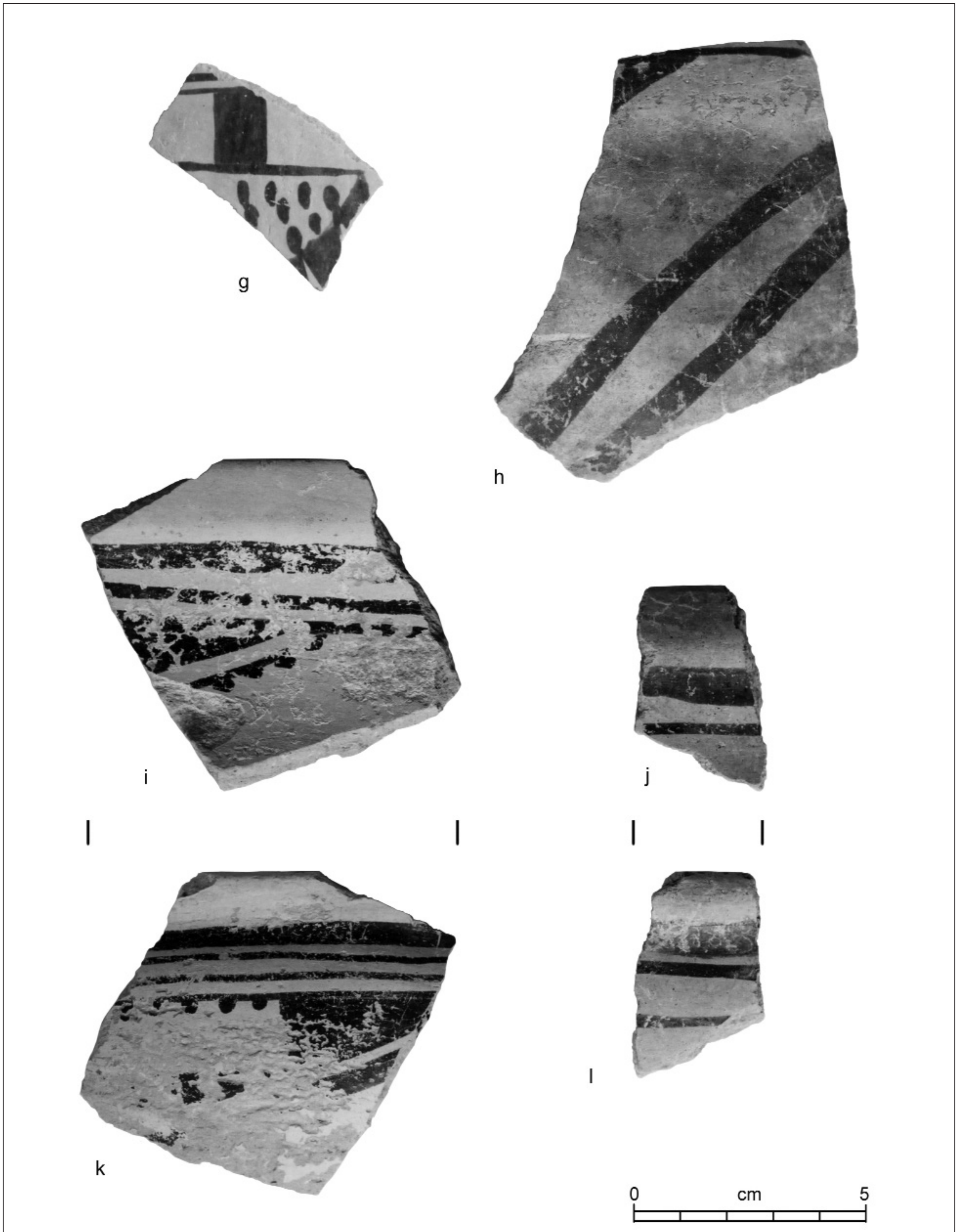


Figure 19.1 (continued): (g, h) sherds from same bowl; (i, j) sherds from the same bowl, interior; (k, l) exteriors of i and j.

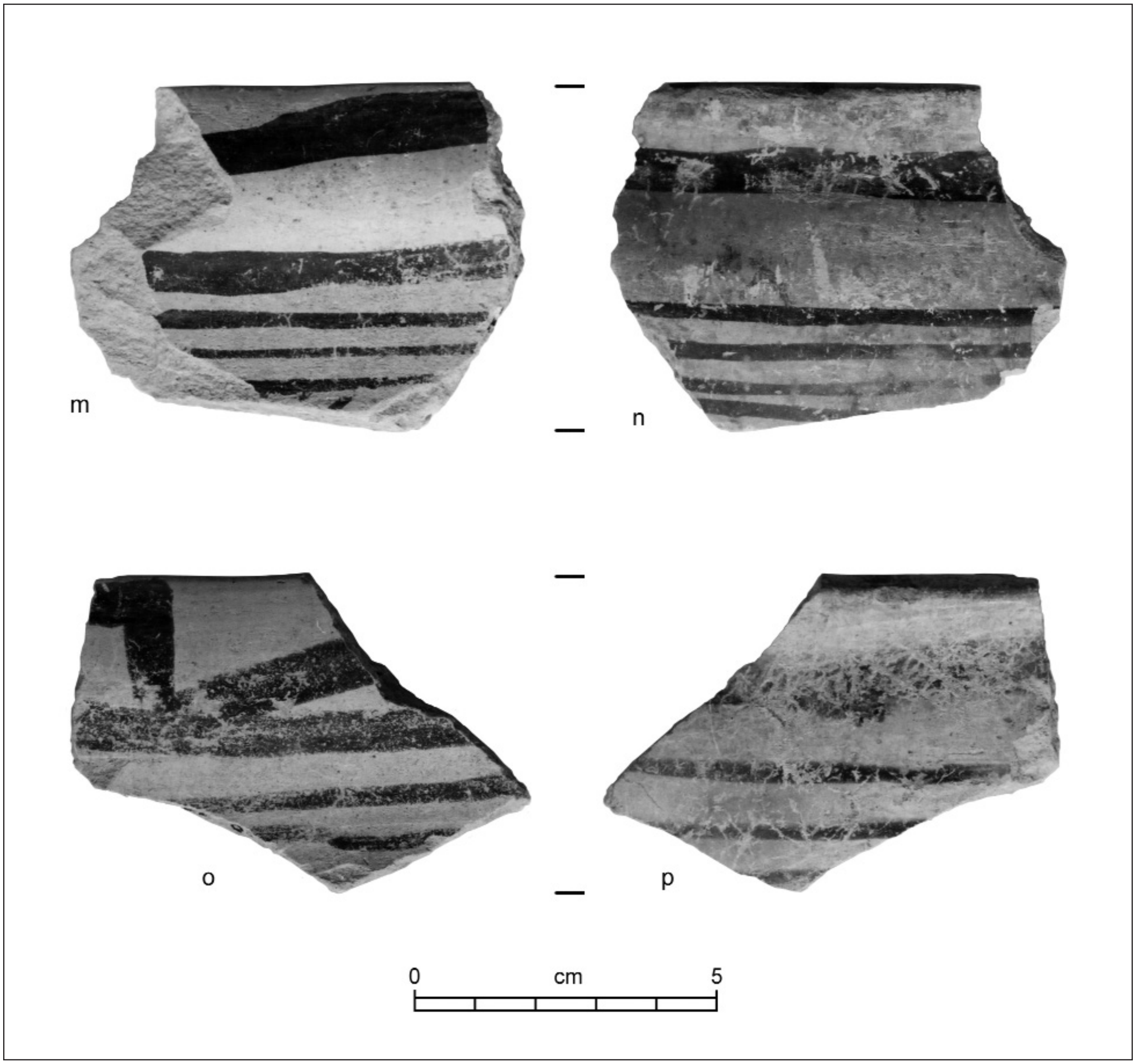


Figure 19.1 (continued): (m, n) interior and exterior of bowl sherd; (o, p) interior and exterior of bowl sherd.

characterized by a distinct exterior treatment (described below) and a very micaceous paste. Surfaces may be covered with a micaceous slip and are tan or dark brown to gray. Pastes are dark gray or black to dark brown, tend to be silty in appearance, and are often vitrified. Sherds of this type are nearly always from jars and tend to be hard, dense, and thin (Fig. 19.2). Sapawe Micaceous-Washboard is tempered with micaceous schist or granite that is most likely a natural constituent of the clay (Fallon and Wening 1987). Surface treatment consists of slightly obliterated coils, creating a series of parallel ridges without distinct junctures between coils. Sherds that exhibited pastes and tempers similar to those of Sapawe Micaceous-Washboard but with plain surfaces were categorized as micaceous utility undifferentiated. Plain gray ware sherds that were similar to Sapawe Micaceous-Washboard but lacked mica were categorized as Classic non-micaceous gray.

Potsuwi'i Incised is a type of utility ware that exhibits a combination of attributes seen in both Classic period Tewa white wares and Rio Grande utility wares (Mera 1932). This type is typified by jars with very smooth or polished exterior sur-

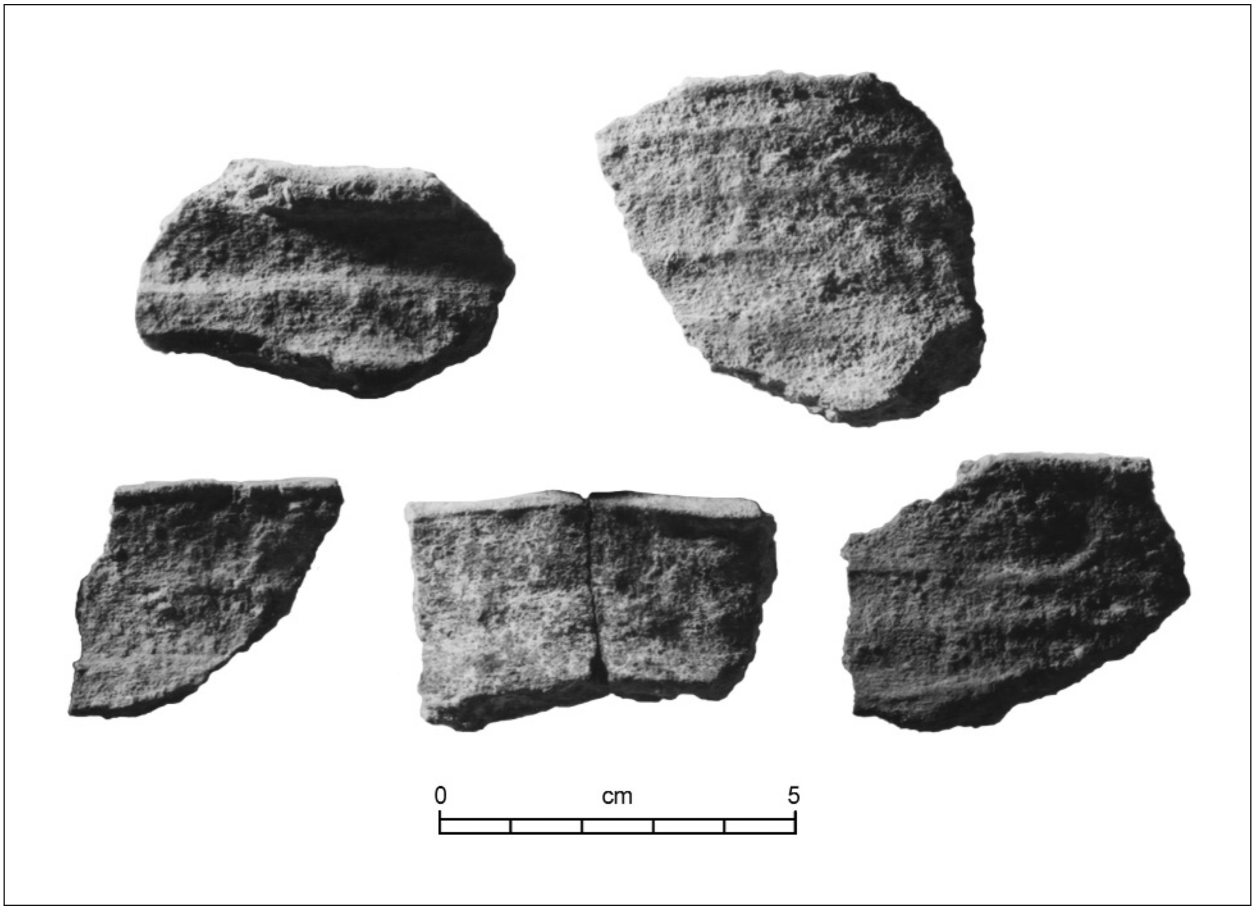


Figure 19.2. Sapawe Micaceous-Washboard jar sherds from LA 66288.

faces. Vessel walls tend to be thin, and exterior surfaces are sometimes covered with a thin micaceous slip and are dull and gray. Pastes are cream or tan and contain a fine tuff or ash temper similar to that used in biscuit wares. Decorations consist of fine incised lines. Designs are variable but often consist of combinations of parallel horizontal and vertical lines, sometimes with punctates.

Historic plain wares. The remaining utility wares are historic plainwares produced by the Northern Tewa, though similar types may have been made by Hispanic potters (Carrillo 1997; Dick 1968; Hurt and Dick 1946). Manufacture of these types began after the Spaniards settled in New Mexico and are common at Hispanic settlements dating to the eighteenth and nineteenth centuries (Batkin 1987). Sherds with unslipped surfaces that are fairly well polished and range in color from buff or tan to light orange were categorized as Tewa Buff undifferentiated. This type is tempered with a fine tuff that is common in historic plain wares.

Kapo or Tewa Polished Black refers to polished and smudged utility wares that were mostly produced by Tewa potters. This type is distinguished by a thick black soot deposited over a red slip that covers the entire vessel surface. The very high iron content of the red slip allows vessel surfaces to be highly polished, which is a characteristic of Kapo Black. Paste profiles are usually gray to brown, and cores are absent. Vessel surfaces that are not sooted are light gray to gray. These pastes refire yellow-red to red, and the slip refires to a dark red. Temper was very similar in all sherds of this type that were examined, consisting of a fine vitric tuff or pumice. Common vessel forms include jars with curved profiles, bowls, and flared bowls.

San Juan Red-on-tan utility ware vessels have a red slipped band just below their rims. Slip color ranges from red to dark brown, and unslipped surfaces are buff to tan. Surfaces tend to be highly polished. The temper is a fine tuff similar to that noted in other plain wares, with some mica particles visible through the surface. Flared bowls were the most common form in our assemblage.

Glaze wares. Glaze wares were produced over much of the middle Rio Grande region from about A.D. 1325 to the early 1700s (Franklin 1997; Kidder and Shepard 1936; Mera 1933). Only two glaze ware categories were used in this study. Most specimens were unpainted, red-slipped sherds that were clearly derived from glaze ware vessels and were categorized as unpainted red body glaze ware. The second type was defined by rim shape and consisted of two specimens of Largo Glaze Polychrome based on a fairly even rim profile that was slightly flattened toward the base of the rim (Fig. 19.3). Decorations were applied to a yellow slip and occur on both exterior and interior surfaces. Designs consisted of a combination of solid triangles and step triangles executed in red mineral paint and outlined in black glaze paint.

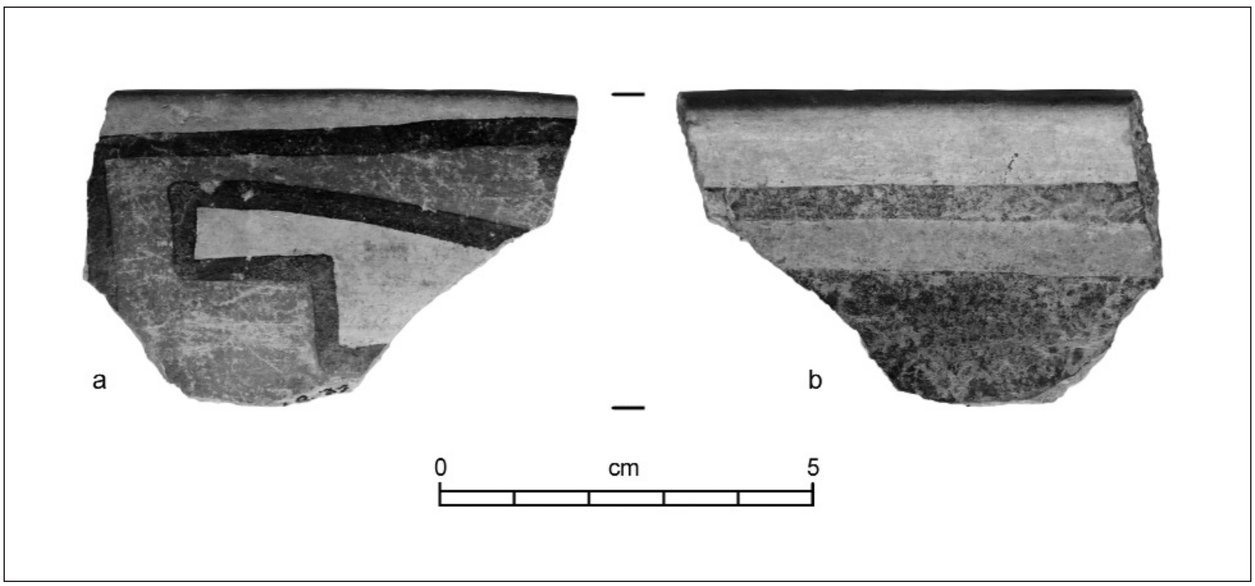


Figure 19.3. Largo Glaze Polychrome bowl sherds from LA 66288: (a) interior; (b) exterior.

Ceramic Trends

Information on the distribution of ceramic types and traits from six sites excavated during this study provide clues about period of occupation, cultural affiliation, patterns of vessel production and exchange, and the way in which pottery was used at different types of sites. Most of the pottery from these sites are types that commonly dominate Classic period assemblages in the Northern Rio Grande (Table 19.1). White ware assemblages from all six sites in this sample were dominated by Biscuit B, though Biscuit A is often present in much lower frequencies. Utility wares are dominated by highly micaceous types that appear to mostly represent Sapawe Micaceous-Washboard vessels, though a few sherds classified as Potsuwi'i Incised and Classic nonmicaceous gray also occur. Glaze ware types including Largo Glaze Polychrome were found at one site.

This combination of types is indicative of occupations dating to the later half of the Classic period. Dating schemes proposed for Biscuit B vary, but taken together they indicate a possible range beginning just after 1400 and lasting until about 1550 and possibly as late as 1600 (Breternitz 1966; Harlow 1973; Lang 1997; Orcutt 1999b; Smiley 1951; Wendorf 1953b). Similar pottery types and vessel forms occur at other Late Classic period sites in the Chama Valley (Fallon and Wening 1987; Hewett 1938; Jeançon 1923; Wendorf 1953b). Potsuwi'i Incised tends to be present in assemblages containing Biscuit B and Sapawe Micaceous-Washboard, but it is rare. The only other dated type in these assemblages is Largo Glaze Polychrome, which appears to date to the fifteenth century (Franklin 1997). Thus, most ceramic types identified in assemblages from these sites indicate occupations ca. A.D. 1450–1550.

The only ceramic evidence of another occupational period is the presence of a small number of historic sherds in an otherwise Classic period assemblage at LA 105710 (Table 19.1). This is not surprising since this site contained Classic period materials washing downslope from Hilltop Pueblo (LA 66288) as well as historic structures.

Ceramic-Related Trends

The ceramic assemblages from these sites contain gray wares and white wares that are typical of Late Classic period occupations through much of the Chama Valley and associated drainages (Fallon and Wening 1987; Hewitt 1938; Hibben 1937). Local production of these very distinct wares reflects the culmination of prehistoric Northern Rio Grande pottery manufacturing technology. Despite the very different combination of traits noted in sherds assigned to these wares, the various types included in each ware exhibit little variation in paste and stylistic characteristics. These intergroup similarities and intragroup differences ultimately reflect interrelated aspects of various conventions associated with the production and use of ceramic vessels, including perceived identity and affiliation, relationships and interaction between groups occupying different areas, and use of ceramic vessels in the overall economic system (Blinman 1988; Pool 1992). For example, as the way in which ceramic vessels were used in various tasks changed, it influenced the development of traditions and manufacturing techniques that were associated with the various wares. These developments may have influenced interaction and exchange between groups who shared complex technologies and decorative styles as well as the exchange of elaborate pottery forms that may have only been produced in one specific area. Thus, much of the remaining discussion will focus on variation between the different ware groups (Table 19.2).

Except for the three glaze ware sherds that appear to have been produced in areas south of Santa Fe, all decorated sherds in our sample seem to be fragments of biscuit ware vessels. While the production of biscuit wares represents a continuation of the use of self-tempered volcanic clays that began during the Late Developmental and Coalition periods, more specific and distinct types of clays were selected for the production of biscuit wares. These clays tended to be very porous, contained extremely fine ash inclusions (Table 19.3), and could be successfully fired at lower temperatures than were possible for earlier pottery types. This combination of porosity and lower firing temperatures allowed decorations executed in organic paint to be retained, even in slightly oxidizing atmospheres. The dominance of decorated bowls in this type suggests that the manufacture of biscuit wares focused on the production of vessels that could be used for serving and consumption.

As part of this study, clays were collected from a probable prehistoric clay mine excavated into a weathered ash flow south of Posi'ouinge, just a few kilometers from many of the sites examined during this project. Types of inclu-

Table 19.3. White ware temper types by site (count and column percentage)

Temper Type	LA 66288	LA 105703	LA 105708	LA 105709	LA 105710	LA 118547	Total
Highly micaceous paste	-	-	4	-	-	-	4
	-	-	3.1%	-	-	-	0.3%
Tuff/ash	2	-	1	-	5	-	8
	0.3%	-	0.8%	-	1.2%	-	0.6%
Fine tuff and sand	673	44	126	34	411	11	1299
	99.6%	100.0%	96.2%	100.0%	98.8%	100.0%	99.0%
Ash (vitric tuff)	1	-	-	-	-	-	1
	0.1%	-	-	-	-	-	0.1%
Total	676	44	131	34	416	11	1312

sions, color when refired, and overall appearance of the clay all appear to be identical to those used in biscuit wares. Like the biscuit ware clays, this material is extremely porous and fires to similar pink colors. Inclusions consist of fine tuff with sand identical to the temper seen in the biscuit wares from our sites (Table 19.3) and the surrounding area. Most biscuit ware sherds from our sites were fragments of thick bowls, though some jars are also represented (Table 19.4). Most of these sherds are thick and exhibit surface treatments and decorative styles characteristic of Biscuit B. The similarity of the clay from the probable mine to the sherds in our study suggest that the late biscuit wares (at least) were manufactured from specific clays occurring in weathered ash deposits.

The vast majority of the utility wares examined during this study also seem to reflect the use of very specific resources and manufacturing techniques. The earliest gray wares produced in the Tewa Basin and adjacent parts of the Northern Rio Grande were tempered with micaceous granite (Anderson 1999; McNutt 1969; Warren 1979). This basic technology continued into the Classic period, when the gray wares reflect use of highly micaceous alluvial clays and crushed granite temper, which is the dominant temper in the gray wares recovered from our sites (Table 19.5). By the Classic period, Northern Rio Grande micaceous wares were dominated by distinct types like Sapawe Micaceous-Washboard. The paste of this type tends to contain more mica than earlier gray wares, fires to the same range of red to yellow as micaceous alluvial clays collected along the Rio Chama and Rio Grande, and has a similar texture. Thus, those deposits appear to be the source of clays used to make gray utility wares in this region. Low-relief surface textures were created by smearing the coils. Vessel walls are usually very thin, and most sherds of this type identified in our study are from jars (Table 19.6). Mica inclusions in the temper may have increased the durability of vessels for cooking. These utility wares reflect a focus on the production of cooking and storage vessels.

Thus, different techniques were used to manufacture the white wares and gray utility wares from our sites. Each was made from a different type of clay, and each was tempered with different materials. Self-tempering clays forming in

Table 19.4. White ware vessel form by site (count and column percentage)

Vessel Form	LA 66288	LA 105703	LA 105708	LA 105709	LA 105710	LA 118547	Total
Indeterminate	16	9	-	-	1	-	26
	2.4%	20.5%	-	-	0.2%	-	2.0%
Bowl rim	13	-	-	-	2	-	15
	1.9%	-	-	-	0.5%	-	1.1%
Bowl body	568	29	131	28	385	11	1152
	84.0%	65.9%	100.0%	82.4%	92.5%	100.0%	87.8%
Seed jar	2	-	-	-	-	-	2
	0.3%	-	-	-	-	-	0.2%
Jar neck	1	-	-	-	-	-	1
	0.1%	-	-	-	-	-	0.1%
Jar rim	-	-	-	-	2	-	2
	-	-	-	-	0.5%	-	0.2%
Jar body	29	5	-	-	12	-	46
	4.3%	11.4%	-	-	2.9%	-	3.5%
Dipper with handle	-	-	-	-	1	-	1
	-	-	-	-	0.2%	-	0.1%
Curved pipe	1	-	-	-	-	-	1
	0.1%	-	-	-	-	-	0.1%
Flared bowl rim	46	1	-	6	13	-	66
	6.8%	2.3%	-	17.6%	3.1%	-	5.0%
Total	676	44	131	34	416	11	1312
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 19.5. Gray ware temper type by site (count and column percentage)

Temper Type	LA 66288	LA 105703	LA 105708	LA 105709	LA 105710	Total
Sand	-	-	7	-	8	15
	-	-	14.0%	-	1.5%	0.9%
Granite and mica	2	-	-	-	3	5
	0.2%	-	-	-	0.6%	0.3%
Granite	9	-	-	-	-	9
	0.8%	-	-	-	-	0.5%
Highly micaceous paste	1167	3	43	1	507	1721
	98.5%	100.0%	86.0%	100.0%	97.9%	98.0%
Sherd	3	-	-	-	-	3
	0.3%	-	-	-	-	0.2%
Fine tuff and sand	3	-	-	-	-	3
	0.3%	-	-	-	-	0.2%
Dark sand	1	-	-	-	-	1
	0.1%	-	-	-	-	0.1%
Total	1185	3	50	1	518	1757
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 19.6. Gray ware vessel form by site (count and column percentage)

Vessel Form	LA 66288	LA 105703	LA 105708	LA 105709	LA 105710	Totals
Indeterminate	23	-	-	-	-	23
	1.9%	-	-	-	-	1.3%
Bowl body	6	-	-	-	-	6
	0.5%	-	-	-	-	0.3%
Jar neck	100	-	1	-	32	133
	8.4%	-	2.0%	-	6.2%	7.6%
Jar rim	17	-	-	-	8	25
	1.4%	-	-	-	1.5%	1.4%
Jar body	1039	3	49	1	478	1570
	87.7%	100.0%	98.0%	100.0%	92.3%	89.4%
Totals	1185	3	50	1	518	1757
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

weathered volcanic ash were used for the manufacture of white wares, while micaceous alluvial clays with added granitic temper were used for the gray wares. Both surfaces of white ware vessels were smoothed and often polished. Slips were applied to one or more of the smoothed surfaces, and decorative motifs were created using an organic paint. In contrast, only the inner surface of gray ware vessels was completely smoothed, and the outer surface was textured by partly obliterating the coils.

These distinct manufacturing techniques are indicative of the range of pottery that was required in daily activities: vessels for cooking and storage, as well as those for serving and consumption. Both clay types were probably widely available to potters in the Gavilan area and elsewhere in the Northern Rio Grande. Though both wares seem to have been manufactured in the same area, given the specialized nature of the manufacturing techniques associated with them, it is possible that the different wares were made by potters from different households or villages. The only pottery recovered from our sites that was clearly not produced in the Gavilan area were the glaze wares, which reflect limited exchange with groups to the south.

Though the consistent occurrence of similar pottery types at our sites indicates that they date to the same occupational period, the proportions of assemblages comprised of the different ware groups varied significantly. Given the small size of the area excavated at the two habitation sites, the number of sherds recovered from each was fairly large: 1,864 sherds were recovered LA 66288 and 940 from LA 105710. Most of the pottery from these sites consisted of sherds from gray ware jars, which comprised 63.6 percent of the LA 66288 assemblage and 55.1 percent of the LA 105710 assemblage. Very different distributions were noted for the four farming sites from which pottery was recovered. Biscuit wares comprised 93.6 percent of the sherds recovered from LA 105703, 72.4 percent of the LA 105708 assemblage, 97.1 percent of the sherds from LA 105709, and 100 percent of the small assemblage from LA 118547. Similar trends were noted at other farming sites in the Northern Rio Grande, which are also dominated by biscuit wares (Mensel in prep.; Wilson in prep.).

These proportional differences suggest that pottery was used differently on different types of sites. The dominance of gray ware cooking jars combined with a high percentage of biscuit wares (of various vessel forms) indicates that pottery was used in a wide range of activities at habitation sites. In contrast, the dominance of biscuit ware bowl sherds at farming sites was initially difficult to explain, since there seemed to be no good reason why bowls were more desirable than other forms.

A cache of three ceramic tools made from fragments of a single Biscuit B bowl provided important clues concerning the use of pottery at the farming sites (Fig. 19.4). These items were found together under a small boulder in a gravel-mulched field at LA 105709. The largest measured about 20 by 12 cm and had fairly straight edges, one of which was an unworked rim. This tool was somewhat rectangular, though one end was wider. Sharp angles between modified edges formed points that could have been used for digging. The second tool measured 13 by 11 cm, had curved edges, and was roughly oval in shape. At least one edge exhibited wear from heavy use that included spalling on the exterior surface. The third tool was rectangular in shape and measured 14 by 9 cm. Each edge was fairly straight and exhibited heavy wear from use, including one that was originally a rim. Evidence of heavy use was not only indicated by wear along edges, there was also spalling on the interior surface and breakage along the most heavily used sections of the tool.

These tools were probably used as scoops or shovels in gravel-mulched fields. A review of photographs and descriptions of biscuit ware sherds from similar sites in the region indicates that this type of usage may have been widespread (Lang 1997). There were probably several reasons that biscuit wares were selected for this use rather than utility wares. Utility wares were not well suited to this use because they were comparatively thin, brittle, and easy to break. In contrast, though biscuit wares are usually soft, they were thicker and less brittle, and therefore less likely to fracture while being used for scooping or shoveling. While some biscuit ware sherds recovered from other contexts were shaped, many were not. The former probably represent sections of ceramic scoops/shovels, while the latter may be parts of broken tools that do not include sections of edges or were not used extensively enough to cause distinct shaping or wear.

Conclusions

Variation in the makeup of ceramic assemblages from Late Classic period sites in the Ojo Caliente Valley indicates that pottery was used in different activities at habitation versus farming sites. Ceramic vessels were used in a variety of tasks at habitation sites that included cooking, storage, serving, and consumption. This balance of activities usually resulted in assemblages that were dominated by utility ware jars and contained a significantly lower percentage of decorated biscuit ware bowls. In contrast, the small ceramic assemblages recovered from features on farming sites are dominated by sherds from biscuit ware bowls. The recovery of three ceramic scoops or shovels from a cache in a field at LA 105709 provided a possible explanation for this discrepancy. The greater durability of biscuit ware sherds apparently made them more suitable for this type of use, leading to their dominance on fields in comparison to the utility wares.

Figure 19.4. Ceramic tools recovered from a cache at LA 105709.

Chapter 20. Faunal Remains

Susan M. Moga

Faunal remains were collected from three of the eight sites excavated at Gavilan. Only one piece of bone was recovered from a prehistoric farming site (LA 118547) dating to the Classic period. Some bone from Hilltop Pueblo (LA 66288), which dates to the same time period, probably washed down a hilltop into the north end of LA 105710, creating a multicomponent site. Only a moderate amount of bone was recovered from these two sites: 21 pieces from LA 66288, and 93 from LA 105710.

Analysis Methods

A complete analysis was performed on the 115 bones recovered from the Gavilan sites. Every bone from a provenience was assigned a field specimen number in the field and an additional lot number during analysis for individual identification. Faunal information was recorded using an established coding format that records the taxon; count; age of the animal; element (body part); side; portion of the bone represented; environmental, animal, thermal alteration; and potential processing and modification information.

When bones are extremely fragmented, bone can only be distinguished as indeterminate taxa and portions of long bones, flat bones, or undetermined elements. Long-bone fragments include all tubular bones (e.g., tibia, femur, humerus), as well as metatarsals, ribs, and phalanges. Flat bone fragments are from the cranium, sternum, vertebrae, innominate, carpals, tarsals, and scapula. Some elements fragment in such a way that it is difficult to determine whether they come from long or flat bones. These are classified as indeterminate elements.

Specimens are aged according to size, compact tissue porosity, and epiphyseal union. The age range choices include: newborn or fetal-neonate, where the element is less than one-third mature size, unfused, and extremely porous; immature, where bones are less than two-thirds mature size, somewhat porous, and unfused; juvenile, where bones are two-thirds to mature size and the epiphysis is partially attached to the shaft or completely separated; and mature, where elements are full size and completely fused.

Animal, environmental, and thermal conditions affect bone. These alterations are individually outlined in the taphonomy section of this chapter. Evidence of human processing and modification of the bone are also discussed later in the text. Faunal identifications were made using the Office of Archaeological Studies comparative collections. Works on New Mexico fauna (Bailey 197l; Findley et al. 1975) were consulted to determine which wild species inhabited the site area.

Taxa Recovered

Unidentifiable mammal remains dominate the faunal assemblage, with few domesticated and wild animals (Table 20.1). Frequencies and descriptions are provided for each taxon represented. In this analysis, the MNI (minimum number of individuals) is the estimated number of animals from an identified taxon in the assemblage.

Unidentified Taxa

Most of the bones recovered from these sites are highly fragmented and could only be categorized by size of the animal (Table 20.1). The categories of unidentified taxa found include small mammal (n = 1), small to medium mammal (n = 1), medium to large mammal (n = 19), and large mammal (n = 27). A single very large mammal bone came from the vicinity of the historic structure, and it could be cow, horse, elk, or bison.

Canis sp. (Dog, Coyote, Wolf)

A fragmented humerus and lumbar vertebrae from a mature canid was recovered from LA

Table 20.1. Faunal bone by site (count and column percentage)

Taxon	Common Name	LA 66288	LA 105710	LA 118547
Small mammal	Rodent to jackrabbit size	1	-	-
		4.8%	-	-
Small-medium mammal	Rodent to dog size	-	1	-
		-	1.1%	-
Medium-large mammal	Dog to deer size	5	14	-
		23.8%	15.1%	-
Large mammal	Sheep to deer size	7	20	-
		33.3%	21.5%	-
Very large mammal	Cow, horse, elk size	-	1	-
		-	1.1%	-
Canis sp.	Dog, coyote, wolf	-	2	-
		-	2.2%	-
Canis latrans	Coyote	-	1	-
		-	1.1%	-
Small to medium artiodactyl	Sheep to deer size	-	10	-
		-	10.8%	-
Medium artiodactyl	Deer, pronghorn, bighorn sheep	6	17	-
		28.6%	18.3%	-
Large artiodactyl	Cow, horse, elk, bison	-	1	-
		-	1.1%	-
Cervidae	Deer or elk	-	1	-
		-	1.1%	-
Odocoileus hemionus	Mule deer	-	3	-
		-	3.2%	-
Antilocapra americana	Pronghorn	1	-	-
		4.8%	-	-
Bos taurus	Cattle	-	3	-
		-	3.2%	-
Ovis / Capra	Domestic sheep or goat	-	1	-
		-	1.1%	-
Equus caballus	Horse	-	1	-
		-	1.1%	-
Medium-large bird	Quail to turkey size	-	2	-
		-	2.2%	-
Very large bird	Turkey or larger	1	-	-
		4.8%	-	-
Buteo cf. *jamaicensis*	Red-tailed hawk	-	-	1
		-	-	100.0%
Gallus gallus	Domestic chicken	-	1	-
		-	1.1%	-
Eggshell	Bird eggshell	-	14	-
		-	15.1%	-
Total		21	93	1

105710. The specimens are similar in size and attributes to both dog and coyote. Both pieces exhibit soil pitting, and the humerus has a spiral fracture.

***Canis latrans* (Coyote)**

Coyotes inhabit all regions of New Mexico and occupy dens dug into the ground (Findley et al. l975:281–282). A root-etched but complete second metacarpal from a mature individual was recovered from LA 105710.

Small to Medium Artiodactyl

Indeterminate bone fragments that resemble animals ranging in size from sheep to deer are included in this category. These fragments (n = 10) are from mature individuals and could be from wild or domesticated animals, since both are present in the prehistoric and historic components at LA 105710. Two of the bone fragments are calcined (burned white).

Medium Artiodactyl

Medium artiodactyl fragments were recovered from LA 66288 (n = 6) and LA 105710 (n = 17). Artiodactyls in this size range include deer, pronghorn, bighorn sheep, as well as large varieties of domestic sheep, goat, and pig. The LA 66288 assemblage includes fragments (n = 6) of long and flat bones, a rib, and a phalanx, all from mature artiodactyls. All of these bones are weathered, pitted, or exfoliated. The bone fragments from LA 105710 are also from mature artiodactyls and include long and flat bones and fragments of a tooth, a mandible, vertebrae, a rib, and an astragalus. One bone is rodent gnawed and another is scatological. Thirteen bones are environmentally altered, either through pitting, exfoliation, or root etching. A spiral fracture was noted on a long-bone fragment.

Large Artiodactyl

Large artiodactyls include elk, cattle, bison, and horse-sized animals. A fragmented rib from a mature individual was the only specimen in this size range recovered from LA 105710. It came from either a wild or domesticated artiodactyl. Abrasion from scraping or butchering is visible on a portion of the rib.

***Cervidae* (Deer or Elk)**

An antler fragment from a deer or elk was assigned to the Cervidae category. This single specimen from a mature individual was heavily exfoliated and was found in a trench at LA 105710. Both species inhabit the area, so it could belong to either animal. The antler could have been brought to the site as residue from a hunting excursion or as a manuport.

***Odocoileus hemionus* (Mule Deer)**

Mule deer range throughout most of New Mexico, except for the eastern grasslands (Findley et al. 1975:328). Portions of a mature mule deer were recovered from LA 105710, including fragments of a mandible (n = 2) and a tibia.

***Antilocapra americana* (Pronghorn)**

Pronghorns inhabit arid and semiarid grasslands throughout New Mexico (Findley et al. 1975:333–334). Half of a calcaneum from a mature individual was found at LA 66288.

***Bos taurus* (Cattle)**

The Spaniards brought cattle into New Mexico in 1598, but it took almost 200 years to get them established. It was not until 1880, when the railroad was built through New Mexico, that cattle began to be shipped from Texas to the remote areas of New Mexico. This new industry soon became very lucrative, causing the value of sheep to rapidly decline (Carlson l969:26, 35). A few fragmented cow bones (n = 3) were recovered from LA 105710. Elements include two pieces of a mandible and a portion of a metacarpal, all of which exhibit exfoliation and pitting.

***Ovis/Capra* (Domestic Sheep or Goat)**

New Mexican missions were provided with sheep, which were used for meat and wool. In turn, the missionaries taught the practice of sheep husbandry to the Pueblo Indians (Carlson l969:26). The vast rangelands of New Mexico were eventually exploited by the sheep industry as the demand for meat dramatically increased in the West. The California gold rush drew men by the thousands to work in the mines. They needed to be fed, so the production of mutton became a lucrative business for New Mexican ranchers (Carlson 1969:28). Starting in 1849, flocks of up to 25,000 sheep were driven to California from New Mexican ranches. By 1860 the sheep trade completely subsided because of hostilities and raiding by the Navajos and Apaches. The hostilities ceased by 1880, and the sheep population in New Mexico increased to approximately four million (Carlson 1969:28, 31, 34).

Goats, which were also introduced into New Mexico by the Spaniards, are heartier than sheep and can survive on diverse terrain with minimal supervision. Goat by-products such as milk, cheese, butter, and meat were additional assets to Spanish households (Scurlock 1998:8–11). Male goats were used as "point goats" or leaders of sheep flocks, because they were more dependable than rams and vocalize warnings when intruders approach. A single black goat, called a *marcadero* (marker) was stationed among every 100 sheep to help herders keep track of their flocks (Scurlock 1998:9–10).

By the early 1900s sheep and goats had severely overgrazed the rangelands of New Mexico and Arizona. Much of this land was eventually designated as national forest by the United States government. Residents living near national forest land were asked to replace their flocks with cattle. Permitting of animals on national forest land continued for another 50 years before it was discontinued in 1972 because of extreme environmental damage (Scurlock 1998:17.19). Sheep and goat bones are difficult to distinguish osteologically, so with the exception of a few elements, they are usually categorized as sheep or goat (Bossneck l970:331). Only one element, a scaphoid from a mature sheep or goat, was recovered from LA 105710.

Equus caballus (Horse)

A horse herd of approximately 1,350 head was introduced into New Mexico by Oñate during his l598 expedition. It is believed that Old World livestock did not occur in New Mexico before his arrival (Baxter l993:101–103). A complete vestigial metapodial from a mature horse, which displays pitting, was found at LA 105710.

Medium to Large Bird

Highly fragmented pieces of bird bone (n = 2) from LA 105710 could belong to a medium or large bird. Considering the prehistoric/historic components at the site, they could be wild bird, chicken, or a small turkey. The bones are from a mature individual. One bone is exfoliated and the other is root-etched.

Very Large Bird

A fragment of a femur from a bird that is turkey-sized or larger was recovered from LA 66288. This fragment is from a mature individual and displays root etching.

Buteo cf. *jamaicensis* (Red-tailed Hawk)

Red-tailed hawks are the most widely distributed of the *Buteo* hawks in New Mexico. They prey on rodents, squirrels, and rabbits (Lignon l96l:64). A talon from a large hawk, probably a red-tailed, was recovered from a gravel-mulched field at LA 118547. It is from a mature bird and is heavily sun-bleached.

Gallus gallus (Domestic Chicken)

Chickens are domesticated fowl that have descended from the wild jungle fowl of Asia (Hargrave l972:16). Juan de Oñate probably brought chickens along with other domesticated animals during his settlement of New Mexico in 1598. A complete chicken femur was recovered from the prehistoric/historic component at LA l05710. It is from a mature individual, and is slightly root-etched.

Eggshell

Fragments of eggshell (n = 14) were recovered from LA 105710. There is no way to determine whether they came from one egg or several. Because a chicken femur was found at the site, the eggshell is probably chicken.

Taphonomy

The natural processes that affect the condition of bone are collectively referred to as taphonomic processes (Lyman l994:1). These processes can be environmental, animal, or thermal. Each process affects a percentage of the bone in this assemblage.

Environmental Alteration

Environmental variables recorded in this assemblage include pitting, sun-bleaching, exfoliation, and root etching (Table 20.2). A good portion (n = 51, or 44.3 percent) of the faunal assemblage displays pitting, which is caused by soil erosion affecting the exterior surface of the bone. Exposure to sun causes bone to dehydrate, splinter, and turn white. The claw from a red-tailed hawk found at LA 118547 is sun-bleached. A good number (n = 18, or 15.6 percent) of bones are exfoliated, the external compact tissue has fine cracked lines, and the tissue flakes away from the bone. Root etching was observed on 12 bones (10.4 percent). Plant roots excrete humic acid, and when they come in contact with bone, the bone dissolves. (Lyman 1994:375).

Animal Alteration

Types of alteration by animals recorded in the assemblage include scatological bone, tooth puncture marks, and gnawing by rodents and carnivores. These alterations only occur on bone from LA 105710. These specimens were recovered from the trash-filled store and lower levels of several excavated grids. Fauna from LA 66288 and LA 118547 had no animal alterations.

Table 20.2. Environmentally altered faunal bone (count)

Taxon	Pitted or Corroded	Checked or Exfoliated	Root-etched	Sun-bleached
LA 66288				
Small mammal	1	-	-	-
Medium-large mammal	4	-	-	-
Large mammal	6	1	-	-
Medium artiodactyl	5	1	-	-
Pronghorn	1	-	-	-
Very large bird	-	-	1	-
LA 105710				
Small-medium mammal	-	-	1	-
Medium-large mammal	6	2	1	
Large mammal	14	2	-	-
Very large mammal	1	-	-	-
Dog, coyote, wolf	2	-	-	-
Coyote	-	-	1	-
Small-medium artiodactyl	1	4	-	-
Medium artiodactyl	5	3	5	-
Large artiodactyl	-	-	1	-
Deer or elk	-	1	-	-
Mule deer	2	1	-	-
Cow	1	2	-	-
Domestic sheep or goat	1	-	-	-
Horse	1	-	-	-
Medium-large bird	-	1	1	-
Domestic chicken	-	-	1	-
LA 118547				
Red-tailed hawk	-	-	-	1
Total	51	18	12	1

Scatological bones have passed through the digestive tract of an animal. In this alteration, stomach acids produce a thinning of the bone table and smoothing of edges. Two fragments of long bones from a large mammal and a medium to large mammal, and an astragalus and a second phalanx from a medium artiodactyl were recorded as scatological. Two indeterminate fragments from a medium to large mammal may also be scatological.

Puncture marks are usually made by carnivores and are often found on the ends of bones. Carnivores start gnawing on the soft cancellous parts of bone, then on the shaft (Binford 1981:46). Only one puncture mark was visible on the end of a very large mammal long-bone fragment.

Short parallel grooves are incised on rodent-gnawed bone, and their dimensions will vary according to the size of the rodent (Fisher l995:40). Rodent gnawing was observed on one medium artiodactyl rib fragment.

Thermal Alteration

Calcined bone becomes white and has a chalky consistency when all the organic material in the bone is depleted (Lyman 1994:384–385). Four bones (3.5 percent) in the assemblage were affected by thermal activity. Individually excavated grids at LA 105710 contained two small to medium artiodactyl bones that were thermally altered, one flat and one long bone. Two medium to large mammal bones, one flat and one long, were calcined after being exposed to a high and continuous heat.

PROCESSING

Evidence of human processing is rather limited, but it may have been obscured by the environmental conditions that affected almost half of the assemblage. The few occurrences of processing came from LA 66288 and LA 105710. Transverse cuts (n = 1) and chop marks (n = 2) are visible on a few medium to large animal bones and probably resulted from dismembering carcasses. Spiral fractures (n = 5) are visible on bones from a medium to large mammal, a dog or coyote, a medium artiodactyl, and a very large bird. They can be intentional or result from unintentional human or animal trampling (Marshall 1989:19). Abrasion in the form of irregular scratch marks was apparent on one large artiodactyl rib.

MODIFICATION

A minute portion of a very large bird femur from LA 66288 exhibits modification. This bone has a spiral fracture as well as intentional cuts and grooves. Because it is so highly fragmented, it can only be classified as manufacturing debris or a small tool fragment, not as a specific tool.

DISCUSSION

The original research design divides the Gavilan sites into two groups: habitation sites (prehistoric and historic) and prehistoric agricultural sites (Wiseman and Ware l996:51). A historic store and the surrounding area at LA 105710 produced a variety of wild and domesticated animal remains, including dog or coyote, sheep or goat, cow, horse, and deer or elk. A number of eggshell fragments and bones from a chicken and a medium to large bird were recovered. Almost half of the fauna recovered from this site (n = 42, or 39.0 percent) came from the store, which was apparently used for trash disposal after abandonment. Refuse from Hilltop Pueblo (LA66228) washed down into the north end of LA105710, creating a multicomponent situation.

Some faunal remains were recovered from three test pits excavated at LA 105710, near the base of Hilltop Pueblo. The number of bones recovered was small (n = 21) but included a variety of species: unidentifiable small, medium, and large mammal, medium artiodactyl (deer, pronghorn, or bighorn sheep), pronghorn, and very large bird (turkey size or larger). These specimens were probably all of prehistoric derivation.

Nine prehistoric agricultural sites were examined during this project, but only LA 118547 produced bone: a talon from a large hawk, probably a red-tailed hawk, was recovered from Feature 15. The talon could have been left in the field by a human or carnivore and exposed long enough to become sun-bleached.

Too few faunal remains were recovered from these sites to allow us to determine any distinct patterns of procurement or consumption. Only eight bones display evidence of processing (chop or cut marks). Several fragments have spiral fractures, but it is difficult to determine whether they were intentional or occurred from natural processes. Trampling by cattle could also cause spiral fractures on exposed bones. Thus, butchering practices could not be defined.

Contemporary archaeological investigations in northwestern New Mexico have focused primarily on Abiquiu and El Rito. Less attention has been paid to the Ojo Caliente Valley (Wiseman and Ware l996:60). Faunal samples recovered from many of the sites excavated in these areas are minimal, with the exception of the historic Trujillo House (LA 59658) near Abiquiu. The large amount of bone (n = 18,043) from this site came from domestic species (91.8 percent). The species identified were comparable to those found in our assemblage: cattle, sheep or goat, horse, pig, chicken, and medium to large bird. Pig is the only domestic animal from this array that is missing from the Gavilan assemblage (109 pig bones were collected from the Trujillo House). Nondomestic species (8.2 percent) from the Trujillo House include deer, elk, squirrel, and rodents. The rodents (n = 200) were most likely postoccupational intruders or human commensals (Moore and Boyer 2004).

Testing at San Juan Pueblo (LA 59 and LA 60) in the early l990s produced only 15 pieces of animal bone from two test pits. All but fourteen specimens were identified as large mammal, and one was believed to be cattle, bison, or horse. All bones exhibit some degree of weathering (Lent and Goodman 1992:61).

When large enough and representative, faunal assemblages can reveal valuable dietary and butchering information regarding site inhabitants. The García store at Gavilan was in business for only a few years. Since the family resided across the road, it is unlikely that the bone recovered is a representative sample of their animal use, especially because debris from Hillside Pueblo contributed to the sample.

Chapter 21. Analysis of Euroamerican Artifacts from LA 105710

Natasha Williamson

The OAS uses a function-based analysis (Boyer et al. 1994), which we believe to be more flexible and more informative than other analytic approaches, such as those based on material types or simple inventories and date ranges. Each artifact was assigned to a functional category, and each category was subdivided into a series of types, each containing items of related, though often quite different, functions. Within each type, specific functions were assigned. This created a hierarchical framework, linking items at specific, general, and very general levels of relationship.

The function-based approach allowed comparisons between sites, which facilitated studies of ethnicity and site function. However, the analytic framework has evolved over the years and recently underwent a fairly extensive modification. This is the first analysis undertaken with the new system, which had as one of its goals a reduction in the percentage of artifacts included in the unassignable category. The major differences are found in the definition of activities included in the economy/production category; a recasting of the furnishings category to include heating, cooking, and fuel-related artifacts as a new type; the description of ceramic ware decoration; and the inclusion of activities and artifacts not previously considered historic but which are becoming so, such as entertainment systems. Nor did we formerly have any way to categorize artifacts usually considered prehistoric but which sometimes occur on historic sites as well, such as chipped stone implements or glass chipped for use as tools. This lack has been rectified, and an entirely new category was created for communication devices.

Certain economic activities important in New Mexico history had also been invisible because the associated artifacts were left unclassified. Thus, wool production, pottery and jewelry making, and the above-mentioned chipped stone technology were added to the economy/production category. Another oddity of the former system was that all artifacts related to horses, oxen, and mules were assigned to the economy/production category, at the expense of recognizing their specific function in transportation. Therefore, an animal power type was added to the transportation category. This allowed a distinction to be made between stock supplies and animal husbandry tools (which were left in the economy/production category) and harness and shoes (which allowed the animal to do its job and belonged in the transportation category).

Another aim of the reorganization was to eliminate certain logical absurdities, which will creep into any analytic system. For instance, coal was previously placed in the unassignable category because there was no other place to put it. Yet coal in an archaeological context has only one function, fuel for heating and/or cooking. This led to the creation of a new type—heating, cooking, and lighting—which now contains coal and other materials related to this function. In the former version, arms and ammunition were included in the economy/production category because they were used for hunting, which produced the absurdity of a cannonball's being considered a means of economic production. Nor was there a way to categorize other military equipment, which usually ended up in the personal effects category if it came off the man, or the economy and production category if it came off the horse. Yet New Mexico has a long military history that was essentially invisible under the previous system. Therefore, arms and ammunition were removed from the economy/production category and combined with explosives and military accouterments to make a new category—arms, explosives, and military.

It is hoped that the new system more accurately reflects the range of human activity, but of course it complicates the comparison of sites analyzed under the different systems. The present site, LA 105710, is unusual in that one component was a small commercial establishment, the García store. The following discussion focuses on the García store rather than the site as a whole. Since such a site has never before been analyzed under this system, comparisons are not a concern.

Methodology

Minimal processing was performed on historic artifacts prior to analysis. Dry brushing with toothbrushes to remove most of the adhering soil was the usual method of cleaning. Glass was occasionally rinsed in water. When necessary, metal artifacts were rinsed in clear water and sometimes scraped gently with a dental pick to remove any encrustations. If warranted, usually to examine lettering, metal objects were immersed in a mild Sparex solution to remove severe corrosion.

Some 25 variables were monitored during analysis, including material type, manufacturer and brand, size, evidence of aging, color, condition or modification, shape, reuse, decorative techniques and design styles, reconstructability, etc. In the case of ceramics, paste and ware were monitored, as were decorative techniques and design. Comparative collections were used where possible. Otherwise, antique catalogues, books for collectors, resources of the public library, and the Internet were used to identify unusual artifacts or obtain dates for companies, brands, and manufacturing techniques.

Euroamerican Artifacts from LA 105710

A total of 1,623 artifacts were available for analysis, excepting adobe samples. Artifacts belonging to all functional categories except economy/production and communication were present, although most occurred in small percentages, as shown in Table 21.1. Table 21.2 displays the functional types occurring in each category. The various categories are discussed separately below, where additional tables display the functions and fragments recorded for each type. This presentation format allows us to ask different questions about the data in each category and design tables presenting that information.

Numerous artifacts show some degree of burning. The variable that allows us to monitor burning, among other things, is condition, which was recorded for 1,538 (94.8 percent) artifacts. Of the artifacts for which condition could be determined, 1.0 percent were burned, melted, or crazed, and another 40 percent had multiple modifications, usually including burning. In addition, 142 nails and pieces of hardware (9.2 percent of the artifacts with condition recorded) exhibited the condition we call "dissolved," wherein the individual iron fibers crack and expand outward from the central axis. This condition has generally been found to be associated with burning, although under the proper conditions, long, slow rusting might produce a similar effect. Thus at least 47.4 percent of the total assemblage exhibited some degree of heat alteration.

Table 21.1. Functional categories of Euroamerican artifacts, LA 105710 (count and column percentage)

Category	No.	Percent
Unassignable	349	21.5%
Foodstuffs	5	0.3%
Indulgences	16	1.0%
Domestic routine	24	1.5%
Furnishings	37	2.3%
Construction/maintenance	1,157	71.3%
Personal effects	12	0.7%
Transportation	5	0.3%
Arms/explosives/military	18	1.1%
Total	1,623	100.0%

Unassignable Category

Unassignable artifacts (Table 21.3) are always a large component of any historic assemblage, either because their fragmentary nature makes their function unidentifiable or because so many types of products formerly came in glass or metal containers that, without other distinguishing characteristics, no specific function can be assigned to the fragments available for analysis. No analyst can be familiar with the millions of types of artifacts produced during the technological explosion of the past two centuries. Oakes (1983) found that an average of 36.47 percent of artifacts from excavated historic sites in New Mexico could not be categorized by function, with a range of 18.67–39.09 percent. At 21.5 percent, our revamped analysis seems to have realized the goal of reducing the size of this category.

Most of the unassignable category artifacts are fragments of ferrous metal (n = 248) and glass (n = 83). The ferrous metal artifacts are almost all

Table 21.2. Type and category of artifacts at the García store (count and percentage of total assemblage)

Type	Unassignable		Foodstuffs		Indulgences		Domestic Routine		Furnishings		Construction/ Maintenance		Personal Effects		Transportation		Arms/Explosives/ Military		Total	%
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%		
Unassignable	349	21.5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	349	21.5%
Miscellaneous unidentifiable	-	-	2	0.1%	6	0.4%	1	0.1%	-	-	25	1.5%	-	-	-	-	-	-	34	2.1%
Canned goods	-	-	3	0.2%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.2%
Beer	-	-	-	-	3	0.2%	-	-	-	-	-	-	-	-	-	-	-	-	3	0.2%
Liquor	-	-	-	-	1	0.1%	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1%
Smoking	-	-	-	-	1	0.1%	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1%
Candy	-	-	-	-	5	0.3%	-	-	-	-	-	-	-	-	-	-	-	-	5	0.3%
Dishes	-	-	-	-	-	-	1	0.1%	-	-	-	-	-	-	-	-	-	-	1	0.1%
Glassware	-	-	-	-	-	-	2	0.1%	-	-	-	-	-	-	-	-	-	-	2	0.1%
Canning	-	-	-	-	-	-	20	1.2%	-	-	-	-	-	-	-	-	-	-	20	1.2%
Heating, cooking, lighting	-	-	-	-	-	-	-	-	37	2.3%	-	-	-	-	-	-	-	-	37	2.3%
Tools	-	-	-	-	-	-	-	-	-	-	2	0.1%	-	-	-	-	-	-	2	0.1%
Hardware	-	-	-	-	-	-	-	-	-	-	207	12.8%	-	-	-	-	-	-	207	12.8%
Building material	-	-	-	-	-	-	-	-	-	-	918	56.6%	-	-	-	-	-	-	918	56.6%
Electrical	-	-	-	-	-	-	-	-	-	-	3	0.2%	-	-	-	-	-	-	3	0.2%
Fencing	-	-	-	-	-	-	-	-	-	-	2	0.1%	-	-	-	-	-	-	2	0.1%
Clothing	-	-	-	-	-	-	-	-	-	-	-	-	6	0.4%	-	-	-	-	6	0.4%
Boots and shoes	-	-	-	-	-	-	-	-	-	-	-	-	4	0.2%	-	-	-	-	4	0.2%
Jewelry	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1%	-	-	-	-	1	0.1%
Money/tokens	-	-	-	-	-	-	-	-	-	-	-	-	1	0.1%	-	-	-	-	1	0.1%
Cars and trucks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.2%	-	-	3	0.2%
Animal power	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.1%	-	-	2	0.1%
Small arms	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	1.1%	18	1.1%
Total	349	21.5%	5	0.3%	16	1.0%	24	1.5%	37	2.3%	1157	71.3%	12	0.7%	5	0.3%	18	1.1%	1623	100.0%

Table 21.3. Unassignable artifacts by material type and function (count)

Material Type	Unassignable	Bottle	Can	Jar	Total
Aluminum	3	-	-	-	3
Cellophane	1	-	-	-	1
Glass	39	43	-	1	83
Paper	1	-	-	-	1
Rock	12	-	-	-	12
Rubber	1	-	-	-	1
Indeterminate coating on ferrous metal	4	-	5	-	9
Ferrous metal	111	1	126	1	239
Total	172	44	131	2	349

can fragments, and the glass artifacts are generally bottle fragments. While most of these artifacts probably belong in the foodstuffs category, this analysis erred on the side of caution and did not assign them to that category without some evidence of what they originally contained.

Another class of artifact represented in the unassignable category is mineral specimens (n = 12), including pumice, gypsum, quartz, scoria, and a few burned rocks. Although the scoria can be identified by function, i.e., highway maintenance, it was not recorded under construction/maintenance because it represents intrusive materials from activities that were not associated with the García store. The gypsum was probably related to whitewashing or plastering. The burned rocks, most of which are pebbles, are probably indicative of burning as a means of trash disposal.

Several other items in this category warrant further discussion. Eleven very thin glass shards are probably from a light bulb or kerosene lamp chimney. The glass ranges in thickness from 0.01 to 0.055 inches, with an average of 0.015 inches. The shards may well be associated with a light bulb base (and therefore could have been placed in the electrical type in the construction/maintenance category), but they were considered unassignable because we cannot be sure of this identification.

One unassignable item is of special interest. It consists of a portion of the base of a small rectangular bottle, probably paneled. The maker's mark, a single unadorned "A," is present. Unfortunately, several companies used this maker's mark. The Adams Co. (1861–91) did not make bottles, so it can be eliminated. John Agnew and Son (1854–1866) is a possibility, but the only product manufactured by that company that is mentioned by Toulouse (1971) is fruit jars. Arkansas Glass Container Corp. (1958–present) postdates the occupation of this site. The most likely candidate is P&J Arnold, Ltd., of London (1724–present), which used the solo A as a maker's mark between ca. 1890 and 1914. They are best known for ink bottles, particularly stone ones, but since this company is discussed in Toulouse (1971), one assumes that they made glass bottles as well. Of particular interest is the fact that their bottles were used for both regular ink and "duplicating ink." The latter was used to make pressed copies of documents prior to the introduction of carbon paper. This use may be indicative of the commercial nature of the García store. This item, like most other datable artifacts, seems to predate the store, although ink bottles were often refilled from a master ink bottle.

A hand-finished bead-and-ring bottleneck also predates the occupational span of the store, since it is made of manganese decolorized glass, and the finish was designed for use with a cork. Manganese makes glass turn amethyst over time, and its use in glass formulas generally ended around 1920. The finish, made with an improved lipping tool, probably dates between 1870 and 1915 (Deiss 1981). Another specimen represents part of the finish, neck, shoulder, and body of an amber bottle with a great deal of decorative molding. Unfortunately, none of the decoration was identifiable. This specimen may be from a bitters, fancy whiskey, or patent medicine bottle. It has a screw thread finish, added above what would have been a brandy finish on an earlier model, which may have been an effort to retain customer recognition of an earlier shape when the new finish was adopted. The thread appears to be the standard screw thread, which would date it after 1919–25 (Lief 1965).

As can be seen in Table 21.4, very little amethyst or aqua glass was found at the store. The preponderance of clear and brown glass is consistent with a date after 1930. The blue and multicolor categories in Table 21.4 represent one piece of cobalt blue glass and several fragments of a possible glass sign, which is discussed under the economy/production category.

Several metal fragments represent the remains of a large-diameter, squat can about 3 inches high that may have been a coffee can. Another specimen is a fragment of a large-diameter can lid, which was opened with an early type can opener.

Economy/Production Category

The economy/production category is interesting for its absence. Even though commercial establishment is a type within this category, nothing was found that could confidently be assigned to that type. However, there were several fragments of a piece of plate glass (unassigned category) that had applied-color in blue and red, and was then coated with a substance that rendered it barely translucent. The color is only visible through the untreated side. These shards are possibly part of a glass sign, perhaps designed to be lit from behind. The few pieces that were recovered exhibited no lettering to assist in identification. Had the fragments been assignable to the commercial establishment type, the economy/production category still would have constituted less than 0.5 percent of the total assemblage, which illustrates how elusive small-scale commercial activities can be in the archaeological record.

Foodstuffs Category

Foodstuffs are represented by a pint jar lid and parts of a meat can and a sardine can. The meat can is a soldered hole-in-top type, with a very wide and irregular soldered seam that exhibits small blobs. This type of can could predate the store by at least 5 years or as much as 40 years. The hole-in-top can went out of style about 1920, and the thick soldered seam was replaced by about 1880, except in home canning. Either way, this artifact must predate the store. It may be an old piece of road trash, since it comes from Level 1, 0–10 cm below the modern ground surface. The sardine can was evidently a three-piece can, but the entire top was removed by an unknown method. The virtual lack of items in the foodstuffs category supports the nonresidential nature of the site.

Table 21.4. Unassignable glass by color and function (count and sample percentage)

Function	Fragment	Aqua	Blue	Brown	Clear	Amethyst	Multicolor	Total
Unassignable	Unidentified	-	5	1	10	-	2	18
	Body	1	-	1	17	-	-	19
	Spall/flake	-	-	-	2	-	-	2
Bottle	Unidentified	-	-	3	5	1	-	9
	Base	-	-	-	1	-	-	1
	Body	-	-	3	12	-	-	15
	Finish	-	-	-	-	1	-	1
	Shoulder	1	1	4	7	-	-	13
	Base and body	-	-	-	1	-	-	1
	Lip	-	-	-	1	-	-	1
	Lip and neck	-	-	-	1	-	-	1
	Lip, neck, shoulder, and body	-	-	1	-	-	-	1
Jar	Base	1	-	-	-	-		1
Total		3	6	13	57	2	2	83
Percent		3.6%	7.2%	15.7%	68.7%	2.4%	2.4%	100.0%

Indulgences Category

The indulgence category contained some road trash, which was included in the analysis, but the dates were removed from the sample before calculating mean assemblage dates. The rest of this category included a tobacco tin that postdates the site, since it has an "invisible" hinge, which was introduced in 1948 (*Modern Packaging* 21[11], July 1948), and portions of several candy wrappers, all from the Curtiss Candy Company. The labels read PEPPERMINT PATTIE /CANDY/DELICIOUS FOOD/ENJOY SOME EVERY DAY. CURTISS CANDY CO. CHICAGO/ OTTO SCHNERING, PRESIDENT. We have given these items a 1916 beginning date, based on the founding of the company, which is still in business as part of Standard Brands, Inc. The Curtiss Company is more famous for its Baby Ruth candy bars and a lawsuit with Babe Ruth instigated by the name. One wrapper was virtually intact, and another was represented by a large fragment. Several aluminum foil remnants from the burned trash were probably also Peppermint Pattie wrappers. They may well represent items offered for sale in the store.

Domestic Routine Category

The domestic routine category was represented by canning jar sealer lids and screw bands. These fragments were all unassignable by manufacturer or brand, but based on the shape and remains of the sealant, they are probably from the Kerr seal system, which would give them a beginning date of 1915 (Toulouse 1971:307). Canning jars themselves have a beginning date of 1858, based on Mason's patent. The lack of jars, coupled with the presence of the sealing system, suggests that the latter items were offered for sale to people who already owned jars. Conversely, they may have been part of the foodstuffs brought for meals by the proprietor, who would have thrown away the nonreusable sealers and possible the bands as well.

Only one ceramic sherd was found, an eroded piece of undecorated white ware with a clear glaze. The erosion pattern, a series of small pits caused by the glaze spalling off, is very similar to that undergone by annular ware, a white ware type often found at nineteenth-century sites. Under microscopic examination, the paste is also very similar to that of annular ware. Although there is very little visual difference in pastes between annular ware and the later granite wares, the latter very seldom spall. This piece is of a thickness more common to annular ware. While a form of annular ware with a yellow paste was made until about 1930 (Noel-Hume 1972:131), it is not usually found in New Mexico, where the white paste variety is most often associated with sites dating to the Santa Fe Trail period (1821–80).

Glassware was represented by two pieces of a pressed glass vessel rim. The rim is very thick (0.163 inches), but the body of the vessel was even thicker (0.245 inches). Its diameter was about 8 cm (3.15 inches). The decoration consists of a molded sunburst with an impressed band below it. This specimen may be from a water tumbler or a decorative piece such as a vase or toothpick holder.

Furnishings Category

The furnishings category was represented by mica or isinglass fragments that are probably from a heating stove, a common fixture in a country store. Ethnographic interviews indicated that the store did have a stove.

Construction/Maintenance Category

The construction/maintenance category percentage is unusually high for an adobe structure (Table 21.1) and probably reflects demolition of the building. Almost half of these artifacts (47.8 percent) are tar paper fragments (Table 21.5). Even with these items removed from consideration, nearly half of the assemblage falls into the construction/maintenance category, which is very high for an adobe structure. Window glass was also very common, comprising 25.1 percent of the total assemblage.

Only one tool was recovered, a screwdriver with a handle and blade made of iron. No reference to solid iron screwdrivers has been found, although Sears and Roebuck offered a cast-iron hammer around the turn of the last century that was called "strictly no good" (Israel 1968:78). Perhaps the screwdriver was discarded for the same reason. The handle was completely separat-

Table 21.5. Construction/maintenance artifacts from the García store (count and sample percentage)

Type	Function	Fragment	No.	Percent
Unidentifiable	Wire	strand	25	2.2%
Tools	Screwdriver, slot	handle	1	0.1%
	Screwdriver, slot	point and shank	1	0.1%
Hardware	Bolt, indeterminate	whole	1	0.1%
	Bolt, indeterminate	threads	1	0.1%
	Bolt, stove	whole	1	0.1%
	Nail, roofing	whole	45	3.9%
		head	8	0.7%
		point and shank	8	0.7%
		head and shank	4	0.3%
	Nail, barbed roofing	whole	12	1.0%
		shank	1	0.1%
		head	4	0.3%
		point and shank	1	0.1%
	Nail, indeterminate	whole	1	0.1%
	Nail, indeterminate wire	whole	16	1.4%
		shank	33	2.9%
		shank fragments	10	0.9%
		head	14	1.2%
		point and shank	14	1.2%
		head and shank	5	0.4%
	Nail, box	whole	5	0.4%
	Nut	whole	1	0.1%
	Washer, lock	whole	1	0.1%
	Nail, common	whole	7	0.6%
		head and shank	1	0.1%
	Keyhole plate	whole	1	0.1%
	Tack, indeterminate	whole	1	0.1%
		head	2	0.2%
		head and shank	1	0.1%
	Nail, casing	head and shank	1	0.1%
	Tack, gimp	whole	1	0.1%
		shank	1	0.1%
		head	1	0.1%
	Screw, sheet metal	whole	1	0.1%
	Screw, oval head flat	whole	2	0.2%
	Nail, flooring	head and shank	1	0.1%
Building material	Unidentifiable	unidentifiable	3	0.3%
	Brick	whole	1	0.1%
		body	3	0.3%
		spall/flake/fragment	7	0.6%
	Linoleum	scrap	2	0.2%
	Plaster	spall/flake/fragment	40	3.5%
	Roofing tar	scrap	7	0.6%
	Window glass	shard	290	25.1%
	Viga	body	2	0.2%
	Putty	spall/flake/fragment	8	0.7%
	Roofing felt	scrap	554	47.9%
	Fire brick	whole	1	0.1%
Electrical	Connector loop	whole	1	0.1%
	Light bulb	base	1	0.1%
	Uninsulated copper wire	strand	1	0.1%
Fencing	Staple	whole	1	0.1%
	Gate hook	whole	1	0.1%
Total			1157	100.0%

ed from the shank at the time of analysis and in needle-sized fragments.

The most common form of nail (n = 73+) in the assemblage was the roofing tack, two varieties of which (American felt and large head barb) were recovered. No date was available for either variety, although the barbed type at least is known to date from the 1890s (Israel 1968:23). As expected, there were few nails and, of those recovered, none were larger than 16 penny. Only 21 of the 50 nails recorded were assignable to a pennyweight because of the extreme degree of dissolution. Roofing tacks do not appear in the pennyweight chart because they are sold by length. While the assemblage of galvanized roofing tacks did undergo some dissolution, in general they are in much better condition than the nails. The smaller sizes shown in Table 21.6 may represent nails used in packing crates, window moldings, door frames, or counters and shelves.

Table 21.6. Type and pennyweight of nails from the García store

Type	2	3	3.5	4	6	7	8	9	10	12	16	Total
Nail, indeterminate	-	-	-	-	1	-	-	-	-	-	-	1
Nail, indeterminate wire	-	-	1	1	1	1	3	1	2	1	-	11
Nail, box	1	1	-	-	-	-	1	-	-	-	-	3
Nail, common	-	-	-	-	-	-	1	2	-	1	2	6
Total	1	1	1	1	2	1	5	3	2	2	2	21

An elderly interviewee suggested that the roofing paper may have covered the floor of the store. Tar paper does indeed make a good and surprisingly long-lasting covering for a dirt floor, but it must be nailed into the dirt to be effective. No nails were found in situ in the floor, nor would the roofing tacks—the only type of nail present in any quantity—have had sufficient holding power to keep the tar paper in place. The excavators first thought that two locations on the floor contained adobe patches over slumped areas. In one of these locations, tar paper fragments were found under the adobe patch. However, the adobe was pinkish, like the plaster used on adjacent walls. What is more likely is that the roof was removed, littering the inside of the structure with tar paper fragments, then rain-caused erosion pulled adobe and plaster off the walls, depositing it in slumped and low areas. Thus, there is no direct evidence for the use of tar paper as a floor covering.

The only other item of interest in this category is the base of a 30 watt light bulb, composed of a copper shell and either a graphite or hard rubber liner. It bears several legends embossed into the rubber, including "5.27 ????/ PENDING" and the letters NE, which may be part of the word ONE or NEW. Other letters are visible but no longer distinguishable. The PENDING is no doubt PAT. PENDING, probably for a new type of base. There was also a connector loop and some very fine wire cable that may or may not be electrical in nature.

Overall, the construction/maintenance category provided little interpretable information, considering the large number of artifacts in it. The presence of two kinds of fired brick at the site is interesting, since there is no indication that bricks were used in construction of the store. They may have formed part of the stove complex, as the firebrick suggests, or they may have been used for patching or propping up a counter, shelving, or other feature on the uneven dirt floor. The electric light bulb is a problematic artifact, since ethnographic interviews (see Chapter 25) indicated that the store had no electricity, nor were electrical supplies mentioned among the goods sold there. Either electricity was added later, or the light bulb came from another source, for example, having arrived at the site in a load of trash. The two scraps of linoleum could have arrived in the same way, or the proprietor may have had a linoleum piece behind the counter as a mat.

The interviews threw some light on roof construction techniques. The store had a shed roof covered with corrugated metal, no trace of which appears in the archaeological record, apart from one sheet metal screw, which may or may not have been part of the roof. The current practice for installing corrugated roofing involves laying down tar paper under the metal, and the practice may have been the same in the 1930s. The roofing and the vigas were removed and recycled when the store was dismantled, leaving only the tar paper fragments behind.

Personal Effects Category

The personal effects category included shoes, buttons, a snap, a stocking supporter, a 1935 New Mexico tax token, and a brooch or lace pin featuring a glass cat's head set in brass (Table 21.7). With the exception of the tax token, the well-used nature of the artifacts indicates that they were not being offered for sale at the store.

The array of buttons recovered included three shell, one vegetable ivory, and one ceramic. Buttons were often used many times over, so only beginning dates could be assigned to them. Shell buttons were introduced into the United States during the 1850s and enjoyed increasing popularity until the early 1920s, when they were almost run off the market by the explosion of the plastics industry after World War I. The small shell buttons, or "pearls" as they were known in the trade, would have been used on underwear, shirts and blouses, and children's clothing, while ceramic buttons were mostly used on cheap dresses and underwear (Pool 1991:6–7). Ceramic buttons enjoyed their greatest popularity in America from the mid-1840s to about 1910 (Albert and Kent 1949; Pool 1991). This ceramic button is of a type often misidentified as milk glass, but it has small dimples on the reverse surrounding the holes that are characteristic of the fused-porcelain process (Pool 1991:7). Vegetable ivory buttons began to be produced in 1859 and lasted through the 1940s. According to Pool (1991:7), they are "absent from the archaeological record" because they are subject to attack by moisture. This button came from Level 4, and a quick burial in a dry climate is no doubt responsible for its survival. Buttons were usually securely sewn to cards for sale, so these specimens were probably lost from clothing. One broken shell button fractured across the holes, a common pattern in button loss.

One of the shoes is a classic child's leather sandal with two buckles and a cut-out vamp. It has a rubber sole and another type of rubber or composition heel. The shoe is well worn, especially at the toe, where it exhibits one nail, probably a repair. The heel has also been repaired or replaced with large headed nails. Sandals of this type are very much a twentieth-century style of footwear. The term *sandal* does not even appear in the 1897 Sears Roebuck Catalogue (Israel 1968). Sandals are mentioned in the 1902 version of the Sears catalogue (1969), but not in reference to the style as we know it today. The shoes so described have solid toes, even high heels, and are more what a present-day catalogue would term a pump. Rubber heels were introduced in 1895; soles somewhat later. Cemented rubber heels and soles became practicable in 1926 with the invention of an improved glue (Anderson 1968:62). If the sole of this shoe were cemented and then repaired by nailing, it would postdate 1926. If the nailed heel is original, the shoe would

Table 21.7. Personal effects from the García store (count and sample percentage)

Type	Function	Fragment	No.	Percent
Clothing	four-hole button	whole	3	23.1%
	two-hole button	whole	2	15.4%
	snap	whole	1	7.7%
	stocking supporter	whole	1	7.7%
Boots and shoes	shoe	insole	1	7.7%
	child's shoe	whole	2	15.4%
	child's shoe	sole and counter	1	7.7%
Jewelry/insignia	brooch/lace pin	whole	1	7.7%
Money/tokens	N.M. school tax token	whole	1	7.7%
Total			13	100.0%

date no earlier than about 1910, based on the style and rubber sole.

Another sole and counter of an infant's shoe has stitching on the foot side of the sole, characteristic of the McKay stitching process, which was invented in 1862. The counter exhibits a coating that may be the remains of white dye. Another shoe recovered from the store is a nearly complete child's oxford. It seems to have a welt, which was invented by Charles Goodyear in 1875. The welt is not between the upper and sole, but was laid on top of the upper, then stitched. This shoe was also repaired with four nails in the toe, which were driven into the stitching line. The heel exhibits the same kind of large nails that were observed in the sandal. The size of these nails is most unusual, since shoe nails have small heads. Large nails may have been used to prolong the life of the child's shoes, or they may reflect the quality of shoe repair available in Gavilan. The large-headed nails would have caused serious damage to wooden floors, so they probably do not represent original manufacture.

Other items in the personal effects category included a clothing snap and a stocking support clip. The most important artifact, however, was a 1935 New Mexico tax token, which was undoubtedly associated with the store. Tax tokens, and coins in general, are considered personal effects because they are usually found at residential sites, where they were dropped or fell between floorboards.

Transportation Category

The transportation category was represented by five items: two related to horses, and three motor vehicle parts. The automotive parts were a cable adjuster, a spring shackle, and the switch from a generator/regulator cutout relay or circuit breaker. The latter is copper and marked with a Ford emblem. The emblem is unusual in that the lettering is somewhat different from the well known logo, and it is not surrounded by the familiar oval. We have dated this artifact to ca. 1903–27, based on Ford histories and the appearance of the oval. It probably actually dates closer to the end of that time frame, or even later.

One of the horse-related items is a leather concho of a kind often used on saddles to hide the joint between saddle and thongs. The other artifact, tentatively identified as a harness ring, consists of an iron ring with an inside diameter of about 1.87 inches. Riveted to it are four leather strips. One end of each strip is rounded; the other end appears to have been cut. We have not identified the type of harness rig that would use four strips, but three strips is a very common combination. Since there is no good reason for a piece of horse harness to have been at the store, it is likely that this artifact was reused for some other purpose.

Arms, Explosives, and Military Category

The arms, explosives, and military category is comparatively large (n = 18), especially considering the commercial nature of the site. All of the ammunition types predate the occupational period of the store. The end dates, based on head stamps and company histories, range from 1900 to 1910, making the ammunition, if associated with the store, over 20 years old. Many people do not hesitate to use old ammunition, but 20 or 30 years seems excessive. Three slugs were found: two .22 caliber slugs and an expended hollow slug that may originally have been a flat point, which weighed 4.9 g (75.6168 grains). Based on weight, this specimen could be a .30 Long rimfire, dating from 1873 to around 1914; or a .35 Smith & Wesson dating from 1913 to 1921 (Barnes 1985). The rest of this category consists of one .38 center-fire case from Union Metallic Cartridge and 14 .22 short cases, all with an "H" head stamp. None of the .22 cases exhibit characteristics of modern cartridges such as slight knurling around the top, which began in 1904 (Barnes 1985). The Union Metallic Cartridge case dates no later than about 1902, when the company merged with Remington. According to Barnes (1985), the .38 long center-fire cartridge was obsolete by about 1900.

What is interesting about this assemblage, other than its age, is the fact that nonmatching slugs and cases were found. One possible explanation for this is that the slugs were fired into the structure and the shells were fired from the structure. If the firing episodes took place after the building was abandoned and dismantled, the ammunition would be even older, most of it no younger than 40 years. Another explanation is that both shells and slugs arrived at the site incorporated in the adobes themselves. In this case, we could be comfortable with the early dates, since the artifacts would have entered the archaeological record before the store was built.

Dating the García Store Assemblage

An ethnohistoric study of the García store indicates that it was in operation during the 1930s, beginning in 1930 and ending in 1936 or 1937 (see Chapter 25). These dates, which are almost certainly accurate, enable us to test our usual dating methods. The results of this test are modestly encouraging. Three venues were examined: all dated artifacts, selected dated artifacts (excluding ammunition), and a specialized analysis of window glass. Window glass dates are not included in the category of all dated artifacts, since no individual fragment can be directly dated. Three additional factors influenced the outcome. The first is that the store was both built and dismantled during the Great Depression. The second is that the store was in northern New Mexico. It is well known that material culture in that area lagged behind that of the country as a whole and even the larger urban areas in New Mexico. The third factor is that the store was often closed for months at a time or opened on an occasional basis.

Not all artifacts are temporally diagnostic, and some that are datable are not helpful in a specific case. For instance, wire nails can be generally dated to after 1890, but that information is scarcely relevant to the García store. Datable artifacts were found in six categories, not including construction/maintenance, which are dealt with in a different analysis. The categories that yielded the most dates were unassignable and arms/explosives/military. It is a peculiarity of the analysis system that glass artifacts that cannot be assigned to a specific functional category can often be dated on the basis of manufacturing technology or maker's marks. Only about 30 percent of the datable artifacts have both a beginning and an ending date.

All Datable Artifacts

For the assemblage of all datable artifacts, the site's mean beginning date was 1889.99, with a standard deviation of 22.75. The mean ending date was 1912.26, with a standard deviation of 16.64. A T-test was run on these data (Table 21.8). Only by adding the full standard deviation and error to the mean can the known dates be approached, which seems an abuse of the statistic, but perhaps accurately reflects conditions in Northern New Mexico in the first half of the twentieth century. In the case of all dated artifacts, if we add the full standard deviation and error mean, we can arrive at a beginning date range for the site of 1910.07 to 1920.76, and an ending date range of 1925.78 to 1937.99, which approaches the actual date range of 1930 to 1937.

Table 21.8. T-test one-sample statistics for all datable artifacts from the García store

Beginning Date	No.	Mean		SD	SD Error Mean	
	72	1889.99		22.75	2.68	
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of Difference Lower	Upper
	704.964	71	.000	1889.99	1884.64	1895.33
Ending Date	No.	Mean		SD	SD Error Mean	
	32	1913.44		17.68	3.13	
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of Difference Lower	Upper
	639.796	30	.000	1912.26	1906.15	1918.36

Selected Artifacts

If we accept that the ammunition artifacts are not associated with the store and can be excluded from the datable assemblage, the dates derived for selected temporally diagnostic artifacts come even closer to the actual dates. A T-test was also run on these data (Table 21.9). Again, it is necessary to use the full standard deviation and error to arrive at a relatively realistic beginning date. Using the full deviation and error, we can arrive at 1920.76 as a mean beginning date and a range from 1914.94 to 1926.58. In the case of the ending date, using the upper end of the 95-percent confidence level and the standard error alone would give us a date of 1936.29, remarkably close to the actual date. Taking the lower end of the 95-percent confidence level and adding the full standard deviation and error again gives a date within a few years of the actual date (1935.03). Being forced to do these statistical manipulations to bring the dates for the assemblage in line with the known dates for the García store, we can conclude either that the proprietor was selling used products; or that most of the materials in our assemblage represent the personal property of the store owner, who brought older, unneeded goods from home to use while working there. Since the latter is likely, most of our assemblage probably does not reflect the commercial nature of the store.

Window Glass

Window glass has been found to vary in thickness through time in a consistent enough manner that assemblages can be temporally diagnostic (Chance and Chance 1976; Roenke 1978; White 1990). Window glass may be the most temporally sensitive construction material, especially for an adobe structure, since few other manufactured construction materials are used in this type of building. Chance and Chance (1976) assert that the mode is the most important statistic when dealing with a single structure. Teague et al. (1977) believe that the mean is most valid for small samples.

The sample of window glass from LA 105710 is relatively small (n = 295) and from a single structure, so both methods can be tested (Table 21.10). Most researchers have measured specimens in inches for these calculations, since glass was originally sold in fractions of an inch, and three decimal places is the accepted level of precision. It is a common practice in this type of analysis to trim 5 percent from both the top and bottom of the range to ensure that only window glass is being measured, as opposed to fragments of mirrors, car windows, or other flat glass artifacts. The aim of this type of analysis is to determine both the mean thickness and the modal points around which the artifact measurements cluster. The researchers mentioned above have generally used a midpoint of the arbitrarily

Table 21.9. T-test one-sample statistics for selected artifacts from the García store

Beginning Date	No.		Mean	SD	SD Error Mean	
	57		1895.93	21.93	2.9	
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of Difference Lower	Upper
	704.964	56	.000	1895.93	1890.11	1901.75
Ending Date	No.		Mean	SD	SD Error Mean	
	16		1921.38	19.05	4.76	
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of Difference Lower	Upper
	403.43	15	.000	1921.38	1911.22	1931.53

Table 21.10. Window glass modes at the García store

True Range	No. of Specimens	Class Total	Midpoint	Mode
.0630-.0690	6	6	0.065	dropped
.0702-.0727	5	9	0.075	dropped
.0773-.0797	4			
.0800-.0848	66	187	0.085	primary (63.39 percent of total;
.0850-.0898	121			69.26 percent of adjusted total)
.0900-.0948	64	83	0.095	secondary (28.14 percent of total;
.0950-.0997	19			30.74 percent of adjusted total)
.1002-.1035	10	10	0.1	dropped
Total	295	295		

determined measurement classes to account for the variation in thickness in individual specimens. For this analysis, three thickness measurements were taken on each specimen and averaged. The overall range was from .0630 to .1035 in, which were then rounded to three decimal places before arriving at the measurement class midpoints. Thus, all measurements between .0800 and .0899 are considered to be .085.

The unadjusted mean window glass thickness for LA 105710 was .0878 in; the adjusted thickness mean was .0881 in. At three decimal places, both fall within the primary mode of .085. The median, at .0882 in, is virtually identical to the adjusted thickness mean. Over 90 percent of the sample falls within the two contiguous modes of .085 and .095. The primary mode is simply the measurement with the greatest number of samples; the secondary mode is the next largest number of samples.

Roenke (1978:116) provides a date of 1855–85 for a primary mode of .085 in and 1870–1900 for a primary mode of .095 in; Chance and Chance (1976) use the same date ranges. Teague et al. (1977), working in a mining town that lasted only from 1883 to 1888, found a primary mode of .095 in, which fits into the 1870–1900 date range. Applied to the García store, such date ranges strongly imply that older glass was used in its construction.

One other possibility has been recognized, namely, that the progression toward thicker glass does not carry on into the mid-twentieth century. Blee (1988), investigating a cabin and later house at a site in Skagway, Alaska, found that the cabin, dating from 1888, had a modal window glass thickness of .094 in, whereas the house, dating after 1896, had a thickness mode of .078 in. As Blee (1988:165) points out, "Thinner window glass is cheaper window glass both to produce and to purchase."

The first specifications for window glass were adopted by the Federal Specifications Board in 1924 (Roenke 1978:38–39). Single-strength glass was expected to fall between .080 and .100 in, double strength between .111 and .125 in; other classes of glass were even thicker. Roenke states that this confirms the idea of a general thickening through time, but considering that glass with a thickness of .085 in dates as early as 1855 in all the published date ranges, this generalization is questionable. By these standards, the glass at LA 105710 would have been perfectly acceptable in 1924, and by extension, in 1930. More twentieth-century sites need to be studied, and certainly more Depression-era sites need to be looked at before this problem can be resolved.

Other facets of window glass that were considered included edge color and patination. Such studies have no chronological value and are considered difficult to undertake because edge color is dependent on the size of the shard. However, only the saturation value changes with shard size, not the basic color. With one analyst conducting the examination, it is possible to come to some basic conclusions concerning these variables. A sample of 175 pieces of window glass was examined for edge color and patination. Four basic colors were recognized: green, blue, blue-green, and clear. Since window glass color is determined by impurities in the basic materials and by decolorizers and other elements in the glass batch, it would seem that four different sources of supply or very different batches were used. There was no strong correlation with thickness for any of the colors. Both green and clear glass were patinated. However, only the clear glass was heavily patinated.

The degree of patination is related to soil moisture and alkalinity, but the tendency to patinate is inherent in the glass itself and is a function of high amounts of soda or low amounts of lime in the glass batch. From 1844 through at least the 1870s, a tendency to patinate, or "rust," was a "marked characteristic of American glass" (Roenke 1978:22). Some glasses cannot be made to patinate. The blue color can be caused by the use of salt cake (sodium sulphate) instead of soda ash (sodium carbonate) in the mix, or by the use of cobalt as a decolorizer. Interestingly, there was a craze for blue-tinted window glass in America during the 1870s, perhaps as a reaction to the rusty glass endured for the previous thirty years. Blue glass is much harder and does not devitrify, the process that leads to patination. The blue glass from LA 105710 bears this out. Though buried for the same amount of time at the same depth in the same soil as the clear and green glass, no patination was observed on any piece of blue-tinted glass.

Conclusions

The commercial nature of the site is all but invisible in the artifact assemblage, showing more in the absence of items from the domestic routine and furnishings categories than the presence of specific artifacts. The paucity of artifacts that can be attributed to the store may be a function of the short time span it was in existence—fewer than ten years. Only one datable artifact, the 1935 tax token, can be confidently ascribed to the occupation of the store. The applied-color glass almost certainly belongs to the store as well, but with a time range of 1915 to the present, it is not much help in dating the deposits.

The fact that all chronological indicators predate the store indicates the following hypotheses: (1) The store was built with recycled materials. (2) The store was built, without much ground disturbance, over preexisting trash deposits. (3) There is much we don't understand about site formation during the Depression.

Any or all of the above may be true. The fact that most of the window glass falls into only two classes (.085 and .095) certainly suggests one building episode with a possible remodel following very shortly thereafter, but with the window glass coming from at least four different sources or batches, based on the colors, scavenging is also a definite possibility. The earliest date for the window glass, 1855–70, can be rejected on the grounds that there was scarcely any window glass in New Mexico during those years. When the United States army occupied New Mexico in 1846, the Palace of the Governors was the only building in the capital with glass windows (Edwards 1847:24). It seems reasonable to suppose that the population centers absorbed any increase in the supply for many years before the hinterlands acquired a supply. Using the 1885–1900 range still has any recycled glass predating the structure by thirty to fifty years, which incidently would be an acceptable time span for many adobe structures in the area to receive window glass, go through their life cycle, and be abandoned.

Chapter 22. Vegetation Transects

Pamela J. McBride and Mollie S. Toll

Six gravel-mulch garden sites along the edge of the first terrace overlooking the floodplains of the Rio Ojo Caliente provided an opportunity to examine modern vegetation characteristics as clues to prehistoric manipulations of growing conditions. The garden sites included LA 105703, LA 105705, LA 105706, LA 105708, LA 105709, and LA 118547. A vegetation survey was conducted in January 1998 within and adjacent to garden plots for purposes of comparison.

The terrace gravel deposits at Gavilan qualify as Great Basin (or Intermountain) grassland, dominated by perennial sod-forming short-grass species (Brown 1994:115–121). Whereas overgrazing in more diverse semidesert grasslands of lower elevations will frequently result in restructuring of the landscape by invasion of a much taller layer of shrubs (mesquite, juniper), overgrazed Great Basin grassland "retains a more or less evenly statured low canopy of plants" (Brown 1994:119), including snakeweed and other short grasses. We see evidence of the short-grass community at Gavilan, where pockets of more intensive grazing impact interdigitate with soil texture variability. Centuries-old human efforts to manipulate growing conditions for crop plants still have a measurable effect today on species composition, plant density, and vigor.

Nine transects were laid out at the six terrace sites: eight were 20 m long, and one was 15 m long (due to failing light at the end of the day). Two of the transects included a 10 m section on the gravel-mulch garden plot and a 10 m section considered to be off the garden. Plant and non-plant intercept lengths were measured to the nearest 0.1 cm along the meter tape. Nonplant categories (bare ground, gravel, cobbles, boulders, and litter) were also recorded.

In the description of results, total cover was calculated as the sum of the intercepts of a given plant taxon or nonplant category (Cox 1975:46). Relative cover was determined by taking the total cover of a particular taxon and dividing by the total cover of all taxa on a transect. To calculate a measure of frequency, each transect was divided into five equal segments, and the presence of a given taxon in the segments was summed and converted to a percentage (e.g., a taxon occurring in three of the five segments has a frequency of 60 percent). *Ecological dominance* refers to the relative importance of a species or group of species in a community. By virtue of their numbers, size, or production, these species "largely control the energy flow and strongly affect the environment of all other species" (Odum 1971:143).

Plant species encountered in the Gavilan transects were identified with the aid of comparative specimens in the collections of the University of New Mexico Herbarium, Department of Biology. In particular, a reference collection of lichens from El Malpais National Monument (DeBruin 2000) enabled us to identify the lichen species occurring on several garden plots.

A single flotation sample from LA 105709 was analyzed. The sample totaled 3.2 liters of soil and was processed using the bucket method of flotation used for all other projects at the OAS (Bohrer and Adams 1977). The sample was scanned under a binocular microscope at 7–45X, producing relative abundance data (rather than actual counts) by botanical taxon and plant part.

Results

As Lightfoot (1993:116) observed for the Northern Rio Grande Valley, appropriate sites for gravel-mulch gardens are typically dominated by native short grasses. At nearly every Gavilan site, both on and off the prehistoric garden plots, the plant found most consistently and occupying the highest proportion of the landscape was blue grama (*Bouteloua gracilis*). LA 105705 was an exception, in that snakeweed (*Gutierrezia sarothrae*) and lichen shared that role on the garden transect, while snakeweed was actually the dominant plant on the control transect (Tables 22.1 and 22.2).

LA 105705 transects are anomalous for sever-

Table 22.1. Vegetation transect results: LA 105703, LA 118547, and LA 105709

Transect	LA 105703						LA 118547						LA 105709				
	1: Control			2: Garden Plot			3: Garden Plot			4: Garden Plot			5: Garden Plot			6: Contrc	
	TC	RC	F	TC	RC	F	TC	RC	F	TC	RC	F	TC	RC	F	TC	RC
Bare	3	-	60	9	-	100	8	-	100	9	-	100	7	-	100	6	-
Gravel	31	-	100	39	-	100	22	-	100	26	-	100	28	-	100	19	-
Cobble 10-25 cm	-	-	-	2	-	40	1	-	20	1	-	20	2	-	40	-	-
Boulder >25 cm	-	-	-	-	-	-	-	-	-	-	-	-	1	-	20	-	-
Litter	23	-	100	6	-	100	31	-	100	18	-	100	16	-	100	28	-
Grasses:																	
Aristida	1	2	20	2	5	40	2	4	40	1	3	20	3	7	80	3	6
Bouteloua gracilis	28	65	100	40	90	100	24	62	100	40	87	100	34	77	100	37	79
Gramineae (Unknown D)	<1	1	20	1	1	20	-	-	-	-	-	-	-	-	-	-	-
Hilaria jamesii	-	-	-	-	-	-	-	-	-	-	-	-	1	1	20	-	-
Muhlenbergia torreyii	6	14	100	-	-	-	<1	1	40	2	4	20	1	1	20	-	-
Sporobolus	2	3	20	-	-	-	5	12	40	2	4	40	1	1	20	-	-
Shrubs:																	
Chrysothamnus nauseosus	2	4	20	-	-	-	1	3	20	-	-	-	<1	1	20	-	-
Gutierrezia sarothrae	3	8	100	1	1	20	5	13	100	-	-	-	3	6	80	-	-
Other:																	
Boraginaceae	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	20	-	-
Chaetopappa ericoides	-	-	-	-	-	-	1	2	40	-	-	-	-	-	-	-	-
cf. *Mammillaria*	-	-	-	<1	1	40	-	-	-	-	-	-	-	-	-	-	-
Opuntia sp.	-	-	-	-	-	-	<1	1	20	1	1	20	2	3	20	-	-
Opuntia imbricata	1	3	40				-	-	-	-	-	-	-	-	-	-	-
Opuntia macrorhiza	<1	<1	20	1	2	40	-	-	-	-	-	-	-	-	-	-	-
Unknown B	-	-	-	-	-	-	1	2	20				1	2	40	<1	<1
Unknown C	-	-	-	-	-	-	<1	<1	20	<1	1	20	-	-	-	-	-
Xanthoparmelia chlorochroa	-	-	-	-	-	-	-	-	-	-	-	-	<1	<1	20	7	15

TC = total cover (percent of occurrence in total length of transect).
RC = relative cover (percent of occurrence relative to other species).
F = frequency (percent of occurrence in five sections of equal or nearly equal lengths of transect).

Table 22.2. Vegetation transect results: LA 105708, LA 105705, and LA 105706

Transect	LA 105708			LA 105705						LA 105706					
	7: Garden Plot			8a: Control			8b: Garden Plot			9a: Control			9b: Garden Plot		
	TC	RC	F	TC	RC	F	TC	RC	F	TC	RC	F	TC	RC	F
Bare	7	-	100	55	-	100	10	-	100	41	-	100	8	-	100
Gravel	39	-	100	2	-	20	28	-	100	-	-	-	17	-	100
Cobble 10-25 cm	2	-	80	1	-	20	-	-		-	-	-	2	-	20
Litter	15	-	100	15	-	80	19	-	100	15	-	100	23	-	100
Grasses:															
Bouteloua gracilis	20	54	100	10	38	60	21	51	80	39	89	100	39	79	100
Gramineae (Unknown D)	1	2	60	-	-	-	-	-	-	-	-	-	-	-	-
Gramineae (Unknown G)	-	-	-	-	-	-	-	-	-	-	-	-	5	9	80
Muhlenbergia torreyii	8	21	100	3	11	80	11	26	60	<1	1	20	1	2	20
Sporobolus	-	-	-	1	2	20	-	-	-	-	-	-	-	-	-
Shrubs:															
Eurotia lanata	<1	<1	20	-	-	-	-	-	-	-	-	-	-	-	-
Gutierrezia sarothrae	1	4	60	11	42	40	3	8	40	4	9	100	-	-	-
Other:															
Chaetopappa ericoides	1	4	80	-	-	-	-	-	-	<1	<1	20	1	1	40
Opuntia sp.	<1	1	20	1	3	20	-	-	-	-	-	-	2	4	20
Unknown E	3	10	80	-	-	-	-	-	-	-	-	-	3	5	60
Xanthoparmelia chlorochroa	1	4	60	1	4	40	6	15	100	<1	<1	20	-	-	-

TC = total cover (percent of occurrence in total length of transect).
RC = relative cover (percent of occurrence relative to other species).
F = frequency (percent of occurrence in five sections of equal or nearly equal lengths of transect).

al reasons. Of all the transects placed on garden plots, the fewest number of taxa occur at LA 105705, along with the highest density of lichen (there was a dramatic change at the edge of the garden, where the lichen disappeared). On the control transect for this site, the percentage of blue grama was lowest, snakeweed was the dominant plant, the percentage of bare ground was highest (55 percent as compared to 3–7 percent elsewhere), and the percentage of gravel was only 2 percent (as opposed to 19–31 percent on other control transects).

During the vegetation survey, our impression was that the off-garden area of LA 105705 displayed a notable degree of disturbance, together with a high density of snakeweed and prickly pear cactus. Four-legged visitors to a water tank and corrals at the western edge of the site may be largely responsible. Trampling of the ground by cattle may have caused compaction and serious changes in soil structure. This is supported by the significant difference in total vegetation coverage between the control (26 percent) and on-garden (42 percent) transects.

Lichens were most evident at LA 105705. The symbiotic association between fungi and algae or cyanobacteria enables lichens to live in some of the harshest habitats on earth. Lichens are often the first to colonize newly exposed rocky areas (Raven et al. 1986). The lichen that occurred in and around garden plots was a foliose or leafy variety, *Xanthoparmelia chlorochroa* (tumbleweed shield lichen), whose distribution is restricted to siliceous rock (Brodo et al. 2001). Sites without lichens include LA 105703, the northernmost garden, and LA 118547. Total vegetation coverage was equal for on- and off-garden transects at LA 105703 and, like LA 105705, there was actually lower taxonomic diversity on the garden transect than on the control.

The control transect at LA 105706 bears some similarities to LA 105705 (just to the south). Here there is a comparatively high percentage of bare ground (41 percent) and an absence of gravel altogether. Although this site follows the pattern we observed repeatedly of higher total vegetation coverage within the gravel-mulched garden area, there is less of a difference between on- and off-garden transects, with only a 7 percent higher coverage for the on-garden transect.

Garden plots at LA 118547 and LA 105709 displayed the highest taxonomic diversity, including purple awn grass (*Aristida* sp.), blue grama, ring muhly (*Muhlenbergia torreyii*), dropseed grass (*Sporobolus* sp.), galleta grass (*Hilaria jamesii*), borage family, lichen, snakeweed, prickly pear cactus (*Opuntia* sp.), rabbitbrush (*Chrysothamnus nauseosus*), and several unknown species (Table 22.1). A flotation sample from LA 105709 expands the list of modern vegetation taxa associated with the site, providing some documentation of the fuller list of taxa to be found during the growing season (Table 22.3). Flotation taxa which reiterate those encountered in our winter vegetation survey are grasses and perennials. Additional taxa revealed by flotation include seven weedy annuals.

LA 105708, bilevel gardens at the edge of the terrace, were just north of a small but deep arroyo. This area looked more disturbed than the complex of gardens to the south (LA 105709 and LA 118547). The presence of several disturbance indicators confirms this characterization, including abundant snakeweed and significant

Table 22.3. Flotation plant remains, LA 105709 (all noncultural)

Taxon	FS 347
Annuals:	
Amaranthus	+
Chenopodium	+
Descurainia	+
Euphorbia	+
Lappula	+
Physalis	+
Portulaca	+
Grasses:	
Gramineae	+++ whole plant
Oryzopsis	+
Sporobolus	+
Other:	
Boraginaceae	+ fruit
Unidentifiable	+
Perennials:	
Cactaceae	+ pad, + spine
Juniperus	+♂ cone, + twig
Platyopuntia	++ embryo, ++
Sphaeralcea	+

Plant remains are seeds unless indicated otherwise.
+ less than 10/liter; ++ 11-25/liter; +++ 25-100/liter.

amounts of prickly pear and cholla cactus. Of the nine taxa identified, blue grama grass was dominant, followed by ring muhly grass. This transect and Transect 3 at LA 118547 had the lowest total vegetation coverage of all transects that passed through prehistoric gravel-mulch gardens.

Sites LA 105703, LA 105709, and LA 118547 were on BLM land with no recent evidence of grazing. Blue grama grass dominated both on and off prehistoric garden plots at these sites. Total vegetative cover and taxonomic diversity both tended to be higher on gardens, compared to nearby nonmulched areas. Anomalies noted at LA 105705, LA 105706, and LA 105708 can be primarily attributed to modern land tenure and range management parameters. These sites are on State Trust land that was actively being grazed at the time of fieldwork.

Vegetation Communities at Gavilan and Medanales

Gravel-mulch gardens and "dot matrix" gardens (pattern of noncontiguous, evenly spaced elements) on terrace and mesa margins were investigated in 1986 at Medanales, about 10 km west of the Gavilan sites in the Rio Chama drainage. Due to funding and scheduling problems, these studies have never been reported. When comparing Medanales vegetation transect results with those of Gavilan, it must be noted that the transects were conducted at different times of the year. The Medanales transects were completed at the peak of the growing season in July, while the Gavilan transects were recorded in January, when plants are dormant (substantially reducing the observable taxonomic diversity), and the winter floral remnants are difficult to identify. Certain taxa identified at Medanales (such as *Astragalus*, *Linum*, *Euphorbia*, *Gilia*, and *Hymenopappus)* would not have been evident during the Gavilan winter survey.

Gravel-mulch gardens at Medanales were primarily along terrace margins, but one transect on the second terrace (LA 48679, identified as a hilltop garden) had the highest taxonomic diversity (12 taxa, versus 5–8 elsewhere) both on and off the garden plot (Table 22.4). The distinct difference between the hilltop garden and those on the first terrace could relate to postgarden land use, such as cattle grazing. Indeed, the control for the hilltop garden had the highest percentage of snakeweed, considered to be an indicator of overgrazing (Elmore and Janish 1976:82). Though continued heavy grazing can have a distinct negative ecological impact, there is evidence that moderate grazing can actually increase plant diversity and land health (White 2001:27).

At both Gavilan and Medanales, grama grasses were the dominant species on and off garden plots in most transects. The exception at Medanales was the control transect at the hilltop garden, where snakeweed was dominant (Table 22.4). The biggest difference between Gavilan and Medanales was that the percentage of bare ground, rocks, and litter was consistently higher in control transects than in garden transects at Medanales, while at Gavilan this relationship varied somewhat. Gavilan included cases where gardens had a slightly higher percentage of nonvegetation (LA 105703), where controls had a higher nonvegetation component (LA 105705 and LA 105706), and where there was no significant difference (LA 105703). Anomalies found on the Gavilan transects at LA 105705 were not present at Medanales. A few individual differences occurred, including a high percentage of bare ground (71 percent) at Control Transect 2, high relative cover of *Bouteloua hirsuta* at Transect 1 (70 percent), and the aforementioned high percentage of snakeweed on the hilltop control transect (55 percent).

Summary and Conclusions

Vegetation analysis using the line intercept technique was carried out at six gravel-mulch garden sites along U.S. 285 near Gavilan, New Mexico. Total vegetation coverage was highest in garden transects, suggesting that gravel mulch provides a more favorable environment for plant germination and primary production. There was considerable repetition in characteristics of the substrate and in composition and distribution of contemporary vegetation at the gravel-mulch and cobble gardens at Medanales.

A tiny body of contemporary agronomic research provides some corroboration of the apparent effectiveness of gravel mulch in addressing farming woes of a limited segment of

Table 22.4. Medanales vegetation transect results

Transect	1: Garden Plot			2: Control for Transect 1			3: Dot Matrix Garden			4: Garden Plot		
	TC	RC	F	TC	RC	F	TC	RC	F	TC	RC	F
Bare	24	-	100	71	-	100	10	-	100	6	-	100
Rock	32	-	100	5	-	60	36	-	100	38	-	100
Litter	6	-	80	1	-	100	4	-	100	9	-	100
Grasses:												
Bouteloua curtipendula	7	19	80	-	-	-	1	3	100	4	8	60
Bouteloua eriopoda	-	-	-	-	-	-	21	40	100	18	36	100
Bouteloua hirsuta	26	70	100	10	43	80	14	27	100	19	38	100
Hilaria jamesii	-	-	-	9	41	100	-	-	-	-	-	-
Sporobolus contractus	<1	<1	20	<1	1	20	-	-	-	-	-	-
Stipa spartea	1	2	20	-	-	-	-	-	-	-	-	-
Shrubs:												
Gutierrezia sarothrae	2	5	60	2	9	40	1	1	20	-	-	-
Other:												
Astragalus brandezii	-	-	-	<1	<1	20	-	-	-	-	-	-
Chaetopappa ericoides	-	-	-	1	4	40	-	-	-	<1	1	20
Linum puberulum	-	-	-	<1	1	20	-	-	-	-	-	-
Moss / lichen?	-	-	-	-	-	-	15	28	100	9	18	100
Opuntia sp.	1	3	20	<1	<1	20	1	1	20	-	-	-

Table 22.4 (continued).

Transect	5: Control for Transect 4			6: Hilltop Garden			7: Control for Hilltop Garden		
	TC	RC	F	TC	RC	F	TC	RC	F
Bare	16	-	100	11	-	100	47	-	100
Rock	41	-	100	39	-	100	3	-	100
Litter	5	-	100	4	-	100	14	-	100
Grasses:									
Aristida sp.	-	-	-	2	4	60	1	2	20
Bouteloua curtipendula	-	-	-	-	-	-	<1	<1	20
Bouteloua eriopoda	18	43	100	17	34	100	<1	<1	20
Bouteloua hirsuta	14	34	100	23	47	100	3	7	60
Hilaria jamesii	-	-	-	-	-	-	7	18	100
Muhlenbergia sp.	-	-	-	-	-	-	1	4	60
Sporobolus contractus	-	-	-	-	-	-	3	7	80
Stipa spartea	-	-	-	-	-	-	<1	<1	20
Shrubs:									
Gutierrezia sarothrae	4	10	80	1	3	80	20	55	100
Other:									
Astragalus brandezii	-	-	-	-	-	-	-	-	-
Chaetopappa ericoides	-	-	-	-	-	-	1	3	60
Compositae	<1	<1	20	<1	<1	20	-	-	-
Euphorbia fendleri var. *chaetocalyx*	1	3	40	1	2	40	1	3	60
Gilia risida	-	-	-	1	2	40	-	-	-
Hymenopappus bilifolius var. *cinereus*	-	-	-	1	2	40	-	-	-
Linum puberulum	-	-	-	<1	1	20	<1	1	40
moss / lichen?	2	6	60	2	4	40	-	-	-
Opuntia sp.	1	3	20	<1	1	20	-	-	-
Unknown	-	-	-	<1	<1	20	-	-	-

TC = total cover (percent of occurrence in total length of transect).
RC = relative cover (percent of occurrence relative to other species).
F = frequency (percent of occurrence in five sections of equal or nearly equal lengths of transect).

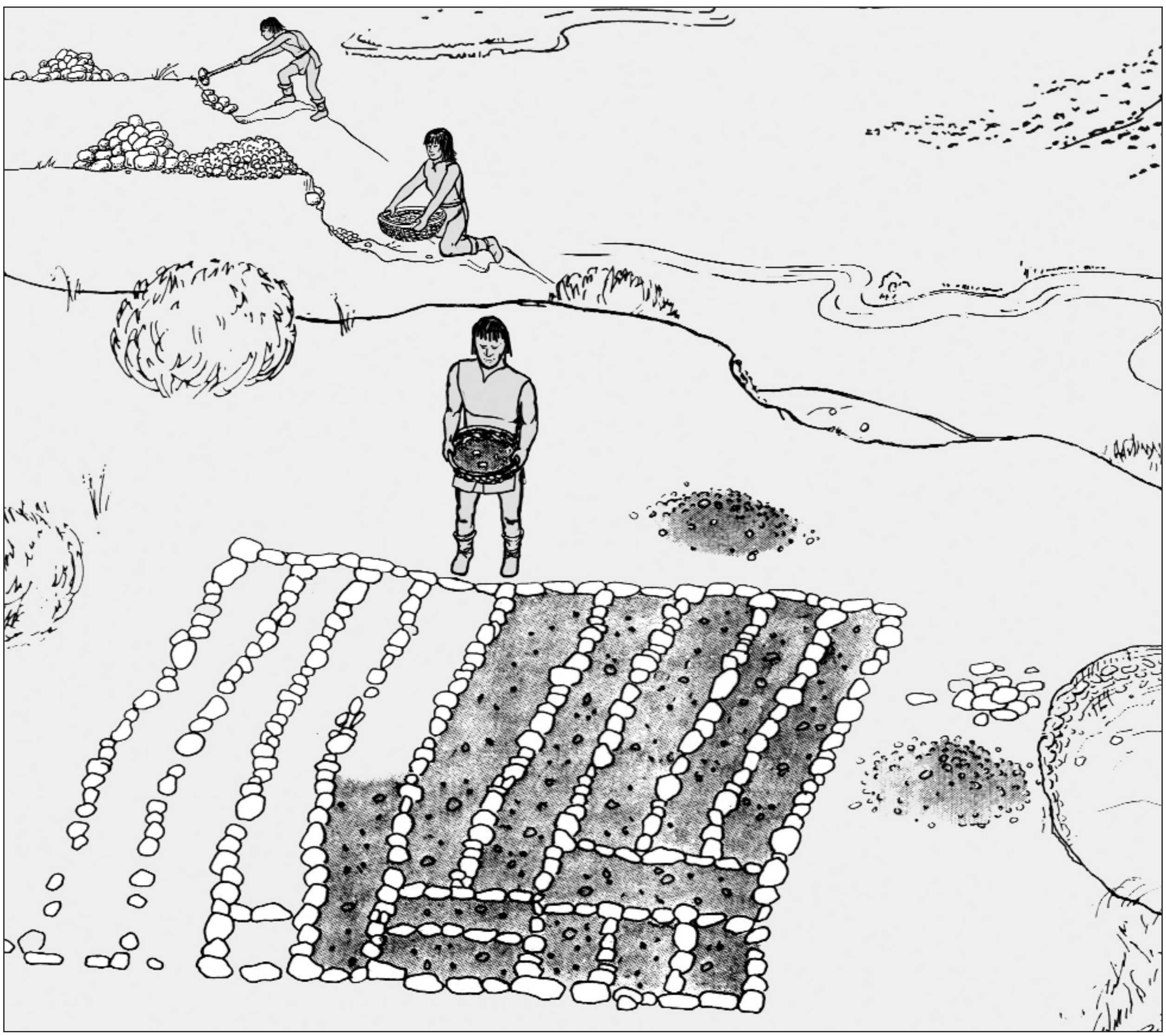
the late prehistoric period in northern New Mexico. In a laboratory study of factors affecting evaporation from soil surfaces, Corey and Kemper (1968:3) found that when gravel was used as a mulch, conductivity at ground surface is "virtually zero and water is by vapor diffusion only." In an experiment conducted at Fort Collins, Colorado, Fairbourn (1973:928) found that gravel mulch reduces soil water evaporation rates and increases soil temperatures at a depth of 15.0 cm by 2–4 degrees C, resulting in higher crop yields. During drought, crop yields from gravel-mulch gardens can be as much as two to four times higher than those grown in bare soil.

Third and fifth grade students who visited the Gavilan prehistoric gardens constructed experimental gardens at Gonzales School in Santa Fe to test potential functions of the gravel mulch. They were able to demonstrate that higher germination rates, larger plants, and earlier fruit production were all associated with their gravel-mulch plot, compared to their nonmulched control plot (Young Investigators in Santa Fe, New Mexico 1999).

There are good reasons to suspect gravel-mulch gardens were more of a survival mechanism than a tool for maximizing production. Both the geographic and chronological distribution of prehistoric gravel-mulch gardens are clues. These gardens have been recorded north of La Bajada in the upper Rio Grande Valley, with major concentrations in the Galisteo Basin and the Chama–Ojo Caliente area (Lightfoot 1993). La Bajada coincides with a significant increase in elevation over the middle Rio Grande Valley, and a critical drop in nighttime temperatures and growing season length. The gardens are further limited to uplands with natural gravel deposits, adjacent to fertile bottomlands in river valleys. These fields are primarily associated with major Classic period settlements for a 200-year period (A.D. 1350–1550 in the Chama–Ojo Caliente drainages, and A.D. 1400–1500 in the Galisteo Basin). Coalition period fields have also been documented in the Rio del Oso drainage (Anschuetz 1998).

Part 4

Interpretations



Chapter 23. Prehistoric Agriculture in the Ojo Caliente Valley

James L. Moore

Though archaeologists identified farming features in the Ojo Caliente Valley long ago, few formal studies of these sites have been completed. A similar array of features is better known and somewhat better studied in the Chama Valley, to which the Rio Ojo Caliente is tributary. Since these sites tend to be extensive, excavation is a difficult proposition, and simply documenting the extent and types of features present can be daunting. While we are beginning to derive a basic understanding of how these fields worked, some of the crops grown in them, and their value to prehistoric Pueblo farming, we still have much to learn about land tenure systems, how fields were tended, and more than just the basics concerning their construction. Beyond this, the overall areal distribution of gravel-mulched fields, the most common type of farming feature in the study area, remains unclear. Currently, archaeological and anecdotal sources suggest that the distribution of this type of field is mostly limited to the Chama and Ojo Caliente Valleys, the Tewa Basin, and the Galisteo Basin. All of these areas are traditionally considered to be the homeland of the Tewas. Thus, a question that will need to be addressed at some point is whether or not the use of gravel mulch in the Northern Rio Grande was limited to a single ethnic group.

Adolph F. Bandelier was the first archaeologist to identify and describe farming features in the Ojo Caliente Valley (Bandelier 1892; Lange et al. 1975). Making comparisons to similar features noted while conducting fieldwork in Sonora and southern Arizona, Bandelier described grids and contour terraces near Hupobi and Posi'ouinge in the Ojo Caliente Valley, and Sapawe in the nearby El Rito Valley, noting heavy gravel mulching in the latter (Lange et al. 1975:91). According to one of his informants, there were traces of "ancient ditches" close to a ruin that lay near the road to Abiquiu, possibly Poshu'ouinge (Bandelier 1892:53). Conversely, he was assured by other informants that no prehistoric "irrigation ditches" had been found in the Ojo Caliente Valley (Bandelier 1892:40).

Hewett (1905, 1906) noted farming sites near Abiquiu but mistook many of them for the foundations of ancient structures whose adobe walls had completely eroded away. This mistake was repeated in the Ojo Caliente Valley in 1910, when an expedition led by Hewett noted extensive farming sites but once again identified them as structural foundations (Morley 1910a, 1910b). Bandelier (1892:51) recognized this problem early on, noting that the linear stone alignments he characterized as gardens were frequently mistaken for foundations. Rather than foundations, Jeançon (1923:71) apparently misidentified some farming features around Poshu'ouinge as shrines. However, he did recognize the remains of fields near Peseduinge, describing linear stone alignments with associated ditches that may have been the remains of water harvesting systems (Jeançon 1911).

During investigations in the Chama Valley between 1929 and 1933, Greenlee (n.d.) described many farming features, mistaking several for the remains of villages. Thus, his Frijoles Creek Ruin, upper Abiquiu Ruin, Plaza Colorada Ruin, and "foundation type" ruins along El Rito Creek were probably farming complexes rather than villages. Greenlee (n.d.) discussed the fields near Hupobi that Bandelier (1892) had also described, noting their resemblance to his "foundation type" ruins, but rejecting the possibility that they were anything other than villages.

Hibben (1937) noted extensive grids during his Chama Valley survey and concluded that they were fields. Luebben (1951, 1953) identified gravel-mulched fields around Leafwater Pueblo (Kap), extending in both directions along the mesa edge from that site. A probable borrow pit was trenched, as was a grid system next to the village. The grids were built on slumped material from the outer wall of the pueblo and thus postdated its occupation, suggesting that the area continued to be used for farming after Leafwater was abandoned (Luebben 1951). A few contour terraces were also found near Leafwater, and Peckham (1981) noted one near Palisade Ruin.

Several researchers have examined farming features near Sapawe. Skinner (1965) described 24 fieldhouses and two rectangular cobble bordered fields. Ellis (1970) documented contour terraces, cobble-bordered and gravel-mulched fields, checkdams, diversion walls, and possible canals. Tjaden (1979) located 20 grid systems, 8 of which had associated one-room fieldhouses. Numerous undocumented fields containing gravel-mulched grids have also been observed around Sapawe.

Fiero (1978) examined gravel-mulched grids and cobble-bordered fields at three sites on a terrace north of the Rio Chama, opposite Abiquiu Mesa. Cobble-bordered fields, gravel-mulched grids, and stone-lined channels associated with floodwater fields were recorded near Ponsipa'akeri in the Ojo Caliente Valley (Bugé 1978, 1979, 1984). Gravel-mulched grids, checkdams, and contour terraces were found near Howiri (Fallon and Wening 1987), and a gravel-mulched grid complex was recorded near Te'ewi (Lang 1980).

Within the last two decades, the Museum of New Mexico has conducted several studies of farming sites in the Chama and Ojo Caliente Valleys. Anschuetz et al. (1985) studied field systems near Medanales in the Chama Valley. Moore (1992) examined similar farming features west of Abiquiu. Ware and Mensel (1992) completed a detailed study of fields in the lower Ojo Caliente Valley. To round out this list of agricultural studies for the region, two dissertations focusing on this topic have been completed. Anschuetz (1998) examined farming systems in the Rio del Oso Valley, another tributary of the Rio Chama, and Maxwell (2000) looked at field systems around Hupobi in the Ojo Caliente Valley.

Addressing the Research Issues

A series of research issues were generated for this study by Wiseman and Ware (1996; see Chapter 5). Two additional research issues that developed during our field studies were also presented in that chapter. Each research issue is further considered in this section in light of data recovered during our field studies and analyses.

Research Issue 15: Dating and Chronometrics

Dating prehistoric fields is very difficult, as Wiseman and Ware (1996:67–68) note. Though fields were a part of everyday activities for much of the year, the tasks performed there were restricted compared to those in the villages where farmers lived and the other types of limited-activity sites that were used. Thus, materials that can provide absolute dates tend to be rare on farming sites.

The only temporally sensitive artifacts recovered from the farming sites investigated during this study were sherds from ceramic vessels. No hearths that were definitely associated with the fields were identified within project limits, so no radiocarbon or archaeomagnetic dates are available. Even if hydration dates from obsidian artifacts recovered from the surface were reliable, so little obsidian was found in the chipped stone assemblages that this dating method would have had little use in our study.

Tables 23.1 and 23.2 list the types and quantities of pottery recorded on the surface or recovered from excavation units and from the surface within the right-of-way at the farming sites. Most of the types recovered were prehistoric, though three historic sherds were found on the surface of LA 105708, and one at LA 105713. In each of these cases the historic sherds undoubtedly represent intrusive materials. Prehistoric sherds were recorded on the surface of all nine farming sites and collected from EUs or within the right-of-way at four.

The most common temporally diagnostic types were Biscuit A and Biscuit B. When both data sets are combined, Biscuit B predominates in four assemblages (LA 105703, LA 105705, LA 105713, LA 118547), and both types occur in equal or nearly equal numbers in three assemblages (LA 105706, LA 105708, and LA 105709). No sherds were collected from the two remaining sites, and very few sherds were recorded on their surfaces (one sherd at LA 105704 and four at LA 105705). Following Wilson's conclusions in Chapter 19, distributions of pottery types suggest that these farming sites were used during the Late Classic period between ca. A.D. 1450 and 1550. This date range is supported by excavational data from several sites. Biscuit B sherds were recovered from the gravel mulch in two excava-

Table 23.1. Pottery recorded on the surface of the farming sites (count)

Ceramic Type	LA 105703	LA 105704	LA 105705	LA 105706	LA 105707	LA 105708	LA 105709	LA 105713	LA 118547
Biscuit A	2	1	1	3	14	10	65	18	5
Biscuit B	10	-	3	3	5	3	39	32	13
Unidentified biscuit ware	1	-	1	-	3	-	17	-	-
Glaze Red	-	-	-	-	1	1	-	-	-
Tewa Gray	-	-	-	-	-	3	-	-	-
Potsui'i Micaceous	-	-	-	-	-	-	-	1	-
Micaceous undifferentiated	-	-	-	-	-	1	3	-	-
Tewa polychrome	-	-	-	-	-	-	-	1	-
Unidentified	-	-	-	-	-	-	5	6	1

Table 23.2. Pottery collected from the farming sites (count)

Ceramic Type	LA 105703	LA 105708	LA 105709	LA 118547
Biscuit A	2	-	3	8
Biscuit B	30	7	31	3
Unidentified biscuit ware	12	124	-	-
Sapawe Micaceous	2	-	-	-
Micaceous undifferentiated	1	43	1	-
Classic period utility ware, undifferentiated	-	7	-	-

tion units at LA 105703, and one EU each at LA 105708, LA 105709, and LA 118547, suggesting that those fields were all in use during the Late Classic period.

Research Issue 16: Crop Mix

Wiseman and Ware (1996:68–69) considered determination of the types of crops grown in these fields to be of critical importance to our understanding of how they functioned in the prehistoric Pueblo economy. In addition to this question, they raised the possibility that borrow pits may also have been used for growing crops, as suggested by several other researchers (Bugé 1981; Lang 1979, 1980; Lightfoot 1990). Pollen samples were obtained from fields and a sample of borrow pits to address these questions. The pollen analysis is fully discussed in Appendix 1. The observations made here are primarily based on pollen concentration values provided in Appendix 1, which combine the counts and the low-magnification scan of samples and are presented in Table 23.3.

Corn and cotton are the definite domesticates in Table 23.3. Corn pollen was identified in all 45 samples, and cotton was found in 24 (53.5 percent). Since both of these pollens are large-grained and are not transported far from flowers by wind, it is certain that these crops were grown in the area. Corn cultivation seems to have taken place in every examined field location at one time or another. The distribution of cotton pollen is not quite as ubiquitous, but the high percentage of samples in which this type of pollen occurs suggests that it was a common crop. Cotton pollen was recovered from half the LA 105703 samples and four of five of the features examined. This crop was also identified in a third of the samples from LA 105704, accounting for one of the two features examined at that site.

Cotton pollen was found in only one of six samples from LA 105708, suggesting that it was grown in at least a section of one of the two features examined at that site. Similarly, cotton was identified in one of two samples from LA 105709, and it was grown in at least one of the two features studied there. Cotton pollen was most commonly found at LA 118547, where it was identified in eleven of twelve samples (91.7 percent) from Feature 15. It may be important that cotton was not found in either of the pollen samples recovered from backhoe trenches.

As Holloway notes in Appendix 1, it is not possible to differentiate pollen from wild and domesticated cucurbits, so we can not determine for certain whether or not the cucurbita pollen identified in four samples (8.9 percent) represents domesticates. However, the presence of this type of pollen in agricultural fields is suspicious and may indeed be an indication that cucurbits were sometimes grown in gravel-mulched fields.

The three remaining pollen types listed in Table 23.3 represent potential crops or plants that might have been encouraged to grow in fields because they were of economic value. Prickly pear occurs in only three samples (6.7 percent), all from LA 105708. The distribution of cholla pollen is much more ubiquitous, occurring in 40 samples (88.9 percent) from all five of the excavated sites. Since both of these plants currently occur naturally on farming sites in the study area, it is doubtful that they were ever purposely cultivated. Evening primrose pollen is also fairly common in samples from these sites, occurring in 22 samples (48.9 percent), and it is represented at all five sites. Though this plant was used in ritual and medicinally (see Appendix 1), it is questionable whether it was purposely grown in these fields. Thus, we have two and possibly three domesticates represented among the pollens identified in samples from the farming sites. A few other types of pollen could represent plants that were intentionally cultivated or at least encouraged, but since this is questionable, they are currently considered evidence of the natural plant community.

Five paired samples were submitted for analysis from LA 105703. Each pair came from an excavation unit that contained two separate layers of mulch, a lower cobble mulch and an upper gravel mulch, and one sample came from each mulch layer. We were hoping that these samples would provide evidence of variability in the crops grown in these mulches, but this does not seem to be the case. However, the paired samples may provide evidence of successive cropping in these features. Both corn and cotton pollen was identified in four of the five pairs. While corn was found in both samples from each pair, the occurrence of cotton was less ubiquitous. Indeed, in three of four pairs in which cotton pollen

Table 23.3. Economic pollen identified during ISM analysis of samples from the farming sites

Site	Feature	EU	Corn	Cotton	*Cucurbita*	Cholla	Prickly Pear	Evening Primrose
LA 105703	2	B	+++	+	+	-	-	-
		C	+++	+	-	+	-	-
		D	++	+	-	-	+	+
	8	A	++	-	-	-	-	-
	18	E[1]	+	-	-	+	+	+
		E[2]	+	+	-	+	-	-
		F[1]	++	-	-	+	-	+
		F[2]	++	+	-	+	-	-
		G	++	-	-	+	-	-
		H[1]	++	+	-	+	-	+
		H[2]	+	-	-	+	-	-
		I	+	-	-	+	-	+
		L	+	-	-	+	-	-
		N	++	-	-	+	-	+
		O	+	+	-	+	-	-
	21	M	++	+	-	+	-	-
	22	J[1]	++	-	+	+	-	-
		J[2]	+++	-	-	-	-	-
		K[1]	+++	+	-	++	-	+
		K[2]	++	+	-	++	+	-
LA 105704	1	A	+++	+	-	+	-	+
		B	++	-	-	+	-	+
	2	C	++	-	-	+	-	-
LA 105708	3	D	++	-	-	+	-	-
		E	+++	-	+	+	-	+
		F	++	-	-	+++	-	+
	9	A	++	-	-	+	-	+
		B	++	-	-	+	-	-
		C	++	+	-	+	-	+
LA 105709	1	A	+++	-	-	+	-	-
	4	C	+++	+	-	++	-	+
LA 118547	15	A	+++	+	-	+	-	+
		B	++	+	-	+	-	+
		C	+++	+	-	+	-	+
		D	+	+	-	+	-	
		E	++	++	-	-	-	+
		F	++	+	-	+	-	+
		G	+	+	-	+	-	-
		H	++	+	+	+	-	+
		I	+	+	-	+	-	-
		J	+	-	-	+	-	-
		K	++	+	-	+	-	-
		L	++	+	-	+	-	-
		BT-1	++	-	-	+	-	+
		BT-2	++	-	-	+	-	+

[1] Sample taken from gravel mulch layer.
[2] Sample taken from cobble mulch layer.
+ = present (<1-10 grains).
++ = moderate concentration (11-30 grains)
+++ = high concentration (>30 grains).

occurred, it was found in only one sample. Cotton pollen came from the cobble mulch in two cases, while in the third it came from the gravel mulch. Cotton pollen occurred in both samples from the fourth pair.

So what do the data from the paired sampled suggest? Since cotton pollen was recovered from both types of mulch, there is no evidence of the restriction of cotton cultivation to a specific type. These data seem to indicate the successive cropping of fields. Although the fields may have been multicropped with corn and cotton, this is less likely than their being grown in the same field successively. During the Valverde investigation of Oñate's colony at San Gabriel, Ginés de Herrera Horta testified that he had "seen the cotton next to the maize fields of the Indians" (Hammond and Rey 1953:653). Though these were probably irrigated fields, the early Spanish colonists were living among the northern Tewas, who consider the villages in the Ojo Caliente Valley to be ancestral. Horta's observation that he had seen cotton growing *next* to the corn fields implies that these crops were not grown together in the same fields. This source provides a thin thread of evidence suggesting that the historic Tewas did not grow corn and cotton together in the same field. The more likely scenario is that corn was the main crop, and cotton was substituted for it in some years.

The lack of cotton pollen in borrow pit samples may be significant. Both of the sampled borrow pits were at LA 118547, and cotton was identified in nearly every sample from the adjacent field. The borrow pit samples came from eolian and colluvial sediments that had built up over time, so it is possible that the corn pollen came from those adjacent fields. However, if the corn pollen was from nearby fields, why wasn't cotton pollen also found in those samples? After all, both crops were grown in those fields. Though this is slim evidence, the lack of cotton pollen in the borrow pit samples may indicate their use as subsidiary farming plots, and that corn was grown in sediments deposited after the pits were used as sources of building materials.

Research Issue 17: Characterization of Field Structure and Dynamics

Wiseman and Ware (1996:69) note that questions pertaining to field dynamics—how gravel-mulched fields were built, how they functioned, their potential productivity, their life expectancy, and other characteristics—represent important issues that have not been adequately addressed. When discussing these issues, most researchers have extrapolated from data produced by modern experiments in the use of gravel mulch to explain past field dynamics. There is a lack of replicative experiments concerning prehistoric gravel-mulched fields in northern New Mexico, so published accounts can only be used as a general guide. However, to adequately conduct experiments on prehistoric gravel mulching, detailed information on field-construction techniques are needed. Data on field-construction sequences and methods, gravel size, raw-material sources, and surface treatment variation are also needed.

Thus, this study was not structured to provide definitive answers to questions about field structure and dynamics. Rather, it was envisioned as an initial step in gathering data that can be used to design replicative experiments aimed at exploring these issues. As such, data concerning gravel sizes, mulch thickness, and construction sequencing were collected.

Gravel sizes. Observationally, there seems to have been minimal sorting of materials used to mulch the fields examined during this study. In most cases, excavators encountered materials sized from pea gravels to cobbles in individual excavation units. Cobbles that from surface indications were often thought to be part of an alignment were instead found to be floating in a gravel matrix. Field observations suggested that only larger elements were sorted out for use in building boundary and internal subdividing alignments. Spoils piles adjacent to and within some borrow pits probably represent stockpiles of potential building materials.

Samples of mulch were also obtained from most features. Unfortunately, the largest size of screen used to differentiate gravel sizes was 1 inch, so larger materials were not separated out. Our tabulation of material sizes was consistent with the procedure designed by Ware and

Mensel (1992) for their examination of field systems in the lower Ojo Caliente Valley. Since that experiment used screens measured in English rather than metric units, the former are also used in this discussion. The mean distribution of gravel sizes for materials from the gravel mulch is shown in Table 23.4.

Experiments by Corey and Kemper (1968:14) suggested that the thickness of a gravel-mulch layer should exceed 0.5 inch, but except where the diameter of the mulch exceeds 0.25 inch, the thickness of the mulch does not need to exceed 1 inch. If the diameter of the mulch exceeds 0.25 inch, then the thickness of the mulch layer should be greater than 1 inch (Corey and Kemper 1968:14). As Table 23.4 shows, 53.3 percent of the gravels used to mulch the fields investigated by this study were larger than 0.25 inches. This contrasts with samples taken from strata in borrow pits (Table 23.5), where only 37.6 percent of the gravels were larger than 0.25 inch. In contrast, 40.5 percent of the gravel-mulch samples were smaller than an eighth of an inch, and 53.7 percent of the gravel strata samples fell into that category.

Most of the materials that were less than 1/8 inch in diameter were sands that had infiltrated the mulch in the centuries since these fields were used. This has probably diluted the percentages of larger gravel sizes. For this reason, particles smaller than 0.125 inch in diameter were dropped from consideration, and Table 23.6 compares the remaining gravel sizes for the farming sites and the small group of samples from borrow pits. The largest percentage of gravels in samples from the farming sites is in the 1+ inch category, and the second highest percentage is in the 0.5 to 1.0 inch category. Except for LA 105704, at least 70 percent of the gravels from these samples were larger than 0.5 inch in diameter, and LA 105704 falls short of that mark by less than 2 percent. The borrow pit samples are more dominated by smaller fractions, and over half the gravels in these samples are smaller than 0.5 inch in diameter. Interestingly, the fraction in the 0.5 to 1 inch diameter category is quite similar for the borrow pits and field samples. These data suggest that Pueblo farmers were purposely selecting larger gravels at the expense of materials smaller than 0.5 inch in diameter.

Mulch thickness. Because larger gravels were selected for mulch, the mulch itself needed to be deeper than 1 inch, or 2.54 cm (Corey and Kemper 1968:14). Overall, the thickness of gravel-mulch layers encountered in excavation units varied between about 1 and 20 cm. Because of this variance, and since erosion undoubtedly rearranged the mulch somewhat after the fields

Table 23.4. Size of gravel samples from the gravel mulch

Gravel Size	No. of Samples	Mean Percentage	SD
1+ inch	36	31.57	12.28
0.5-1 inch	36	14.51	5.87
0.25-0.5 inch	36	7.26	4.04
0.125-0.25 inch	36	6.18	2.45
<0.125 inch	36	40.49	12.26

Table 23.5. Size of gravel samples from borrow pits

Gravel Size	No. of Samples	Mean Percentage	SD
1+ inch	5	17.58	17.24
0.5-1 inch	5	11.36	9.2
0.25-0.5 inch	5	8.64	4.97
0.125-0.25 inch	5	8.68	3.94
<0.125 inch	5	53.74	33.46

Table 23.6. Size of gravel samples from fields and borrow pits (particles <0.125 inch eliminated)

Gravel Size	LA 105703	LA 105704	LA 105708	LA 105709	LA 118547	Borrow Pits
1+ inch	51.92%	44.45%	61.78%	52.69%	47.98%	24.96%
0.5-1.0 inch	21.43%	24.16%	21.55%	25.95%	28.15%	21.43%
0.25-0.5 inch	12.94%	14.14%	8.59%	10.97%	14.18%	23.6%
0.125-0.25 inch	13.71%	17.25%	8.08%	10.4%	9.69%	30.01%
No. of cases	14	2	5	6	11	5

were abandoned, especially at their edges, mean mulch thicknesses are probably more accurate estimations of original thicknesses. These figures are available for 13 EUs at LA 105703 and range from 3.4 to 11.2 cm, with a mean of 8.2 cm. Only three gravel-mulch thicknesses are available for LA 105704, ranging from to 6.3 to 11.6 cm, with a mean of 8.4 cm. In the five EUs at LA 105708, the gravel mulch ranges from 5.6 to 9.4 cm thick, with a mean of 7.3 cm. Only two thicknesses are available for gravel mulch from LA 105709: 8.3 cm and 9.0 cm, which average out to 8.7 cm. Finally, gravel-mulch thicknesses are available from 12 EUs at LA 118547 and range from 4.5 to 12.1 cm, with a mean of 9.0 cm.

The mean thickness of gravel mulch at these five sites is 8.4 cm, ranging from a low of 7.3 cm at LA 105704 to a high of 9.0 cm at LA 118547. This is a tight range, though the variance in measurements from individual excavation units is larger. If the upper and lower 11 percent of the means for EUs are dropped to account for some of the more extreme variation that may be due to erosive processes, we are left with an overall range of 6.2 to 10.6 cm, and our mean thickness remains at 8.4 cm. This is still a fairly tight range, with a variance both above and below the mean of 2.2 cm, which is somewhat less than 1 inch.

The relatively thick layers of gravel mulch that were used at these sites were necessitated by particle sizes. The mean mulch layer for our sites is 3.3 times thicker than is recommended by Corey and Kemper (1968:14). Since over half of the gravel used to mulch these fields exceeded the size used in Corey and Kemper's (1968) experiments, these greater mulch thicknesses were probably necessitated by the size of the materials selected for use.

Construction sequencing. As discussed in individual site reports, some evidence of the sequenced construction of fields was collected. Though nearly all was gathered through surface observations, enough data exist to allow a preliminary discussion of this topic. Evidence of sequenced construction is first discussed for each site where it occurs and then summarized for the project. A few of the farming sites yielded no evidence of the staged construction of fields. While there is no reason to suspect that these sites were built in single construction episodes, we cannot demonstrate in this case that separate features were built at different times.

LA 105703 provided four types of evidence for sequenced construction. First, Feature 3 was built along the east edge of Feature 2 and distinctly mounded above the surface of the earlier feature. Second, the lobed shape or overlapping configuration of several borrow pits suggest that they were used as material sources on multiple occasions, though this type of evidence is not as strong as that for overlapping fields. The third type of evidence is the existence of material stockpiles—one between Features 2 and 5, and a second at the southeast edge of Feature 10. These probable stockpiles suggest that some parts of the field system were still being built or modified at the time it was abandoned. Finally, there are several examples of gravel mulch overlying cobble mulch. Unfortunately, this construction style is not well understood. While it could be evidence for the remulching of features with gravel that were originally mulched with a layer of cobbles, it could also simply be a more elaborate mulching technique. Further study of this type of mulch is needed before conclusions concerning its use can be drawn. Thus, alternate layers of cobbles and gravel cannot at this time be assumed to demonstrate sequenced construction.

Three lines of evidence of sequenced construction are available from LA 105705. First, Feature 11 partly overlays Feature 9 and is distinctly mounded above its surface, indicating that it was built after Feature 9 was in use, and perhaps after that plot was abandoned. Second, the presence of both terrace-edge and terrace-interior borrow pits may be evidence of at least two main field-construction episodes, as discussed below for other sites. Finally, a rock pile between Features 9, 11, and 13 represents a probable material stockpile, suggesting that field construction was still occurring when this site was abandoned.

Though evidence of sequenced field construction is not abundant at LA 105707, it does exist. This site is on a fairly narrow terrace finger, and there was not much room for field construction except at the terrace edge. While there were no terrace interior borrow pits, evidence of sequenced field construction was noted in three sections of Feature 13. The first was an unmulched area in the south leg of this field, which probably represents a planned extension that was never completed. The second is an area that contains material stockpiles represented by separate concentrations of cobbles and gravels, which may indicate another planned extension that was never finished. Directly north of the stockpiles in Feature 13 is a well-preserved field that partly covers another plot and is mounded 5 to 10 cm above its surface.

Quite a bit of evidence of multiple field-building episodes was found at LA 105708. When compared to most of the other farming sites, LA 105708 is rather wide and contains many terrace-interior borrow pits ringed by gravel-mulched fields that display a definite mounding above the natural terrace surface. Gravel-mulched fields that follow the edge of the terrace are not as highly mounded and are in a worse state of preservation than those on the interior. Thus, there seem to be two bands of fields at this site. The original band mostly follows the edge of the terrace and was apparently built with materials from terrace-edge borrow pits. A second band was built at a later time next to terrace-interior borrow pits. This band is represented by Features 7, 14, and 16, which overlap fields of the first band and are mounded above their surfaces. The highly deteriorated nature of some parts of the first band of fields suggests that materials were salvaged from them for building later fields. Further evidence of this was found when EU-A was excavated into Feature 9. That area contained a cluster of cobbles on the surface, which probably represented materials stockpiled for further field construction. Since these cobbles were piled on top of a field surface, that part of Feature 9 was abandoned when the stockpile was made.

The only evidence of sequenced field construction from LA 105709 was found in Feature 6, which appeared to be an unfinished plot. Feature 6 was not visibly mounded above the adjacent terrace surface, it was not mulched, and it included two cobble concentrations that seemed to represent material stockpiles. Thus, this plot remained unfinished at the time the site was abandoned.

The configuration of farming features at LA 118547 was quite striking and provides good evidence of multiple construction episodes. Two bands of features were visible across the northern three-quarters of this site—one along the terrace edge and a second toward the terrace interior, adjacent to the first. The terrace-edge band was the first one built, and it was primarily comprised of Feature 15, which undoubtedly represents many originally separate plots that eventually grew together. Feature 16 was included in the terrace-edge band, but it was built after Feature 15 and partly overlaps it. Thus, the terrace-edge band of fields almost certainly attained its current form through accretional growth. Most, if not all, of the terrace-edge borrow pits seem related to construction of the terrace-edge band.

In contrast, terrace-interior borrow pits at LA 118547 were all adjacent to a second (interior) band of fields, and they were probably sources for the materials used to build them. The interior band includes Features 18, 20, 22, and 23, as well as several unmapped fields. All recorded fields in the interior band were qualitatively distinct from those in the terrace-edge band. Their boundary alignments were better preserved and more visible, and their surfaces were clearly mounded above those of the terrace-edge band. Interior band fields overlapped those of the terrace-edge band in some instances. Boundary alignments in the interior band may be better preserved because construction materials were salvaged from the earlier (terrace-edge) band for use in the newer (interior) band.

As this discussion shows, there was overt evidence of sequenced field construction for at least six of the ten farming sites examined during this study. The most convincing evidence came from LA 105708 and LA 118547. Both of these sites contain two bands of farming features—an early band running along the terrace edge and a later band toward the interior of the terrace but adjacent to the back edges of the earlier fields. We were able to determine which band was earlier and which was later because plots in the interior band often overlap those of the terrace-edge band and are distinctly mounded above their surfaces. The presence of unfinished fields at several sites also indicates sequenced construction, in that some fields were planned but uncompleted when these sites were abandoned. Material stockpiles adjacent to fields on other sites may be more evidence of this, but they are not as strong an indicator. Similarly, the presence of both terrace-edge and terrace-interior borrow pits is not by itself direct evidence of sequenced field construction, but the similarity of this configuration to that of LA 105708 and LA 118547 suggests that the same process was at work. Perhaps the strongest evidence of sequenced construction is overlapping fields. When a field overlaps another field and is mounded above its surface, it is obvious that it was built later and is good evidence of sequenced construction.

More circumstantial evidence comes from the large and irregular shapes of many of the features examined during this study. Good examples of this are Feature 13 at LA 105707 and Feature 15 at LA 118547. These fields are very large and irregularly shaped, with numerous interior subdivisions. They seem to have been built in multiple construction episodes, and plots grew together through time. Some evidence of this process was seen at LA 118547, as noted earlier: Feature 16 overlapped Feature 15 but otherwise represented an extension of the earlier plot. Most of the large gravel-mulched field complexes examined during this study probably began as several smaller plots near one another and grew outward from those cores.

Research Issue 18: Embedded Lithic-Extraction and -Processing Activities

Wiseman and Ware (1996) note that some studies of gravel-mulched fields have concluded that chipped stone artifacts indicative of raw-material quarrying were common on field surfaces. Indeed, Ware (1995) wrote that lithic raw-material extraction and initial core processing were important activities embedded in field construction and use at sites further south in the Ojo Caliente Valley. Part of our chipped stone analysis was directed at determining whether this pattern pertains to farming sites in the northern valley as well.

As detailed in Chapter 18, this pattern extends to the sites included in this study. Raw-material extraction seems to have been the main activity in which chipped stone artifacts functioned at the five farming sites that had no associated occupational areas (LA 105703, LA 105704, LA 105706, LA 105713, and LA 118547). Raw-material extraction was also important at the four farming sites that had associated occupational areas (LA 105705, LA 105707, LA 105708, and LA 105709). However, raw-material extraction at the latter was not simply embedded in farming and field construction; it was also part of the domestic routine associated with part-time residence at those sites.

Research Issue 19: Methods of Field Tending

Scatters of artifacts, sometimes with associated features, that represent temporary occupational areas were found at four farming sites: LA 105705, LA 105707, LA 105708, and LA 105709. These occupational areas provide some information on field tending and, possibly, prehistoric land tenure systems. Though we identified no definite structures that were occupied by Pueblo farmers while tending fields, temporary structures were almost certainly built in the occupational areas. Indeed, Feature 21 at LA 105707 is a heavy concentration of cobbles, small boulders, fire-altered rock, and chipped stone artifacts that appears to represent one or more temporary field shelters. In close association are at least three deflated thermal features and a much larger scatter of artifacts (Feature 24).

The possible occupational zone at LA 105705 consists of a comparatively heavy concentration of chipped stone artifacts, which lacks evidence of thermal features or temporary structures. LA 105708 is bisected by an occupational area (Feature 18) that contains numerous chipped stone artifacts, between four and six probable thermal features, and a few sherds. Though no structures were defined from surface indications, temporary shelters probably existed in this area. The occupational area on LA 105709 consists of a fairly heavy scatter of chipped stone and ceramic artifacts, but no associated thermal features or structural remains were defined.

As discussed in Chapter 18, the four farming sites that contain occupational areas also exhibit evidence for the performance of a wider range of activities than were defined for the farming sites that lack occupational areas. Most of these tasks can be considered indicative of a residential function. In particular, fragments of ground stone tools were found on LA 105707 and LA 105708, indicating that vegetal foods were processed for consumption at those sites. Occupational areas probably contained temporary residences used during the growing season. The lack of substantial shelters supports the assumption of warm-season use. Year-round occupation was undoubtedly in the large Classic period villages that occur nearby: Ponsipa'akeri, Nute/Hilltop Pueblo, or Posi'ouinge.

Even though residential villages were fairly close to the field complexes, Pueblo farmers obviously felt a need to maintain a presence near their gravel-mulched fields during at least part of the growing season. Since fields attract herbivores, farmers probably maintained a presence near their crops to protect them from the depredations of deer and rabbits. Projectile points are fairly common at the farming sites with occupational areas and also occur at some of those that lack occupational areas. This suggests that large herbivores attracted to the fields were hunted, protecting crops and providing meat that could be easily transported back to the residential village.

Some of the farming sites in our sample that lack associated occupational areas are comparatively small and occur near farming sites that do have occupational areas. The boundaries between sites are artificial and assigned for the ease of archaeological recording, and they do not replicate prehistoric land tenure patterns. Thus, there is really no separation between LA 118547 and LA 105709 to the north, and LA 118548 to the south. The latter, outside our study area, is another large complex of gravel-mulched fields (Levine 1997). The fields at LA 118547 and LA 105709, at least, may have been tended from the occupational area on the latter site and thus could represent part of the landholdings of a single corporate group. LA 105705, LA 105706, LA 105707, and LA 105708 represent a sequence of fields that is broken only occasionally by natural topographic features, similar to the situation at LA 105709, LA 118547, and LA 118548. However, in this case, at least three occupational areas are represented. This suggests that LA 105705–LA 105708 may represent part of the farmlands of at least three groups. Further examination of areas in which other sites without occupational areas (LA 105703, LA 105704, and LA 105713) occur should provide evidence of similar land tenure patterns.

Conclusions

Data collected during our study of farming sites near Gavilan allowed us to examine all of the questions posed for this site type in the project research design (Wiseman and Ware 1996), as well as a few other lines of inquiry developed through field observations. Research Issue 15 concerned the dating of these farming sites. The only accurate type of chronometric data available was provided by pottery. Most assemblages contained mixtures of Biscuit A and Biscuit B sherds, suggesting that the fields were primarily used during the Late Classic period between ca. A.D. 1450 and 1550. According to Orcutt's (1999a) climatic reconstruction for the Northern Rio Grande, most years between 1450 and the mid-1480s saw drought conditions. The climatic model developed by Rose et al. (1981) follows a similar pattern, with mostly below-average precipitation levels between 1449 and 1485. Maxwell's (2000) reconstruction for the Chama River Basin also agrees with this pattern, with below-average precipitation levels between 1452 and 1486.

Even though our chronometric data are weak, it is probably no coincidence that these fields may have been initially built during a 30+

year period of drought. The heavy use of water-conserving farming technology was probably a response to both an expanding population and below-average rainfall. This is not to say that gravel-mulched fields were not built in the area before 1450, because this is clearly not true. Anschuetz (1998) recorded gravel-mulched fields dating to the Coalition period in the Rio del Oso Valley, so this technology was used almost from the beginning of Pueblo occupation in the Chama–Ojo Caliente Valleys. However, drought conditions in the second half of the fifteenth century may have provided an impetus for a much greater use of this technology to feed an expanding population.

Research Issue 16 concerned the types of crops grown in these fields. Direct evidence for the cultivation of corn, cotton, and possibly cucurbits was recovered by the analysis of field sediments for pollen content. While other common species could feasibly represent plants that were either semidomesticated or at least encouraged, there is currently little real evidence of this. The recovery of both corn and cotton pollen in several samples may be evidence for the sequenced planting of these crops in different years. However, it could also be evidence that the plots containing these plants were next to one another. Our scale of analysis cannot differentiate between these patterns, though we consider the former to be more likely.

An ancillary question the pollen analysis may have helped address concerns the use of borrow pits for farming. No cotton pollen was found in samples taken from borrow pits at LA 118547, though most samples from the adjacent Feature 15 did contain cotton pollen. If the corn pollen in these samples reached the borrow pits through erosion, why was no cotton pollen also washed down to them? It seems more likely that corn pollen in the borrow pit samples reflects the use of those features as small farming plots, probably (though not definitely) after sediments had begun to build up in them.

Research Issue 17 concerned the characterization of field structure and dynamics. Noting that insufficient data exist for the implementation of accurate replicative experiments in prehistoric gravel-mulch technology, Wiseman and Ware (1996) designed this question to collect information on gravel sizes and mulch thickness. An additional inquiry into field-construction sequencing was added during this study.

Examination of gravel sizing suggested that prehistoric Pueblo farmers selected for elements larger than 1 inch in diameter. Observations made during the field study corroborate this, and in most cases it seemed that only larger elements were chosen for use as building materials. Comparison with samples obtained from borrow pits suggest that much of the smaller fraction of gravels was discarded before the mulch was applied. Thus, Pueblo farmers were selecting gravels that were larger than the size considered optimal in experiments by Corey and Kemper (1968).

The comparatively large size of elements used in the gravel mulch probably directly contributed to the thickness of the layer applied to fields. Our data indicate that the overall mean thickness of gravel-mulch layers at these sites was 8.4 cm, ranging from a low of 7.3 cm at LA 105704 to a high of 9.0 cm at LA 118547. This range is tight, though variance in individual excavation units is much larger. This mean is 3.3 times the optimal thickness suggested by Corey and Kemper (1968), and this greater thickness was necessitated by the much larger gravel used in the fields versus the size of gravel used in Corey and Kemper's (1968) experiments.

Our analysis of construction sequencing indicated that these fields were not built in a single planned episode but grew by accretion through time. Fields were initially placed along terrace edges, probably at least partly because building elements were obtained more easily there. When there was no more terrace edge available for exploitation, and probably as the yields from those fields began to decline, a new band of fields was built when there was enough space. The new band of fields was situated toward the interior of the terrace but adjoined and often overlapped the earlier fields of the first band. Indeed, the more highly deteriorated condition of the terrace-edge bands versus the terrace interior bands suggests that some of the building materials used to construct the new fields were salvaged from older plots. In several instances, planned fields were not completed when these farming sites were abandoned.

Research Issue 18 was designed to examine chipped stone technology on the farming sites to determine whether there was evidence of embedded raw-material extraction and processing. As our analysis of the chipped stone assemblages indicated, raw-material extraction and initial processing were important at all of these sites, and they were carried out by the farmers who used the fields. In addition, however, we determined that a suite of activities using chipped and ground stone occurred at farming sites with associated occupational areas, and that evidence of those activities was mostly missing from sites lacking occupational areas. This suggested a part-time residential function for the sites with occupational areas, the use of which focused on the growing season.

Finally, we examined evidence of field-tending methods, suggesting that the occupational areas indicate temporary residence by farmers in areas next to some fields. These task groups probably mixed field tending with hunting herbivores attracted to their crops. That such duty entailed fairly lengthy stays at the fields is indicated by the occurrence of ground stone in two occupational areas, large scatters of chipped stone debris, and formal chipped stone tools indicative of a variety of tasks. We also suggested that the distribution of occupational zones in relation to fields might provide some information on land tenure systems, though the data we collected were insufficient for an in-depth study of this question.

Though we were able to address all of the issues posed in the research design, this discussion has raised more questions than it has answered. This is usually the case in such a study. The identification of occupational areas at several sites may be one of its most important contributions. This is not the first study to identify artifact scatters adjacent to fields, but it is the first to suggest a direct association between those scatters and farming in adjacent fields. A large-scale areal study of the distribution of fields and associated occupational areas could provide a much more detailed understanding of prehistoric Pueblo land tenure in this region and allow comparison of that system to its modern equivalents.

Chapter 24. Shrines and Trails in the Northern Rio Grande

James L. Moore

Types and Functions of Shrines in the Chama–Ojo Caliente Valleys

Shrines can be one of the most difficult aspects of Pueblo culture to understand and document. In many cases, shrines may have served multiple purposes. In addition to being places of veneration, they may also have served to mark the routes of pedestrian corridors and territorial boundaries. In form, shrines range from particular trees, rocks, or geological formations to elaborately constructed enclosures. While the latter are generally recognizable, more ephemeral types of shrines can be misidentified or missed during archaeological survey or excavation. Pueblo peoples are also usually reluctant to provide information on shrine location and use, especially when access to certain shrines is restricted. Parsons (1939:307) provides a very broad definition of Pueblo shrines:

> Shrines range from a mere boulder shelter or rocky ledge or cave to a ring or cairn of stones, from a miniature stone-slab house to an elaborately carved and painted tabernacle (Zuni Shalako roof box), from the great crater pit in Laguna's "southeast corner" or at Zuni Salt Lake to the small depression near the Taos house door devoted to filth boy. In fact, any place which is visited habitually to pray and make offerings may be considered a shrine: a tree, a spring or pool, a housetop (Oraibi).

Modern pueblo shrines tend to be physically and visually understated (Swentzell 1997:186). Important points in the Pueblo cosmos are marked by an inconspicuous stone or group of stones (Swentzell 1997:187). Since everything is sacred in the Pueblo world, there is little need to create distinctions between people, objects, or even places (Swentzell 1997:187). Thus, Pueblo shrines tend to have low visibility.

Harrington (1916) describes many shrines in the Tewa Basin, and Ortiz (1969) explains the structure of shrines around modern Tewa villages. However, both of these studies concentrate on the nature and locations of historic shrines. How similar to their modern counterparts are prehistoric shrines, did they serve the same function, and were they placed in similar locations? Obviously, most shrines represented by trees, shrubs, or geological formations are difficult or impossible to identify unless they have been modified in some lasting manner. Built shrines are usually more easily identified, though it may be difficult to establish their ritual function.

Though no attempt at a comprehensive study of shrines will be attempted in this chapter, we will examine types of built shrines to demonstrate similarities and differences between prehistoric and historic Tewa shrines of the study area and those of other regions. Shrines consisting of perishable materials (trees, shrubs, etc.) and those represented by unmodified geological formations are not considered.

Shrines of the San Juan Region

The most common types of shrines identified in the Chaco area are stone circles and *herraduras* (horseshoes). Windes (1978) presents the most comprehensive study of the former, noting that at least 20 stone circle shrines have been identified in Chaco Canyon. These are massive structures along the lines of Chacoan great houses. They usually consist of a double-coursed uncored masonry wall up to 1 m high and 7-30 m in diameter. All occur on exposures of bedrock along high cliff edges, and nearly all have one or more cut bedrock basins in association. Though most of these structures are round, a few rectangular examples have also been found. While the enclosing walls are thought to have been pierced by openings, only one shrine has a definite opening—the rest were obscured by collapse. Visibility seems to have been an important aspect of feature location, and they were placed where great kivas and other shrines were visible. A few similar structures have been noted at Chacoan outliers in the San Juan Basin and are described by Marshall et al. (1979). One has a southerly entrance, while a questionable shrine has an easterly entrance. There is a possible circular shrine near Guadalupe Ruin in the Rio Puerco Valley, though no construction details are available.

Herraduras are massive, low, circular or U-shaped masonry walls, and tend to be located near Chacoan roads (Nials et al. 1987). They range from 3.5–12 m in diameter, but most are between 5 and 7 m in diameter. In about 60 percent of known cases, herraduras open to the east (Nials et al. 1987:11). These structures are consistently located on major topographic breaks where there is extended visibility in both directions along the associated road segment (Nials et al. 1987:11). A similar type of shrine is the *zambullida*, which may be an elaborate form of the herradura (Kincaid et al. 1983).

Hayes (1981) recorded several other types of shrines in Chaco Canyon, though some may have been built by Navajos. Stone cairns, a very common type of shrine in the region, range from low, carelessly piled stone mounds to carefully built, truncated, conelike pylons up to 1.65 m tall (Hayes 1981:40). In addition to shrines, some cairns may represent stockpiles of building materials or trail markers, and others may have been built by Navajos (Hayes 1981:40). Open-faced boxes made of upright slabs or masonry about 1 m square were found at several sites (Hayes 1981:41; Kincaid et al. 1983). They resemble a common type of shrine used by the Hopis as a repository for offerings (Fewkes 1906). Also common are stone arcs or U-shaped walls about knee high and 30 ft across their open ends (Hayes 1981:41–42). Two "gateway" shrines have been identified in the Chaco area (Hayes 1981; Kincaid et al. 1983). These structures are 5–7 m in diameter and have openings on their east or south sides. Both are built of massive compound masonry, with walls about 1 m high and occur in elevated situations where access is difficult and visibility is good. Massive Bonito-style (carefully stacked, cored masonry) cairns occur in association with both of these structures, in one case consisting of a series of 13 cairns running along a cliff edge from the stone circle for nearly a quarter of a mile toward the southeast (Hayes 1981:43). Kincaid et al. (1983:9–21) feel that these shrines served as boundary markers for Chaco Canyon; hence the name "gateway shrines."

Rohn (1977) describes several shrines on Chapin Mesa at Mesa Verde. While they do not exactly replicate those identified in the Chaco area, they are often situated on bedrock exposures at cliff edges. Three examples are U-shaped masonry constructions built on sandstone ledges with features identified as associated hearths that could be basins similar to those at Chaco. A possible fourth example is a low round masonry enclosure built on a slight promontory. At least five thick-walled rectangular structures with walls less than a story tall are tentatively classed as shrines, though most may consist of multiple connected enclosures. Other shrine types include low masonry arcs, sometimes with associated hearths, and possible small niche or vault shrines. The latter, however, are similar to kilns or slab-lined hearths, and so they are doubtful. Hayes (1964:113) recorded several small shrines on Wetherill Mesa, mostly consisting of monuments of carefully stacked stones, all on cliff edges or projecting ledges.

There are some resemblances in form and location between the major types from the Chaco and Mesa Verde regions, suggesting a similarity in function and cultural derivation. Visibility seems to have been an important aspect of shrine location in both areas. Though circular shrines are common in parts of the Northern Rio Grande, they are built and situated differently, and they tend to date much later. There is also a great difference in the formality of shrine construction. Many of those described for the Chaco and Mesa Verde areas were carefully built, massive, coursed stone walls. There are few analogues to this form in the Northern Rio Grande, where shrines tend to be physically and visually understated (Swenzell 1997). Thus, there seems to be little direct relationship between the shrines of the San Juan region and those of the Northern Rio Grande except in the concept behind their use.

Classification of Shrines in the Rio del Oso Valley

Anschuetz (1998) summarizes data on shrines associated with ancestral Tewa sites in the Rio del Oso Valley, defining seven types.

Shrine Type 1 consists of large cobbles or boulders with cupules pecked or ground into them (Anschuetz 1998:460). The cupules tend to be 2–5 cm in diameter and 1–2 cm deep, and they occur singly or in clusters of up to 100 (Anschuetz 1998:460). Though he estimates that over 100 such shrines occur in his study area, Anschuetz (1998:460) indicates that this type only occurs at habitation sites with associated ash piles and are mostly situated at breaks in slope and at the edges of ash piles.

Shrine Type 2 consists of boulders with large oblong ground facets and is limited to the large villages of Ku, Te'ewi, and Peseduinge, where they occur in clusters that enclose the village's physical limits (Anschuetz 1998:467).

Shrine Type 3 consists of small cobble structures, all but one of which occur at Classic period sites (Anschuetz 1998:468). One example is a small keyhole-shaped construction with a south-facing stone-bordered path. Two other examples are small (1.5–2.5 m diameter) semicircular rock alignments that open toward the east and resemble a historic Tewa shrine that was also recorded in the area. These varieties occur among gridded and terraced field complexes. Another variety consists of large stone rings up to 5 m in diameter, which occur around the large villages of Te'ewi, Ku, and Peseduinge. These shrines are typically full of ash and only one course high. Three small rings comprised of piled basalt gravel and cobbles were identified at Peseduinge and may represent postoccupational features (Anschuetz 1998:468).

Petroglyphs are Shrine Type 4 (Anschuetz 1998:468). All of his examples occurred in association with visible field complexes. Examples of Shrine Type 5 are shaped stones, two of which are reported from Rio del Oso: a small boulder with an incised keyhole-shaped motif, and a possible *timponi*, or Corn Mother (Anschuetz 1998:469). Large world-quarter or middle-place rock rings exemplify Shrine Type 6. They tend to occur near some Classic period villages (Anschuetz 1998:469). Shrine Type 7 is represented by a single ethnographically documented example—a large upright gray boulder next to a cleared area.

Other Types of Tewa Shrines

Several other categories of shrines are mentioned in ethnographic studies of the Tewas. All springs are considered sacred, but certain springs and certain caves are deemed places of emergence. The Tewa place of emergence is a small brackish lake in the sand dunes north of Alamosa, Colorado (Harrington 1916:564–565; Hewett and Dutton 1945:23). The Tewas consider a pair of caves near La Cueva in the Ojo Caliente Valley to be the emergence place of the Keres (Devereaux 1966; Harrington 1916:166; Hewett and Dutton 1945:24). Sacred waters, associated with the four cardinal directions, occur in the Tewa Basin; for example, the sacred spring of the west is less than a mile southwest of Perage (Hewett 1938), a Classic period village across the Rio Grande from San Ildefonso. The hot spring at Ojo Caliente is one of the most sacred Tewa shrines and has several connections to Poseyemu, the Tewa culture hero (Harrington 1916:164; Hewett and Dutton 1945:40). Another sacred hot spring is associated with a shrine complex on top of Tsikomo Peak (Douglass 1917:345). Douglass (1917:364–365) discusses a cave shrine on Black Mesa, but he never visited it.

One of the most common types of shrine in the Tewa area, and indeed for the Pueblos in general, is the rock pile (Ellis 1969:173). These shrines vary greatly in size and sometimes incorporate perishable materials. Douglass (1912, 1917) describes a large rock pile as part of the Tsikomo Peak shrine complex. This rock pile was 3 m in diameter by 1.5 m tall and had a peeled spruce pole protruding from its top. A similar rock pile, without the spruce pole, is on top of a peak at the southwest corner of the Baca Location 1 Grant, within view of Tsikomo (Douglass 1917:358), and it is also part of a shrine complex.

Ellis (1969:168–169) and Parsons (1929:238) discuss a type of Tewa rock pile shrine referred to as a *kaiye*, which contain elongated stones that are often white and set upright. This is one of the most common types of Tewa shrines. Examples of this type are also known in the Pecos area and the Chama–Ojo Caliente Valleys (Ellis 1969:174). Every hill in the San Ildefonso Pueblo grant is said to have a shrine on it, usually consisting of a pile of rocks on its crest (Douglass 1917:367). A rock pile shrine also occurs on top of a hill sacred to Tesuque Pueblo (Harrington 1916:389). Numerous small rock pile shrines have been noted near Nambe Pueblo (Harrington 1916:366).

Stone-enclosure shrines are quite varied in form and size, ranging from small alignments less than 0.6 m in diameter to massive rings over 15 m in diameter. Stone-enclosure shrines can be circular, oval, U-shaped, and rarely V-shaped. This category includes the type often called world-quarter shrines, though it is not limited to those features. Anschuetz (1998) also refers to world-quarter shrines as "middle-place rock rings." Ortiz (1969:141) calls them earth navels, and defines three types for the Tewas. Examples of one type of earth navel, a large rock ring with an opening pointing toward the village, are at the summit of each of the four sacred directional mountains and hills. Another type, the mother earth navel, represents the spiritual center of the village and therefore the world. At San Juan Pueblo it is a loose circle of stones in the south plaza (Ortiz 1969:21). At Nambe the mother earth navel is represented by a flat stone in the middle of the plaza (Parsons 1929:246). The third type of earth navel occurs on hilltops at about the same elevation as the sacred hills or in open places in the lowlands, and they are hunting shrines (Ortiz 1969:24). The latter type is smaller than the directional variety, and Ellis (1969:170) indicates they open toward the east. However, this is the modern scheme, which could differ somewhat from the types and classifications used in the past.

The best known of the directional earth navels (or world-quarter shrines) is part of a complex on top of Tsikomo Peak (Douglass 1912, 1917). Ortiz (1969:19) notes that lakes or ponds are associated with each of the sacred directional mountains. At Tsikomo the body of water is a nearby hot spring (Douglass 1917:345). This earth navel is an enclosure of loosely placed unshaped stones that measures 4.6 by 3.4 m, with several openings in the east section of wall. There was a saucerlike depression in the center of the shrine, and when it was first described, several prayer sticks and a jar set into the ground were observed west of the depression (Douglass 1912:172). Reportedly, this shrine is used by Tewas, Keres, Towas, Northern Tiwas, and Navajos. As discussed earlier, a large rock pile containing a peeled spruce pole forms a separate component of the shrine complex.

Jeançon (1923:70–73) identified numerous shrines around the ancestral Tewa village of Poshu'ouinge in the Chama Valley, though some of the features he classified as shrines may in fact have been gravel-mulched farming plots. All four of the hilltop directional earth navels related to this village were found, and a large earth navel he referred to as a "world shrine" was located just over 1 km southeast of the village. The latter was a large stone circle 12.2 m in diameter with an opening to the east, which Jeançon suggests might once have been topped with an adobe wall. Eight minor shrines, placed on and between the cardinal points around the earth navel, consisted of circles, squares, and a triangle, presumably outlined in cobbles. Similar large shrines also occur near the villages of Hupobi and Posi'ouinge in the Ojo Caliente Valley. Both of these large shrines (15+ m in diameter) are formed of cobbles and boulders piled in a circle. Upright slabs and boulders line the interiors of both shrines, and they open to the east. In both cases, the surrounding walls seem to have collapsed and thus were probably once much higher. A similar earth navel was also found 0.8 km southwest of Sapawe in the El Rito Valley (Ellis 1994:108). It is possible that mother earth navels were originally placed outside villages but were moved into plazas during the historic period and built to make them unrecognizable to outsiders. If so, then these large stone circles may represent the original locations and forms of the mother earth navel.

Jeançon (1923:71) briefly describes possible stone enclosure shrines associated with a series of three tanks 228 m northeast of the world shrine at Poshu'ouinge. All around the tanks were stones in V-shaped alignments, squares, circles, and triangles, as well as other undescribed shapes. The V-shaped alignments pointed toward the village and seem similar to a shrine described by Harrington (1916:222) near San Juan Pueblo. A hill sacred to that village has two peaks, each with a shrine on its summit. On top of the north peak is a hilltop directional earth navel about 1 m long, while the shrine on the south peak is V-shaped, with its opening toward the pueblo and a large slab of yellow stone where the lines of the V meet.

Small stone circles also served as shrines in the region. Jeançon (1923) noted numerous examples of this type around Poshu'ouinge but does not describe them. Douglass (1917) noted several small stone circle shrines on top of Black Mesa that ranged between 0.5 and 1.5 m in diameter. Ellis (1994:109) notes, "Many, though not all shrines have a stone pile or a stone-outlined area a few feet (a meter) across in or near them where prayers are said and a small offering is left." Thus, small stone enclosures as well as rock piles may be just one aspect of a shrine, and the actual shrine may be difficult to identify.

Cobble pavements are also mentioned as shrines by some investigators. Douglass (1917:364) describes a circular stone pavement 1 m in diameter on top of Black Mesa that was sacred to the village of San Ildefonso. Three cobble pavements were noted near a hill sacred to San Ildefonso, ranging from 0.3 to 1 m in diameter (Douglass 1917:366). At times, a single boulder can be a shrine, with or without human modification. These can include the boulders with pecked cupules in the Rio del Oso Valley (Anschuetz 1998). Douglass (1917) noted a similar shrine near San Ildefonso consisting of a semicircular wall of loose stones opening to the north with an associated boulder with 11 pecked cupules. Two of the shrines that mark the edge of San Juan Pueblo are comprised of single stones (Ortiz 1969:20).

A Tentative Classification of Tewa-Built Shrines Compared to Those of Other Groups and Regions

Rock pile shrines. This category can be broken into at least three subvarieties: large rock piles, small rock piles, and rock piles containing elongated cobbles. Few large rock piles have been reported, and those that are currently known occur on mountain tops, sometimes in association with other features to create a shrine complex. Small rock piles are common features, and if we are reading the literature correctly, they can occur both with and without elongated cobbles. When elongated cobbles (kaiye) occur, they are often set upright in modern shrines.

As Ellis (1969) notes, small rock pile shrines are fairly widespread, occurring among many Southwestern groups. Small rock piles are common in the Navajo Reservoir district, occurring as isolated features on the ends of ridges overlooking valleys (Dittert et al. 1961:43). As discussed earlier, they also occur in the San Juan region, usually in situations similar to those in the Navajo Reservoir district. Lang (1977) recorded simple probable rock pile shrines and rock pile shrines with elongated stones in the Galisteo Basin near villages ancestral to the Tanos (Southern Tewas). These shrines often occur at mesa edges. Several rock piles were part of a shrine complex in the Piro area of the Rio Abajo, which appear to have originally had elongated slabs set upright in them (Marshall and Walt 1984:187). Small rock piles, which have also been identified in the Southern Tiwa area (Schmader and Hays 1988), are commonly used as shrines by the Hopis (Fewkes 1906; Page and Page 1982). Indeed, Hopi farmers will sometimes build small rock piles in their fields as shrines (Parsons 1939:307–308).

Stone-enclosure shrines. While this category could doubtless be divided into numerous types, only two very general divisions are made here: earth navels and stone enclosures. Though the name and possibly function of earth navel shrines may differ from group to group, the general shape and construction style of this type is fairly consistent. Earth navels are round to horseshoe- or U-shaped enclosures with an opening in one side and vary considerably from small features about 1 m in diameter to large, elaborate structures up to 15 m in diameter. Construction style also varies, from a border of rocks a single element high and wide to massive piles of cobbles, sometimes bordered by upright slabs.

Small earth navels are common around Keres villages. Most open toward the east, but sometimes they open toward the village or to the north (Boas 1928:299; Ellis 1969:167; Goldfrank 1927:70; Starr 1900). The Towas of Jemez, who have borrowed numerous features of Keres religion, also use earth navels (Ellis 1969:167). At least one small earth navel is described for the Hopi Tewas (Fewkes 1906:358). Elaborate earth navels similar to the possible mother earth navels of the Chama–Ojo Caliente area occur near ancestral Tano villages in the Galisteo Basin, as do smaller earth navels (Lang 1977; Nelson 1914). The possible mother earth navels occur on the south sides of villages and open to the east (Nelson 1914). Small earth navels that open to the east or south have been recorded in the Southern Tiwa area near Albuquerque (Schmader and Hayes 1988). Earth navel–shaped shrines at Zuni consist of semicircular or rectangular stone enclosures open to the east and containing upright slabs on the west (Mindeleff 1891:86; Stevenson 1904:117). A few shrines of this type have also been noted in the Hopi area. Fewkes (1906:367) describes one that consists of a stone circle with an east-oriented opening and a large rock set on its west side. Page and Page (1982) illustrate a Hopi shrine on top of San Francisco Peak that is crescent-shaped and built of uncoursed stones.

Stone enclosures usually range from 0.5 to 1.5+ m in diameter and are generally represented by a border of rocks a single element high and wide. This type of shrine can be round, oval, square, or V-shaped. Stone-enclosure shrines appear to be common at Hopi, usually with a large rock on the west side (Fewkes 1906). The Zunis appear to use small stone semicircles and rectangular enclosures as shrines (Holmes 1989:19; Mindeleff 1891:92; Stevenson 1904).

Cobble pavements. Cobble pavements consist of collections of cobbles placed closely together in a rough circle, often less than 1 m in diameter. This type of shrine does not appear to have been recorded ethnographically among other Pueblo groups, though Starr (1900:220) illustrates at least one example from Cochiti that is similar to this type.

Isolated cobbles or boulders. This type consists of large isolated cobbles or boulders that have been assigned a ritual or sacred status. Anschuetz (1998) defined one such feature ethnographically in the Rio del Oso Valley, consisting of a gray boulder with an adjacent area that had been cleared. Ellis (1969:166) and White (1962:49) note that there are two or three such stones in the plaza of modern Zia. Certain boulders that appear to have been used as shrines at Taos Pueblo are considered to have indwelling spirits (Parsons 1936:104). Hopi farmers often plant their prayer sticks and spruce twigs obtained from kachinas at the foot of a small boulder in their fields, suggesting that this type of feature sometimes served as a field shrine (Parsons 1939:307–308).

Boulders with pecked cupules. As defined by Anschuetz (1998), this type of shrine consists of a boulder with one or more small cupules pecked into its surface. Though boulders with pecked cupules can occur as isolates, at times there may also be other features related to them nearby. Other than the ethnographic example reported by Douglass (1917) near San Ildefonso, examples of this type of feature are scarce in the literature. At Hopi, the shrine of Kwataka consists of a large petroglyph of a mythological bird containing three hollows for the placement of war medicine (Fewkes 1906:362–362). Starr (1900:222) describes several boulders near Cochiti with pecked cupules in them that appear to have had a hunting association.

Rock art. Shrines or sacred areas are often marked by rock art, sometimes in association with another feature and sometimes not. Anschuetz (1998) noted that all his examples of petroglyphs were associated with fields, suggesting that they might represent a type of farming shrine. Schaafsma (1990) describes a shrine in the Galisteo Basin consisting of two rock shelters containing numerous painted figures and notes that similar shrines are known in the Tiwa, Piro, and Tompiro areas. White (1935:166–167) illustrates "stone images" at eight sacred spring shrines used by Santo Domingo Pueblo. Though he does not specify what form the stone images take, his illustrations suggest that they are rock art. Examples of rock art associated with shrines have also been documented for the Hopis (Fewkes 1906; Page and Page 1982), Tanos (Nelson 1914), and Zunis (Stevenson 1904). Clusters of petroglyphs near the heads of small water courses in Petroglyph National Monument near Albuquerque probably mark the locations of Southern Tiwa shrines.

Shaped or carved stones. This type of shrine is comprised of a stone or stones that have been purposely altered into a new form. The examples provided by Anschuetz (1998) include a small boulder with an incised keyhole-shaped motif; and a possible timponi, or Corn Mother. Two carved human figures in different canyons near Otowi, an ancestral Tewa village, were probably used as shrines (Douglass 1917:369). Examples from other areas exist but are not common. Perhaps the best known is the Shrine of the Stone Lions, near the village of Yapashi in Bandelier National Monument. A second set of carved lions is also known from nearby Potrero de los Ídolos. Both shrines are enclosed in horseshoe-shaped stone enclosures open to the east (Douglass 1917:371, 373; Ellis 1969:166). They appear to have been used by the Keres residents of the Pajarito Plateau, and Harrington's (1916:420)

Tewa informants indicated that the Stone Lion shrine was still being used by Cochiti Pueblo in the early 1900s. A Zuni Shalako shrine contained a number of carved stone kachina images, some elaborately shaped and others barely altered (Parsons 1939:334).

Discussion

These seven basic types, some with subvarieties, seem to represent the main classes of built shrines used by the Tewas. Obviously, due to a reluctance of the subjects of ethnographic interviews to discuss sacred matters, all types of built shrines are certainly not included. This scheme may also oversimplify the subject, since important differences may be ascribed to different forms of shrines that were not revealed through ethnographic investigations and certainly cannot be discerned archaeologically. Finally, we reiterate that this discussion includes only built or otherwise artificially marked shrines. Many important types have been omitted because they would not be visible archaeologically, including shrines built of perishable materials, sacred trees, unmarked springs or ponds, unmarked caves or crevices, sacred geological formations, shrines built of earth, and formerly occupied villages.

None of the seven types defined above are restricted to the Tewas, so no specific type can be considered a good indication of cultural affinity. However, there are important differences in shrine type preferences and in the distribution of certain subtypes. Circular or U-shaped shrines with openings oriented in a certain direction have been used for at least 900 years. This form is fairly common in Chaco Canyon and along the roads that radiate from it, and it also seems to be common in the Mesa Verde area. Though two examples of this type, the "gateway shrines," may have been boundary markers, such use was probably unusual. Cairns are also common in these areas, but most seem to have been carefully stacked rather than simple rock piles, though the latter also occur. These types of shrines tend to occur in topography that is unlike that of most of the rock pile shrines of the Tewas. Stone arcs and other types of smaller stone-enclosure shrines have also been recorded in the San Juan region.

The earth navel shrine may have developed out of these early forms in the San Juan region, perhaps conveyed to the Northern Rio Grande during the Keres migrations into that region. However, while this form now appears to be universally used by Pueblo peoples, the elaborate constructions near several ancestral Tewa villages in the Chama–Ojo Caliente Valleys and ancestral Tano villages in the Galisteo Basin that may represent early versions of the mother earth navel do not seem to be replicated elsewhere. Though similar in form and elaborate construction to the circular shrines of Chaco Canyon, they were built and placed differently. This form of the mother earth navel appears to have fallen out of use, probably during the historic period. Smaller earth navel shrines are used by all Pueblo groups, though there are certain elaborations that may not be universal. For example, Ellis (1969) notes that many Keres earth navels she had seen contained pieces of petrified wood, which do not appear to be found in Tewa earth navels. Several of the Keres earth navels described by Starr (1900) contained boulders—again, something that is not described in studies of Tewa shrines. Among the Hopis and Zunis, most described earth navels have large stones or boulders on their west sides opposite the opening, which do not appear to occur in Tewa earth navels.

Vaults for offerings, common at Hopi and Zuni, also seem to occur prehistorically in the San Juan region (Fewkes 1906; Hayes 1981; Rohn 1977; Stevenson 1904). Though Steen (1977, 1982) reports observing this type on the Pajarito Plateau, none have been described ethnographically for the Keres or Tewas, which is why it was not listed above as a separate type. If this variety of shrine was actually built on the Pajarito Plateau, it probably fell out of use before the Classic period.

Other differences occur in subvarieties of the rock pile type of shrine. Though all Pueblos use simple rock pile shrines, the addition of elongated stones seems to be restricted to Tanoan groups, currently reported for the Tewa, Piro, and Towa (Pecos) regions, though the addition of upright slabs to earth navels in the Tano region may be a similar application. Ellis (1969:177) remarks on the modern Keres emphasis on petrified wood and the Tewa affinity for elongated stones, ascribing both to a common belief in Stone People.

Thus, the types of shrines used by various

Pueblo groups are both similar and different. Similar forms occur across most of the region, but there can be subtle differences in construction style and associated materials. The use of shrine type to assign cultural affinity could be a perilous endeavor, and it might be equally dangerous to draw analogies between the uses of modern and prehistoric shrines. Aspects of the religious systems of all Pueblo groups have changed through time, especially between 1250 and 1350, when populations were dislocated and migrated across the region on a large scale, and new religious and organizational concepts like the Kachina Cult were introduced (Adams 1991).

Changes in shrine use and distribution in the prehistoric Tewa region have been documented. Anschuetz (1998) found important differences in the occurrence and distribution of Coalition and Classic period shrines in the Rio del Oso Valley. Shrines seemed to be rare at Coalition period sites and did not demonstrate the patterned distribution described by Ortiz (1969) for the modern Tewas. The occurrence of two or three elaborate earth navels at the late Coalition period village of Ku, probably mother earth navels, may represent the development of a new kind of corporate ritual space (Anschuetz 1998:476). No similar features of comparable antiquity have been identified elsewhere in the Chama–Ojo Caliente region. There was a major change in the use and placement of shrines by the late fourteenth century (Anschuetz 1998:474). After that, more and larger shrines were built in direct association with visible field complexes that lacked livable structures (Anschuetz 1998:474). This change seems to reflect a need to permanently mark land-use areas by the late fourteenth century that was not a concern during the earlier period of occupation (Anschuetz 1998:473). It may have been stimulated by the growing population of the region and practical concerns over the distribution of arable lands (Anschuetz 1998:493).

Another important consideration in the development of boundary-marking shrines was probably the influx of Keres groups into the Northern Rio Grande and an accompanying competition for resources. Thus, the Tewas may not have been simply marking areas controlled by certain villages; they may also have been delineating the region they felt belonged to them in the face of the invading Keres. The formalization of the system of shrine boundary markers may have been related to direct competition for land with both the Keres and other Tanoans that were displaced by migrants. While these possibilities are offered quite tentatively, they provide a direction for future research into the intriguing changes noted by Anschuetz in shrine use and placement between the Coalition and Classic periods.

Shrines at Gavilan Project Sites

Shrines identified at the sites examined during this project fall into four categories: rock piles, cobble pavements, stone enclosures, and isolated boulders. Since we did not closely examine any of the large Classic period villages in the valley, the absence of boulders with pecked cupules or ground facets, and of ash-filled stone enclosures is not surprising. The lack of petroglyphs in field settings is a bit harder to understand, but since few boulders that were both large enough and of the right kinds of material for such use were seen on these sites, perhaps that lack is not really so surprising.

Twenty-one definite and possible shrines were identified on eight sites. The lack of shrines at the other sites is probably more a reflection of our inability to recognize them than an actual absence of this type of feature. Indeed, though we identified potential shrines on eight sites, we cannot be certain that all such features were recognized in those cases either. Not all of the possible shrines noted at these sites are discussed as such in the individual site reports.

Though no rock piles containing elongated cobbles were found, several probable simple rock pile shrines were identified, though most have been knocked over and scattered by grazing livestock. Because of this damage, we could not determine whether some of these features represented rock piles or cobble pavements. The only potential shrine identified at LA 105703 falls into this category. This was a simple rock pile on Feature 10, which could also feasibly represent a material stockpile.

The only possible shrines defined at LA 105705 were also of the rock pile variety. Feature 6 is a single element high and appears to be more of a cobble pavement than a rock pile. A small rock pile on Feature 11 is a single element high, with elements that appear to have tumbled over. This small feature, which seems to represent the remains of a rock pile shrine, measures 0.85 m north-south by 0.8 m east-west. Feature 12 is a cluster of rocks between Features 9, 11, and 13 that measures 1.4 m north-south by 1.5 m east-west. This rock cluster is a single element high and like Feature 6 seems to represent a cobble pavement rather than a rock pile.

The only possible shrine defined at LA 105706 was another cluster of rocks that seems to represent a collapsed rock pile. This cluster of rocks is between Features 3 and 4 and is now only a single element high, measuring 1.3 m by 1.35 m. Three possible rock pile shrines were identified at LA 105707. A cluster of rocks on the east side of an extension of Feature 13 represents either a collapsed rock pile or a cobble pavement. Two rock piles on the west side of the southern extension of Feature 13 may also represent shrines. The first is one element high and measures 1.15 m by 1.1 m. The second is a more questionable feature that is one element high and measures 1.2 m by 0.9 m.

Three possible rock pile shrines were identified at LA 105708. One is a cluster of rocks between Features 9 and 15 that is one element high and measures 1.3 by 1.0 m. The second is a low rock pile on the east edge of the trail (LA 118549) near the south end of Feature 3. The third possible rock pile shrine at this site is more problematic. This feature consisted of a pile of cobbles that was deliberately placed on top of Feature 9. Though this feature was investigated during the excavation of EU-A, no real structure could be defined. While this rock pile represents a possible shrine, it more likely was a materials stockpile created by salvaging cobbles from Feature 9.

Though no shrines were initially defined for LA 118547, upon further reflection we determined that Feature 26 might belong in this feature category. This is a roughly rectangular concentration of cobbles measuring 3.2 by 2.6 m that sits on top of the terrace surface and resembles possible historic graves recorded at LA 118548. It could be a cobble pavement shrine, but this is questionable. The condition of this feature suggests that if it does represent a shrine, it most likely postdates use of the farming features at LA 118547.

One definite and three possible isolated boulder shrines were defined on two sites. The definite example was found in Feature 4 at LA 105709 and consisted of a boulder set into a plot that was not part of a wall or alignment of noncontiguous large elements. This part of Feature 4 was investigated during the excavation of EU-C, and three crushed ceramic scoops that were probably used in farming activities were recovered from under the boulder. The deliberate placement of these tools in a situation where intact recovery was unlikely suggests that they were an offering of some sort, and that the boulder represented a field shrine. This was a fortuitous discovery, since the boulder was unmodified and could simply have been classified as a building element.

Three possible isolated boulder shrines were identified at LA 105707. A large boulder in Feature 1 initially seemed out of place and was thought to represent an isolated boulder shrine. However, upon further examination we determined that this boulder could have been part of an evenly spaced series of large noncontiguous elements. Thus, its true function remains uncertain. However, two boulders set in the southern extension of Feature 13 seemed truly isolated and are better candidates for shrines. Unfortunately, all three potential isolated boulder shrines were outside the highway right-of-way, so they could not be investigated in more detail.

The only stone-enclosure shrine identified on these sites was found at LA 105709. Feature 9 is an earth navel that opens to the east and is about 14 m in diameter. The placement of this feature suggests that it was not a directional shrine associated with a nearby village. Instead, it may have functioned as a hunting shrine as suggested by Ortiz (1969) for the modern Tewas. In possible association with the earth navel was a V-shaped cobble alignment that points toward that shrine. This alignment is on the south side of Feature 12, about 30–40 m north of Feature 9.

The two remaining possible shrines have no definite cognates in the literature examined. The first of these was Feature 11 at LA 105708, a large double borrow pit that was modified by the excavation of a smaller borrow pit near the west edge of the earlier pit. The second pit was surrounded by a spoils pile except on the north side, where it was open. The trail (LA 118549) truncated the west edge of Feature 11 and was bermed along its approach to this feature. The juxtapositioning of the trail, berming along its downslope side, and the elaborate borrow pit suggests that Feature 11 was modified into a ritually significant feature—a shrine. The spoils pile that surrounds the smaller interior borrow pit except on the north may have formed a type of earth navel that is ethnographically and archaeologically unknown.

The final feature in this category is also questionable. This possible shrine consists of a two element wide (0.45 cm) and 10 m long cobble alignment that crosses the segment of LA 118549 that is adjacent to LA 118547. No ethnographic cognates to this potential shrine are known, and it is possible that, as discussed in the report for this site, the cobble alignment actually represents a historic boundary marker. However, since it is the only such feature noted in the project area and crosses a trail that passes several ritually significant locations, we must consider the possibility that it represents another such feature.

Summary and Conclusions concerning Shrines

Research Issue 20 in Chapter 2 concerned the possible shrines defined at our sites and whether they match descriptions of modern shrines used by the Tewas. We also asked whether the shrines are integrated into field complexes, and how they compare to prehistoric shrines identified in other parts of the Southwest.

Two of these questions have already been addressed. With the exception of Feature 11 on LA 105708 and a double cobble alignment on LA 118549, the potential shrines documented during this study match types that are ethnographically known for the Tewas. The double cobble alignment at LA 118549 is a very questionable shrine and, except for its placement along a prehistoric trail, would not have been classified as such. In all likelihood, this feature was not a shrine and is probably unrelated to prehistoric use of the trail. Feature 11 at LA 105708 is another matter. The trail (LA 118549) truncated the west edge of this feature, and its approach from the south was bermed on the downhill side, an elaboration that also occurs as the trail approaches the earth navel on LA 105709. Added to this was the elaboration of the original borrow pit at Feature 11 with a second, interior pit that was bermed with spoils on all but the north side. This configuration turned what was originally a simple borrow pit into a possible earth navel of a style different from others documented archaeologically as well as ethnographically.

Most of the potential shrines documented at the Gavilan sites were integrated into field systems. This is especially true of the rock pile, cobble pavement, and isolated boulder types. In some cases these probable shrines were set into fields (the isolated boulder type). In other cases they were adjacent to fields or on top of field surfaces (rock piles and cobble pavements). Those occurring on top of field surfaces were probably built after the fields were abandoned, but while other nearby fields were still in use.

However, at least three of the probable shrines do not seem to have been directly affiliated with fields. The earth navel at LA 105709 (Feature 9) may have been a hunting shrine, if the functions listed by Ortiz (1969) can be projected back in time. The V-shaped cobble alignment nearby may have been related to the earth navel, but this is uncertain. Finally, though Feature 11 at LA 105708 represents a modified farming feature, its subsequent possible use as a shrine seems more related to the trail and/or one of the nearby Pueblo villages that were occupied at the time.

The third part of this question has also already been addressed. The most common shrine types defined in the study area seem to occur among all Pueblo groups in the northern Southwest. Rock piles are ubiquitous. Circular or U-shaped stone enclosures with openings on one side, most commonly to the east, also seem to have been used by the same groups. For the Tewas this is the earth navel type, and that term may be appropriate for most other Pueblo groups as well. Isolated boulders are also commonly used as shrines, though the cache of ceramic farming tools found under the boulder shrine in Feature 4 at LA 105709 seems to be a unique find. Simple cobble enclosures and patterns were also commonly used as shrines. Only the cobble pavement type seems to be unique to the Tewas, and this may simply be due to a lack of documentation elsewhere.

If Anschuetz (1998) is correct, the use of built shrines by the Tewas increased greatly in the Early Classic period. This included the construction of large elaborate earth navels at several villages in the Chama–Ojo Caliente and Galisteo Basin areas, which may have been the original form of the mother earth navels now in village plazas. In addition to their ritual function, shrines seem to have become used as boundary markers at this time, perhaps in response to a growing population, but more likely because of the movement of Keres into the Northern Rio Grande and the attendant competition for resources and territory.

In form, the earth navel type seems to be descended from the circular massive masonry shrines found in Chaco Canyon, as well as the herraduras associated with the system of roads emanating from Chaco. Yet, this similarity is mostly general in form, since the Classic period and historic earth navels of the Tewas occur in different physiographic situations. The only shrines that approach the elaborate construction of the Chacoan circular shrines are the possible early mother earth navels near some Classic period Tewa villages, but both types probably functioned differently in their respective ritual systems.

Perhaps the impetus for certain styles of shrines began in the San Juan region and moved outward from there, first as information traveling through the large integrated Chacoan system and its successor(s) in the San Juan region, and then with the San Juan population as it abandoned its homeland and moved elsewhere. However, there is currently little hard evidence of this possibility. Indeed, built shrines were probably far outnumbered by those represented by unmodified features of the landscape, including imposing pinnacles, caves, crevices, certain trees, etc. By studying the types of built shrines in an area and how they vary through time, we can document changes in both land tenure and ritual systems that may otherwise be difficult to see.

Trails in the Northern Rio Grande

Little information on trails has been gathered. An exception is the prehistoric "road" systems of the San Juan region, known predominantly in the San Juan Basin, but which extend into southwestern Colorado and southeastern Utah (Adler 1994; Kincaid 1983; Nials et al. 1987; Severence 1999). Segments in northwest New Mexico have been extensively documented. Rather than pedestrian corridors, they seem to be "cosmological corridors that link ceremonial architecture to various topographic features, horizon markers, and directional-astronomical orientations" (Marshall 1997:71). Most of the known trails in the Northern Rio Grande seem to have functioned primarily as pedestrian corridors and thus filled a different niche than the Chacoan roads, though some ritual pathways have also been documented for this region.

An example of ritual pathways in the Northern Rio Grande is at the well-documented directional earth navel on top of Tsikomo Peak. Douglass (1912, 1917) indicates that each pueblo that uses this shrine has its own trail, all radiating from the eastern shrine entrance. Parsons's (1929:241) drawing of the entrance to this shrine disagrees with Douglass's description, instead showing a single trail leading into the enclosure and several secondary trails joining it just before the main trail enters the shrine.

Jeançon (1923:70–71) describes the landscape around Poshu'ouinge in the Chama Valley, noting that paths lead out from the ruin in many directions, all apparently ending at shrines. While the features Jeançon saw at Poshu'ouinge may indeed have been formal trails leading to shrines, it is also possible that he was describing some of the cobble-bordered gravel-mulched fields that occur around that village. However, a similar trail seems to approach the mother earth navel shrine south of Posi'ouinge in the Ojo Caliente Valley. As we suggested for Jeançon's formal pathways at Poshu'ouinge, this trail is lined by cobble alignments that appear to border gravel-mulched fields. Thus, the formal-looking trail that approaches the shrine may simply represent an area that was left clear during field building to allow unrestricted access to the shrine. Then again, the formal appearance of this approach may not have been entirely unintentional.

Harrington (1916) documents several trails in the Tewa Basin but notes that it was difficult to obtain satisfactory information on the ancient trails of the region. He notes the existence of trails passing through Santa Clara and Guaje Canyons to the Jemez area, one in the El Rito region leading to the Tierra Amarilla area, and several others. The entire Cochiti region (including Frijoles Canyon) is said to be covered by a network of trails (Harrington 1916:421). One or two trails are noted in the Ojo Caliente area, but both cross Canoe Mesa, one continuing into Comanche Canyon and leading into Ute territory (Harrington 1916:199). Bandelier (Lange et al. 1975:86) found a well-defined trail leading to Posi'ouinge and barely perceptible trails heading north along the mesa that forms the west rim of the Ojo Caliente Valley.

Steen (1982:7) reports that trails are common on the Pajarito Plateau and are usually associated with habitations. However, near the upper end of Mortendad Canyon he found a trail that is deeply cut into tuff and lacks associated habitation sites (Steen 1982:7). At Bandelier National Monument, Powers and Van Zandt (1999:142) found seven structures associated with well-defined trail segments. Hewett (1906:16) wrote that a trail at Navaju, a prehistoric Pueblo village on the Pajarito Plateau, had been worn hip-deep by foot traffic.

Two basic types of corridors seem to be represented by trails. The most common type is a pedestrian corridor, usually leading from one residential site to another or to an area used for farming or that contains resources used on a regular basis. The second type is a ritual corridor, leading to a location of esoteric importance, usually a shrine or a source of important ritual materials. Some trails may have been used for both purposes. The Zunis had three trails that led to Acoma, which were both used as trade routes and to access sacred areas (Holmes 1989:18). The Zunis also used at least two trails for their pilgrimages to Zuni Salt Lake, one for foot traffic and a second suitable for burros (Kelley 1988:2–7). Acoma and Laguna had their own trail to Zuni Salt Lake (Kelley 1988:2–8). These trails had shrines along them where offerings were left by pilgrims on their way to gather salt (Kelley 1988). The Acoma-Laguna trail was marked in places by cairns, and the shrines along it were small earth navels that opened to the east (Kelley 1988:2–8). Another trail led from Zuni Salt Lake to the confluence of the Zuni and Little Colorado Rivers, where the Zunis say they originated (Kelley 1988:2–8). This trail is sacred to the Zunis and Acomas and has shrines along it (Kelley 1988:2–8).

Harrington (1916:164) indicates that the hot spring at Ojo Caliente, just below the ancestral village of Posi'ouinge, is one of the most sacred places of the Tewas. Springs and bodies of water are often held sacred, but this spring also has important associations with Poseyemu, the Tewa culture hero. Poseyemu is said to have occasionally entered the hot spring when he still lived among the Tewas of the area. The spring is also the home of Poseyemu's grandmother, and he is said to visit her once a year (Harrington 1916:164). People at San Juan Pueblo told Harrington (1916:164) that the Tewas still drank water from the hot spring and, presumably, had done so in the past.

The nature of the trail recorded during our study, LA 118549, suggests that it may not have simply been a pedestrian corridor. The route that it follows is certainly not the easiest way to traverse the Ojo Caliente Valley, since it mostly travels along a terrace slope, about halfway up. Normal pedestrian traffic would be expected to take an easier route, though the land tenure system may have helped determine where such corridors could be placed. If most of the valley floor and the rim of the terrace that forms the east edge of the Ojo Caliente Valley were covered with fields, the terrace slope may have been one of the few corridors open to pedestrian traffic that would not cause friction with local farmers. However, the fields that rimmed the terrace edge formed a comparatively narrow band, so a simple ascension of the terrace and a short walk to the other side of the band of gravel-mulched fields would have carried travelers to a fairly flat area where foot-travel was easy and no modifications to the corridor were needed.

If the trail was the main route to the gravel-mulched fields, one would expect it to ascend to the terrace top at fairly regular intervals. It does not do this. Indeed, the trail tops out in very few places within our study area, and when it does, there is usually a shrine or shrinelike feature at that point. The trail does not even ascend to the terrace top at the village of Ponsipa'akeri. Instead, two trails documented by Bugé (1978) lead down to it. A few faint traces of trails leading up to fields were noted during our study, but none of them were improved or as well defined as LA 118549 itself.

When all of this information is combined, our suspicion is that LA 118549 does not represent a simple pedestrian corridor. Rather, it seems more likely that it represents a ritual pilgrimage route to the hot spring at Ojo Caliente. The berming noted along segments that approach and cross the terrace top is similar in idea to earthworks noted along Chacoan roads as they approach great houses (Nials et al. 1987:15), though in both cases the reason for the berming may be mundane. The construction of more elaborate roads or trails as they approached ritually important locations could have generated spoils, most easily discarded by simply placing them along the road or trail. This would have further emphasized the corridor in these areas.

Though the trail does not connect with the earth navel (Feature 9) at LA 105709, the segment south of that shrine contains the longest and most elaborate approach to the terrace top of those that were documented. The trail next ascended to the terrace top at LA 105705 and was bermed along its downslope side as it approached and crossed the terrace top. The only possible shrines identified in this area were two rock piles, probably field shrines rather than ritually important locations accessed by the trail. The next point at which the trail ascended to the terrace top was adjacent to Feature 11 at LA 105708, and its downslope side was again bermed through that area. The next approach to the terrace top (heading north up the valley) was at LA 105707. A short section of trail crosses the terrace top at the edge of that site, and its downslope side was bermed, though much of the berm, the ascending section of trail, and probably whatever ritual feature occurred in that area were removed during earlier road construction. These were the only places that the trail ascended to the terrace top within our study area.

However, the descent of the trail and its disappearance in the area around Hilltop Pueblo and Nute suggests that a strictly ritual use cannot be assigned to this landscape feature. Part of its function must have been as a pedestrian corridor; otherwise, why would it disappear in this area? Like some of the trails between Zuni and Acoma, LA 118549 probably had many purposes. As we have seen, trails could be simple pedestrian corridors or paths linking important ritual locations, or they could serve both functions at different times. Our analysis suggests that LA 118549 may have served both purposes. This trail may have linked villages in the Ojo Caliente Valley together and provided local farmers with a route to their fields. It also probably served as a ritual route for pilgrimages to the sacred hot spring, providing access to other important shrines along the way.

Chapter 25. An Ethnohistoric Examination of LA 105710 and the Ojo Caliente/Gavilan Areas, Rio Arriba County, New Mexico

Linda J. Goodman

An ethnohistoric study was initiated to examine several historic structures and features found at LA 105710, a large multicomponent site. According to the original survey (Marshall 1995), the site included a morada, a house foundation (later discovered to be a small store), an old road, and the remains of an old "cattle guard." Oral interviews soon revealed several other structures at or near LA 105710 that were added to the study. These included livestock corrals and animal pens, another small store, a Via Crucis (Way of the Cross, a processional path), a Calvario (symbolic location of the crucifixion), and two oratorios (private chapels).

Research methods included site visits, a brief review of published sources relating to the region, an examination of historical documents and other archival materials, and interviews with knowledgeable individuals from the area. Upon completion of a preliminary site visit and discussion with several local residents, a questionnaire was developed that was designed to gather information on land ownership history, time of original construction, materials used, dates of occupation, functions and uses of sites and structures, activities conducted in or near them, information on families and/or individuals connected with these structures, identification of features not archaeologically visible, and the placement of the sites and features in a larger sociocultural context. To determine land ownership history and the general history of the region, there followed a limited review of the archival literature and relevant legal materials at the Bureau of Land Management Office, Santa Fe; the New Mexico State Archives and Records Center; the New Mexico State Historic Preservation Office; the Museum of New Mexico History Library; the Museum of New Mexico Photo Archives; and the Laboratory of Anthropology Library.

At and near LA 105710, a variety of structures supported activities related to religion, commerce, and economic subsistence—all essential for the survival of a small northern New Mexican Hispanic village in the nineteenth and early twentieth centuries. Therefore, the goals of the present research were to gather relevant material on the above topics (religion, commerce, and economic subsistence) as they related to the structures at LA 105710; and, as part of the original research design, to answer eight site-relevant questions related to the age, construction, and use of these structures.

Historical Overview of the Ojo Caliente Region

The Indian Presence

Long before the appearance of the first Europeans, local Indian tribes were well aware of the existence of mineral hot springs in the area now known as Ojo Caliente. Considered sacred, these springs were often visited by members of a number of American Indian tribes who lived in or traveled through the region. According to Harrington (1916), a greenish pool of hot water at Ojo Caliente was one of the Tewas' most sacred places. It was home to various mythological beings and provided an essential passage between this world and the spirit world. The Tewas considered this region, called Posipokwi (greenness spring), to be their cradleland (Harrington 1916:162–165).

Five large prehistoric Pueblo villages built nearby indicate that a sizable resident Pueblo Indian population formerly inhabited the area. The Tewa villages of Howiri and Hupobi were constructed about 3 km north of the springs; Nute and Ponsipa'akeri, a few kilometers south; and Posi'ouinge on a mesa just south of Posipokwi (Ojo Caliente Springs). Dating to A.D. 1300–1530, these prehistoric villages may have housed from 2,000 to 5,000 people at any one time (Beal 1987:10; Bugé 1981; Schaafsma 1999:1–7; pers. comm., C. Schaafsma, 1999). Using a variety of agricultural methods, all of these settlements successfully grew quantities of corn, beans, and squash in this arid environment (Schaafsma 1999:1–2; Schroeder 1984:283). In addition to farming, these prehistoric Pueblo peoples continued to gather useful wild plants, hunted game such as deer and rabbits, probably raised turkeys, and engaged in a variety of craft activities (Schroeder 1984:283; Schaafsma 1999:2). Their villages were mostly abandoned by the time the Spaniards entered New Mexico and certainly so by the time the first Spanish colony was established in 1598.

Two hypotheses have been presented concerning the abandonment of these large communities. C. Schaafsma (pers. comm., 1999; Schaafsma 1999:5–7) believes that a preponderance of the evidence indicates abandonment before the appearance of the Spaniards in the area in 1540. He feels the abandonment was largely due to the arrival of marauding Apaches from the east, who made life unsafe and unpredictable for the formerly stable Pueblo societies. Schroeder (1984:284–285), on the other hand, felt that Apaches were in the area about the time of the Spanish arrival and that Indian attacks, combined with other environmental stresses, caused the Pueblo abandonment somewhat later, perhaps in the late 1500s to early 1600s.

One piece of evidence strengthens Schaafsma's hypothesis. In 1598 the Spanish colonizer Juan de Oñate, having established a base of operations at Yuqueyungue (across the Rio Grande from present-day San Juan Pueblo), assigned eight priests to various Pueblo areas; none, however, were sent to the Ojo Caliente area, the location of the five large pueblos mentioned above (Schroeder 1984:284). Had these villages still been occupied, chroniclers certainly would have mentioned them, priests would have visited them, and the clergy probably would have tried to establish a mission in the vicinity. During the first Valverde investigation, Juan Rodríguez, a pilot and navigator who knew mathematics and was with Oñate between 1598 and 1602, testified that he had visited all the pacified pueblos and had also been on an expedition to the plains with the governor (Hammond and Rey 1953:289–290, 860–868). Valverde asked Rodríguez to guide a mapmaker (Martínez) in the creation of a map which showed all the existing pueblos as of 1602. The resultant map, which has been reprinted on the inside front cover of Hammond and Rey (1966), shows no pueblos at all along either the Chama or Ojo Caliente rivers at that time. In 1608 the Spaniards noted that a number of pueblos in this northern area had been destroyed and burned by Apaches (Hammond and Rey 1953:1059; Schroeder 1984:284–285). To date, no statements concerning occupied pueblos in the Ojo Caliente region have been discovered in existing Spanish documents.

During the early years of Spanish exploration and settlement, Utes, Comanches, Navajos, and Apaches continued to camp, hunt, and travel throughout the Chama and Ojo Caliente River Valleys, making the area inhospitable for Spanish settlers. In 1598, Oñate described some of these non–Pueblo Indian people as numerous, living in jacales, and farming in the upper Rio Grande (Hammond and Rey 1953:345, 485; Schroeder 1984:284). Even though members of some nomadic tribes were engaged in part-time agricultural activities, these groups never settled and became permanent residents. Other records state that nomadic groups were present west of Taos and in the vicinity of Abiquiu in the early 1600s, and in the region approximately one day's travel north of Santa Clara Pueblo in the 1620s (Beal 1987:20; Hodge et al. 1945:85, 89, 306; Schaafsma 1979; Schroeder 1984:284). In 1705, according to the Spanish governor, Don Francisco Cuervo y Valdez, these tribes were still nomadic most of the time, sedentary only for short periods, and constantly waging war against the settled communities (Hackett 1937:382).

The Spanish Occupation

The initial date of Spanish settlement in the Ojo Caliente area remains an open question. No existing records note any Spanish settlements in this area before the Pueblo Revolt of 1680 or as late as 1693. On July 14, 1694, the Don Diego de Vargas expedition, returning from Colorado, camped in the Ojo Caliente River Valley and made no mention of any settlement at all in this locale. In his writings, de Vargas described the area in some detail, the difficulty of protecting it because of its terrain, and precautions taken by his troops due to fears of Ute ambush or attack by Tewa rebels living 10 leagues away (Kessell et al. 1998:311). Any former or contemporary Spanish settlement in the area would certainly have been noted by him at this time. C. Schaafsma (pers. comm., 1999) feels that due to the continued presence of marauding Indians, settlers could not have survived here before approximately 1710–20. Since the first actual mention of settlers in the area occurs in writings of 1733, it is logical to assume that settlement began in the Ojo Caliente area sometime between 1694 and 1733.

Apparently a settlement had been established at Ojo Caliente by 1733 because the Spanish Archives of New Mexico (SANM 1735) include a record of a lawsuit concerning agricultural land and its use and ownership. Deposition statements from the involved parties indicate that people were already living at Ojo Caliente and beginning to clear the land by this time. One Antonio Martín had been given a royal grant for land there. This lawsuit provides the earliest recorded information concerning the existence of a Spanish settlement at Ojo Caliente.

For approximately the next 60 years, the history of Ojo Caliente is filled with strife and turmoil, caused mainly by frequent Indian attacks, lack of adequate protection by Spanish militia, and Spanish governors more intent on supporting and protecting the larger, better-established settlements at Santa Fe (established in 1610) and Santa Cruz de la Cañada (established in 1695) than the poor, isolated settlers on the fringes of Spanish territory. On numerous occasions, Ojo Caliente was abandoned when Indian raids made it unsafe to remain. Periods of resettlement occurred when the danger was perceived to have diminished. At times the Spanish governors, not fully understanding the gravity of the situation, ordered the settlers back to their land, with varying degrees of success.

Spanish reports confirm a series of occupations and abandonments of Ojo Caliente. In 1744, Father Miguel de Menchero provided a small amount of information regarding this settlement. Forty-six Spanish families lived at Ojo Caliente and survived by raising crops and herding sheep, as did some Indians, though he did not state how many or from which tribes. A chapel had already been built, and the families were ministered by the priest at the Taos mission, six leagues away (Thomas 1932:94; Hackett 1937, 3:399; Swadesh 1974:34). On March 28, 1748, permission was requested and shortly thereafter granted by Governor Joaquín Codallos y Rabal to abandon Ojo Caliente, Abiquiu, and Pueblo Quemado (a few miles from the mouth of the Rio del Oso, southwest of Ojo Caliente; Swadesh 1974:34) until danger of Indian attacks from Utes, Navajos, and other hostile tribes was lessened (SANM 1748; Adams and Chávez 1956:78 and n. 6). On March 15, 1751, a decree from a new official, Governor Cachupín, ordered the immediate resettlement of Ojo Caliente, since "the Ute Nation" had been "converted to friendship for us" (Boyd 1957:347). The occupants responded:

> We the undersigned residents of the settlement of Santa Cruz de Ojo Caliente, appear before the greatness of your excellency. . . . At the present time we are without means and oxen to plow the ground, and finding the houses and church tumbled down, and for other reasons of no less weight that prevent us from the present execution of this order, we petition your Excellency to extend the time for us to the month of October, a time which, God willing, is better for said resettlement. (Signed by Blas Martín Serano, José Martín Serano, Dyego Lucero, Manuel Días del Castillo, and María de Herrera, 1751 [SANM 1753, as quoted in Boyd 1957:347–348])

As of January 18, 1752, the residents had not yet returned to their homes (SANM 1753, as quoted in Boyd 1957:348).

Other edicts and proclamations were issued in 1752 and 1753. A few families may have returned to Ojo Caliente, most, however, did not (SANM 1753). According to Abiquiu mission records, Genízaro pueblo land grants were established in Ojo Caliente in 1754 (Swadesh 1974:40). Genízaro grants provided "detribalized Indians who desired freedom from servitude in settlers' homes, with the means for an independent life—in exchange for active militia service" (Swadesh 1974:40). In 1765 the residents had once again deserted their houses and property due to renewed Indian attacks; only a few remained to tend the land. In 1766 there was more correspondence regarding these families and their presence or absence on the Ojo Caliente land (Boyd 1957:348-351; Jenkins n.d.:9). Some of it reverted to the Crown when owners refused to resettle, claiming their acreage was too small to support their families. This land was then regranted to new Spanish owners or given to "half-breed Indians who wished to settle at Ojo" (SANM 1768).

Spanish governors strongly supported settlement of the Chama and Ojo Caliente River Valleys to keep marauding Indians away from the more heavily populated areas of Santa Fe and Santa Cruz. Residents of Ojo Caliente, Abiquiu, and Pueblo Quemado provided this human barrier; not well protected by Spanish soldiers, they were left largely to fend for themselves. After a number of harrowing years, many settlers chose to lose their land rather than their lives. They moved elsewhere and started over. Troubles continued for those who remained at Ojo Caliente or moved there later. Each new governor of the territory had a somewhat different approach to the problem. None of these solutions, however, were very satisfactory to the people whose lives were constantly in danger (Boyd 1957:350–358; Ebright 1994:145-146).

The following quote is typical of the attitude of the Spanish governors of the time in regard to the necessity of settlement of Ojo Caliente and the lack of regard for the lives and safety of the inhabitants. On March 31, 1769, Governor Pedro Fermín de Mendinueta stated,

> Residents of the river of Ojo Caliente have abandoned their houses and possessions to live in different places of this kingdom on account of a panic of fear of the Comanches and past battles fought with this nation—all of which have been favorable by virtue of measures taken and constant detachments of soldiers maintained for their protection. There is urgent and clear need to maintain the frontier of Ojo Caliente, because if it is left unprotected none of the districts of Santa Cruz de la Cañada would be secure, but all of them would be exposed to total ruin on account of their dispersion and because there would be no fortress for their defense, and as the frontier of Ojo Caliente is such a fortress, as has been demonstrated by experience, I order all residents of said river and plaza who lived (there) through the month of October last past, to return to occupy same under penalty of two hundred pesos fine. (SANM 1769, as quoted in Boyd 1957:353)

Since the settlers usually could not read or write, they responded in person to the alcalde in charge, who then reported them to the governor (Boyd 1957:355). A typical reply, dated May 28, 1769, given by Diego Gómes, was recorded as follows:

> [He says] that he understands it all; that he obeys what he is ordered and has planted corn, but that he will not take his family up there on account of the many warnings he has experienced and seen at said Ojo Caliente, as in his presence five of his relatives have been killed and he was not able to prevent it. Thus he yields the right to the house and lands which he has at said Ojo Caliente. (SANM 1769, as quoted in Boyd 1957:354)

As a result of this type of response, on June 20, 1769, Governor Mendinueta personally inspected Ojo Caliente. He discovered the indefensibility of the location, which was exactly as the settlers had described. The governor then ordered that his previous decrees be suspended, the doors to the plaza, the houses, and the chapel be walled up, and Ojo Caliente be abandoned (Boyd 1957:356–357). On June 29, 1769, he noted that Ojo Caliente was

> dominated on the east by a ridge of hills which extends from said plaza about two leagues toward the south, the ravines of which allow the enemies to get near it without being seen and attack it from said hills. . . . On the west . . . it is similarly constituted and the high hills which dominate it form another ridge to the south which extends to an equal distance, and between the two they form a long, narrow pass composed of forests and arroyos where a very few enemies can stop travel even to seek help when attacked. On the north the obstacles are not less. (SANM 1769, as quoted in Boyd 1957:356)

Ten years later, on August 17, 1779, Governor Juan Bautista de Anza visited and described the deserted village of Ojo Caliente:

> The above mentioned pueblo is one of those

> abandoned on account of the hostilities of the enemy, as well as one proposed for the establishment of a presidio. For this reason I devoted myself today surveying it. I found it lacking all the conditions required for such an establishment. . . . Altogether there are twenty-five or thirty families scattered over more than four leagues, their houses unfortified. For this reason it is not strange that there were such attacks, as this disorder brought upon them the loss of their poor fields, to which, in substance, the possessions of the inhabitants were reduced. (Thomas 1932:124)

Subsequently, de Anza led an expedition against the Comanches, resulting in their defeat and the death of their leader, Cuerno Verde. Following this, nearly twenty years of peace ensued with the Comanches in the area (Boyd 1957:357; Thomas 1932:124).

No documents refer to Ojo Caliente again until 1790, when a group of Spanish citizens petitioned Governor Fernando de la Concha requesting that nineteen families be allowed to form a fortified settlement at Ojo Caliente. Even though the governor requested that the petitioners resettle the area known as "Viejo," north of Ojo Caliente on the outskirts of la Cañada de los Comanches, they refused, and no action was ultimately taken on their petition. However, the villagers remained where they had been living, and the settlement continued to develop in an informal pattern (Boyd 1957:358).

By 1793 the situation had changed dramatically. The Comanche threat had largely abated, and a number of families were living on the land. Fifty-three households under the leadership of Antonio José Espinosa, Juan Samora, and Salvador Maese petitioned Governor de la Concha for a community grant, which was soon approved and issued. Each petitioner was apportioned 150 varas of land by Manuel García de la Mora, chief alcalde and war captain of Santa Cruz de la Cañada. Boundaries, watering places, orchards, and communal land were also established. After all the years of battles with Indians as well as Spanish government officials, the settlers finally prevailed in choosing and settling on land adjacent to the river, where they wished to live, rather than where territorial governors ordered them to live (Bowden 1969:1190–1192; Boyd 1957:358–360; Jenkins n.d.:9–11; SANM 1793). The pattern of choosing one's own desired settlement was followed by many other early Spanish settlers along the Rio Grande and its tributary streams (Boyd 1957:360; Pratt and Snow 1988:223).

Fourteen years later, in 1807, Zebulon Pike, one of the early non-Spanish explorers who traveled through the Ojo Caliente region, left a written description of what he saw (Bowden 1969:1192; Twitchell 1911:462, 466–467):

> The village of Warm Springs or Agua Caliente (in their language) is situated on the eastern branch of a creek of that name, at a distance, and presents to the eye a square enclosure of mud walls, the houses forming the wall. They are flat on top, or with extremely little ascent on one side, where there are spouts to carry off the water of the melting snow and rain when it falls, which we are informed, has been but once in two years previous to our entering the country.
>
> Inside of the enclosure were the different streets of houses of the same fashion, all of one story; the doors were narrow, the windows small, and in one or two houses there were talc lights. This village had a mill near it, situated on the little creek, which made very good flour.
>
> The population consists of civilized Indians, but much mixed blood. . . . This village may contain 500 souls. The greatest natural curiosity is the warm springs, which are two in number, about ten yards apart, and each affords sufficient water for a mill seat. They appear to be impregnated with copper, and were more than 33 degrees above blood heat. (Pike 1810:206–207)

It appears that in 1807 there was indeed a regular village with streets, a plaza, and houses placed around it. This description differs markedly from earlier Spanish writings, which do not speak of a village and plaza organization but rather of individual ranchos (agricultural land and houses), unfortified, scattered over a large area along the river (Boyd 1957:351; SANM 1769; Thomas 1932:94, 124). As of 1750 there was neither a square plaza nor a solid row of houses with gates for entry and exit, as instructed by

Governor Cachupín (Swadesh 1974:35–36). However, in 1769 Governor Mindinueta spoke of boarding up the plaza and church at Ojo Caliente, and ten years later Governor Anza described the inhabitants as living in scattered, unfortified houses. Perhaps both the plaza and the rancho type of settlement patterns coexisted here for many years, though no official documents have been discovered which indicate that this was the case. Currently, no vestiges of an early plaza and town organization remain, and local residents have no memory of it. The rancho habitation pattern first mentioned by the early Spanish writers appears to be prevalent today. Agricultural land with access to the river and/or acequia dominates the landscape and usually includes a house on each family plot.

Population increased in the Ojo Caliente Valley during the early part of the 1800s. Some people purchased grant land, others squatted and never received official title. Confusion abounded by the 1820s, so in 1824, Francisco Trujillo of Abiquiu was ordered to Ojo Caliente to validate titles and measure individual allotments. This was successfully accomplished, and those who were not original grantees could, upon payment of a fee, receive an allotment (Jenkins n.d.:10–12).

Throughout the 1800s the settlers enjoyed periods of peace during which they traded and interacted with surrounding nomadic Indian tribes, followed by periods of raiding and general disturbance. Once the Indian threat finally subsided, settlement continued, as did an agricultural and pastoral way of life. Small towns such as Ojo Caliente were out of the mainstream during the Mexican occupation (1821–46) and the following American occupation (1846–present). These Hispanic/Genízaro enclaves were far removed from the primary trade routes, along which the Euroamerican newcomers tended to congregate. Therefore, for a number of generations, life in these small towns of northern New Mexico continued quietly, and the population experienced only modest changes, mostly in the areas of introduced materials and products (Campa 1979:121–128).

Hispanic Life in the Ojo Caliente Region

Settlement and Land-Use Patterns

The Spanish Crown was the ultimate owner of all the land in New Mexico that was claimed by Spain. Private individuals or groups were allowed to apply to the sovereign for land grants, which were issued in three categories: a municipal grant to an individual or group who wished to found a new community; a private grant to a farmer, stock raiser, or other person who agreed to develop rural land; and Pueblo Indian grants which awarded title to a particular tribe so members could maintain possession of all the lands they occupied or used (Simmons 1969:7–8).

Aside from the grant stipulations, Spanish citizens who wished to settle in New Mexico also had to adhere to certain rules and regulations established by the Spanish government. Regarding the creation of a new town, issues of health, climate, and defense had to be carefully considered before a specific site could be selected. Then, strict Spanish laws governed the organization of these towns. First, it was necessary to draw up a plan for a new community utilizing the grid system. This included straight, parallel streets with rectangular blocks and one or more rectangular plazas. The principal plaza was designated the *plaza mayor*. Land was to be reserved for government and church buildings, then lots were to be distributed to the settlers. As quickly as possible, the residents of a new town were also required either to build a palisade surrounding the main plaza or dig a large ditch around it to protect the inhabitants from Indian attack. In addition, each family was urged to fortify its own house (Simmons 1969:8). Sometimes a slightly different plan was followed. Compact settlements constructed around a central plaza included houses built wall-to-wall in a square with no windows on the outside, forming a protective fortress. Often a watch tower (*torreón*) was placed at one or more corners (Ebright 1994:25).

These rules and regulations applied to and affected the lives of the settlers in the Ojo Caliente region. It is interesting to note, however, that these people had the independent mind-set of many other early Spanish settlers in New Mexico. No matter what the laws and regulations stated, they knew where and how they wished to live and did not let the authorities deter them. Therefore, the actual settlements often took a form quite different from what was officially sanctioned. The general pattern that developed included a predominantly rural population living in numerous small, loosely organized communities scattered throughout northern New Mexico.

More specifically, as the population increased throughout the region, new villages were created in the Ojo Caliente River Valley. Settlers needed new irrigated lands, expanded ranges, and better opportunities for trade with the Utes (Swadesh 1974:72). Thus, small clusters of settlers cleared land and built houses more or less where they wished, usually adjacent to a river or stream. Traditional land-use patterns in this area did not include the development of large urban centers, and the settlement at Ojo Caliente never became a city. For many years, both Abiquiu and Ojo Caliente were described as *parajes* (encampments) or *puestos* (outposts) because settlement consisted of a few small, scattered ranches and lacked a local administrative machinery except for a *teniente* (deputy to the alcalde of Santa Cruz). Each family was responsible for its own economic survival and defense (Swadesh 1974:133).

The early settlers and their descendants raised cattle and sheep on their land, planted fruit trees, and prepared fields where they grew corn, wheat, beans, and a few vegetables. Subsistence agriculture was maintained mostly by the women, children, and elders, while the men were principally involved in herding livestock, buffalo hunting, trading, and fulfilling militia requirements (Pratt and Snow 1988:222; Swadesh 1974:133–134). As the good farmlands around the village and river were acquired by early settlers, later ones had to select locations farther away. Thus it is probable that outlier communities such as Duranes and Gavilan to the south were settled later than the principal village of Ojo Caliente.

Since early Spanish subsistence in New Mexico revolved around agriculture and livestock, the typical settlement pattern of isolated ranchos along a stream made good economic sense. It appears that initially, at least, the Ojo Caliente settlers ignored the Spanish government's legal requirements for a town and plaza constructed on the grid system. They built their houses near their fields to protect crops from Indians and wild animals, and for ease of access (Ebright 1994:22–26; Simmons 1969:17). This arrangement left them quite vulnerable to frequent Indian raids; thus, as mentioned earlier, for many years they were forced into a cycle of abandonment followed by reoccupation of their lands and houses. Eventually, however, for their own protection, some Ojo Caliente settlers evidently did build an actual village with a plaza ringed by homes, since such a place was described by Mendinueta in 1769 and Pike in 1807 (Bowden 1969:1192; Boyd 1957:356–357; Pike 1810:206–207; Pratt and Snow 1988:220–224; SANM 1769). The date and exact location of this formal plaza remains unknown, although it is likely that it was adjacent to the old church, which dates from 1793.

In 1793 residents of Ojo Caliente applied for and were officially awarded a community grant with the approval and blessing of the Spanish Crown (SANM 1793). Each settling family received an allotment of land for a house (*solar de casa*), an irrigable plot of farming land (*suerte*), and the right to use the remaining unallotted land on the grant (*ejido*) in common with other settlers for such things as pastures and watering places for livestock as well as areas for hunting, fishing, herb gathering, firewood gathering, rock quarrying, and log cutting. After four years of working the land a settler owned his allotment free and clear, and could then sell it as private property. The common lands, on the other hand, were owned by the community and could not be sold (Ebright 1994:24–25; Pratt and Snow 1988:234).

Settlements on a community grant usually included more intensive utilization of parcels adjacent to the river, where agricultural fields were cleared and planted and family homes built. Less intense use, such as for livestock grazing or firewood gathering, occurred on the common lands at a distance from the river. Grazing animals commonly moved onto and destroyed planted fields (Ebright 1994:26).

Irrigation ditches (acequias) were an essential component of each agricultural community. Though exact dates are unknown, several early acequias were dug in the Ojo Caliente Valley. The

6.4 km (4.0 mi) long Ojo Caliente Acequia is the oldest, perhaps dating to 1793, and was said to flow past the plaza. The 4.5 km (2.8 mi) long Duranes Acequia may date to 1793 or possibly 1824. The 5.0 km (3.1 mi) long Gavilan Acequia probably dates to 1824 and perhaps even earlier (Jenkins n.d.:12–13). Individuals were granted rights to irrigable lands running from the *acequia madre* (mother ditch) to the river (Pratt and Snow 1988:233–234). It is likely that ownership of long, narrow strips of land, called "long lots," developed from this system of irrigation. Water was drawn from the acequia and used to water the rows of crops through gravity flow. The excess was allowed to return to the river (Pratt and Snow 1988:233–234).

Trade between Spanish settlers and Indians constituted another significant activity in the area. Peaceful times allowed for more contact and increased transactions; trade necessarily decreased during periods of intensive raiding. Direct barter with Indians for contraband goods was often quite profitable. Official fairs also occurred annually. Taos held a trade fair each July for the Comanches, and Abiquiu held a similar one for the Utes. A trading post established in 1853 in Abiquiu to increase the Ute trade closed in 1872 (Ahlborn 1968:129). No mention is made of trade fairs or trading posts at Ojo Caliente. Trade also flourished in Indian territory. Young men known as *comancheros* traveled east onto the buffalo plains and developed profitable trade networks with the Comanches and other Plains tribes. Some of these networks lasted for generations (Goodman 1993:25; Swadesh 1974:3–4, 23–25).

Until some years after the opening of the Santa Fe Trail in 1821, cash was insignificant and generally did not circulate through the northern New Mexican villages. The populations in this area had insufficient quantities of goods to exchange for cash until much later. Thus, traditional ways of doing business continued here much longer than in other parts of the state. Not until the opening of a wage-labor market and the development of an effective transportation system in the region did cash become more prevalent, setting the stage for a number of cultural changes (Pratt and Snow 1988:68).

Since World War II, northern New Mexican villages like Ojo Caliente have undergone significant changes. Many people left to become part of the war effort. After the war, the young people in these villages began to leave in search of jobs and more comfortable lives elsewhere. Farming did not interest them, and good jobs were seldom available locally. Older people, however, have continued to live in these villages or return to them for their final years (Weber 1979:83–84). Radio, television, and, more recently, computers have increased knowledge of Anglo life and society. Improved highways and the easy availability of cars and trucks have increased contact with surrounding Anglo communities and desire to acquire material goods. In the past most village men farmed, ranched, or were hired as herders. These occupations were replaced after the war by wage work on the railroads and highways, seasonal migratory farm work, and a variety of other jobs in urban communities. All of this has led to the breakdown of many northern New Mexican Hispanic villages. The hope is that new economic endeavors will allow some of them to be repopulated and reestablish themselves as strong, viable communities (Swadesh 1974:198–203). Another recent trend with negative implications for the survival of village life is gentrification. Houses and land are being bought by developers and other wealthy Anglo outsiders who move in and change the character of the land and villages (Swadesh 1974:201–202). The formerly strong community and religious beliefs have, in many cases, been pushed into the background (Bunting et al. 1983:33; Knowlton 1969:465).

Religious Activities and Patterns

Even though the Franciscans set up Catholic missions in a number of Rio Grande pueblos after their arrival in the 1600s, the religious needs of Spanish settlers in the region were largely ignored by the Church. Perhaps this was due to the fact that the priests were specifically paid by the war fund (*ramo de guerra*) of the Spanish Empire to work in the Pueblo Indian missions and not with the Spanish populace, other than in major population centers such as Santa Fe. Most of the Spanish population during the 1600s lived in or near Santa Fe or near a Pueblo Indian mission; therefore, contact with priests and Catholicism could at least minimally be maintained (Steele and Rivera 1985:4–5).

During the 1700s two significant changes were instrumental in the development of an organization which came to be known as the Penitente Brotherhood. First, the Franciscans suffered a devastating decrease in numbers. Eventually this reduction affected the faithful in the Rio Grande region—mission priests who died or became too old to serve could not be replaced. Secondly, as the Spanish population in the area increased during the 1700s and on into the 1800s, the pressing need for land meant that new villages were created, often in isolated places that were hard to reach, even by horse or wagon. Thus, not only were fewer priests available, but the difficulty of traveling to outlying regions meant that the padres seldom came to minister to the local Spanish Catholic village populations (Steele and Rivera 1985:4–5; Swadesh 1974:72–74).

In order to fill this serious religious vacuum, a lay brotherhood called La Cofradía de Nuestro Padre Jesús Nazareno (Brotherhood of Our Father, Jesus the Nazarene), also known as the Penitentes, emerged in many villages of northern New Mexico, probably between 1790 and 1810. A variety of names have been used to refer to this group. Some of the more common are Cofradía, Confraternity, Hermandad, Brotherhood, Los Hermanos Penitentes, the Penitent Brothers, Los Hermanos, The Brothers, and Los Penitentes (Weigle 1976:xvii). The term *penitentes* has come to have pejorative connotations among certain groups of outsiders; however, in the past, it was a descriptive term which honored its members (Chávez 1954:97). A precise date and place of origin for this confraternity is unknown. (See Chávez 1954:97–98, n. 1, and 108–112; Steele and Rivera 1985:7, n. 11; and Swadesh 1974:75, n. 20, for more detailed discussions of possible Penitente origins, dates, and relationship to the Third Order of St. Francis, a Franciscan confraternity.)

The purpose of the organization, as related in an oath of the Cofradía in Taos in 1861, was

> to serve God our Creator in the belief that Jesus Christ is the Saviour of the World according to the teaching of the Holy Gospel; to keep the Ten Commandments of the Law of God; to live humbly; to abjure discord and unjust dealings with our fellow men; to shun saloons and all other temptations the world offers . . . ; to act toward one another with charity and mutual love like brothers in Jesus Christ; to provide a good example for each other, helping in illness, afflictions and time of need, pardoning one another's offenses, and mutually tolerating our weaknesses. (Kutsche and Gallegos 1979:91)

The Penitente Brotherhood was composed of Hispanic males. Women were not members but could and did serve as auxiliaries (Ahlborn 1968:124; Bunting et al. 1983:33). Each community developed its own local chapter of the Cofradía, which maintained two principal focuses: one religious, the other devoted to providing necessary aid to members of the community. Since continuous support from ordained priests was unavailable, the Brotherhood concerned itself with such tasks as caring for the sick and dying, leading prayer services and wakes for the dead and their families, and digging graves. Members also helped bereaved families with plowing, harvesting, and other heavy tasks; organized mutual welfare benefits at times of crisis; organized food sharing occasions during Lent and Holy Week; settled village disputes; and punished those who violated village norms. These activities were vital for community survival and unity (Bunting et al. 1983:31–32; Knowlton 1969:462; Swadesh 1974:74–75; Weigle 1976:xi, 139; Weigle and Lyons 1982:231–232).

The religious focus of the Cofradía was most readily seen during Lent and Holy Week, before Easter. At these times, aside from financial and organizational responsibilities, the Hermanos were principally occupied with specific religious duties, obligations, and rituals. Including both public and private events, the devotion of the members took the form of prayer, discipline, music, and ritual (Weigle 1976:154).

During Lent (which begins on Ash Wednesday, 46 days before Easter), various fasts and abstinences were observed by the Brotherhood. Every Friday, public recitations of the Stations of the Cross were held during the day and in the evenings. Customary activities included private meetings and/or flagellant processions (Weigle 1976:158–159). The last two weeks of Lent, known as Passion Week and Holy

Week, closely imitated the final days of Jesus's mortal life. Brothers spent most of Holy Week in retreat at their *morada*—literally, "dwelling," but this word denotes both the actual meeting house of the local Brotherhood and the chapter itself (de Cordova 1972:59; Weigle and Lyons 1982:231). Even though each morada had its own specific Lenten customs, there were similarities among them as well. In general, during their Holy Week retreat the Hermanos slept little, maintained constant vigils, welcomed and worshipped with many groups of visitors, visited other moradas, and at various times undertook public processions and services (Weigle 1976:158–162).

Throughout Lent and especially Holy Week, a number of physical penances were engaged in by some members. Frequently, these included self flagellation, the dragging of a large, heavy cross, or going from morada to morada on one's knees. The purpose of these penances was to strengthen spiritual discipline and to express religious devotion. Such exercises were carried out as part of a total worship complex and did not represent masochistic self-indulgences or sadistic tortures. Penitentes who undertook these activities were almost always accompanied by other members who were engaged in singing, praying, playing the *pito* (flute or whistle), and carrying sacred images as guides (Weigle 1976:160–162).

For the Penitentes, Holy Week focused on expressing the Passion of Jesus, which included both his internal and external suffering from the time of the Last Supper until his death on the cross. This Passion was often evoked through *alabados* (traditional religious hymns), the Via Crucis (Way of the Cross), penitential processions, and certain stylized, dramatic reenactments or tableaux. The performance of alabados was appropriate because many of them vividly described and recounted the Passion. The Via Crucis, outside the morada, was an important symbol of Christ's route to Mount Calvary. During Holy Week, a series of small crosses representing the Stations of the Cross was set up along the Via Crucis. A number of major processions, some along this route, usually took place on Wednesday, Thursday, and Friday of Holy Week (Weigle 1976:163–166).

One or more dramatic tableaux were enacted on Holy Thursday and Good Friday by Penitentes in each village. These enactments of the final events in Jesus's life were highly stylized and symbolic. They centered on a single incident and usually involved santos carried in a procession. For example, one of these dramatizations is called El Encuentro (The Encounter) and centers on the meeting between Jesus and his mother on the way to Calvary, the fourth Station of the Cross. This scene was often enacted during the late morning of Good Friday. The women processed from church or chapel, carrying an image of the Virgin Mary, usually Nuestra Señora de los Dolores (Our Lady of Sorrows). The Penitentes came from the morada bearing an image of the Cristo, usually Padre Jesús Nazareno. When the two groups met there was a recitation or an alabado commemorating the passion. At the appropriate time, the figures were tipped and brought close together in a symbolic last embrace of Mother and Son. Much weeping and intense emotion accompanied this dramatization (Weigle 1976:166–167).

In some communities, a simulated crucifixion took place on Good Friday afternoon—an event always carefully supervised by appropriate Penitente members. It was an honor to be selected as the person who would imitate the final suffering of Christ. The chosen Brother was usually bound by rope to the cross for 20 to 30 minutes. He often fainted fairly quickly, and when this happened, the others took him down, brought him into the morada, and gently revived him. Again this was a time of intense emotion, often with sobbing and wailing from the crowd (de Cordova 1972:46; Weigle 1976:171–173).

The Tinieblas (darkness) service of the Penitentes was usually held on Holy Thursday and Good Friday nights and was preceded by a rosary service. Villagers, families, and friends gathered either in the village church, the Penitente oratorio, or the morada and were soon followed by the Penitente members, many of whom were practicing penance in a variety of forms. The Tinieblas service symbolized the chaos following Jesus's death. Once all were inside, the door was quickly closed and all lights extinguished except for 15 candles in a triangular candelabra on the altar. A single singer from the morada stood next to the candelabra and began a haunting alabado. At the end of each verse, he put out one candle flame, and the interior slowly grew darker. Finally, after he extinguished the last candle, he quietly slipped out a nearby door, and the interior was in total darkness. Almost immediately a tumult and deafening noise of all kinds began, including hand clapping, beating drums, whirling *matracas* (wooden clackers), flutes, chains, foot stamping, and possibly Penitente self-flagellation. When the raucous noise died down, prayers for the dead were said in a semiwhisper by the assembled group. Then, in a few minutes, the ear-splitting noise picked up once again. This pattern of cacophony followed by quiet prayer was repeated a number of times in the pitch black interior for the duration of the service, which usually lasted about an hour. Finally, much to the relief of many attending, the lone singer reentered and the first candle was relit, followed shortly by the others, and the service came to an end. If the ceremony had been held in the church or oratorio, the Brothers quickly left and returned to their morada. If held in the morada, the non-Penitente visitors left immediately. Sounds of the pito and singing could be heard by the villagers all night long as various groups of Penitentes made *visitas* (formal visits) to nearby local religious sites and traveled along the road to moradas in other nearby villages (de Cordova 1972:42–44; Weigle 1976:174–175). When a repeat of this same service ended on Friday night (called Los Maitines), the rituals surrounding the Passion of Christ were ended until the following year (de Cordova 1972:46–47). No Penitente events occurred on Easter Sunday. Penitentes in the Ojo Caliente/Gavilan region engaged in most of the activities described above. Non-Penitente friends, relatives, and neighbors often participated in the less dramatic portions of these religious observances.

Social and Economic Patterns

In addition to its own religious activities, each Hispanic village in northern New Mexico also functioned as an autonomous social and economic unit. Largely in remote areas, isolated by hostile Indian tribes and, until recently, by impassable roads, each community was forced to develop coping mechanisms which relied heavily upon its own economic and cultural resources. Subsistence agriculture combined with livestock raising and, often, trade with nomadic Indian tribes sustained most families. On their family-owned land near acequias and rivers, villagers grew wheat, corn, beans, chile, fruit, vegetables, and sometimes alfalfa for livestock. Herds of sheep, cattle, and horses were kept on nearby communal ranges. *Ciboleros* (buffalo hunters) from each village hunted buffalo on the plains to the east to supply local families with extra meat and hides. As mentioned earlier, parties of comancheros made excursions onto the plains where they traded successfully for many years with the Comanches and other nomadic tribes. Some Spanish villagers engaged in an active contraband trade with the nearby Utes. This Ute trade, which continued from generation to generation for over 100 years, was often quite lucrative because Spanish or Mexican taxes were not paid. Hispanic villagers commonly received from the Utes such things as dressed hides, meat, and captive women and children. In exchange they provided the Indians with *punche* (a locally grown tobacco), horses, metal goods, and especially knives (Knowlton 1969:459; Swadesh 1974:24–25, 156, 163–165; Weber 1979:80).

The two organizing principles of Hispanic social organization in this area were the extended family and the village. Family unity was emphasized, but within it the males were always dominant over the females. The father was the principal authority figure, and his oldest son was second in command. Mothers and wives were expected to be obedient, tolerant, and faithful. Brothers protected and defended younger siblings. Often fathers were somewhat aloof and formal with their children; mothers were not. Endless hard work was essential for survival in this harsh environment, and from an early age the children were expected to help. As they grew older, their obligations grew. All members of an extended patriarchal family were expected to work closely together, mutually assist each other, and present a united front to the rest of the world. These local kin groups and also the Penitente Brotherhood maintained social control in the villages (Knowlton 1969:460–461; Swadesh 1974:152–155).

The extended patriarchal families were also intermeshed with the *compadrazgo* (ritual godparent) system. Parents chose godparents who would sponsor their children at important rites of passage such as baptism, confirmation, and marriage (Knowlton 1969:460–461; Swadesh

1974:189–192). These ties, sometimes but not always between members of different families, were for life, and "frequently unified an entire village population into a functioning system of religious and economic cooperation and responsibility" (Knowlton 1969:461).

Extended families, the compadrazgo system, and the Penitente Brotherhood were encompassed by the next larger social unit—the village. Until the last sixty years or so, the village comprised the total social universe of its inhabitants and met most of their social, economic, and religious needs. An individual felt safe and secure in his or her village and was reluctant to move elsewhere under most circumstances. Residents seldom identified with larger regional or national social, political, or religious units. The village, with its attached land and water rights, was essentially all they needed to sustain them (Knowlton 1969:458–460).

For over 300 years, the Spanish settlers of northern New Mexico have remained small landowners and maintained a mixed economy of agriculture, herding, and trading. They have always been tough, resilient people who took advantage of new opportunities, adapted to change when necessary, and traded with Apaches, Utes, Navajos, and Spanish people in other isolated villages. No matter what the hardships, they managed to maintain a strong sense of community, in part fostered by their strong kinship ties and religious beliefs (Swadesh 1974:3–4).

A Brief History of LA 105710

LA 105710 fits comfortably into the above picture of Hispanic life in northern New Mexico. Over the past 100+ years several structures were built on this site: a Penitente morada, a small store, corrals, animal pens, and a shed. Several other structures directly related to those at LA 105710 were built on adjacent or nearby land. Only small sections of the adobe morada walls remain standing; otherwise all of these structures have been abandoned, dismantled, and the materials reused. A former wagon road has also been abandoned, as has a trail (LA 118549) which ran along or near the edge of the ridgetop east of LA 105710. The following sketchy history of this land leaves many gaps, some of which may be filled by additional research in the future.

The earliest written information concerning LA 105710 and surrounding land may be found on an 1877 plat of the Ojo Caliente Land Grant, surveyed by Griffin and McMullen (Fig. 25.1). This appears to be the first official survey of the Ojo Caliente Grant, which was created in 1793. LA 105710 was part of this grant, which at that time included 33,590 acres and extended roughly 7 mi (11.3 km) east of the Ojo Caliente River. The surveyors' notes stated that the land on the eastern part of the grant was rolling and heavily timbered with piñon and cedar. The central area afforded good pasture, and the area just east of the river included cultivated lands extending about 5 mi (8.1 km) north to south and about 5 to 10 chains in width. LA 105710 was directly east of the cultivated land shown on this map. Most likely the land on the ridge top to the east, just above LA 105710, was the main area of the ejido. Noted on the 1877 map as "prairie lands" and "grama grass lands," this large area was crisscrossed by roads and trails to Cieneguilla, Taos, Abiquiu, and Conejos, and also showed a "wood road." Local resident Flora Trujillo stated that she had never heard the term *ejido*, but when she was young, people grazed their livestock and went for firewood on the ridge east of the Ojo Caliente River Valley and beyond. Each summer, people grazed their cattle up on top and moved them north to the areas around Taos Junction and Cerro Azul. In the winter, the livestock returned to the farms in and around Ojo Caliente, where their owners cut hay for them and installed little pumps and water tanks on their property or opened gates so the animals could go down to the river for water.

On the 1877 map, three small communities are shown in the Ojo Caliente River drainage on the east side of the river. From north to south they were the Plaza de Ojo Caliente, with a church; Plaza de los Gallegos; and Gavilan. According to the accompanying field notes (Griffin and McMullen 1878), the total population was about 250. The land between the river and the road to the east, and between Los Gallegos on the north and Gavilan on the south, is noted as "under cultivation." Only the Ojo Caliente Springs are shown on the west side of the river, at the base of a ridge rising behind them

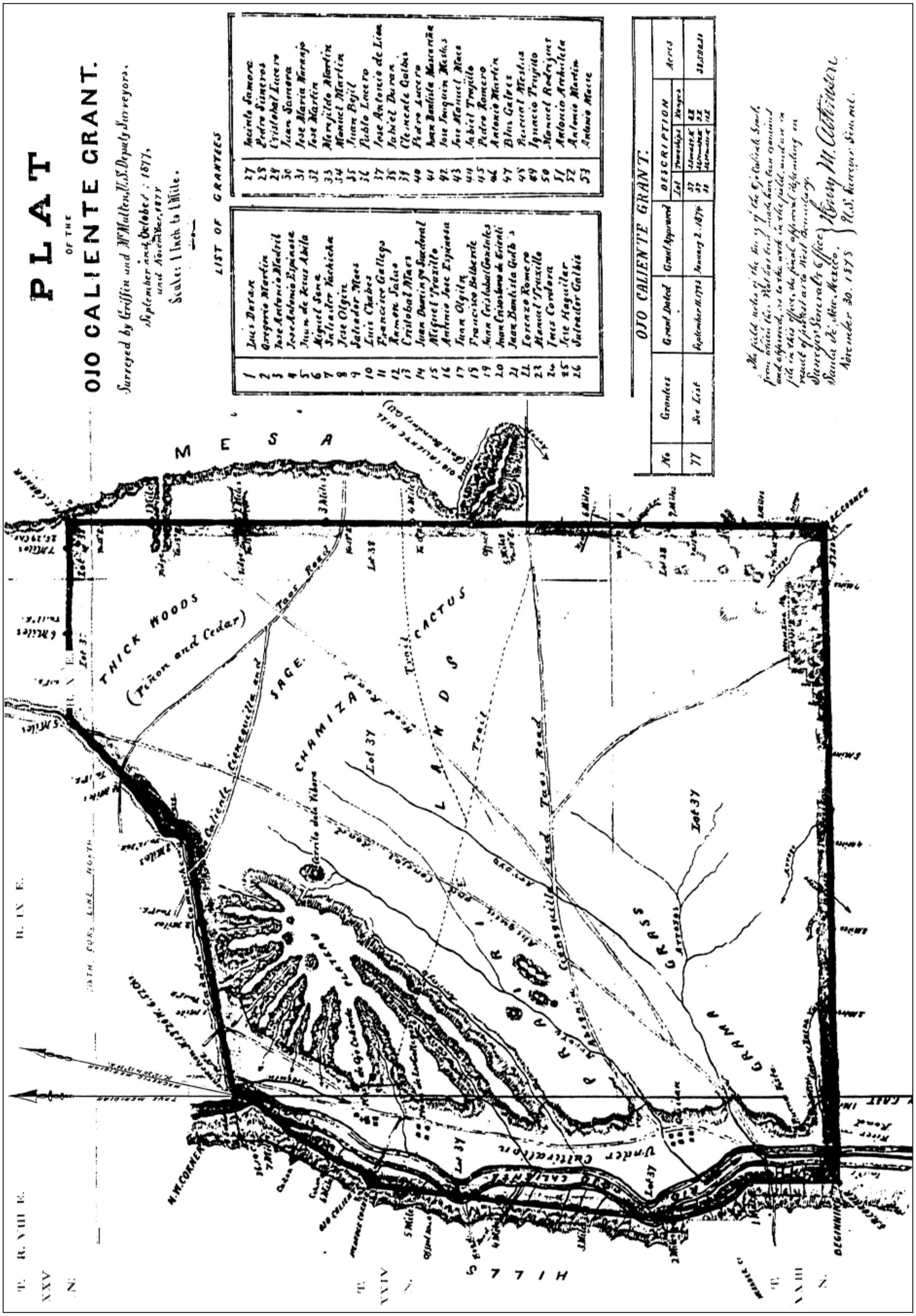


Figure 25.1. Plat of the Ojo Caliente Grant in 1877 by Griffin and McMullen.

to the west. No other significant cultural information is presented on the map aside from the location of the Ojo Caliente church and a list of names of the 1793 grantees (Fig. 25.1).

By the time of an 1882 survey by Curry and Jones, the grant boundaries had shrunk significantly, from 33,590 acres to 2,854.64 acres. The entire ridge area east of the road appears to have been excluded from the grant and was divided by the surveyors into sections, as shown on a 1919 BLM survey map (Fig. 25.2) created by surveyor William B. Douglass, which was based on the 1882 subdivisions created by Curry and Jones (Douglass 1922). Ownership of the ejido in 1882 is unknown, but it is possible that this land might have become part of the public domain by that time. In his field notes accompanying the boundary survey of the Ojo Caliente Grant, Douglass (1922) mentions the location of the Ojo Caliente cemetery, several cross-cutting roads, log corrals, the Church of the Penitentes, the village of Gavilan, the stable and house of C. M. García, the house of Juan C. García, and the house of Juan Archuleta. It is clear from his descriptions that the cemetery was in its current location as was the morada and the houses of the Garcías and Archuletas. These two families were relatives of Flora Archuleta Trujillo (Fig. 25.3), an elder and lifelong resident of Gavilan/Ojo Caliente with an excellent memory and extensive knowledge of local history. Much of her information will be presented later in this report.[1]

An 1895 plat of the Ojo Caliente Grant, surveyed by Sherrard Coleman (1894), also shows the grant as a long narrow strip paralleling the river and extending to the east and west only as far as the ridges on either side of the river (Fig. 25.4). The area of the grant has shrunk even further, to 2,244.99 acres. On his map, Coleman indicates the Ojo Caliente spring west of the river, the village of Ojo Caliente east of the river, Gallegos south of Ojo Caliente, and Gavilan south of Gallegos. Interestingly, neither of the early maps (1877 and 1895) shows a community called Duranes between Gallegos and Gavilan. Perhaps settled more recently, Duranes is present on the 1953 USGS Ojo Caliente Quadrangle topographic map. Flora Trujillo knew that this area had been called Duranes but said that it was also known as South Ojo Caliente. Even though Gallegos is shown on all of the above maps, Flora stated that she never heard this name applied to the area.

Little is currently known concerning the land-ownership history of LA 105710. According to Flora Archuleta Trujillo, part of LA 105710 and the surrounding land formerly belonged to her paternal grandfather, Juan Antonio Archuleta, and part belonged to Juan Antonio García, her maternal granduncle. She did not know who owned the portion where the morada was situated. Some of Juan A. García's land was later transferred to his sons Candido and Manuel García.

A 1939 New Mexico Department of Transportation map (NMSHTD 1939) shows ownership of much of the land adjacent to the highway at that time (Fig. 25.5). A portion of LA 105710 east of the road belonged to Josephine García, a daughter of Candido García. As can be seen on this map, several structures existed on Josephine's property. Near the south end was a tiny adobe house (later discovered, through interviews with Gavilan elders, to be her father Candido García's store). A few hundred feet north was a log corral, and just north of it, a log pig pen and sheep pen. All were inside the 1939 right-of-way and were to be removed by WPA forces. Descriptions of these structures by Flora Trujillo are presented later in this report. The land east of these structures, which also belonged to Josephine García, was noted on the 1939 map as "sandy pasture" and "sandy flat." The morada, north and east of the corrals on LA 105710, was on land of unknown ownership, as were the remnants of an old dirt road. Neither are shown on the 1939 map.

Josephine García also owned a smaller parcel of land on the west side of the road, directly across from her father's store. It was described on the 1939 map as "Farm Yard." Her uncle Manuel García's land, also designated as "Farm Yard," was on the west side of the road, just south of Josephine's. Directly north of her land was a small area called "Church Land" (Fig. 25.5). According to Flora Trujillo and her nephew, Fred Archuleta Jr. (another resident of Gavilan), the Penitente oratorio, which does not appear on this map, was outside the right-of-way on this "Church Land." Flora stated that it had been donated for this purpose by Ascencionita García Sisneros, her maternal grandmother.

Candido García's name did not appear as owner of any of the land along either side of the

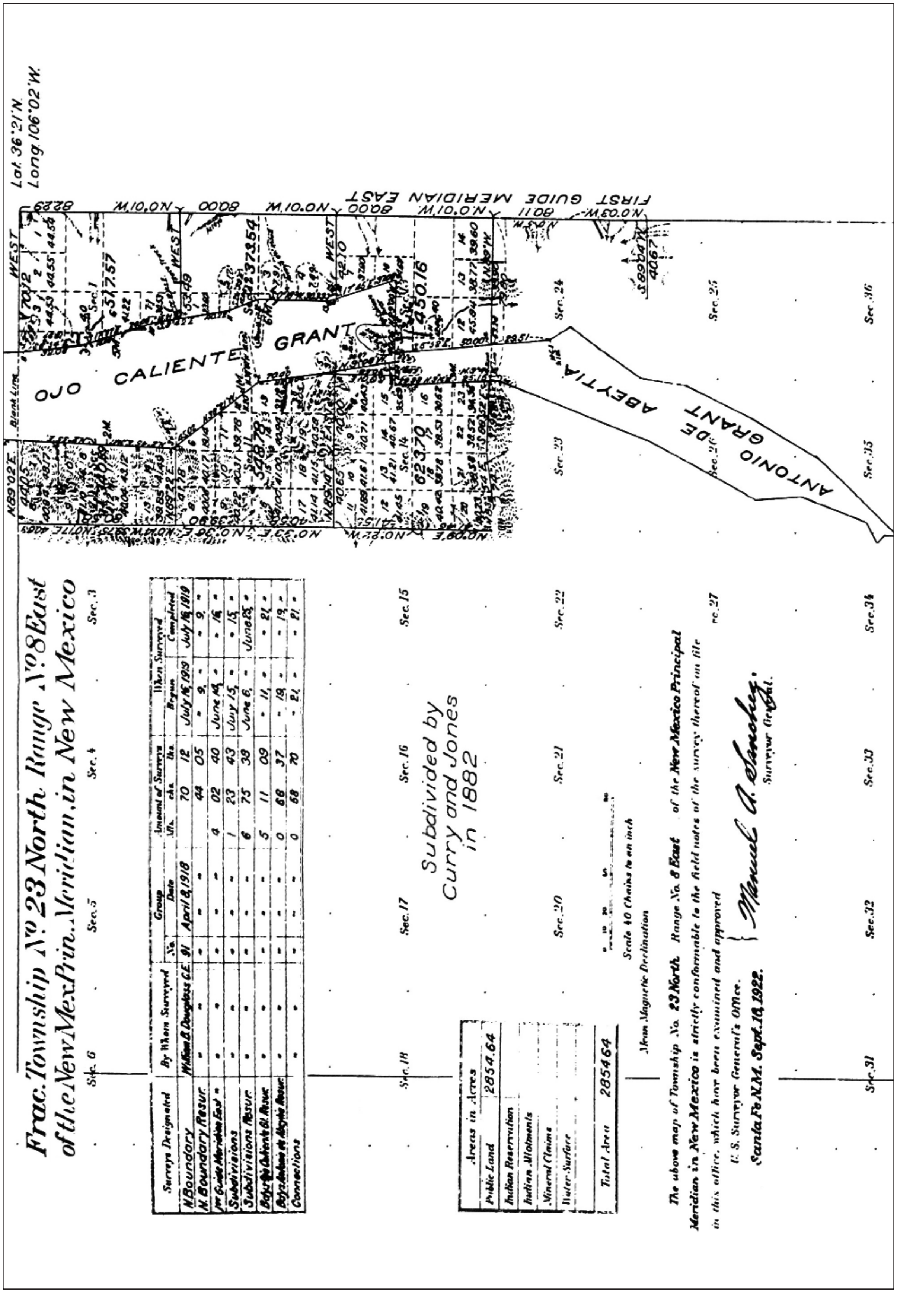


Figure 25.2. Plat of the Ojo Caliente Grant in 1919 by Douglas, based on 1882 survey by Curry and Jones.

Figure 25.3. Flora Archuleta Trujillo, a retired teacher, in front of her Gavilan house, with her dog, Brandy.

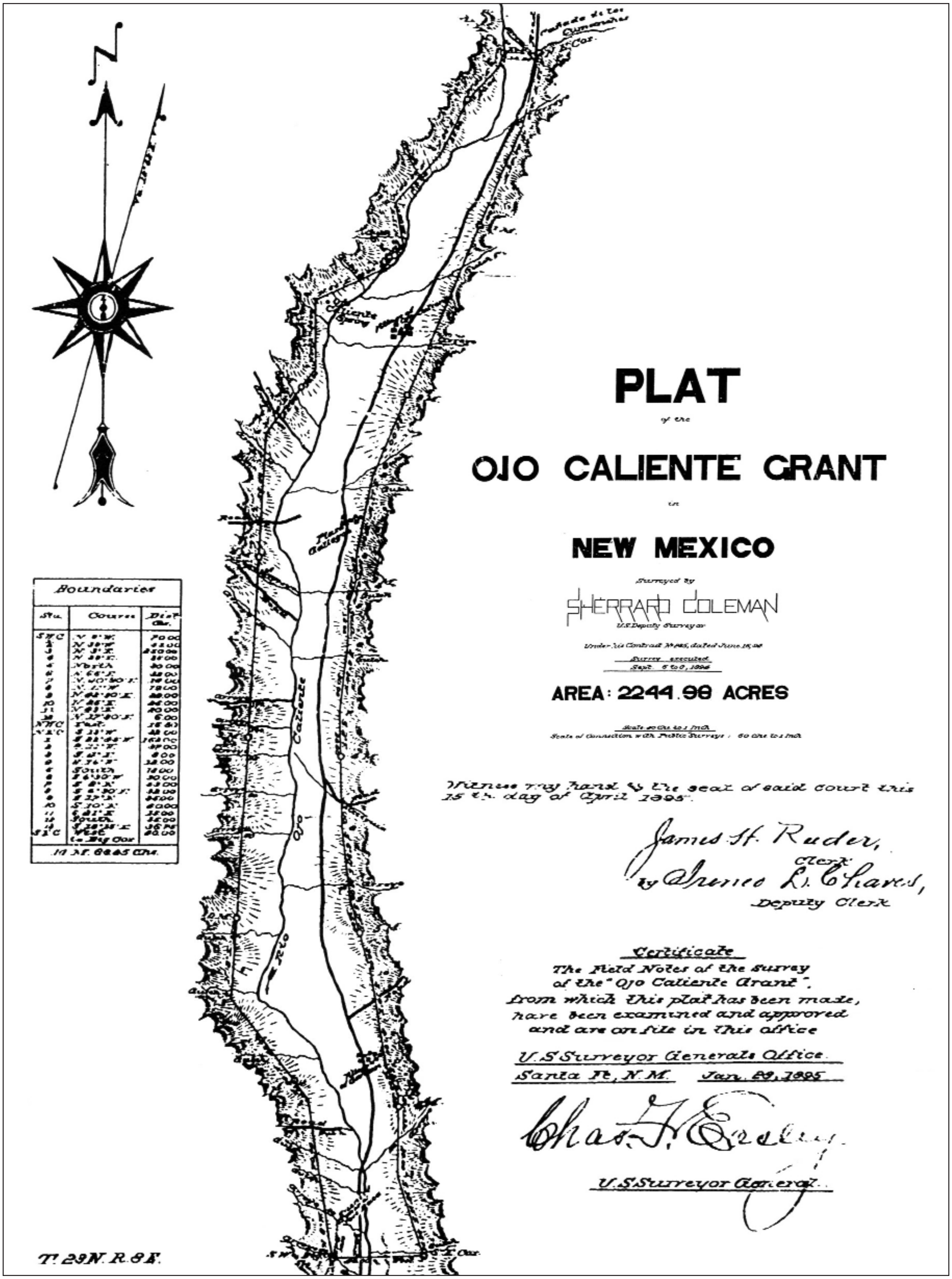


Figure 25.4. Plat of the Ojo Caliente Grant in 1894 by Coleman.

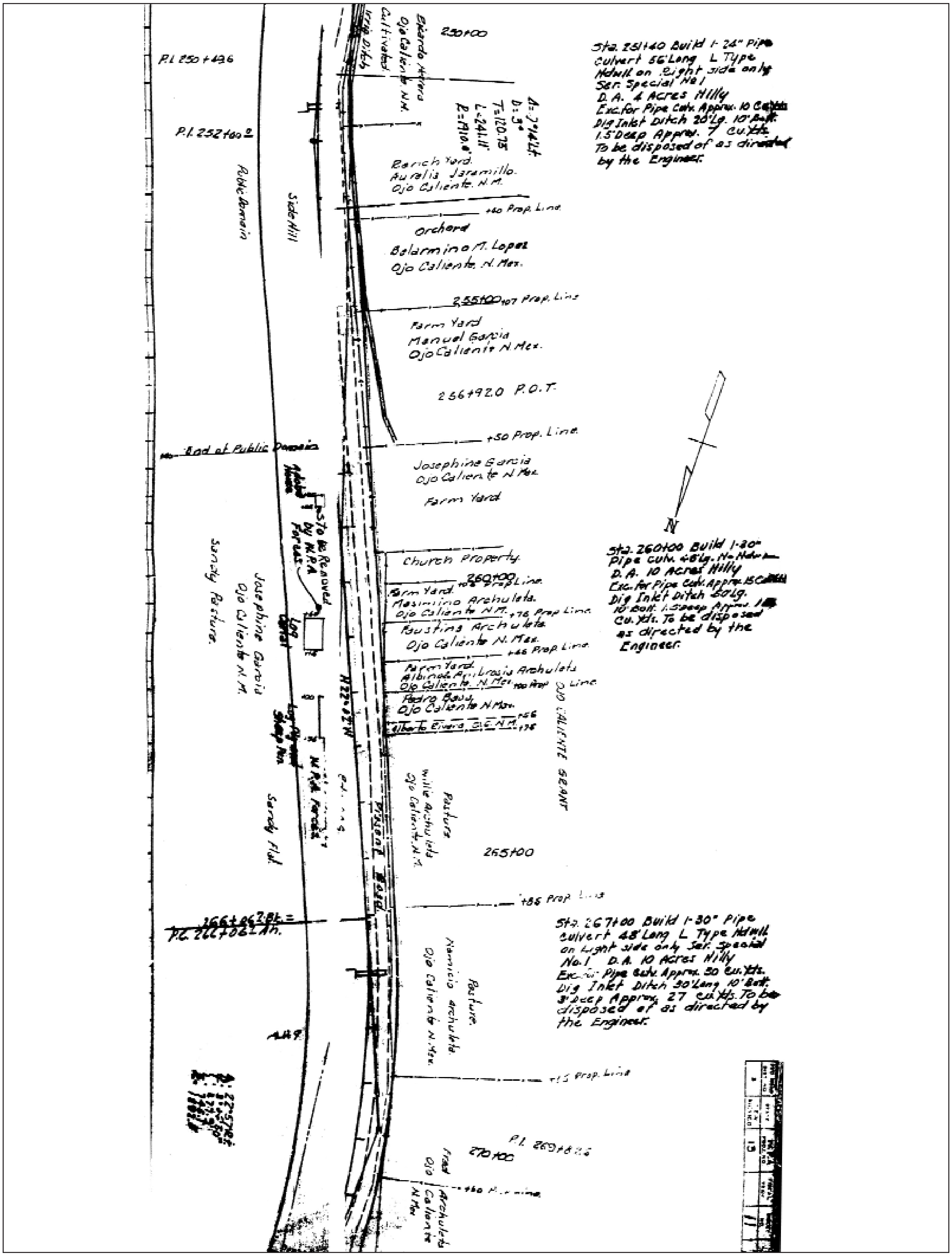


Figure 25.5. Sheet 11 from 1939 construction plans for U.S. 285 (NMSHTD 1939), showing ownership of land adjacent to the highway near LA 105710.

road in 1939, even though Flora Trujillo knew that his little store east of the road and his large house west of it had been built on land that he owned. Flora stated that Candido may have deeded this land to his daughter for financial reasons.

Flora Trujillo recalled that Candido had a homestead in Gavilan for a number of years, although she did not know exactly where it was or what happened to it. BLM records show a homestead application for this land (which appears to have included a portion of LA 105710) filed in the name of Candido M. García on July 16, 1930 (BLM Serial No. and Homestead Patent Number SF 062055). The original homestead, dated December 29, 1916, was also noted on the document, but without the name of the individual who filed it at that time. No other information was recorded concerning this homestead, except that on April 2, 1935, Candido M. García's homestead patent was canceled by relinquishment. The reasons are unknown, but finances may once again have been the issue. Perhaps his daughter, Josephine, acquired it after her father relinquished it. It is also possible that this land reverted to the public domain after Josephine's ownership lapsed. According to Flora Trujillo, Josephine and her husband moved away from Gavilan about the time of World War II and never returned. She died over 30 years ago. It is clear, however, that after 1939 this land came under BLM control when that agency gained jurisdiction over all U.S. public land not managed by the USDA Forest Service.

Structures, Features, and Use-Areas along U.S. 285 at or near LA 105710

The Small Stores

In the 1930s Candido García built and ran a small store east of U.S. 285 on LA 105710, within project boundaries, 0.15 mi (0.24 km) south of the morada. Candido's brother, Manuel García, built and ran a very similar little store directly across the road on the west side of U.S. 285, also in the right-of-way. Neither store had a name. Local residents simply called them the García Brothers' *tienditas* (small stores). During the few years these tienditas were in operation, the brothers were always in competition with each other. Unless noted otherwise, information concerning the brothers and their stores, as well as other features on or near this site, was related by Flora Trujillo, a cousin of the García brothers.

Never very profitable, these small stores were only open for a few years, from approximately 1931 to 1937, according to Flora Trujillo and her nephew Fred Archuleta Jr. When the García brothers closed their businesses, each dismantled his store, took the adobes and beams, and reused them elsewhere. Only the foundations were left.

The mud and rock foundation of Manuel's store, just a few feet west of the roadway, was eliminated in 1939 when the road was first paved. The concrete foundation of Candido's store was left intact at that time. It remained on the east side of the highway, back from the roadbed but within the right-of-way, until additional road work was undertaken in 1998.

Each of these one-room structures was built to be a store, and neither was used for any other purpose. Both were made of adobe and had at least one window. Candido's store had a cement and rock foundation upon which the adobe block walls were built. The roof was corrugated metal, basically flat, but with a slight pitch so water would run off. It had a "lumber" floor and a door that faced the road to the west. Flora recalled one small window but couldn't remember whether it was on the north or west wall. Manuel's store had a mud and rock foundation upon which the adobe block walls were built. The door of Manuel's store faced the road to the east.

The interior of each store was plain and functional. In Candido's store, aside from the small window in the north or west wall, a wooden counter stood near the east wall, and a scale sat on the counter (Fig. 25.6). Wooden shelves lining the north wall held canned and other dried goods. FSs of dry food were piled on the floor along the south wall. No chairs or benches were present. A wood-burning stove was near the west wall, close to the south corner, with a wood box next to it. There was no electricity. A single kerosene lantern provided artificial light.

The interior of Manuel's store was similar, but the store was oriented differently due to its placement in relation to the road (Fig. 25.7). The counter was near the north wall, and a window

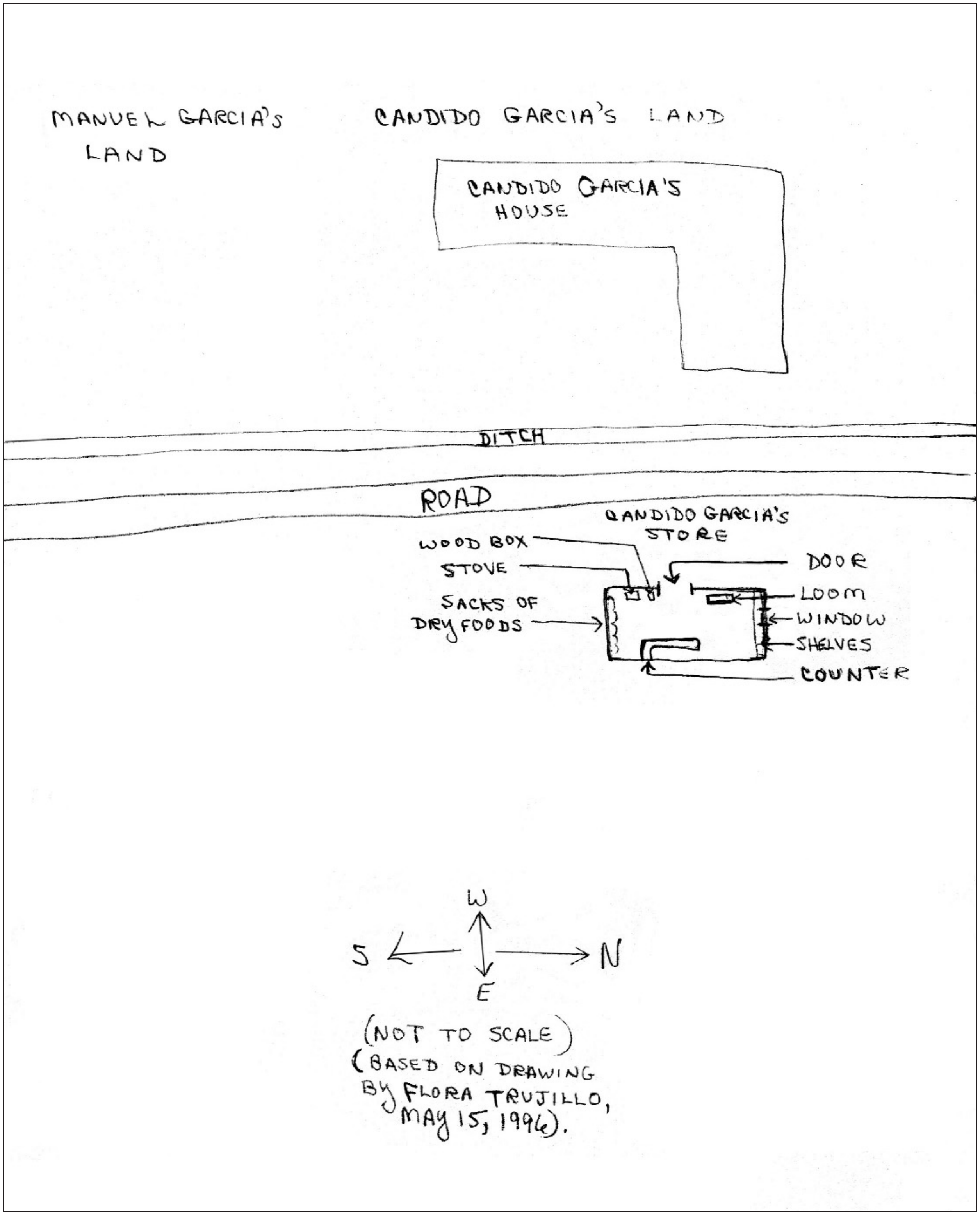


Figure 25.6. Adaptation of Flora Trujillo's 1996 sketch plan of Candido García's store and house at Gavilan.

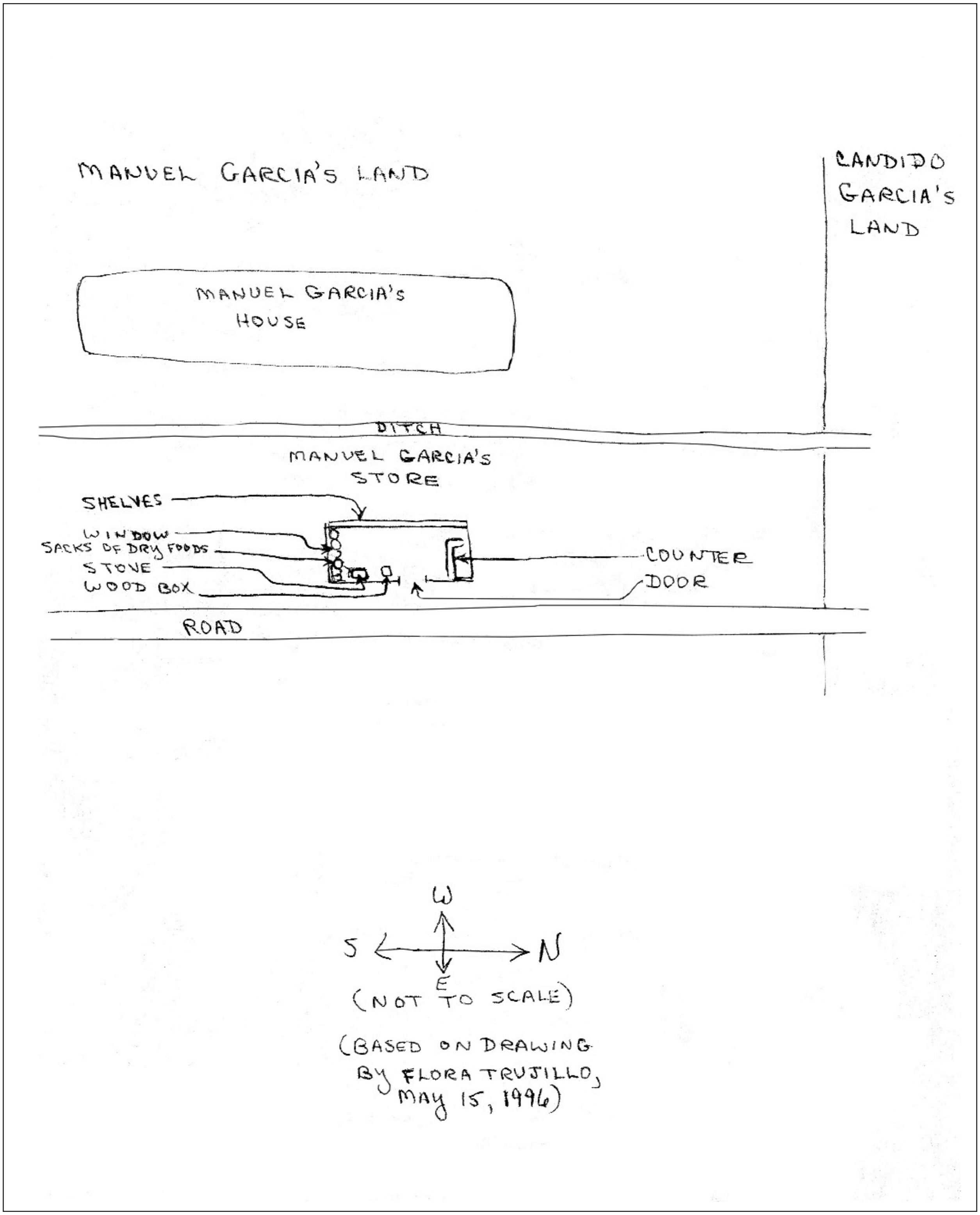


Figure 25.7. Adaptation of Flora Trujillo's 1996 sketch plan of Manuel García's store and house at Gavilan.

was on the south. Sacks of dried goods were beneath the window. Shelves along the west wall held the canned goods. A stove was placed near the east wall, close to the south corner, and a wood box was next to it.

Flora Trujillo recalled a special time when she worked in Candido's store. She had learned how to weave in school one year, and the following summer, Candido, who always wanted to learn to weave, built a loom and invited her to spend a month weaving inside his store. He never could spend enough time to really learn how to weave, but Flora's loom was set up in the northwest corner of the room, and she worked there every day. Her mother helped her card, spin, and dye the wool. She enjoyed talking to people when they came in to see what she was doing. The store was open continuously during that month. She only did the weaving demonstration for this short period of time, however, because her interests soon led her back to school, where she trained to become a teacher.

The García stores were not open on a regular basis since each brother supported his family primarily by farming and raising livestock. Candido also worked part time as a carpenter and built many of the houses in the Gavilan area. The stores were a secondary undertaking and remained closed and locked much of the time. Often, persons in need of an item had to seek out the owner or his wife and ask them to unlock the store so they could purchase the goods they needed.

In their stores, the brothers did not buy or sell produce and livestock raised by local families. They primarily sold canned goods and canned meats as well as dry foods such as flour, pinto beans, piñon nuts, potatoes, sugar, coffee, salt, baking powder, baking soda, and candy. Nonfood items included soap, lamp oil, matches, and balloons for the children. According to Flora Trujillo they did not sell shoes or clothes, nor did they have a gasoline pump. However, Ben Maestas, a nephew of Manuel García, did recall a gas pump at his uncle's store and a big sign which said, "Polarin," the name of the gas company. Ben's uncle also sold pop and had barrels of candy. Few cars traveled the dirt road at that time and, according to Ben, his Uncle Manuel didn't do very well financially.

Flora Trujillo stated that the García brothers did not extend credit. They were poor people and needed the cash to purchase more goods. When they were financially unable to stock the shelves, their little stores might be closed for months or even a year at a time. These were very small businesses, always on the financial edge. According to Flora, "Neither had very much trade at their little stores and they didn't charge high prices. They did their best to buy canned goods and other products cheap so they could charge a reasonable price and make a little profit" (Goodman Field Notes, 1998). Flora recalled that they went to a special place to buy things more cheaply, but she could not remember where.

Both families survived largely by farming, growing fruit, and raising livestock on their land. They had orchards in some of their fields near the river and annually harvested plums, peaches, apricots, cherries, and apples. They also grew chile. As the fruit ripened they picked it and then traveled to Monte Vista, Pagosa Springs, and other towns in Colorado, where they sold it. The Garcías strung and sold chile *ristras* and sometimes exchanged their produce for items they didn't grow, such as potatoes. They also gathered piñon nuts in good years and sold them in Colorado. Neither brother sold fruit, chile, or piñons in his little store. Every summer and fall Candido and Manuel hired people to pick apples and other fruit for them from their orchards, pick chile from their fields, and string ristras. They didn't take advantage of people who worked for them; they treated them well.

Concerning social and familial patterns, the García brothers were related to everyone in Gavilan and as a result were closely tied to the community (Fig. 25.8). Aunts, uncles, and other relatives lived all around them. Candido and Manuel (first cousins of Flora Trujillo's mother) lived only a few houses away from Flora's grandparents, for example. The brothers were respected, were considered to be honest and hardworking, and were no wealthier than anyone else in the local area. Both were well liked and responsible, and they participated in a variety of communal activities such as ditch cleaning, planting, harvesting, and so forth.

Flora recalled that each brother lived in a large house on adjacent land (Figs. 25.6 and 25.7). Manuel's house was directly south of Candido's. Each owned about 10–12 acres (4.1–4.9 ha) stretching from the Gavilan ditch on the east in a long lot to the river on the west. Ditch water was used to irrigate their crops and the fruit trees in their large orchards. Each house was just west of the ditch. Each brother also had a well on his property that supplied drinking water.

Candido's house for his wife and nine children was on the west side of the road, while his store was on the east side. Manuel's seven-room house for his wife and nine children was down the hill behind his store; house and store were both on the west side of the road. After he closed and dismantled his store beside the road, Manuel turned one of those seven rooms into a new store. He and his wife operated this store in their home for many years. One of his specialties was ground chile. As an old man, he moved to Santa Fe to live with one of his daughters.

Flora Trujillo felt there were two main reasons why the brothers closed their little stores. First, there was a great deal of jealousy between them; they were in stiff competition all the time. Second, neither store showed a profit, and it was a financial strain to keep them open.

When Candido closed and dismantled his store, he never opened another. He sold his large house and with his family moved to the west coast during World War II to be near one of his sons, who was ill. None of them ever returned to the Ojo Caliente area. Flora Trujillo stated that Bob Smith and his family bought Candido's house and land, while Ben Maestas, who had always loved this area since he was a small boy, later purchased his uncle Manuel García's house and land.

The Archuleta Corrals, Animal Pens, and Shed

Approximately 0.04 mi (.06 km) north of Candido García's little store, on land formerly belonging to Flora Trujillo's paternal grandparents, Juan Antonio and Faustina Archuleta, were the Archuleta cattle corrals, sheep corrals, chicken pens, a pig pen, a large wood pile, and a shed where the wagons were housed and harnesses and saddles hung (Fig. 25.9). When she was young, Flora was told that her grandfather owned all this land. Later, she was told that it belonged to the government. Flora thought that probably her family never had a deed to this land, and since all the land was inherited in this area, there was probably no need for a deed. Built on a portion of LA 105710 on the east side of U.S. 285, these Archuleta structures took up a significant amount of space, as did adjacent areas for storing hay and other feed. Flora recalled their presence as late as 1934, when she went to gather wood from the woodpile there, following a *velorio* (vigil) held for her granduncle Albino Archuleta's deceased baby. Some of these structures were shown on a 1939 New Mexico Department of Transportation map (NMSHTD 1939), which also indicates that they were slated for removal by WPA forces (Fig. 25.5). They were most likely dismantled shortly after this time, and no trace of them remains. The land where they formerly stood, currently unused, is across the highway from the large, two-story house that belonged to Flora's paternal grandparents, Juan Antonio and Faustina Archuleta. This structure now stands abandoned, back away from the west side of the road. Several other houses have been built beside and in front of it.

Flora stated that the land to the east of her grandparents' corrals on the ridge above LA 105710 was open, free land where people let their cattle and horses graze. She remembered that the hills to the east were beautiful—formerly they were covered with grasses that provided plenty of forage for the livestock. Now those hills are barren, and anyone who keeps livestock there must buy feed for them. No one had to buy feed when she was young. Local families raised large quantities of corn and wheat for human consumption and as feed for chickens and hogs.

Roads Directly North of the Morada

According to several elders, an abandoned dirt road on LA 105710 that runs up the mesa to the east just north of the morada had several uses. It served mainly as a wagon road for the men of Gavilan when they went to gather firewood on the ridge east of the village. Since it has been out of use for many years, current residents were unsure whether or not this road had, at one time, also connected Gavilan with the Rio Grande villages to the east. According to several elders, it was also the principal road used when the Penitentes walked in procession up to the Calvario. Over time this road has become an arroyo, and only the dim outline of a two-track

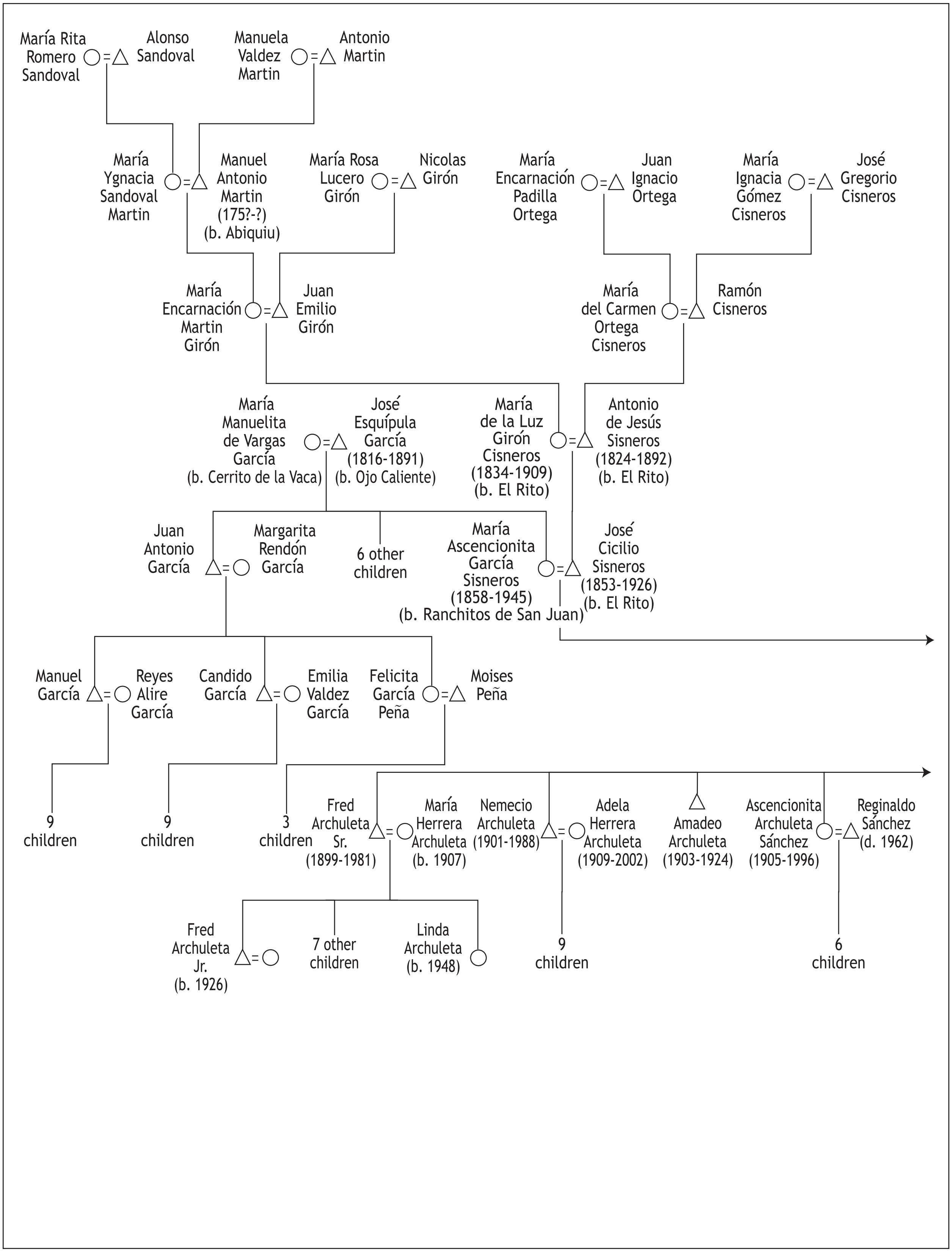
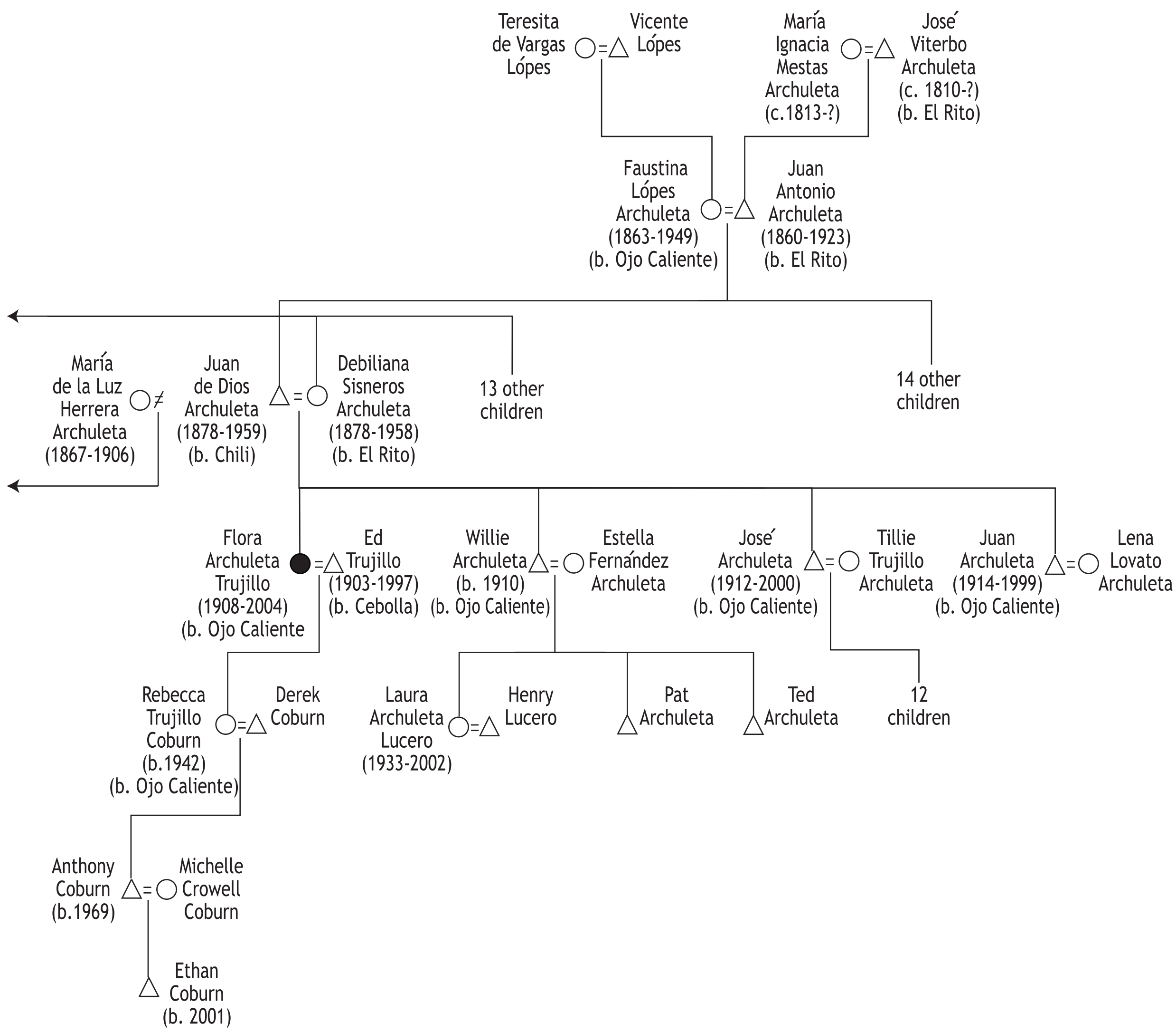


Figure 25.8. Genealogical chart of García-Sisneros-Archuleta family. Compiled from information supplied by Flora Archuleta Trujillo and Anthony Coburn.



Teresita de Vargas Lópes
Vicente Lópes
María Ignacia Mestas Archuleta (c.1813-?)
José Viterbo Archuleta (c. 1810-?) (b. El Rito)
Faustina Lópes Archuleta (1863-1949) (b. Ojo Caliente)
Juan Antonio Archuleta (1860-1923) (b. El Rito)
María de la Luz Herrera Archuleta (1867-1906)
Juan de Dios Archuleta (1878-1959) (b. Chili)
Debiliana Sisneros Archuleta (1878-1958) (b. El Rito)
13 other children
14 other children
Flora Archuleta Trujillo (1908-2004) (b. Ojo Caliente
Ed Trujillo (1903-1997) (b. Cebolla)
Willie Archuleta (b. 1910) (b. Ojo Caliente)
Estella Fernández Archuleta
José Archuleta (1912-2000) (b. Ojo Caliente)
Tillie Trujillo Archuleta
Juan Archuleta (1914-1999) (b. Ojo Caliente)
Lena Lovato Archuleta
Rebecca Trujillo Coburn (b.1942) (b. Ojo Caliente)
Derek Coburn
Laura Archuleta Lucero (1933-2002)
Henry Lucero
Pat Archuleta
Ted Archuleta
12 children
Anthony Coburn (b.1969)
Michelle Crowell Coburn
Ethan Coburn (b. 2001)

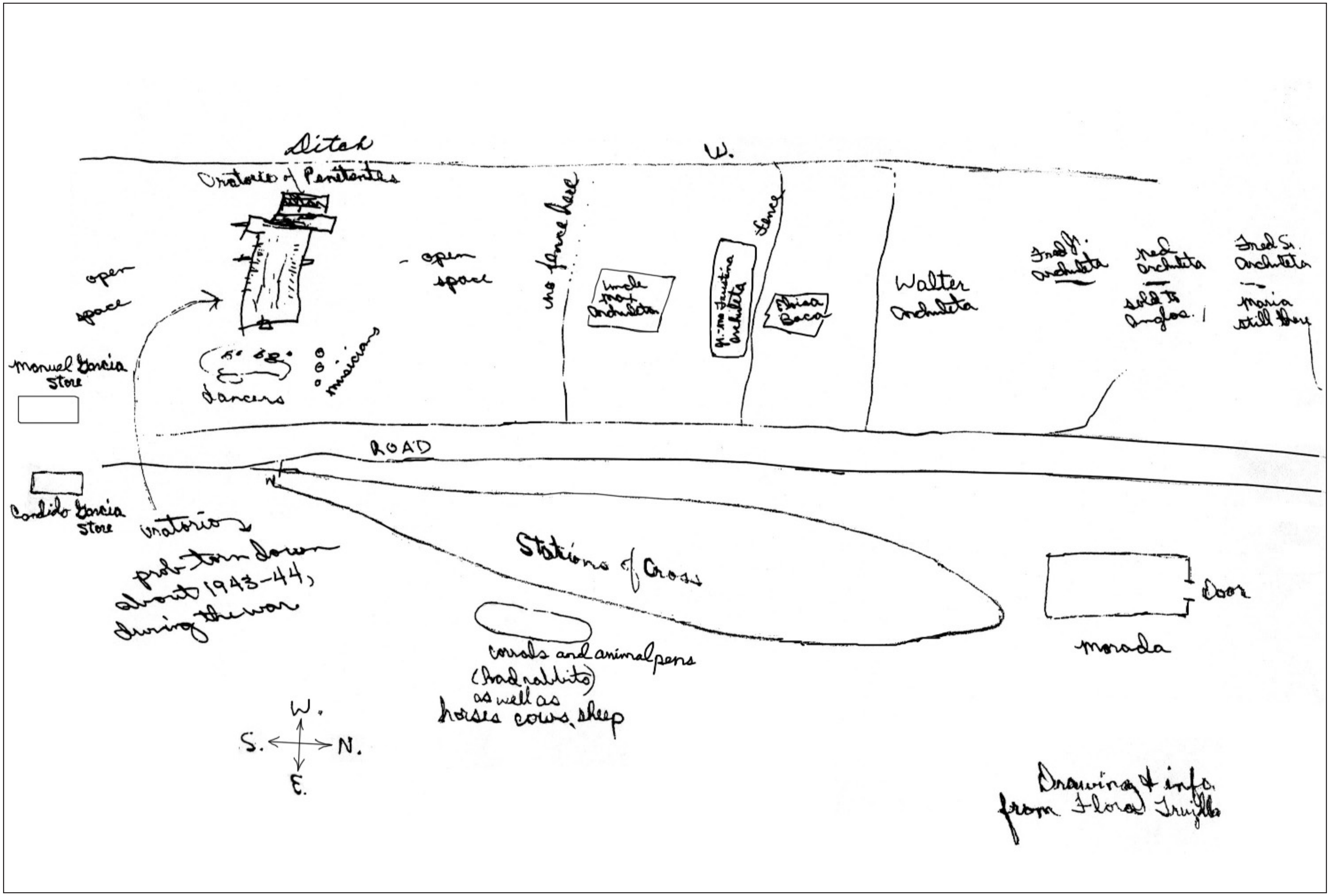


Figure 25.9. *Adaptation of Flora Trujillo's 1998 sketch plan showing the location of the Penitente oratorio, morada, and other features and structures along U.S. 285 at Gavilan.*

can be seen just to the north and west of the morada.

Another more usable dirt wagon road was visible winding up the south end of a rather steep cliff face approximately 0.20 mile (0.32 km) north of the first road on the east side of U.S. 285. This road was also used by the men when they went to gather wood. According to Flora Trujillo, when she was young there were a great many trees over the ridge to the east, and it was easy to gather large quantities of wood there. At that time firewood was free, and people just took what they needed. Flora recalled that her grandfather, Juan Antonio Archuleta, used to hitch up his wagon, leave the house at 3:00 AM, and travel up either of these two roads to gather wood. When his wagon was full, he would return to the house, usually about 10:00 AM, and continue with his daily tasks. According to Fred Archuleta Jr., the road farther to the north was the one that Ojo Caliente and Gavilan families always took when they went to visit the Rio Grande villages to the east, when he was a young boy in the 1930s. This second and perhaps newer road is no longer used today.

The Gavilan Morada

The remains of the Gavilan morada are on LA 105710, about 0.15 mile (0.24 km) north of Candido García's little store, on a slope on the east side of U.S. 285 and adjacent to but just outside the right-of-way fence. The morada was known as La Morada de Nuestro Padre Jesus (Fig. 25.9). According to interviewees, no other morada ever existed in this area. North of the land that belonged to Juan Antonio and Faustina Archuleta, this morada was originally built by the Penitentes of Ojo Caliente and Gavilan, perhaps between the 1850s and 1870s, and was used principally for religious purposes. Flora Trujillo's mother, Debiliana Sisneros Archuleta, had said it was built before she was born in 1878.

The interior of the morada was described somewhat differently by two interviewees who attended services in it between 1930 and 1960. About 1948–52, it underwent some modification, and this may be responsible for the differences. No other elders were able to remember much about the interior or the exterior. Flora Trujillo attended services in this morada in the 1930s, while Ben Gallegos remembered the morada from his visits in the 1940s and 1950s. They both agreed that the morada's only door was made of wood, had no window in it, and faced north. The windows of this adobe structure were on the west wall. Flora Trujillo recalled one window made up of a number of small panes of glass, while Ben Gallegos remembered three separate windows in the west wall. Flora stated that there was only one large room inside; Ben, however, was certain that there were two rooms: a large one, where most ceremonies and activities were held, and a small one at the south end of the building, where the altar and a number of saints were kept.

Flora, in describing the interior of the large room, stated that it was very dark inside. A large adobe fireplace (*fogón*) was in the northwest corner, and a big bucket of water often sat beside it. This water was heated, then sagebrush was dipped into it and used to wash the wounds of Penitentes after they completed their penance through flagellation. Yucca leaves were used as whips for penance, which Flora thought took place inside the morada. A pile of wood for the fire was placed just outside the door, to the northeast. Wooden benches lined the east wall of the morada, and cots were set up along the west wall, beneath the window (Fig. 25.10). Oil lamps hung on the walls, as did some candle holders. When no oil was available, candles were burned. For some ceremonies, the people lit candles and set them in a row on the floor. Along the north wall were benches and a very large wooden table where food was placed when it was brought in from the outside. At the opposite end of this long room was an altar that consisted of a plain wooden table upon which stood candles and a few hand-carved santos. A large crucifix hung on the wall above. Flora could only recall statues of St. Anthony, the Blessed Virgin Mary, and the Sacred Heart of Jesus, although she knew others had been placed there as well.

According to Flora, at first the Stations of the Cross were not inside the morada; they were in the Penitente oratorio, across the road. Later, however, as the walls of the oratorio started to crack and it was dismantled, the wooden Stations of the Cross were placed in the morada, and the local community used them there. When certain ceremonial activities were to take place in the

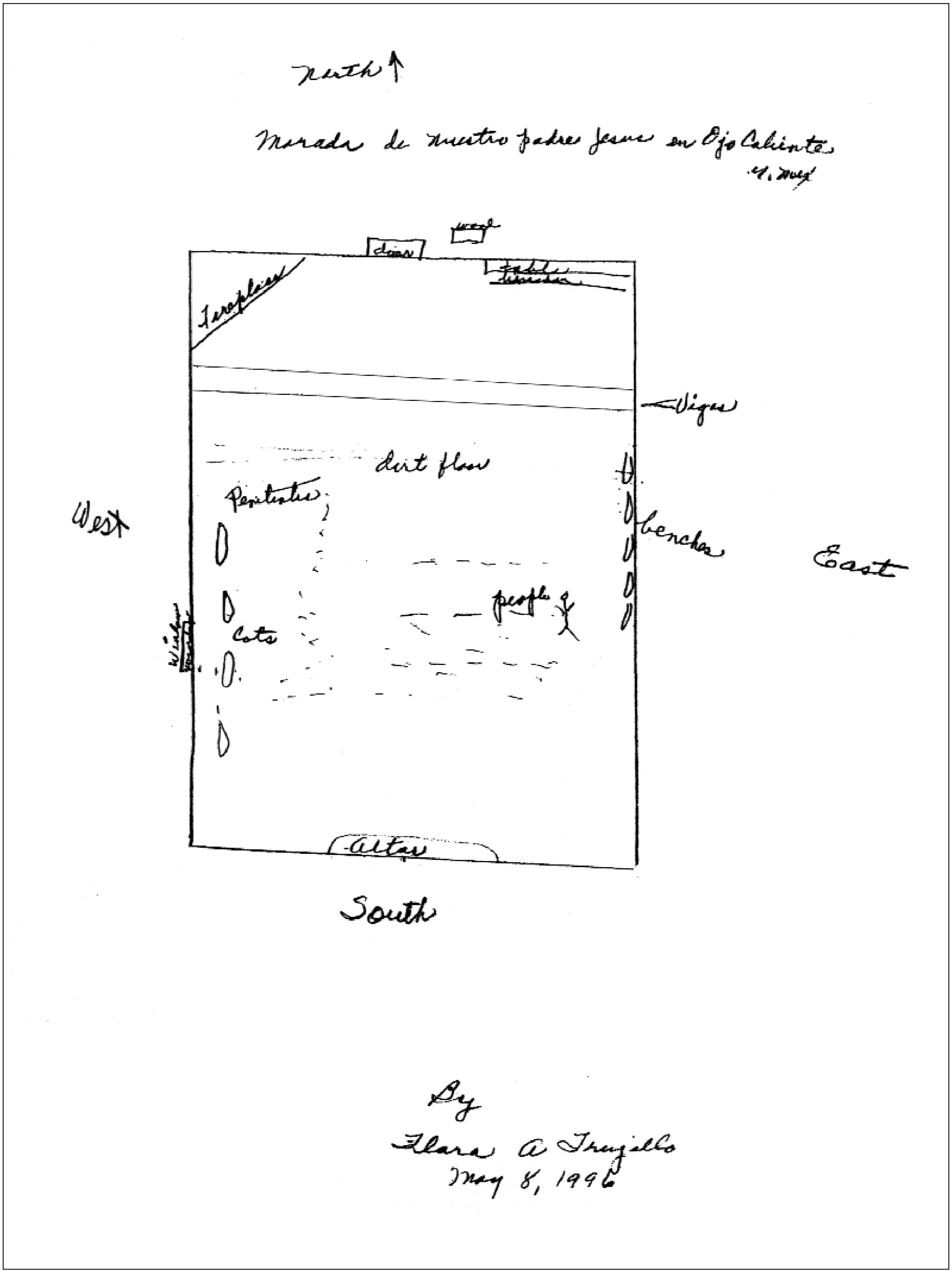


Figure 25.10. Adaptation of Flora Trujillo's 1996 sketch plan of the Penitente morada at Gavilan.

morada, some of the men moved the benches and placed a few in front of the altar so people could sit there. Non-Penitentes sat on these benches on the east side of the middle aisle in the morada. The Penitentes stood (but never sat) on the west side of the center aisle.

The floor of the morada was dirt. Large, wooden, hand-hewn vigas were visible in the ceiling, laid across the narrowest dimension of the room from east to west. The room could only be as wide as the length of the beams, which came from trees cut in the mountains around El Rito. Flora recalled that dried blood was clearly visible on them. The exterior roof, she said, was flat and had dirt on top of it.

Ben Gallegos stated that as long as he could remember (since the mid to late 1940s), the morada had two rooms: a large room with a fireplace, benches, and two windows in the west wall; and a small room beyond it that held the altar with its many saints. This small room had one window in the west wall. Most ceremonies and activities took place in the large room, at the north end of the building. After the Penitente oratorio across the road collapsed in about 1942, he recalled that people used the small room of the morada for an oratorio. Here they prayed and lit their candles. He also stated that the Stations of the Cross were always inside (though he did not say in which room) when he was young. They never put them outside during his lifetime. Flora Trujillo was enough older to have seen and participated in praying the Stations of the Cross when they were placed outside and southwest of the morada (Figs. 25.9 and 25.11).

According to Flora, Penitente men or sometimes their wives were responsible for cleaning the morada. Women auxiliaries (wives, sisters, mothers, and daughters of Penitentes) brought food when asked to do so. Food donations were frequently requested and always given. Different families provided meals at different times, so no one had to bear an excessive burden. Two guards were stationed outside the door at the north end of the morada so that nonmembers could not enter when Penitente activities were in progress. (Ben Gallegos stated that people went up the hill when they needed a bathroom. He did not know of an outhouse anywhere nearby.)

None of the interviewees recalled precisely when the morada was dismantled. Both Ben Maestas and Flora Trujillo knew that it had been in use in 1942 and 1943, but they didn't know how much later than this it was still operational. Fred Archuleta Jr. stated that it was still standing when he returned from California in 1972, after an absence of more than twenty years. Eloisa Baca, another lifelong resident, recalled that the morada was falling apart in 1974, when her husband Pedro, who had been a Penitente, passed away. She said that the remaining Penitentes began taking it apart that year. Some took adobes, while others took vigas, the roof, doors, and windows.

Ben Gallegos had some specific information about the morada structure, since his father had been a Penitente. Ben stated that the morada was made only of adobe; no rocks were used in its construction. When he was a teenager, roughly between 1948 and 1952, some remodeling took place, and a pitched tin roof was put on. It wasn't too long, however, before a tremendous windstorm blew it off. So the Penitentes divided up and used the tin and lumber. However, they repaired the morada again and continued to use it a bit longer. Ben recalled that the morada was falling down and was dismantled before his father passed away in 1972. He thought that it had been taken apart in the late 1960s or early 1970s. At that time, the few remaining Penitentes took the vigas and adobes to be reused elsewhere. The information given by the two people whose father and husband had been Penitentes suggests the building was dismantled in the 1970s. If so, the Gavilan morada was in use for approximately 100 years before being abandoned.

The Via Crucis and the Exterior Stations of the Cross

The Stations of the Cross (*estaciones*) were placed in a roughly oval pattern in a specific outdoor location along the Via Crucis in Gavilan at the beginning of Holy Week each year (Figs. 25.9 and 25.11). According to Flora Trujillo, the term Via Crucis means "Stations of the Cross," and the two terms were used interchangeably by local residents. The exterior Stations of the Cross, which included fourteen parts of the story of the crucifixion and death of Jesus, was a temporary feature erected annually by the Penitentes on

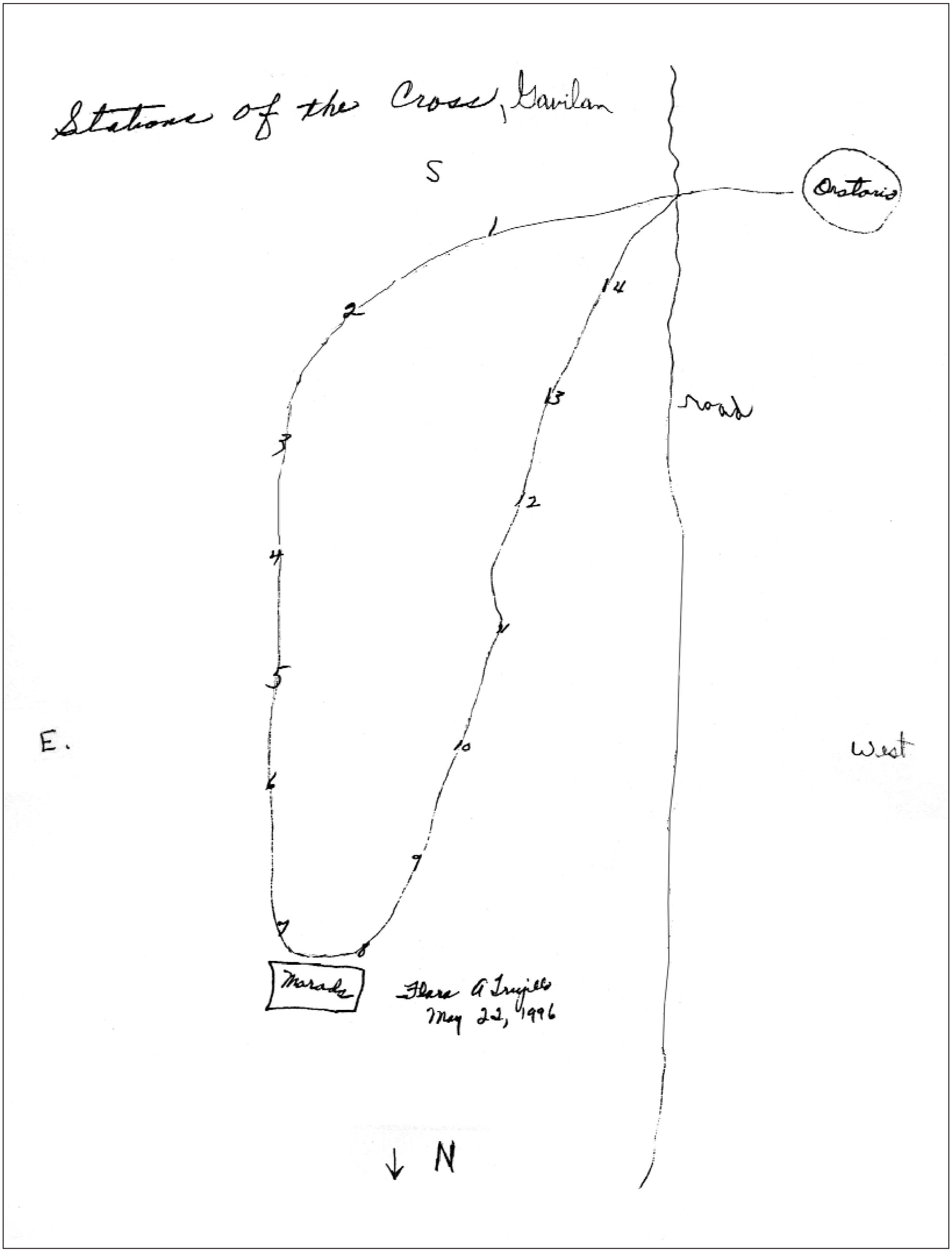


Figure 25.11. Adaptation of Flora Trujillo's 1996 sketch plan of the outside Stations of the Cross at Gavilan.

land south and slightly west of the morada and west of the Archuleta animal pens and corrals on LA 105710, within the project area. The first of the fourteen Stations of the Cross was placed directly east, across the highway from the Penitente oratorio in a large open space. The next six Stations of the Cross were then placed along one half of an oval shape, moving counterclockwise in a northerly direction toward the Morada. The last seven Stations of the Cross were along the other half of the oval, moving in a southerly direction back toward the oratorio (Fig. 25.11). Penitente members evenly spaced small wooden crosses outdoors in this location whenever they planned to pray the Stations of the Cross, which might be on any Friday during Lent, but always on Wednesday, Thursday, and Friday of Holy Week before Easter. This outdoor activity did not occur at any other time of the year. According to Flora, by the time she was older they had dispensed with the small wooden crosses altogether. Instead, members of the procession sang as they moved to one of the former stations. At this spot, one of their number made a recitation relevant to that particular Station of the Cross.

Flora recalled that when she was young, Penitentes and non-Penitentes alike would begin praying the Stations of the Cross in this outdoor setting about 3:00 PM on Wednesday, Thursday, and Friday afternoons of Holy Week. Penitentes led the procession; non-Penitentes followed behind them. All moved in a counterclockwise circuit from Station 1 through Station 14, singing, kneeling, praying, and listening to the recitations. A flute, drum, and matraca (noise-maker) often accompanied them. Upon completion of all the stations (about 4:30 PM), the participants reentered the oratorio, where they said a short prayer before departing. Penitentes then returned to the morada and non-Penitentes to their homes. This outdoor religious activity probably ended in the late 1930s or early 1940s.

The Calvario

The Calvario (the symbolic place where Christ was crucified) was most likely on a hill above and northeast of the morada. The last Penitentes in Gavilan died between 1992 and 1995, and their relatives could not recall specifically which hill the Calvario had stood on. The general consensus was that it was the hill northeast of the morada, where Hilltop Ruin (LA 66288) is located. Ben Gallegos, the son of a Gavilan Penitente, stated that the Calvario had been on the top of the hill where the ruins are. A few people thought it might have been on the hill just to the south, but they were not sure. The Penitentes climbed to the Calvario on the dirt wagon road just north of the morada. This road has since become an arroyo. According to Flora, there was no name for the path the Penitentes took up to the Calvario from the morada.

No permanent structures were ever built as part of the Calvario, and no construction was involved in creating it. Activities of the participants included dragging or carrying huge wooden crosses to the designated spot during Holy Week every year. This was done in procession while they prayed, sang, and whipped themselves. Usually three large, wooden crosses were placed on the Calvario at this time. Other Penitente activities held there were private, and non-Penitentes were not allowed to witness the proceedings. Processions going to and activities occurring on the Calvario ended 50 to 60 years ago.

The Old Trail (LA 118549)

An old foot path, LA 118549, ran up and down the hillsides along the ridge directly east of the highway (see Chapter 17). None of the residents of Gavilan knew anything about it. Some remembered playing on this path as children, but they had never been told anything about it by parents or grandparents. Flora Trujillo did mention that there was a path that the Penitentes took during Lent and Holy Week, when they moved in procession along the ridge top east of the highway. She saw them do this when she was very young but did not know whether they used LA 118549 or a different route. She also mentioned that starting from the Calvario, some of the Penitentes went in procession to Alcalde, El Rito, Abiquiu, and Hernandez during Holy Week each year—journeys that involved the use of several different paths. However, she could not recall any of her elders ever talking about the path that constitutes LA 118549. Neither she nor Fred Archuleta Jr. knew anything specific about it, nor did her grandson, Anthony Coburn, who recalled play-

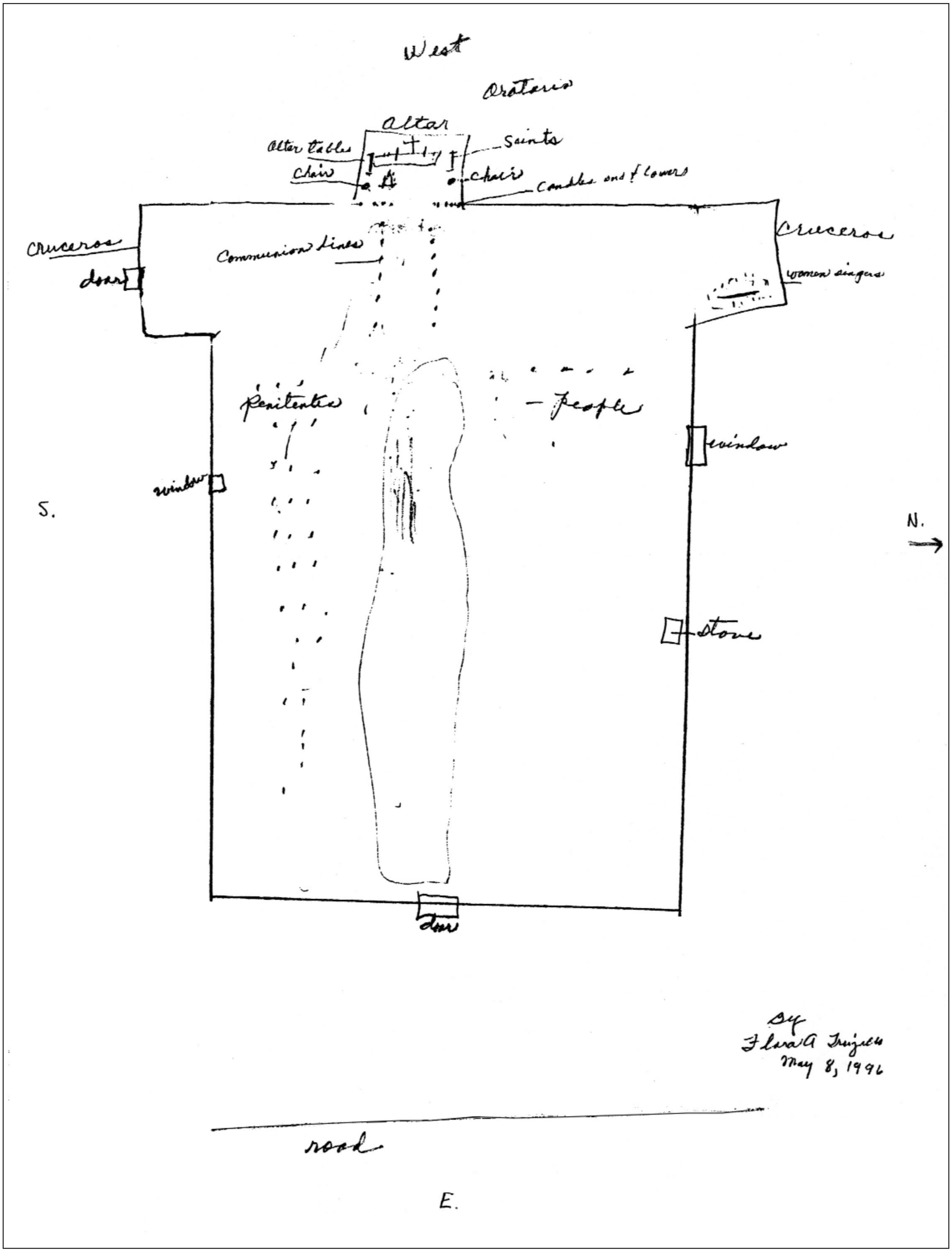


Figure 25.12. Adaptation of Flora Trujillo's 1996 sketch plan of the interior of the Penitente oratorio at Gavilan.

ing on it as a child.

LA 118549 was probably a prehistoric Indian trail, generally unknown to the Spanish settlers in the area. There is no conclusive evidence on whether or not the Penitentes occasionally used it, and no other ethnohistoric material is currently available concerning it.

The Cattle Guard

The "cattle guard" that Marshall (1995) mentioned in his survey report (near U.S. 285, just north of the morada) was unknown to the people interviewed. Upon further investigation, project personnel discovered that it had been part of a drainage feature, a concrete culvert box, which funneled water from the arroyo channel above it under the highway and down toward the Ojo Caliente River to the west. It was probably constructed in about 1939, when the highway was first paved. Ben Gallegos stated that this culvert was put in because water used to run down the dirt road just north of the morada. Another identical feature was found at the mouth of the arroyo channel near the former location of Candido García's store. Neither of these drainage features had any connection with the Hispanic use of LA 105710.

The Penitente Oratorio

The Penitente oratorio, on the west side of U.S. 285 about 0.10 mile (0.16 km) south of the Gavilan morada and approximately 60 ft (18.3 m) outside the right-of-way, stood on land donated by Flora Trujillo's maternal grandmother, Ascencionita García Sisneros. It is unclear when this oratorio was built. On three different occasions Flora Trujillo provided three different scenarios, but she could not say which was the most accurate: (1) The Penitente oratorio, dedicated to our Padre Jesús, was built shortly before or at the time the García-Sisneros oratorio was being torn down in 1923–24. (2) The Penitente oratorio was originally built as a small structure around 1900 and enlarged about 1915. Flora remembered receiving her first Holy Communion in the Penitente oratorio about 1920 or 1921, when she was 12 or 13 years old, which would indicate a construction date before 1923. (3) The Penitente oratorio had been built by the Penitentes in the late 1800s and was in existence before Flora was born in 1908. Thus far, no corroborating information has been found for any of these dates, and no other interviewees knew for sure when the Penitente oratorio had been built. An educated guess might place the construction of this oratorio between 1890 and 1924.

Flora felt that the Penitentes built their own oratorio because the older García-Sisneros oratorio was attached to a family's house (on private land), and the brotherhood probably felt uncomfortable using it in the middle of the night, when they might disturb the family. Once they built their own oratorio on their own land, they were free to use it whenever they needed to do so.

The Penitente oratorio was an adobe structure built in the shape of a cross. The main entrance opened to the east and faced the road (Figs. 25.9 and 25.12). Another, smaller door, used only by the Penitentes and only during Holy Week, was on the south side, on the arm of the cross, or *crucero*). One small window on each long side wall (north and south walls) let a small amount of light into the whitewashed interior. A wood-burning stove sat roughly at the midpoint on the north wall with a wood box next to it. Constructed of wood and adobe, this oratorio had an earthen floor and a ceiling of vigas and latillas. It was covered by a flat roof. The vigas had been peeled with special knives but were not finely finished.

The altar, at the west end of the building in what could be called the top of the cross, consisted of a wooden table covered with a crocheted white cloth on which stood hand-carved, painted statues of St. Joseph and the Blessed Virgin Mary, the priest's chalice, pictures of saints, candles, and vases of flowers. On the altar stood St. Joseph, who was dressed in yellow, and Our Father Jesus, who was tall, dressed in purple, and had long, stringy, black human hair, and a strange, ugly mouth. Flora said it was unpleasant to behold. She didn't know the meaning of this unusual carved figure nor what had happened to these santos or others in the oratorio, nor to the large crucifix that hung on the wall above and to the right of the altar. As a child, she had first seen these objects inside the García-Sisneros oratorio. After it was torn down, she saw them again when they were safely ensconced in the Penitente oratorio. When the latter fell apart, the objects were removed to unknown locations.

In front of the altar table, at each end, was placed a wooden chair. The priest sat in one of these chairs when he came to offer mass, and an altar boy or assistant sat in the other. A triangular candelabra, which stood to the left of the altar in front of the communion rail, held candles that were placed there by people praying that a certain petition would be answered. (A petition was made to request help for a problem such as illness or drought.) If more candles were needed than the candelabra could accommodate, they would be lit and placed in holes in a wooden board on the dirt floor behind the communion rail. Other candles in holders on the walls were used to light the interior of the oratorio, usually for velorios held there at night. The Stations of the Cross, consisting of 14 small, painted wooden retablos, were also placed on the interior walls—seven on each side. These too, came from the older García-Sisneros oratorio after it was torn down.

Most people sat and knelt on the earth floor during mass. Flora could not recall any benches or chairs. Women brought blankets, spread them on the floor, sat and knelt on them, and put their babies to sleep on them. Non-Penitentes sat on the north (right) side of the oratorio; Penitentes sat and knelt on the south (left) side. A central aisle separated the two groups. When a group of women (wives of the Penitentes) were requested to sing for the mass, they stood in the crucero on the north or right side of the oratorio. The priest came to conduct mass in the oratorio only once or twice a year during Lent, always very early in the morning, according to Flora.

The oratorio also functioned as a chapel where services were held for Penitentes and others in the community. It was used constantly during Holy Week each year, and at other times as well. In May, local families prayed the rosary every day in the oratorio, had processions for the Blessed Virgin Mary, and held velorios. St. Joseph's Day was celebrated inside and in front of this structure every November 19. Easter processions commenced at the oratorio, passed through the outdoor stations of the cross, then returned to the oratorio. Velorios for deceased Penitentes and others were held in the oratorio or the individual's home the night before the funeral. The next day, the priest from El Rito came and conducted a funeral mass in the old church in Ojo Caliente before the burial in the Ojo Caliente cemetery.

No one could recall exactly when the Penitente oratorio was abandoned, fell into disrepair, and was dismantled. Flora Trujillo thought that it fell apart some time in the 1940s and was torn down then or in the early 1950s. Afterwards, the big room of the morada was used as an oratorio, where rosaries and the Stations of the Cross were prayed and velorios were held.

An unfinished three-sided cinderblock structure with no roof or east wall now stands on the site of the former Penitente oratorio, on the west side of U.S. 285, outside the right-of-way. For many years the two people living on either side of it claimed ownership: Flora's uncle, Max Archuleta, to the north; and Bob Smith, on the south. The former passed away, and the latter moved away. It is unclear whether ownership of the building was ever determined. Houses currently stand all around the location of the old Penitente oratorio.

Other Structures in the Vicinity of Gavilan and LA 105710

LA 105710 and the surrounding area constitute a region of cultural significance. For approximately 100 years it has been at the heart of many religious and social activities as well as some of the economic activities of residents of Gavilan and Ojo Caliente. Most religious and related social activity in Gavilan centered on the area that included the Penitente morada, near the north end of LA 105710, and the oratorio, adjacent to LA 105710 but across the road and a little to the south (Fig. 25.9). The Via Crucis and outdoor Stations of the Cross provided a connecting link between these two structures when they were most intensively used—during Lent and Holy Week each year. However, these were only a few of the significant structures that provided various kinds of support for this small, isolated, Hispanic community over the years. Flora Trujillo was kind enough to describe, and in some cases illustrate, several of these other structures and discuss their importance to the local community.

The García-Sisneros Oratorio

The García-Sisneros oratorio was approximately 0.34 mile (0.55 km) south of the Penitente oratorio in Gavilan, on the west side of U.S. 285 at the base of a steep dropoff outside project limits. According to Flora Trujillo, it was built before the Penitente oratorio, which replaced it. Even though the García-Sisneros Oratorio was a private, family oratorio, the Penitentes and others in the community always had permission to use it whenever they wanted to do so. Probably built after 1850 by Flora Trujillos's maternal great grandparents, Esquipula García and Manuelita de Vargas García, it was already in existence when Flora's mother, Debiliana, was born in 1878. Debiliana used to say that, as a young child, she had watched the Penitentes come with whips from the morada to her parents' oratorio to make visits during Holy Week each year.

This family oratorio was attached to the south end of Manuelita and Esquipula García's house on land they owned. It shared a common wall with their dining room; however, there was no entrance to the oratorio from their house. At the south end of the structure were several adobe steps which led up to the oratorio entrance. The wooden door was beautifully carved, possibly by Esquipula García. This long, rectangular, flat-roofed adobe building had a dirt floor and vigas and latillas for the ceiling. The vigas were huge, much larger than those later used to construct the ceiling in the Penitente oratorio. Also, the adobes in the García-Sisneros oratorio were about three times the size of those used today. According to Flora, adobes of unusual shape were made to fit into specific spaces. Some were thick on one end and thin on the other.

The García-Sisneros oratorio (Fig. 25.13) was not built in the shape of a cross like the later Penitente oratorio; rather, it consisted of just one long room, approximately 14 by 35 feet (4.3 by 10.7 m). Four windows, two on the east wall and two on the west, were covered with white curtains, which allowed the sun to flood the space with natural light. Flora stated that the interior, with its whitewashed walls, was pretty and clean, and she liked going there. Fourteen small retablos representing the Stations of the Cross were hung on the walls—seven on one long wall, and seven on the opposite wall. Number one was at the northwest end of the oratorio, closest to the altar. Number seven was at the southwest end, nearest the door, as was number eight, which was placed at the southeast end. Finally, number 14 was at the northeast corner, back near the altar. People made a counterclockwise circuit whenever they prayed the Stations of the Cross.

The altar was at the north end of this long room against the common wall. On the floor in front of it was a long board with regularly spaced holes. When people made petitions, they lit candles and placed them in this holder. The altar itself consisted of a wooden table covered with a lace-edged, embroidered altar cloth, upon which candles and a crucifix were placed. A large crucifix hung above. Also present were the two *bultos* mentioned earlier: St. Joseph, dressed in yellow, with a round face, a crown on his head, and a book in his hands; and Our Father Jesus, dressed in purple, with long, stringy, black human hair, and a deformed mouth. On either side of the altar stood a long, wooden table upon which stood St. Joseph, St. Jude, St. Anthony, and many other santos. When it was decided that the García-Sisneros oratorio would be torn down, the crucifixes, saints, and stations of the cross were removed and placed in the Penitente oratorio. Also, on each side of the altar stood a large triangular candelabra. In front of the altar was a communion rail with a gate in the center, so the priest could exit to give communion to those who could not walk. Usually, however, attendees knelt in a long line that formed against the communion rail, extending from both ends of the gate.

Flora could not recall whether or not there were benches inside this oratorio. If so, there were not very many—perhaps only four. Those who did not sit on a bench prayed and knelt on the cold dirt floor. Flora's family carried blankets and sat on the floor. When not filled with people, the oratorio interior was a large, open, empty space.

During Lent, the Stations of the Cross were prayed every Friday in the García-Sisneros oratorio. Velorios were held there every night during Holy Week. Usually the priest came from El Rito and held mass in this space once during the long Lenten period. Each year during May, the month of the Blessed Virgin Mary, the oratorio saw continual use—mostly by women, who said a rosary in Her honor every afternoon and every evening

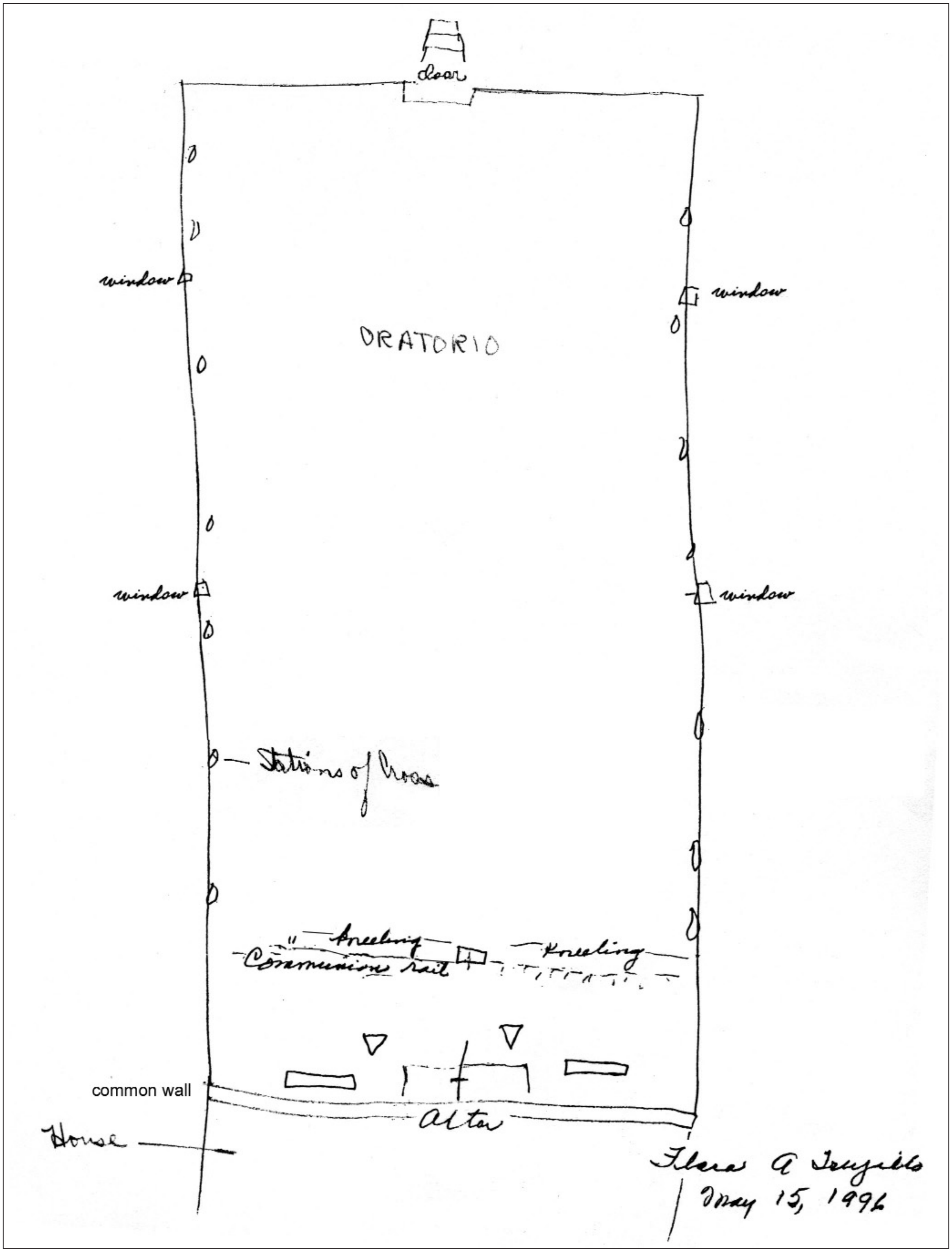


Figure 25.13. Adaptation of Flora Trujillo's 1996 sketch plan of the interior of the García-Sisneros oratorio at Gavilan.

after supper. The young girls kept the altar supplied with fresh flowers.

This García-Sisneros oratorio was also used when local residents passed away. The deceased was laid out and cared for in its large open space, and sung and prayed over all night during a velorio before the funeral the next day. According to Flora Trujillo, in about 1913 or 1914, a baby, the son of Juan and Simonita Trujillo, passed away in this oratorio and was buried inside the structure, under the floor. Flora, only five or six at the time, was not aware of this incident, but her mother told her about it later. Flora did not know which part of the floor the infant had been buried under.

The Penitentes were not responsible for the upkeep of this family oratorio. Rather, Flora's aunts and cousins used to do all the cleaning, painting, and the washing, starching, and ironing of the altar cloth, curtains, and so forth.

After the death of great-grandfather Esquipula García, Flora's great-grandmother, Manuelita, asked her daughter, Ascencionita, and the latter's husband, Cicilio Sisneros (Flora's grandparents) to come from El Rito to Gavilan and live with her. All she asked was that they bury her inside the old Ojo Caliente church, which they later did. In return she gave them all her property—her fields, the house, the oratorio—everything. This occurred in approximately 1891. All these structures had been built long before this time, but the exact date is unknown.

Flora thought that the family oratorio was torn down around 1924. She had discussed this with her younger brother, Juan Archuleta, before he passed away in 1998, and also with her brother, Willie. Both told Flora that they had stayed with Grandpa Sisneros in 1923 and 1924, and that the oratorio was "knocked down" during that time. Flora recalled that it was always in perfect condition and was a place she loved. However, over time, its upkeep became too much for the family to manage. More and more people wanted to use it for funerals and other occasions, and when they came for services, they parked their horses and buggies on the south side of the building, leaving a large quantity of horse droppings for the family to clean up the next day. Babies were often put to sleep in the family's beds, and since there were no diapers, the sheets often needed to be changed and washed, making extra work for the women. Flora's mother, Debiliana, and other family members did not enjoy these jobs, which became more and more frequent and unpleasant over time. Therefore, a decision was finally made to close and dismantle the oratorio. Many of the vigas and adobes were reused to build a house for her uncle, Anselmo, approximately 0.6 mile (1 km) to the north. The land where the oratorio formerly stood was leveled, according to Juan Archuleta, and a new house was later built there.

The García-Sisneros House

The García-Sisneros house was probably the first structure built on the family property, perhaps even before the mid-1800s. It first belonged to Esquipula and Manuelita García, later to their daughter Ascencionita and her husband, Cicilio Sisneros. Consisting of a series of long, narrow, connected rooms, it housed several parts of the extended family at various times in its history. Later, the oratorio was added and attached to one end of the house. In 1996, when discussing this combined structure, Flora showed it as L-shaped and oriented along an east-west axis. In 1998, when checking some of this information, she indicated that she had oriented it incorrectly in 1996 and redrew the structure, orienting it on a north-south axis, changing the positions of most of the rooms. Since the house and oratorio were torn down more than 60 years ago, it is hard to know which orientation was the correct one. Therefore descriptions and drawings of both are included.

In her 1996 drawing (Fig. 25.14), Flora Trujillo sketched the connected oratorio and house in a large L shape. The door to the oratorio was at the far west end. This long room stretched from west to east. Next came a common wall separating the oratorio from the house. The house included two rooms: a combination sleeping and living room east of the oratorio, and a kitchen to the east of the living room. At a common wall at the north end of the kitchen, the house turned into an L shape. This wall separated Ascencionita's house from the three-room home of her brother, Victor García. His portion of the house was oriented north-south. Victor's house included a large room used as a social hall, north of Ascencionita's kitchen. Next came his kitchen,

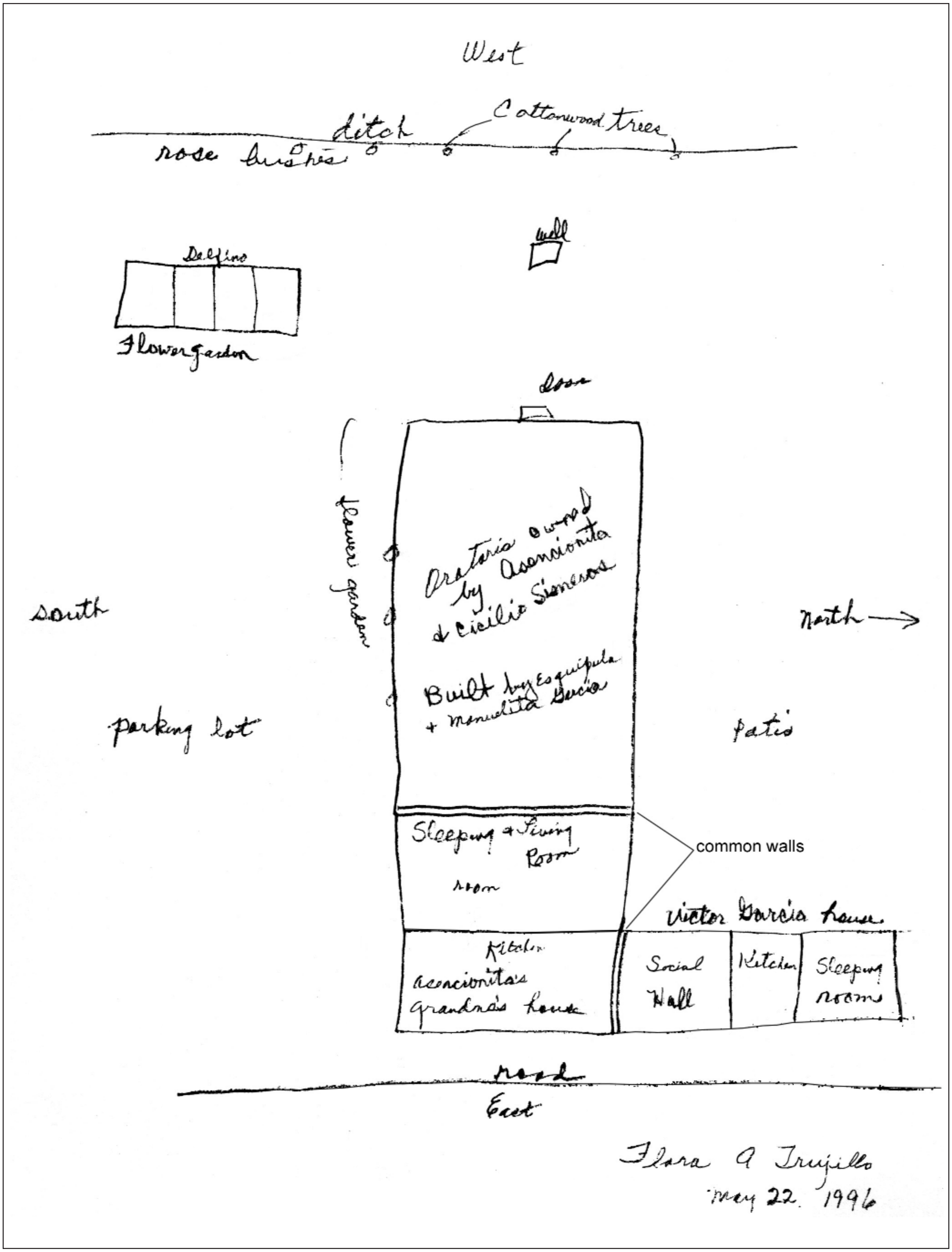


Figure 25.14. Adaptation of Flora Trujillo's 1996 sketch plan of the García-Sisneros house and oratorio at Gavilan.

and beyond it to the north was a sleeping room.

According to Flora's 1996 drawing, the road was just east of Victor's part of the house, and the parking area for people attending functions at the oratorio was south of that part of the structure. A patio was on the north side of Ascencionita's house, a well was to the west, just beyond the door of the oratorio, and a little further west was the acequia, lined with rosebushes and cottonwood trees. Southwest of the oratorio was a detached structure consisting of a group of four sleeping rooms, where a number of the unmarried sons slept.

In her 1998 drawing (Fig. 25.15), Flora changed the orientation of the García-Sisneros oratorio, house, and surrounding use-areas. The house was now oriented north-south and paralleled the road, which at that time was just to the east. The oratorio was the room farthest south, and its entrance was on the south. A common wall on the north separated the oratorio from Ascencionita's dining room. The rest of Ascencionita's five-room house formed an L in the center of the structure. Her kitchen was west of the dining room, with one sleeping room to the west of the kitchen. Two other sleeping rooms were built north of the first sleeping room, completing the L shape. Victor García's house extended north from a common wall with Ascencionita's dining room. So Ascencionita's dining room was sandwiched in between Victor's home on the north and the oratorio on the south. There were no interior doors connecting these three separate spaces. At the south end of Victor's house was a hall used for social dances, usually associated with weddings. Next to this room was a kitchen, and beyond it to the north was a sleeping room. The parking area was southeast of the oratorio, and the well was southwest. The patio was north of Victor's hall, and the ditch was south and west of the oratorio and house.

The oratorio was dismantled in 1923 or 1924. In 1945 the family tore down Victor's and Ascencionita's attached houses, leveled the land, and built a rectangular house with four rooms. The two rooms on the north side belonged to Flora's uncle, Antonio Sisneros, who later added two more rooms on the north end of his house. At the south end, two rooms were given to his daughter, Viola Sisneros. At some point she bought the rest of this house from other family members. It currently stands unoccupied, west of her own house and north of Flora Trujillo's house in Gavilan.

The Churches in Ojo Caliente

The old adobe church in Ojo Caliente, La Iglesia de Santa Cruz, dates officially from 1793. However, according to written accounts, it was in existence considerably earlier than this. As early as 1744, Father Miguel de Menchero mentioned the presence of 46 families and occasional visits from the priest at the Taos mission, which implies the presence of a church or chapel (Hackett 1937:399). A document dated 1751 states that the church and houses at Ojo Caliente were tumbled down (SANM 1753), so obviously a church had been built there before this date. Governor Mendinueta, after inspecting Ojo Caliente in 1769, ordered the chapel, houses, and plaza to be boarded up and abandoned (SANM 1769). Deliberately built into the side walls of this church were a number of small loopholes through which firearms could be discharged when defending against Indian attacks. Flora Trujillo's grandmother recalled running to the church for protection whenever an alarm was raised. It is not known if the chapel or church mentioned by these early writers is the same structure known in 1793 as the Ojo Caliente church. The 1793 church was refurbished in 1994 by a combination of local and nonlocal groups (Fig. 25.16). It is on the south side of NM 414, approximately 0.10 mile (0.16 km) west of its junction with U.S. 285.

According to Flora Trujillo, in 1945 a new church called St. Mary's was built directly west of the old 1793 church. While digging the new foundation, construction workers found coffins of people buried long ago. Apparently this land was part of a former cemetery in front of the old church. All the unearthed coffins were reburied, but Flora was not sure where. She thought that they were reburied near the old church or in the *camposanto* (cemetery) on the east side of U.S. 285, across from the new post office.

The Ojo Caliente Cemeteries

According to elderly interviewees, Ojo Caliente

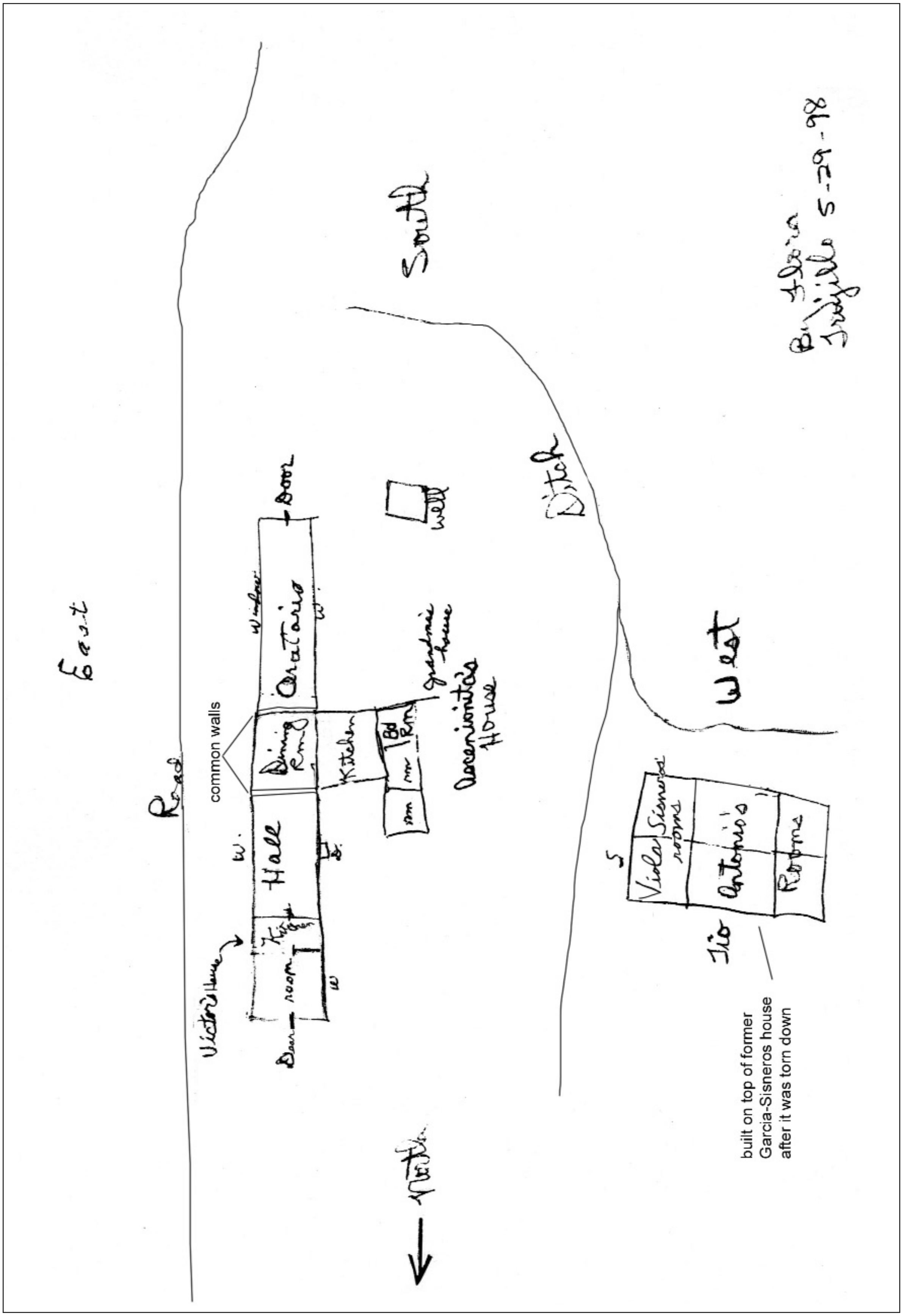


Figure 25.15. Adaptation of Flora Trujillo's 1998 sketch plan of the García-Sisneros house and oratorio at Gavilan.

Figure 25.16. The Church of Santa Cruz, Ojo Caliente, originally built in 1793, refurbished in 1994, and photographed in 1998. Note the loop (gun) holes in the church wall just below the shadow. Photo by Linda J. Goodman.

has had only two cemeteries since it was first settled. Early settlers were buried inside the old Ojo Caliente church or on land directly west of the church entrance. Flora Trujillo stated that long ago people were buried in and around the old church first, then when this space was filled, a new cemetery (which is still in use) was created farther away. Her great grandmother, Manuelita García, was probably one of the last to be buried inside the church, at a cost of $50 to the family (considered to be a large sum of money). Manuelita was the only one buried in the church at that time, because this practice had mostly ended by then. According to Flora, the burial ground in front of the old Ojo Caliente church was still being used as late as 1908, when a baby brother of Flora's mother, Debiliana, died and was buried there. This baby died the same year that Flora was born. Flora stated that all her relatives from her great-grandparents' time and earlier were buried in the church or the church yard.

Approximately 0.10 mile (0.16 km) south of the junction of NM 414 and U.S. 285, outside the right-of-way on the east side of U.S. 285, the current Ojo Caliente cemetery was placed a moderate distance away from established living areas. The exact date of its creation is not known; however, in his 1919 boundary survey of the Ojo Caliente Grant, Douglass (1922) noted its existence. Therefore, this cemetery was most likely established between 1908 and 1919. Flora recalled that her grandparents and all later relatives were buried in the newer cemetery. Currently it is the only one in use in the area.

Stores in the Ojo Caliente Region

The García brothers were not the only ones who owned stores in the area. There were quite a few other stores within roughly a 5 mi (8 km) radius. Some were quite small, others larger. Following is a brief description of several of these stores. Most of this information was provided by Flora Trujillo and supplemented by Fred Archuleta Jr.

and Ben Maestas.

The Lucero family, originally from Antonito, Colorado, set up, owned, and ran a large, well-stocked store in Ojo Caliente. They were good business people and did well financially. Since they had moved to Ojo Caliente many years earlier (before 1900) and had established large sheep farms in the area, they were considered a local family. In approximately 1900, Jesús Lucero built his first store on the west side of U.S. 285, about 1 mi (1.6 km) south of the junction with NM 414 on the outskirts of Ojo Caliente (in the area perhaps known as Gallegos). His livestock corrals were on the east side of the road. Sometime after 1930 he built a new store where his corrals had formerly stood, and later added a dance hall at the south end (Fig. 25.17). For an unknown period of time the dance hall also served as a meeting house for the SPMDTU (Sociedad Protetiva Mutual de Trabajadores Unidos). Flora Trujillo recalled that for many years community social dances were often held in the Lucero dance hall, also known as La Sala Grande. Jesús Lucero later added a small bar at the south end of the dance hall. Both the dance hall and bar have long been closed, though the structures still stand and are now part of the Oliver Vigil store, just north of LA 105713. The Lucero store carried a variety of dry goods as well as lamp oil, soap, canned goods, other foodstuffs, medicines, and hardware. This was a much larger store than either of the García brothers' stores, and the Luceros were able to extend credit to their customers.

After Jesús Lucero died in 1957, his son, Pete, ran the store for a few years, then sold it to Oliver Vigil's family in about 1965. Now called Oliver's store, it continues to be a viable business and is still owned by the Oliver Vigil family. According to daughter-in-law Helen Vigil, the family of Oliver Vigil Sr. bought this store and named it in honor of Oliver Vigil Jr., who had passed away a few years before its purchase. The Vigils, who are from El Rito, where they have extensive land and cattle holdings, are not considered local in the same way that the Luceros or the García brothers were. According to Flora Trujillo, they owned no land and had no family in the Ojo Caliente area. Their store, which today contains all types of

Figure 25.17. The former Lucero store (left), the dance hall (center), and the bar (right end of structure). All are now part of the Oliver Vigil store. Photo by Linda J. Goodman, 2000.

foodstuffs as well as a few dry goods and hardware items, continues to serve the local community. Gasoline can also be purchased there.

Another of the large, older stores in Ojo Caliente, the Carlos Hernández store, was located across the road from the old Ojo Caliente church. The Hernández store was also a general store built before 1908. The Hernández family moved to Ojo Caliente from Taos, and since they had neither land nor family in the area, they were not considered local. Flora did not know whether the Hernández or Lucero store was older, but she knew that both allowed people to buy on credit and that both families became wealthy. The Hernández store carried a variety of goods comparable to the Lucero's, and local residents used to frequent both for a variety of necessities. The Hernández store was eventually sold to the Wilson family, and in the recent past it was sold again. Now called the Mercantile at Ojo Caliente, it is still across from the church on the north side of NM 414 and sells an assortment of upscale clothing and art objects.

Another of the large, older stores was owned and run by Flora's paternal granduncle, Santana López—a local man who owned a great deal of land in the area and raised many cattle. López built a house with an attached general store, grocery store, and liquor store on a piece of land south of the present Church of Saint Mary in Ojo Caliente. This store, too, was probably in existence before 1908. Santana was a good man who always worked hard for what he had. In 1913, however, he died in a tragic accident when hauling barrels of liquor to his store in a wagon. He left a wife and five children. His widow remarried a few years later. Her second husband sold the store as well as all the land and cattle shortly thereafter, which eventually left the family in poverty. Currently, neither the store nor the house exists.

Two other small stores, comparable to those of Candido and Manuel García, were owned and run by another pair of local brothers—Rosinaldo and Vicente Archuleta, first cousins of Flora Trujillo (their fathers were brothers—Elías Archuleta and Juan Antonio Archuleta, respectively). The Archuleta stores were built in front of their parents' house in an area known by the locals as South Ojo Caliente. This small community, called Duranes on the Ojo Caliente topographic quadrangle, is approximately 1 mile (1.6 km) north of Gavilan. The stores were on opposite sides of a narrow dirt road which begins 0.2 mi (0.32 km) south of Milepost 351 on U.S. 285 and runs west and then south, roughly parallel with U.S. 285, approximately 0.1 mi (0.16 km) west of it. On the west side of this dirt road Rosinaldo sold groceries and liquor in his small store, while Vicente, on the east side, sold groceries, gasoline, and candy to the school children. The small South Ojo Caliente Post Office, which was housed inside Vicente's store, served Duranes and Gavilan from approximately 1962 through 1969. Its window and awning overhang were still visible on the exterior west wall at the north end of the store in 1998.

According to Flora Trujillo, the Archuleta brothers were in fierce competition with each other and had little contact. It is thought that they opened their stores around 1940, a few years after the García brothers closed their stores in Gavilan. Rosinaldo closed his store about 1950 and moved to Los Gatos, California, where he remained until he passed away in 1991. His store has been torn down. Vicente moved his store across to the west side of the dirt road sometime after 1969, and a faded sign above it still reads, "V. Archuleta." He ran this small store (without the post office) until just a few years before his death in 1993 or 1994. Both of Vicente's stores, whitewashed and with pitched metal roofs, are still standing very near the dirt road, but they are deserted and deteriorating (Figs. 25.18 and 25.19).

Another small local store existed on the west side of the Ojo Caliente River, in the southwest corner of the building that formerly housed the hotel at the Ojo Caliente Mineral Springs Resort. This was the second hotel built on this spot. The first was destroyed by fire in the 1890s. The Fareses family ran this operation when Flora was young, and she recalled that people used to cross the river on a little wooden bridge to pick up their mail there. This store no longer exists, and Flora did not know when it closed.

Yet another small store, originally built by José Vargas later than the store at the mineral springs hotel, still exists on the west side of U.S. 285 about 0.9 mi (1.5 km) south of the junction of N.M. 414 and U.S. 285. Gasoline as well as a variety of foodstuffs are sold in this store, which is now owned by Marcellina Herrera.

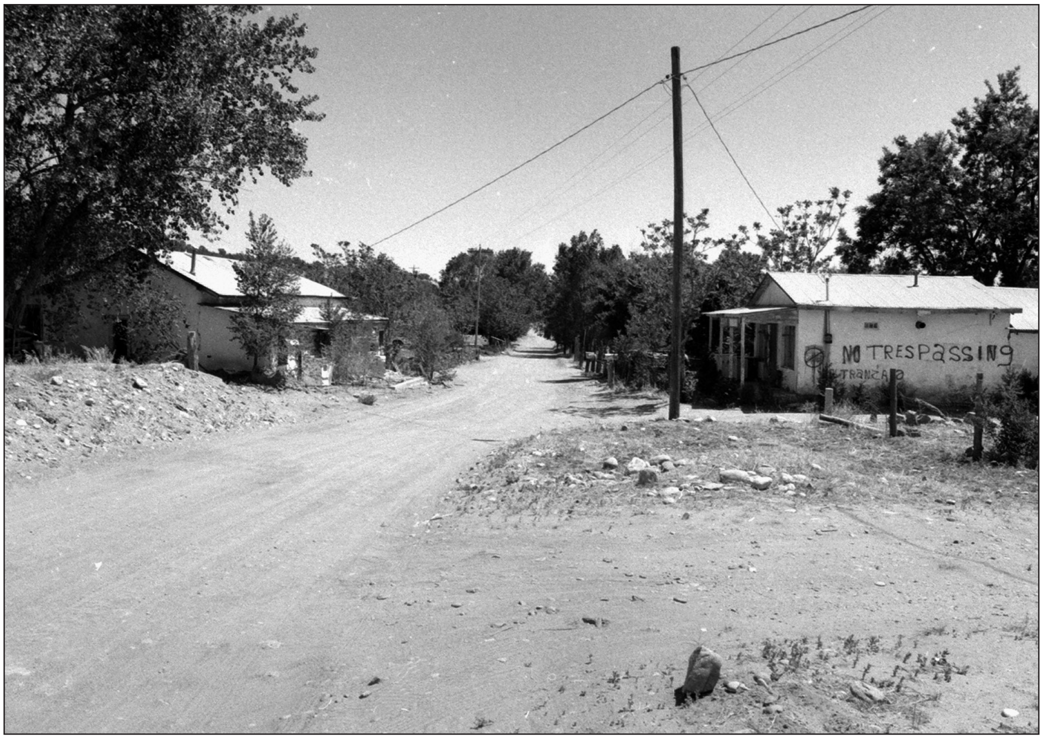


Figure 25.18. The two stores formerly owned by Vicente Archuleta, beside the dirt road in South Ojo Caliente, looking south. Photo by Linda J. Goodman, 1998.

Figure 25.19. Vicente Archuleta's store, on the west side of the dirt road in South Ojo Caliente. Photo by Linda J. Goodman, 2000.

Certain goods were not carried at any of the stores in the Ojo Caliente area, and local people traveled to the big store at San Juan Pueblo (run by Parker Wells's father, according to Flora) or the large Bond store in Española. Both of these establishments were much larger and carried more interesting and unusual items than the stores around Ojo Caliente. Children enjoyed occasional family trips to these more distant stores.

It is clear from this brief examination of stores in the Ojo Caliente area that many families hoped to supplement their incomes by this means. The owners of the larger stores carried many types of goods and extended credit to their customers. All of these families prospered. The owners of the numerous small stores did not fare as well. Because it was difficult to keep the doors open and the shelves stocked, these stores were often quite short-lived, or were run on the proverbial shoestring. Today, only three stores continue to coexist: Oliver's, the Herrera store, and the Mercantile at Ojo Caliente. The others have all closed.

Dance Halls

Dances were the high point of social life in Ojo Caliente and Gavilan for many years and were well attended by the local and sometimes regional communities. On these occasions people visited, ate piñons, danced, flirted, and enjoyed themselves. Often the public programs held on July 4 or Shrove Tuesday also took place in one of the local dance halls because no other space was large enough to hold a crowd.

Dances were held frequently because many religious holidays and celebrations ended with this pleasant social activity. As a result, several dance halls sprang up in the area. Although dates and exact locations are not available, Flora Trujillo spoke briefly about the dance halls she recalled. The first belonged to Felix Archuleta and was known as Felix's Dance Hall. It was near the present Herrera store (close to Flora's mother's former house) on the north side of Ojo Caliente, west of U.S. 285. Dances were often held here for weddings, on New Year's, Holy Saturday before Easter, and July 4 celebrations. Eventually this hall was sold to Jesús González, and he remodeled it into a house with a number of rooms for his large family. By this time Jesús Lucero had built a dance hall behind his store (probably in the early 1940s), and it became the main dance hall in the area (Fig. 25.17).

Victor García's little hall, adjacent to the García-Sisneros oratorio, was often used for dances specifically associated with weddings. It generally was not used for other types of social dances. Another dance hall, south of Flora's land on the west side of U.S. 285 (adjacent to Arthur Rodarte's land), was used for social dances connected with St. Joseph's Day on November 19 each year. St. Joseph's Day activities and the associated social dance ended after this dance hall unexpectedly collapsed (date unknown). These four halls were the only ones Flora recalled. All have been closed for many years, and the only one still standing is the former Lucero dance hall.

Religious Activities and Annual Holidays Occurring at or near LA 105710

LA 105710 and nearby sites to the south and west of it were all part of one large culture use-area and provided space for activities that were essential for the psychological and religious well-being of the families living in the vicinity. When the Gavilan morada and oratorios were in use, the Penitente Brotherhood governed essentially all of the religious life in the area. Some activities took place indoors; others occurred outdoors. Certain events were open to the entire community, while others, for Penitente members only, were held in secret.

New Year's Celebrations

New Year's celebrations had no religious overtones. According to Flora Trujillo, on December 31 a big dance was held at the Lucero dance hall. A much-loved social event, it was attended by almost everyone in the community, including entire families, old ladies, and babies. It began about 8:00 or 9:00 PM on December 31 and ended sometime after midnight on January 1. A group of local musicians provided lively guitar and fiddle music for the dancers.

When the dance ended, the women and children returned to their homes. The men, however, gathered as a group and went from house to house in the village, serenading, and in return receiving food and drink at each stop. The women made empanaditas, biscochitos, candy, and lots of other good food. They served pots of steaming posole, fresh sopaipillas, and chile. The men usually did not eat too much since they brought their own whiskey and proceeded to get more and more drunk as they moved from house to house. They were "singing in the New Year," performing songs called Versos de Nuevo Año, which were sung to every member of the house. In their repertoire were songs such as "Esta Mañana," always sung to the accompaniment of guitar and fiddle. (Tio Polito Alire played violin; Abel Ribera played guitar. One of the best singers was Alejandrino Velásquez.) According to Flora Trujillo, "In those days everyone had time to enjoy life together" (Goodman Field Notes, 1996).

Shrove Tuesday, Ash Wednesday, and Lent

A series of secular celebrations were held on Shrove Tuesday each year. In the morning, flag-carrying members of the SPMDTU led a parade in which musicians played the national anthem. They rode in a buggy and played guitar and violin. After lunch, people arrived at the designated dance hall, where a public program for the community was held. This might include several speakers and/or a previously prepared program put on by one of the school classes. Following the afternoon program, visitors from other communities were invited to houses of local families for dinner. At night a dance, which lasted from 8 PM to midnight, was held at one of the dance halls. People came from all the surrounding communities—Española, La Madera, El Rito, Taos, and others—for this enjoyable social occasion.

By the following morning (Ash Wednesday), however, the entire tone had changed. There were no more celebrations. Lent was a quiet, contemplative time. Some people began a period of fasting on Ash Wednesday and also prayed the Stations of the Cross. Some fasted throughout this period, others only for the last several days of Holy Week. No one ate meat on Fridays. In this case, fasting meant no food or drink in the morning. There was plenty of food at noon, however, and a small amount at night. Therefore, fasting in this manner was not a hard penance.

During the 46 days of Lent each year, processions and visitations by the Penitentes occurred frequently, many of them in private. The Brotherhood held velorios in their oratorio every Friday night. Generally this was a serious time when people were supposed to remember Jesus and how he died on the cross.

Flora Trujillo recalled a Lenten service she and her mother attended inside the morada when she was young:

> At three in the afternoon they rang a little bell to let people know that it was time to come in to pray. So we went in and we knelt wherever we wanted. And after all the people were in, the Penitentes started coming in, in a line. The singers would be the first ones to come in—they would come in singing. Everyone stood up until the hymn was finished. And afterwards they knelt down and started praying the usual prayers for such an occasion. The praying and the singing of alabados would last for about an hour and a half. . . . Then, after they were finished, the Penitentes would thank the people for coming to pray with them. The people would leave and the Penitentes would remain in the morada. (Goodman Field Notes, 1996).

Holy Week and Easter

A number of sacred activities took place during Holy Week, preceding Easter. During this time the Gavilan Penitentes traveled to other villages for visitas, and members from other villages came to Gavilan for the same purpose. On Wednesday, Thursday, and Friday of Easter week the Gavilan Penitentes held a number of processions, some of which involved whipping and other penitential activities undertaken by designated members. Flora Trujillo remembered that when she was small, she and her family used to go to her half-brother Ned Archuleta's house, near the Penitente oratorio, to watch these processions (Fig. 25.9). Most local people who were not participating gathered at appropriate times and places to watch. During processions where whipping occurred, the Penitentes wore black cloths over their heads and faces so they could not be recognized as their blood flowed freely. At times the processions involved men carrying large crosses, a man who played a pito, several who sang, and another who played the matraca. These processions might go from the morada to the oratorio, from the oratorio to the morada, or sometimes to the Calvario. After the processions were over for that day, the Penitentes returned to and remained inside the morada, where their wives or other non-Penitente members of the community brought them hot food for supper.

Flora stated that everyone worked on Monday and Tuesday of Holy Week to be ready for the events of Wednesday, Thursday, and Friday. The women cleaned house and cooked large quantities of food. The men chopped wood and did other necessary tasks. No one worked on Wednesday, Thursday, and Friday; rather, they were expected to spend their time praying. Everyone over the age of 13 was also supposed to fast on those three days; they were not to eat or drink in the morning. Flora and her family fasted as required (they did not eat breakfast) and waited in great anticipation for the big noon meal. All kinds of special foods were prepared for this occasion: calabacitas, torte de huevo, chile colorado, beans, posole, panoche, pumpkin pies, apple pies, and many other dishes.

The entire community participated in praying the outdoor Stations of the Cross on Wednesday, Thursday, and Friday afternoons of Holy Week. Beginning about 3:00 PM, the Penitente men led the procession and sang the first verse of an alabado as they walked to the first Station of the Cross. Here they knelt and prayed and had a recitation. Then they began singing the next verse of the alabado as they walked to the next station. (Two outstanding local singers frequently in attendance were Polito Alire and Arturo Pacheco.) Participants sang a different verse as they walked to each station, often accompanied by flute, drum, and matraca. Non-Penitentes followed behind them. After completing the fourteenth Station of the Cross, the group returned to the oratorio, where they finished their prayers and sang more alabados. The Penitentes then departed for the morada, and everyone else returned to their respective homes.

After dinner every Friday night during Lent and on Wednesday, Thursday, and Friday nights of Holy Week, a velorio was held at the Penitente oratorio. The community gathered from about 7 to 10 PM to pray and sing, sometimes in the presence of Penitentes who whipped themselves or did other penance in fulfillment of personal vows. These vows, prayers, and penitent acts were performed for a variety of reasons, for example, to aid relatives, to improve or maintain health, to bring good weather, to bring rain, or to help find a job.

According to Flora Trujillo, the Tinieblas ceremony, organized and run by the Penitentes, took place in the Penitente oratorio late on Friday night of Holy Week after the conclusion of the velorio. Members of the Brotherhood were the first to enter the oratorio at the appointed time, followed by men and women of the community who had been given permission to attend. When she was a teenager, Flora and several of her girlfriends attended the Tinieblas ceremony just once. She first noted that many candles were lit in three places: in the tall triangular candle holder at the front of the oratorio, in a long row across the floor in front of the altar, and in each of the wall candle holders along the sides of the oratorio. Alabados were sung, and at the proper time one of the Penitentes began extinguishing the candles, one by one. All the while, the singing continued. Finally, when all the candles were out, the oratorio was enveloped in total darkness. More Penitentes entered. Flora's description bears strong resemblance to that of Marta Weigle (1976). Weird noises and screams began. Big drums were beaten, matracas were sounded, whistles blew, noise and commotion swirled around everyone in the dark. Someone might try to pull a person's coat off, something might pull on a person's leg or their foot, sometimes the women's' hair was pulled—all in complete darkness. It was unnerving. After a certain period of time passed, the appointed person began lighting the candles again, slowly, one by one. As light returned to the oratorio, all the noise and abnormal happenings stopped, and things returned to a more normal state. Flora said that she and her friends left before the Tinieblas was completed because they did not like being there—it was very uncomfortable. They told the doorkeeper that one of their friends was fainting and felt sick, so the doorkeeper let them out. They never attended another of these ceremonies (Goodman Field Notes, 1998).

The only event that occurred on Holy Saturday was the Blessing of the Water. Flora's three youngest brothers filled large buckets with water and placed them in the church in El Rito, beside all the other water troughs and containers to be blessed by the priest. Afterwards, the brothers brought their buckets home, used some of this special water to bless the house, then gave some to neighbors so they could bless their houses as well. On Saturday night, upon conclusion of the religious activities connected with Holy Week, a big social dance was held at the large Lucero dance hall.

On Easter Sunday everything was quiet. Penitente activities were concluded for another year. Some families went to El Rito to attend mass at the church, others stayed home. There were no services in the Ojo Caliente church. Easter itself was anticlimactic following the preceding Holy Week activities.

May—Month of the Blessed Virgin Mary

Every evening during May after the day's work was done, the women and children gathered in the García-Sisneros oratorio, lit candles, and placed flowers on the altar, then prayed the rosary and sang hymns in honor of the Blessed Virgin Mary. Attractive white flowers called *flores de mayo* grew everywhere in abundance at this time of year. Young girls delighted in picking these flowers and placing them on the altar along with fresh lilacs and apple blossoms. After the García-Sisneros oratorio was torn down, the women held this service in the Penitente oratorio each May. According to Flora Trujillo, her aunt, Elena Sánchez García, and the latter's daughter each had wonderful voices and did much of the singing. They alternated performing the solo parts on different evenings, while the group of women responded as a chorus.

After the rosary was completed each evening, the children in attendance went to their mothers and aunts to receive blessings from them. These blessings came from the Blessed Virgin Mary through the adult women to strengthen the children. This ceremony probably ended in the 1930s.

May 31—Women's Velorio

On May 31 of each year the women of the area gathered at the Penitente oratorio for a service held about 1:00 PM. First they prayed and sang in honor of the Blessed Virgin Mary. Then every woman took one of the many santos housed there and carried it in a procession from the oratorio to Arroyo de los Valdezes on the north, then down by the Ojo Caliente River as far south as Arroyo Pula. From there, the women made their way back to the road and north to the Penitente oratorio. After returning the santos to their proper places in this chapel, the women went home for dinner. In the evening they returned to the Penitente oratorio and held a velorio that continued for a number of hours. During this time the women offered prayers to the saints, prayed the rosary, and sang hymns until they ended their "watch" at midnight.

Other Velorios

A velorio (from *velar*, to watch or keep vigil over) involves the offering of prayers for a specific situation: for someone who is ill or has died, for the saints during the month of the Blessed Virgin Mary, for a particular saint at certain times of the year, for someone who has a special request or need, and so forth. For example, one year when Flora was a young woman, there had been a terrible drought, and all the crops were drying up and dying. The women felt they had to do something, so in June they held a velorio. First, during the day, they had a procession in which they carried the saints to the arroyo, the river, and back. At night they held a velorio in the Penitente oratorio. They prayed and sang until midnight. About 10:00 PM it began to rain. It rained all night, and the drought was ended. In those days everyone believed in the power of the velorio—it was like a miracle. Now, according to Flora, no one would hold a velorio for this purpose, and no one would believe that it could work.

A velorio was almost always held when someone died. In the past, these "watches" continued for many hours—sometimes all night. People prayed, kept watch, and at times sang alabados for the deceased. Now, at least in the vicinity of Ojo Caliente and Gavilan, this is no longer the case. Such occasions are not even called *velorios* anymore. Presently, a regular service lasting one or two hours in the evening is held at the mortuary for the deceased person.

First Communion

First communion was the culmination of a period of religious education for children in the community. Flora Trujillo recalled her own. Before she and several other children her age (about 12 or 13) could receive their first communion, much preparation, study, and memorizing were necessary. The priest from El Rito, Father José Pajol, came on the appointed evening to the Penitente house of Julian Rivera. There he conducted examinations of the students who wished to receive their first communion. He quizzed them relentlessly. Those who knew their prayers and gave correct answers to his questions passed his exam and were allowed to take communion the next day. A few others were not so lucky.

The morning following the examination everyone went to the service—Sunday Mass—which was held in the Penitente oratorio and was conducted by the priest. The girls wore new white dresses and carried white candles. All the children who passed their exams took their first communion. The singing was done only by the Penitente men. There were blessings from both sets of grandparents, and afterwards, each family held a feast at home to honor the child who had received his or her first communion. Often, friends, neighbors, and relatives were invited. Flora said that she expected something unusual or wonderful to happen when she took her first communion, but nothing ever did.

July 4 Celebrations

The Fourth of July was a much loved secular holiday celebrated every year in Ojo Caliente and Gavilan. In the morning, people arrived from the surrounding region in buggies and wagons, ready for a big parade with flags, music, and firecrackers. The parade started at the Lucero dance hall and went to the Ojo Caliente springs, then turned and went as far as the arroyo on the south, then turned again and proceeded north, back to the dance hall. (A procession also took this path on Shrove Tuesday.) About 1:00 PM an hour-long program featured special speakers and was most often held in the SPMDTU hall. SPMDTU members organized the July 4 celebrations. The audience sat on benches in the hall while the men who were members of this organization made a circle in the middle and sang hymns. After the speeches, those in attendance proceeded to the Lucero dance hall, where dancing lasted until about 8:00 PM. Participants then went home for dinner, changed into good clothes, and returned to the hall, where they danced all night. Violins, guitars, and sometimes an accordion provided the music. People came from many of the surrounding villages to attend this enjoyable social occasion.

August 15—Day of the Blessed Virgin Mary

The Day of the Blessed Virgin Mary is a relatively new celebration in Ojo Caliente. It began during World War II, when the community built the Church of St. Mary (ca. 1942). Upon completion of the new structure, a feast was prepared on August 15 to celebrate the grand opening—a celebration that has been repeated every year since. First, a low mass without a choir was held about 6:00 PM. Afterwards the women of the community brought large quantities of home-cooked food, which they placed on a series of long tables either outside or inside the old high school gym. Everyone came to eat, visit, listen to the music (guitar and fiddle), and have a good time. Money acquired from the food purchases was used to maintain the church. Over the last few years, however, the priest from El Rito has shown little interest in continuing this celebration, and it has lapsed.

All Soul's Day—November 1

All Soul's Day was not a major holiday. There were no dances or major feasts. A mass was celebrated in the morning at the Penitente oratorio or in the church. Local people who attended wrote down the names of their deceased relatives so the priest could pray for them. Confession and Holy Communion also took place on this day, and people made donations in honor of their deceased relatives. In the afternoon people stayed home from work and prayed, or else visited friends. This was a quiet, contemplative day.

St. Joseph's Day—November 19

On the calendar of saint's days, St. Joseph's Day occurred on March 19 each year; however, since this day often comes during Lent, the holiday was moved to November 19 so it could be celebrated properly. Far in advance, people began to prepare for this holiday. In the summer they cleaned their yards, planted flowers and vegetables, cleaned their houses, replastered, and painted. Some worked in the Colorado beet, bean, and vegetable fields to have enough money to participate (Goodman Field Notes, 1996).

Friends and relatives who were invited often came a day early, on November 18, to participate in various activities and spend the night. They usually arrived around noon and ate lunch with their host family. Late in the afternoon, the priest from El Rito conducted vespers in the Penitente oratorio. Afterwards, in front of the oratorio, the Matachines danced to music played by local musicians. Following this performance, visitors from surrounding villages were invited to the homes of local residents for dinner. That night, a big dance was held at the little dance hall in Gavilan, about 1/4 mi south of Flora Trujillo's present house, beside the highway, near the land that today belongs to Arthur Rodarte's family. There was no official name for this dance hall.

On the morning of November 19, the Penitente oratorio was packed with people attending mass. Afterwards, the Matachines appeared again and danced for about an hour in front of the oratorio. Spanish musicians came from the area around San Juan Pueblo to play for the Matachines; however, the violin player, Torivio López, was from Ojo Caliente. All of the Matachines dancers were from the local area, and the adult men were members of the Society of St. Joseph. Some were Penitentes as well, but this was not a requirement. The Monarca (king), the principal figure, wore an elaborate headdress and costume, and carried a three-pronged trident in his right hand. The man selected was usually a fine dancer. The Malinche was a little girl from the community who was willing to learn to dance this role. She wore a long white dress and had a wreath around her long hair. The Torito (little bull) was played by a small boy wearing an animal skin and horns. An older man, roughly dressed, who wore an ugly mask and carried a whip, was the Abuelo (grandfather), much feared because he used his whip on anyone who misbehaved. At the end of the dance, he killed and castrated the bull (Champe 1983:7–16; Goodman Field Notes, 1996, 2000).

When the Matachines concluded their dance, lunch was in order. All the houses were open, and guests were welcome anywhere they wished to go. Afterwards, everyone rushed off to the dance hall, where they had danced and socialized the previous night. At the end of the day, community members and their visitors retired to their respective houses for supper, changed into more festive clothes, and returned to the dance, which lasted until about 1:00 AM.

In communities such as Gavilan, dances were the preferred form of social entertainment. Almost everyone loved to dance, and residents and visitors alike especially relished the dances connected with St. Joseph's Day. There was always live music, often performed by local musicians who played guitar and fiddle. Included were many square dances, polkas, and waltzes, as well as other types of dances. Girls usually made new dresses for this greatly anticipated social occasion. Young men who came from the surrounding communities, anxious to see which girls would attend. This was a time for courting. Some romances deepened over time, and a number of marriages resulted from the St. Joseph's Day activities.

Even though St. Joseph's Day was a mixture of religious and social activities, it was not an old holiday. When Flora was a child, there had been no celebration at all on this day in Ojo Caliente and Gavilan. The celebration started in the early 1920s, but it is not known who started it or why. Unfortunately, the St. Joseph's Day celebration was short-lived. It disappeared about 1940, when, according to Flora Trujillo, the dance hall collapsed.

Christmas

Christmas in Ojo Caliente and Gavilan was a very quiet day. There were no church services or other special activities. Since most of the local population was poor, there was little to be given in the way of gifts. If possible, parents tried to give one practical gift to each of their children. Sometimes they would give a shirt, a pair of shoes, or even a little money. There was no elaborate gift giving.

Instead of staying home to celebrate Christmas, some families, Flora Trujillo's included, went to San Juan Pueblo to spend time with Indian friends. The Spanish family usually arrived at the pueblo on Christmas Eve and went to the house of friends, where they stayed until almost midnight. Then the families attended a series of three masses together: Midnight Mass; the Mass at Dawn; and Christmas Morning Mass, held about 9:00 AM. Between these masses they found a little time to eat and sleep. On Christmas day they watched Indian dances at the pueblo, shared a large midday meal with their friends, and made the return trip home to Ojo Caliente or Gavilan in the late afternoon. This was an enjoyable time for both the Spanish settlers in the region and the Pueblo Indians because it offered all of them an opportunity to visit, renew acquaintances and friendships, and catch up on the past year's events and news.

Answers to Questions Originally Posed in the Data Recovery Plan

A series of questions relating to the historic structures on LA 105710 were posed as part of the original data recovery plan (Wiseman and Ware 1996:62–64). Though most of these questions have been answered in the body of this report, each is summarized here. Research Issues 1–6 concern prehistoric sites and are addressed elsewhere.

Research Issue 7: Construction Details and Dating of the Morada

According to interviewees the morada was constructed of adobes and hand-hewn wooden beams. It had a flat earthen roof, an earthen floor, windows with small glass panes, and a large corner fireplace. Between 1948 and 1952 some repair and remodeling work occurred. At this time the one large interior room may have been remodeled into two rooms, and instead of just one window, three separate windows may have been placed in the west wall. A pitched metal roof was put on, but a severe wind and thunderstorm soon followed, which blew the new roof off. The metal was divided up and used by various Penitente families, and a flat roof was put on once again. According to Flora Trujillo, corner buttresses were most likely part of the later repair work, not an original feature of the morada,.

A specific date for construction of the Penitente morada in Gavilan is not available, and no written records have been found. Elderly residents did not know when it was built. The only substantive information was provided by Flora Trujillo, who stated that her mother, Debiliana Sisneros Archuleta, knew that the morada had been built before she (Debiliana) was born in 1878. As a young girl, Debiliana recalled watching the Penitentes go from the morada to the García-Sisneros oratorio and was told by her elders that both the morada and oratorio were built before she was born. The Penitentes established themselves in northern New Mexico sometime between 1797 and 1833 (Steele and Rivera 1985:3); however, it is not known when the Ojo Caliente/Gavilan chapter was founded. Based on Debiliana Archuleta's information, however, it appears that La Morada de Nuestro Padre Jesús in Gavilan existed in 1878, and it may have been built between 1850 and 1870.

Research Issue 8: Internal Organization of the Morada

Two lifelong residents of Gavilan remember different interior features of this morada. It is possible that Flora Trujillo, who is 26 years older than Ben Gallegos, recalled the morada from the time before it was remodeled, when it had only one room, and that he remembered it from the time after it was remodeled, when it had two rooms. This could explain the discrepancies in their recollections. (Refer to their descriptions, presented earlier, and Fig. 25.10).

Research Issue 9: Location and Construction Details of the Calvario

No active Penitentes remain in Gavilan. The elders living there in the late 1990s discussed among themselves the location of the Calvario. They knew it was on one of two hills—the hill to the east and slightly south of the morada or, more likely, the hill to the northeast of the morada, where Hilltop Pueblo sits. Most people were fairly certain that the latter was correct. They also stated that an old wagon road once crossed the land north of the morada and went to the top of the ridge to the east, and that the Penitentes formerly walked up this road to the Calvario. Long ago, however, this road became a deep arroyo. No permanent structures were ever built as part of the Calvario, and no construction was involved in creating it.

Research Issue 10: Location and Organization of the Via Crucis

The Via Crucis (and exterior Stations of the Cross) were on LA 105710, on land south and slightly west of the morada, west of the Archuleta animal pens and corrals, and east of the highway. This sacred area was reestablished temporarily during Holy Week each year, when small wooden crosses representing the Stations of the Cross were placed in a particular pattern between the Penitente oratorio and morada (see Figs. 25.9 and 25.11).

Research Issue 11: Oratorios

Two oratorios formerly existed in Gavilan. The first, a family oratorio, was built by Flora Trujillo's great-grandparents, Esquipula García and his wife, Manuelita de Vargas García, sometime before 1878, perhaps ca. 1850–70. This oratorio was attached to the existing family house, which was approximately 1/3 mi (0.55 km) south of LA 105710 on the west side of the road. The Penitente oratorio was probably built later on a piece of land donated by Flora Trujillo's maternal grandmother, Ascencionita García Sisneros. It was directly west of LA 105710, across the highway. Flora Trujillo could not remember when this oratorio was built and gave three possible dates: before 1900; in the early 1900s: or in 1924, when the García-Sisneros oratorio was torn down. No precise date exists since no one else in the community knew when it was constructed, and there are no written records. It is possible that this oratorio was built between 1890 and 1924, and that it was dismantled in the late 1940s or early 1950s (see Figs. 25.12 and 25.13).

Research Issue 12: Construction Details and Interior Organization of the Store

Flora Trujillo said that there had been two small stores across the road from each other, operated by the García brothers, who were her cousins. In about 1931 Candido García built and began operating his small one-room store at the south end of LA 105710, on the east side of U.S. 285. On the west side of the highway just across from Candido's store, his brother, Manuel García, also built and operated a small one-room store at about the same time. The brothers were in fierce competition with each other. Neither store was very successful, and both closed in about 1937 (see Figs. 25.6 and 25.7).

Research Issue 13: Specific Types of Goods Sold and Their Points of Origin

The García brothers sold basic staples, canned goods, and sacks of dry foods such as flour, sugar, pinto beans, potatoes, and coffee at their stores. They did not sell specialty items, clothing, or hardware. Manuel had a gas pump and sold gasoline; Candido did not. The elders of Gavilan had no idea where the brothers bought the items they sold, nor did they know any of their business arrangements. In general, the Garcías did not sell local produce in their stores; the foodstuffs they carried were acquired elsewhere. These stores had little impact on the surrounding community. Local people were largely self-sufficient, raising their own livestock, fruits, and vegetables. When necessary, families did the majority of their shopping at the larger stores in Ojo Caliente, San Juan Pueblo, or Española. Later, after both Garcías had closed their little stores along the highway, Manuel turned one room of his house into a small store and for many years sold his own ground chile there as well as a few other foodstuffs and necessities.

Research Issue 14: Social Dynamics of the García Store

According to Gavilan elders, the García brothers did not take unfair advantage of their customers. They were related to everyone in Gavilan and were well liked in the community. Their little stores never made them rich; they always remained at the same economic level as most of the residents of Gavilan. The families of both brothers survived principally by farming and raising livestock, not by being store owners. These stores were never large enough and never turned enough profit to be of much financial benefit to the families. Therefore they do not fit into the exploitation and usury pattern suggested by Kutsche and Van Ness (1981:18, 137). However, there were a number of other stores in the Ojo Caliente area that were larger and quite profitable for their families. These stores extended credit to their customers, and the owners sometimes acquired parcels of land as payment for debts. Concepts relating to merchants, their practices, and acquisition of wealth (Kutsche and Van Ness 1981; Swadesh 1974:26–27, 59) are relevant to some of the larger stores in the area.

LA 105710 and Its Relation to Sociocultural Events in the Ojo Caliente/Gavilan Area

For 100 to 150 years (early to mid-1800s to 1970s), the Hispanic community of Gavilan/Ojo Caliente used a number of structures on and surrounding LA 105710 for a variety of economic and religious purposes. This area can be called a local Hispanic region of cultural significance. Religious activities were important to many members of this strongly Catholic community, and since there was no resident priest to sponsor and support religious undertakings, Gavilan, and especially LA 105710, became the center of ceremonial activity for the area. The land was donated by members of the García and Archuleta families. About 4 mi (6.4 km) south of Ojo Caliente, this locale became a focal point for Penitente and non-Penitente religious activities conducted by local residents. In days past, Gavilan, a fairly isolated area, was ideal for Penitentes, who shunned public exposure of their rituals and ceremonies. Thus, the Penitente morada, the external Stations of the Cross and the Via Crucis, the Calvario, the Penitente oratorio, and the García-Sisneros oratorio were built or placed on LA 105710 and the surrounding land. No other place in Ojo Caliente or Gavilan contained such a cluster of religious structures and activity areas, which drew together most of the local, and part of the regional. population a number of times each year.

Many other northern New Mexican Hispanic villages built similar types of structures for essentially the same reasons. Without a resident priest, the local population found it necessary to develop their own institutions and activities to meet their immediate religious and social needs. Thus, the Penitente Brotherhood and a variety of moradas, the Via Crucis, the Stations of the Cross, Calvarios, and oratorios sprang up in or near small villages throughout the region. Most were placed at a distance from the official Catholic church. According to Pratt and Snow (1988:259), "after 1850, when penitent rites became a spectacle for the curious, moradas began to be located in more remote areas in order to avoid observation." Chapels were generally placed to the west of the church (Pratt and Snow 1988:259). This was true in the case of both the García-Sisneros oratorio and the Penitente oratorio in Gavilan—both were south and west of the morada. Pratt and Snow (1988:259) indicated that in the smaller moradas, most functions were performed in one room. This fits with Flora Trujillo's statement that there was only one large room in the Penitente morada, where she attended various services. Ben Gallegos, 26 years younger, stated that he recalled two rooms, and that the oratorio was a small room at the south end of the structure. This would be a variation on the more traditional pattern, but certainly possible, especially since the morada was remodeled. Although undocumented in the published literature, it is clear from oral interviews that the residents of Gavilan and Ojo Caliente built, maintained, and used a complete Penitente religious complex, all of which was at or near LA 105710.

Secular activities which fit the typical northern New Mexican subsistence pattern—essentially an agricultural and pastoral way of life—were also reflected by structures on LA 105710. Several sheets from the 1939 highway construction plans showed that many (though not all) families in this area placed their animal pens and corrals on the east side of the highway at the edge of the ejido (NMSHTD 1939). These families built their houses and acequias on the west side of the road, with agricultural fields and orchards between the house and the Ojo Caliente River, farther to the west. This pattern was evident at LA 105710 in the presence of a shed, wood piles, animal pens, and corrals. All were placed on the east side of the road at the edge of the ejido. Residences of the García and Archuleta families, who owned a portion of LA 105710 and much of the land south and west of it, were on the west side of the road, as were their fields, orchards, ditches, and wells. An organizational plan such as this could not work successfully until the danger of Indian raids in the area had subsided. So, even though there are no exact dates, this type of land use and placement of structures and activity areas undoubtedly developed after the threat from nomadic tribes had largely abated. Once the threat of outside attacks was eliminated, it made good sense to separate livestock from the agricultural fields and living areas, and it allowed for ease of movement of livestock to different ranges as necessitated by the changing seasons and climatic conditions each year. Thus the pattern here, as elsewhere, was a practical one: to keep the animals as close as possible to good pasture land and maximize the use of irrigated land for agricultural purposes.

Considering the location of agricultural land, it is reasonable to ask why both oratorios were on the west side of the highway, while the morada, Via Crucis, and Calvario were on the east side. One would think that placing the oratorios on the east side of the highway would free more land for agricultural use. In this case, however, specific circumstances probably determined otherwise. The earlier García-Sisneros oratorio was built as an attachment to a previously existing house on the west side of the road. It was a fairly common practice for a family home to have its own chapel. Therefore, the addition of this chapel to the García house made sense, since one existing wall could be used in the new construction. The men of the family then had to build only three additional walls and a roof to create another functional room.

According to Flora Trujillo, the Penitente oratorio, probably constructed later than the García-Sisneros oratorio, was built on land donated for this purpose by her maternal grandmother, Ascencionita García Sisneros. It is not known why she donated this particular piece of land, but her gift certainly explains the presence of this oratorio on the west side of the highway.

The presence of the Penitente morada, Via Crucis, and Calvario on the east side of the road might be explained by the fact that they were placed on land considered to be ejido—land which belonged to everybody and nobody—which was not part of the valuable agricultural acreage. Since the Penitentes kept most of their activities separate and often secret, it was ideal to locate these special areas away from normal living spaces. Flora Trujillo stated that the morada was on land north of that which belonged to her paternal grandparents, Juan Antonio and Faustina Archuleta. She did not know whether they or anyone else had ever legally owned this land. The Via Crucis and external Stations of the Cross appeared on a temporary basis on Juan Antonio and Faustina Archuleta's land during Holy Week each year, to the west of their animal pens and corrals on the east side of the road. Spaced between the Penitente oratorio and morada, the Archuleta land was ideally situated for the placement of the Via Crucis and Stations of the Cross. The Calvario, involving no construction at all, was most likely on top of the hill northeast of the morada near the ruins of Hilltop Pueblo, because it was isolated from daily activities and habitation areas, yet fairly close to the Penitente morada.

Evidence of another type of economic endeavor was also identified at LA 105710. The presence of a small, single-room store near the south end of the site was an indicator of one type of mercantile activity that occurred in northern New Mexico. Two small, short-lived stores belonging to Candido García on the east side of the road and Manuel García on the west side of the road fit into a larger pattern of local stores scattered throughout the region. Owners of numerous small stores hoped to supplement their meager agricultural incomes and provide better lives for their families. Owners of larger stores, often with more economic resources at hand, were more focused on turning their establishments into successful business ventures. In reality, the larger stores, with more stock and the ability to extend credit to customers, tended to survive, while most (but not all) of the little stores struggled valiantly for a few years, then ceased to exist.

Thus, LA 105710 and the surrounding area supported essential religious and economic activities in the community. The location was convenient and practical for residents of Gavilan. However, as economic and also religious circumstances changed over time, so did the use of the various structures and activity areas. People moved away to seek better jobs or join the war effort. Livestock and agriculture became less desirable pursuits, and eventually there was no need for corrals, pens, and sheds. On the religious front, as the Catholic Church became stronger in the region and the priest from El Rito came many Sundays to hold mass in St. Mary's Church in Ojo Caliente, most of the Penitente activities that had taken place at LA 105710 and in the surrounding area fell out of favor and gradually disappeared. There is no longer an active Penitente brotherhood in the Ojo Caliente and Gavilan region. Today this community, with its unique Hispanic culture, is losing its sense of history and strong religious ties and is slowly becoming gentrified as Anglo outsiders move into the area. Formerly a vital and central part of the community, LA 105710 is now entirely devoid of structures and activities. Some houses still exist on parcels of land surrounding this site, but the Penitente activities, the associated social occasions, and the agricultural, pastoral, and mercantile way of life are largely gone. A casual glance as one drives by this area would never reveal all that has transpired on this land in the past.

Note

1. C. M. García was Candido M. García, Flora Archuleta Trujillo's cousin; "Juan C. García" was probably Juan A. García, Flora's maternal uncle. There was no other Juan García who owned land in the area at that time. Juan Archuleta was undoubtedly Juan Antonio Archuleta, Flora's paternal grandfather, who also owned land in the area at this time.

Now closed and empty, this structure served as the first post office (date unknown) in Ojo Caliente. Photo by Linda J. Goodman, 2000.

Individuals Interviewed and Consulted about Gavilan and LA 105710

Fred Archuleta Jr. (1926–). Nephew of Flora Trujillo, mayordomo of the Gavilan acequia. Fred lives across the highway from the Gavilan morada. He grew up in Gavilan and moved to California as a young man but returned to Gavilan over 20 years ago. As a young person he acquired considerable knowledge of the area.

Eloisa Baca (1911–99). Lifelong resident of Gavilan, she was a first cousin of Flora Trujillo and wife of Pedro Baca, a Gavilan Penitente. Eloisa had knowledge of various aspects of Penitente life and activities.

Benjamin Gallegos (1934–). Son of a Gavilan Penitente, Ben became an assistant who aided the Penitentes in the years before the Gavilan chapter closed. He is knowledgeable about some aspects of Penitente activities as well as the morada, Calvario, and Penitente oratorio.

Ben Maestas (1928–). Nephew of Manuel García. Born in Salida, Colorado, from the age of four he spent summers in Gavilan with his uncle and aunt. He is knowledgeable about his uncle's little store, some aspects of life in Gavilan, and the history of New Mexico.

Felipe Ortega (1953–). A lifelong resident of La Madera, New Mexico, and friend of several people in Gavilan. Some members of his family are Penitentes, and he is knowledgeable about some aspects of the Gavilan morada.

Flora Trujillo (1908–2004). Former schoolteacher and lifelong resident of Gavilan and Ojo Caliente. She has extensive knowledge of the area, the people, and the religious structures as well as excellent recall of past history, events, and activities.

Helen Vigil (age unknown, approximately mid to late forties). Married into the Oliver Vigil family. Lives in El Rito, works at Oliver's store in Ojo Caliente. She has knowledge and background information concerning the Oliver Vigil store.

Chapter 26. LA 105710 in the Gavilan Community: Synthesis of Ethnohistoric and Archaeological Information

Jeffrey L. Boyer

In the data recovery plan for this project (Wiseman and Ware 1996), a series of eight research issues were posed regarding the historic components of LA 105710. Issues 7 through 11 focused on the Penitente morada and associated structures and features, while Issues 12 through 14 focused on the Candido García store and its role in the Gavilan community. The research issues recognize two important aspects of data recovery at LA 105710:

1. The historic structures and other features at LA 105710 are not isolated features in the Rio Ojo Caliente Valley. Rather, they are integral features of the Gavilan community. Their presence and locations help identify the community (see Steele 1983), and they should be considered in that light. Goodman's research (Chapter 25) supports this perspective by showing not only the interrelationships of the structures and features at and surrounding LA 105710, but also their roles in the Gavilan community.

2. Data from LA 105710 and its constituent features was recovered largely through ethnohistorical rather than archaeological means, primarily because most of the features were outside project limits and so were not subjected to excavations. Only the Candido García store was actually available for excavation, and, as discussed in Chapter 14, the data recovery plan assumed that excavations would not reveal significant information. Chapters 14 and 21 show that such was not the case. Although the remains of the morada building were not excavated, archaeological observations were made that can be used to expand or clarify ethnohistorical data.

This chapter examines both the archaeological information presented in Chapters 14 and 21 and the ethnohistorical information presented in Chapter 25, in light of the research issues defined for LA 105710.

THE GAVILAN MORADA

Research Issue 7: Dating the Morada

Initial construction. No archaeological data is available concerning initial construction of the morada building. No documentary evidence was found that would date its construction, and informants were not sure of its construction date. However, there is ethnohistorical evidence that the morada was built before 1878, and Goodman (Chapter 25) speculates that construction took place between 1850 and 1870.

Structural remodeling. Archaeological evidence of remodeling consists of cement plaster on the exterior of the building's walls, buttresses at each corner of the building, and ceramic flue pipe fragments at and near the building's northwest corner. In Chapter 14, we suggested that these factors point to remodeling after World War II. Goodman's informants stated that the morada was repaired and remodeled between about 1948 and 1952. Specifically, one informant stated that the buttresses dated to this period. Although she did not mention the cement plaster, it certainly postdates the buttresses, which were built with adobe mortar but covered with cement plaster.

There was no observable evidence of the pitched metal roof or the extra windows that, according to informants, were installed in the late 1940s or early 1950s. Goodman's informants stated that the original window and the new windows were in the building's west wall. Demolition of the west wall to remove the windows, as described by the informants, may explain why the building's west wall was reduced to a low mound, while portions of the east wall remained at the time of our investigations. It is possible that installation of the ceramic flue pipe coincided with construction of the new roof.

Characteristics of the morada generally fit architectural criteria proposed by Bunting et al.

(1983), who identified three periods of morada construction. The informant described the building as originally having a flat roof supported by hand-hewn beams, an earthen floor, a single window with small panes, and a f*ogón* (corner fireplace), matching the description by Bunting et al. (1983:43–46) of "early period" (pre-1900) moradas. Likewise, the ca.-1950 renovations described by informants largely match the description of "middle" (1900–1940) and "late" (post-1940) moradas. Particularly, Bunting et al. (1983:45–46) state that corrugated metal roofing dated after 1920 in most cases, and that windows installed between the two world wars were wooden, factory-made, multipane windows. After World War II, metal casement windows were available; because renovation of the Gavilan morada took place not long after World War II, wooden multipane windows may have been more readily available than metal casement windows, particularly in this relatively remote area.

Bunting et al. (1983:40) also state, "The only source of heat in early times, of course, was the fireplace (*fogón*). Later, when iron stoves became available, they were preferred because of their greater efficiency, and in some instances the old *fogón* was removed." Iron stoves were, apparently, most common during the "middle" (1900–1940) period. While the fogón in the Gavilan morada was not removed in the ca.-1950 renovations, it was probably remodeled, including installation of ceramic flue pipe.

Research Issue 8: Internal Organization of the Morada

Two informants identified the large fogón in the northwest corner of the building, matching the location of the ceramic flue pipe fragments observed at the structure. The older informant remembered one large room, while the younger remembered two rooms. The large room, according to the younger informant, may have been divided into two rooms in the early to mid 1940s so that the smaller, southern room could be used as an oratorio. Given that the renovations identified by both informants occurred around 1950, division of the building into two rooms probably also took place at that time. There was no observable evidence for division of the single large room into two rooms, suggesting that the dividing wall was not built of adobe bricks. If it was, in fact, built in the 1940s, it may have been made of milled lumber. Bunting et al. (1983:38–39) state that single-room morada buildings are the exception; they apparently occur only when the oratorio is a separate building.

There was no observable evidence of the locations of other features within the morada building as described by informants. However, those features were impermanent and portable (see Research Issue 11, below), so their presence might not be evident, even had excavation taken place.

Research Issue 9: Location and Construction Details of the Calvario

Informants stated that the Calvario—the location of the large cross or crosses at the end of a short pilgrimage route used during Holy Week and sometimes associated with the Via Crucis (Way of the Cross)—was on a hilltop above (to the east of) the morada building. They could not concur on which hilltop, but most agreed that the Calvario was on the hill near (or at) Hilltop Pueblo (LA 66288). Apparently, no structure or other construction was associated with the Calvario (Chapter 25); there was no observable evidence of the Calvario on either hill (Chapters 6 and 14).

Goodman's informants also stated that an "old wagon road" climbed the hill north of the morada and was used for access to the Calvario. According to the informants, erosion turned the road into an arroyo. Figure 6.1 shows an abandoned two-track road climbing the slope of the hill south and west of Hilltop Pueblo. There was no indication that the dredged arroyo immediately north of the morada was originally a road, although that possibility cannot be ruled out. Still, it seems possible that the abandoned road shown in Figure 6.1 was the one used for access to the Calvario, and that informants confused it with the arroyo. If so, then the road may have been abandoned when the morada was abandoned and dismantled in the late 1960s or early 1970s.

Research Issue 10: Location and Organization of the Via Crucis

Informants placed the Via Crucis in the area south and west of the morada (Chapter 25). Although the Via Crucis often connects the morada to the Calvario (Bunting et al. [1983:37] state this is always the case), this pattern seems to have characterized situations in which the morada meeting house also contained the oratorio. At Gavilan, two oratorios were located southwest of the morada building, and the Via Crucis was placed between the morada and the oratorios. There was no archaeological evidence of the Via Crucis, because, as Goodman's informants stated, there were no permanent features or markers of the Via Crucis, and the 14 Stations of the Cross were temporarily reestablished each year during Holy Week.

Research Issue 11: Oratorios

Informants identified the locations of two oratorios in Gavilan; both were southwest of the morada on the west side of the highway (Chapter 25). The older oratorio was built by the García family at the family house before 1878; apparently, its construction was approximately contemporaneous with that of the morada. The younger oratorio, known locally as the Penitente oratorio, was apparently built later, after about 1890 and perhaps as recently as 1924, when the older García-Sisneros oratorio was to be torn down. According to informants, the Penitente oratorio was probably torn down in the late 1940s or early 1950s; that date would make its dismantling approximately contemporaneous with renovations to the morada that included division of the original single-room building into two rooms, one of which was then used as an oratorio. After the renovations to the morada building, the Stations of the Cross were apparently kept in the morada rather than being set up outside for the Via Crucis. This may have been because the access route up the hill to the Calvario was not conducive to use as the Via Crucis, since it had not been designed for that purpose originally.

Regarding the oratorio, which they also call the oratory or the chapel, Bunting et al. (1983:39) state,

> The most important room in a morada, the oratorio, is subject to the greatest architectural variation. If several types of building materials have been used in the construction of a particular morada, the one considered the finest will be used for the chapel . . . where a difference exists, the chapel is the more finished or better constructed.

Examination of the descriptions in Chapter 25 of the morada building and the two oratorios, provided by Goodman's informants, supports this observation. The description of the morada building is relatively simple. before the ca.-1950 renovations, it was a single large room with an earthen floor, a flat roof supported by vigas, one plain wooden door, one small window, and a fogón in the northwest corner. All other interior features were portable: oil lamps or candles, benches, wooden tables for food and an altar, santos, and retablos. During renovation, a pitched roof was constructed of milled lumber and corrugated metal, three windows were installed in the west wall, the fogón was remodeled, and the single room was divided, probably by a milled-lumber wall. With the dismantling of the second oratorio, there were, apparently, more santos, retablos, and other ceremonial items in the morada, including the Stations of the Cross; all of these were, however, still impermanently installed and portable.

The simplicity of the morada building contrasts with descriptions of the García-Sisneros and Penitente oratorios (Chapter 25). The García-Sisneros oratorio was attached to the García house but had its own entrance (see Steele 9183:39). The single wooden door was elaborately carved. The flat roof was supported by "huge" vigas, and the walls were built of oversized adobe bricks. The structure's east and west walls each had two windows that were covered with white curtains. The interior walls were whitewashed, and the 14 retablos portraying the Stations of the Cross were hung on the two long walls. The altar consisted of a wooden table covered with a lace-edged, embroidered cloth. One wooden candelabra was on either side of the altar; in front of the altar were a wooden-board candle-holder and a communion rail. Numerous santos, bultos, and retablos were present.

The Penitente oratorio, built and maintained by members of the morada (unlike the privately owned but community-used García-Sisneros oratorio), was built in the shape of a cross. It had two doors, one used only by the Penitentes during Holy Week, and vigas that had been "peeled with a special knife." Most of the portable features that had been in the García-Sisneros oratorio were moved to or replicated in the Penitente oratorio when the former was closed—the altar table and cloth, the santos, bultos, and retablos, candelabra, communion rail, and the 14 Stations of the Cross.

Descriptions of the morada and the oratorios in Gavilan support the distinctions made by Bunting et al. (1983) and the observation that the structures and associated nonstructural features were integrated parts of the Gavilan community. None of them can be understood individually.

Discussion

Steele (1983:295) makes the following observation about Spanish settlement on the New Mexican frontier:

> Because the Spanish came into New Mexico with their religion already formed and because they were not as space-oriented as [the region's Native inhabitants], they found it impossible to employ the same means of integrating the locales in which they now lived into their scheme of things. They had come into the middle of a world of things unknown. First of all, there was no continuity with the former world they had known in Mexico, for the new foundation of 1598 was separated by hundreds of miles from the former extent of European control. Second, the various portions of the colony were separated from one another by the topographical divisions of the terrain.

In order to accommodate this frontier situation, and with a need to identify themselves in space and in time and to connect themselves with other Spanish Europeans, Spanish New Mexicans utilized two means of assigning place-names: intrinsic and extrinsic denomination (Steele 1983:299). The former assigns a place-name based on descriptive, historic, or ethnographic characteristics of the location. Two examples relevant to this project are Gavilan and Ojo Caliente. Steele (1983:299) argues that "intrinsic denominations would give the group bestowing and using the name a sense of comprehension of the place they inhabit." As discussed in Chapter 14, we do not know whether the community name "Gavilan" was adapted by Spanish settlers from a Tewa name for the area.

Extrinsic denomination assigns place-names after other places, such as a city in Mexico or Spain, or for a Catholic saint. In so doing, a connection is made between settlers living in an unfamiliar land and a land with which they are familiar: "If the new settlers of an area do not reach for the intrinsic intelligibility of a place and encapsulate it in a name, they can at least import some intelligibility from outside and bring it to bear on the place in question" (Steele 1983:299). This point is particularly important for Spanish Catholic settlers in isolated frontier circumstances because "in New Mexico the villages, one by one, were centered and inserted in the sacred calendar by naming the chapel and in many cases the village itself with the name of a sacred personage" (Steele 1983:300; see also Van Ness 1979:26). Steele (1983:300) goes on to assert that

> the name of the chapel served as a designation of identity; the space of the village received its most profound and universal validation in the name of the saint. Since . . . the Spanish attribute primacy to time rather than to space, the main function of the name of the saint is to tie the chapel and the village and the people into the liturgical cycle of the Roman Catholic church.

In turn, the liturgical cycle links people who are co-participants in "the wider Spanish and Catholic world" (Steele 1983:300) but are isolated from each other, in the same "universal" time-frame calendar, to maintain unity and continuity among widely separated groups of Spanish Catholics.

The factor of isolation presented a problem. Annual fiestas in honor of patron saints provided each community with ritual participation in the liturgical calendar. But as Steele (1983:301) pointed out,

> The lunar-solar cycle that brings Lent, Holy Week, and Easter each year keys the central

> common Christian feast, and on these holiest of days, only the parish centers would have enjoyed the full priestly rituals. For this special time of the year, each village without a priest would have had to manufacture a ceremony of its own.

It is in that context, Steele (1983:301) contends, that "the *Hermanos penitentes* kept New Mexico in the Christian-European orbit of religion and culture." That is, along with their social functions in their isolated communities (Chapter 25; Weigle 1976; Kutsche and Gallegos 1979), the Penitentes provided their communities with a critical ritual connection to the rest of the Spanish Catholic world during the common holy season of Lent, Holy Week, and Easter, and, in so doing, provided continuity of Spanish Catholic identity, spatially and temporally. This was important both in the face of frontier conditions of population separation from other groups and from critical church functions, and during events and periods of social change: "Perhaps of greater significance was the fact that La Fraternidad remained a fortress of cultural identity when the Hispanic settlers and natives were faced with Indian incursions and later with the more culturally destructive forces of the dominant Anglo-American society" (Bunting et al. 1983:32).

Bunting et al. (1983:32) state, "Brothers' religious views were not necessarily espoused but certainly acknowledged by all members of Hispano village society as part of their cultural heritage." Although not all members of the Gavilan community participated in or even supported the local Penitente organization and its activities, social and ritual (Linda Goodman, personal communication, 2003), the prominence of the Penitentes and their structural and nonstructural features is not disputed. Examination of the Gavilan morada reinforces this perspective (Chapter 25).

The Candido García Store

Research Issue 12: Construction Details and Internal Organization of the Store

Descriptions of the Candido García store obtained from Goodman's informant (Chapter 25) and from archaeological excavations (Chapter 14) are essentially similar, although each provides details not supplied by the other. The informant remembered that Candido's store was a small, one-room structure with a cement-and-rock foundation, in contrast to his brother Manuel's store, also a small, one-room structure, but with a foundation of mud and rock. Excavation of Candido's store revealed a small, one-room structure represented by a rectangular foundation, three sides of which were made of concrete poured on a footer of large cobbles. The fourth, western, foundation was simply a footer of large cobbles. Although excavations showed that the northern and southern walls extended past the western wall, perhaps supporting a portal along the building's western side, Goodman's informant did not mention such a feature.

Goodman's informant did recall that the building's walls were constructed of adobe bricks. Although no bricks were found on the wall foundations during excavation—an observation explained by the informant's statement that the structure was dismantled after its abandonment—brick fragments were encountered in the fill. The interior wall surfaces had been covered with adobe plaster and a single coat of whitewash plaster; the single layer of whitewash supports informant statements that the store was in use for only a few years.

Goodman's informant also stated that the store had a "lumber" floor. Excavation revealed no evidence of a wooden floor and suggested that the structure's floor was packed earth, based on artifacts on what appeared to be a hard, earthen surface. Of course, if a wooden floor had been removed during structural dismantling, any items left in the building at that time or deposited there later would be found on the dirt below the former floor. However, Williamson's analysis (Chapter 21) shows that of 98 nails and nail fragments that could be identified by type, only 1 is a flooring nail, and only 13 others are box or common nails that could have been used to construct a wooden floor.

Likewise, no archaeological evidence of a corrugated metal roof was found, as described by the informant. However, numerous small and large fragments of "tar paper" roofing felt were found, inside and outside the structure. Within the structure, tar paper fragments were found on the "floor" and in all three fill strata but were least common in Stratum 1, the melted adobe plaster and brick material found immediately above the "floor," and most common in Strata 2 and 3, the colluvial and eolian sediments. Outside the structure, tar paper fragments were found in all excavation levels below the modern ground surface. The ubiquitous presence of tar paper fragments suggests that the structure's roof was covered with tar paper, which was torn and scattered when the structure was dismantled. Williamson's analysis (Chapter 21) also shows that, of the 98 identifiable nails, 73 (74.5 percent) are roofing nails. Under these circumstances, it seems likely that the 13 box and common nails, and perhaps many of the indeterminate nail fragments, were used in construction of the roof, rather than a wooden floor. The scarcity of asphalt roofing tar adhering to tar paper fragments (only seven pieces of tar were recovered) shows that the roof was not coated with roofing tar, which may support the informant's memory of a corrugated metal roof.

Excavation confirmed the informant's recollection that the structure had a door in its western wall. The informant also remembered a single window but was not sure whether it was in the northern or eastern wall. Window-glass fragments were most common within the structure on the "floor" near the southern wall, suggesting that the window was in the southern wall (Chapter 14). However, since the structure was completely dismantled, it is quite possible that the pane or panes in the window were broken and discarded, and that their archaeological locations did not reflect their location in a structure wall.

Excavations revealed no clear evidence of the internal features described by Goodman's informant: a counter along the east wall, shelves along the north wall, and a wood-burning stove and wood box in the southeast corner. Still, as Williamson (Chapter 21) points out, the fire bricks and other bricks and brick fragments could have been associated with the stove or the shelves, and several thin mica fragments may have come from the stove.

An interesting and enigmatic issue is raised by the light bulb base, possible bulb glass fragments, connector base, and copper wire fragments recovered during excavation (Chapter 21). They suggest that the building was wired for electricity, but Goodman's informant denied this, stating that the store was lit by a single kerosene lamp. Although we were not able to determine with certainty when electricity came to Ojo Caliente, it was probably not available before World War II, since the Kit Carson Electric Cooperative, which serves Taos County and parts of Rio Arriba County, was formed in 1944, and the Jemez Mountains Electric Cooperative, which serves most of Rio Arriba County, was formed in 1948, the year that electricity came to the La Madera area, north of Ojo Caliente (Pringle 1993:77). Since the store had been abandoned for about a decade by that time, it is unlikely that it had electricity, and the electrical artifacts were probably introduced at a later date.

Research Issue 13: Specific Types of Goods Sold and Their Points of Origin

Goodman (Chapter 25) summarizes informant information about items and goods sold by Candido García and his brother Manuel as follows:

> The Garcia brothers sold basic staples, canned goods, and sacks of dry goods such as flour, sugar, pinto beans, potatoes, and coffee at their stores. They did not sell specialty items, clothing, or hardware. Manuel had a gas pump and sold gasoline; Candido did not. The elders of Gavilan had no idea where the brothers bought the items they sold nor did they know any of their business arrangements. In general, the Garcias did not sell local produce in their stores; the foodstuffs they carried were acquired elsewhere.

Of 1,623 Euroamerican artifacts recovered from the Candido García store, 349 (21.5 percent) could not be identified by function (Chapter 21). Most of them (n = 322; 92.3 percent) are can and bottle fragments, and many of the latter represent modern road trash. The remaining 1,274 artifacts can be assigned to eight function categories. Of those, most (n = 1,157; 91.1 percent) are in the construction/maintenance category and would not be related to items for sale at the store. Of the remaining 117 artifacts, 27 (23.1 percent) are probably or certainly older than the store. They include a (possible) ink bottle base, an amethyst glass bottle finish, a sardine can fragment, a meat can fragment, a Ford automobile circuit breaker, a ceramic button, three shell buttons, three bullet slugs, and 15 bullet cases. Twelve items (10.8 percent), a tobacco tin and eleven artifacts in the indulgences category (see Chapter 21), are younger than the store. Thirteen items (11.1 percent) are unlike those described by informants as available at the store; they include two automobile parts, a saddle concho, a harness ring, two fragments of a pressed-glass vessel, a white ware sherd, two children's shoes and an infant shoe, a clothing snap, a stocking supporter, and a brooch. The two children's shoes are worn and had been repaired. Williamson (Chapter 21) notes that the other personal effects items were also worn. In addition, a few glass artifacts could not be identified but may have been fragments from an internally lit glass sign. There is no indication from informant data that the store had a sign, and the absence of electricity probably precludes that possibility (Chapter 21).

Besides artifacts unlikely to represent items for sale in Candido García's store, we are left with 27 artifacts that could have been associated with the commercial aspect of the store. They include 20 canning jar lids and sealer bands, one pint-jar lid, five candy wrapper fragments, and a 1935 New Mexico tax token. Williamson (Chapter 21) suggests that the presence of so many canning jar sealer lids and bands, combined with the absence of canning jars and identifiable jar sherds, may indicate that the store sold supplies to local people who canned their own foodstuffs. That might also account for the pint-jar lid. Goodman's informant (Chapter 25) included candy among items sold by García, which could account for the candy wrapper fragments recovered during excavation. Williamson (Chapter 21) does note that some fragments were burned.

The 1935 tax token is the only artifact that clearly dates to the years of the store's use. As Williamson (Chapter 21) notes, while the token is classified as a personal effects artifact, it properly reflects the common use of those tokens as money. This probably confirms the association of the token with the store, making it the only artifact recovered during excavations that can be securely associated with the store as a commercial establishment.

It is also important to note Williamson's observation that, of the artifacts for which condition was recorded, 47.4 percent showed evidence of burning. Since so few artifacts can be potentially associated with items sold at the store, while almost half the artifacts were apparently burned, it seems likely that the artifact assemblage represents three depositional situations:

1. The construction/maintenance artifacts, which comprise over 70 percent of the assemblage, largely reflect items used in construction of the building and were deposited in and around the building when it was dismantled. The probable exceptions are the electrical artifacts.

2. Most of the other artifacts were deposited during episodes of trash disposal after the building was dismantled. This would account for the frequency of burned artifacts and the worn conditions of other artifacts, as well as artifacts that are older or younger than the store and items not likely to have been available at the store, given ethnographic information.

3. Only the tax token can probably be associated with the store. The canning jar sealer lids and bands, the pint-jar lid, and the candy wrappers could represent items for sale at the store.

Research Issue 14: Social Dynamics of the García Store

The research design for this project focuses Research Issue 14 on an observation by Kutsche and Van Ness (1981:18, 137) that "entrepreneurial activities in rural northern New Mexican villages could cause social disruptions" (Wiseman and Ware 1996:64). Succinctly, these disruptions stem from

> a general belief among rural northern New Mexicans that store owners take advantage of their customers through various means such as high prices [for store merchandise] and low prices for local produce. In small communities, where families must cooperate for ditch cleaning, harvesting, and other activities, suspicions of taking advantage of people can create serious rifts that manifest through-

out village life. (Wiseman and Ware 1996:64)

In addition to perceptions of price-gouging, merchants have sometimes sold goods in usury and taken payment in land and other property when their customers could not finally settle their accounts with cash. Swadesh (1974:26–27, 59) links this situation to the advent of American merchants during the Mexican period (1821–47), while González (1969) and Weber (1979) see it becoming significant after the 1870s. Certainly, it attests to increasing participation by rural New Mexicans who for generations had pursued a local/regional, agricultural-pastoral, subsistence economy in an increasingly cash-based United States national economy.

Weber (1979:81) summarized the differences between subsistence and cash economies:

> The orientation of a cash economy is in direct opposition to that of a subsistence economy. While the latter stresses local independence in production and consumption, a cash economy requires regional (and often national or international) inter-dependence. Basic to a cash economy is a market system where goods and labor may be readily converted to cash which in turn can be readily exchanged for an almost unlimited number of goods and services. This convertibility factor leads to the utilization and development of specific rather than generalized resources. Another critical distinction between subsistence and cash economies is production for local *vs.* extra-local consumption. [Note: it may be a recognition of this point that leads Swadesh to link social issues associated with merchants with ties between New Mexico and the United States beginning in the Mexican period.] The lifestyle within a subsistence economy is limited by one's ability to derive his total livelihood from that area. The more complex cash economy implies specialization in production and labor, sale of the product, and purchase of goods from other similarly specialized producers.

Further, Weber (1979:81, 80) points out that in northern New Mexico, "While the family formed the basic biological and sociological unit, families combined into villages to form self-sufficient economic units. . . . As with families, each subsistence settlement shared a generally similar environment and produced most of the same goods." Weber (1979:82–84) identifies five factors that increased rural New Mexican villagers' involvement in the United States' national economy. Prior to the Great Depression of the 1930s, northern New Mexicans were introduced to and became increasingly dependent on the growing national cash economy through taxes, itinerant employment, decreasing land bases needed for agricultural and pastoral pursuits, and growing population numbers. He contends, "The extent of the reliance on external sources became apparent during the Great Depression. It closed off outside sources of income, and previously employed itinerants were forced to return or to remain at home" (Weber 1979:83).

In this position, Weber follows González (1969:118–120), who argues that the advent of the railroad in the 1870s and 1880s brought greater participation on the part of all New Mexicans in the national economy.

> Jobs were available for all who cared to labor—part-time or full-time. Many Hispanos used this means of supplementing their small income from farming [this statement reveals changes from truly subsistence farming to income-producing farming], thus making it possible to continue life in the rural villages in spite of decreasing productivity there. In time wage labor became the mainstay, supplemented by homegrown produce. (González 1969:120)

Gonzáles (1969:123) goes on to argue,

> The opportunities for wage labor outside the home village and the income derived from it succeeded in covering up the real situation until the early 1930's, when the widespread depression decreased and almost cut off completely the available jobs.
>
> When this situation occurred, the men tried to fall back upon the more traditional sources of income—farming and sheepherding—and then discovered that changes in the ecological balance, new laws, and competition with modern techniques made it impossible for farming and sheepherding to support the

existing population.

Amelioration of these circumstances—to which rural New Mexicans responded by depending on federal relief programs; by becoming increasingly and more widely seasonally migratory; and by moving to cities in California, Arizona, and Colorado—did not really begin until World War II (Weber 1979:83).

It is in this context that we can examine the observations made by Kutsche and Van Ness (1981) in regard to the García brothers' stores. Her ethnographic information leads Goodman (Chapter 25) to conclude that the stores owned by Candido and Manuel García did not fit the pattern of usury and exploitation ascribed by Kutsche and Van Ness to some stores operated in small Hispanic communities. Since the brothers were related to all their customers and neighbors in Gavilan, and since their stores were small, were not open consistently, did not traffic in local produce, did not offer credit, and did not make much profit for their owners, Candido and Manuel García were not perceived as taking advantage of their customers. Apparently, as Goodman (Chapter 25) points out, "These stores had little impact on the surrounding community."

Certainly, the stores represented shifting economic orientations in the Rio Ojo Caliente Valley, from subsistence-based, agricultural, and pastoral economics to cash-based, labor-specific economics. However, the goods sold by the García brothers largely mirrored the foodstuffs produced by families in the local communities. The stores did not offer a range of specialized or limited-availability items that may have been needed by but were not produced in local communities. According to Goodman's informants (Chapter 25), when families in Gavilan needed such items, they tended to buy them from larger stores in Ojo Caliente, San Juan, or Española. If the 20 canning jar sealer lids and bands recovered during excavations do indeed reflect some of the items sold by Candido Garcia, they suggest that he did stock items that could have been useful to local subsistence activities.

The García brothers established their stores during the Great Depression period of the 1930s, when the national cash economy was unstable and that of the valleys of northern New Mexico more so (González 1969; Weber 1979). As we noted earlier, northern New Mexicans responded to the Great Depression by, among other things, attempting to fall back on farming and herding, with varying degrees of success. Consequently, by opening small stores that were dependent on cash because they sold goods that had to be purchased with cash, largely sold the kinds of goods that could be produced by local families, but did not sell or trade local produce during the Great Depression, when northern New Mexicans were attempting to refocus economic pursuits away from cash bases, the García brothers probably doomed their stores to failure. Goodman (Chapter 25) observed that the stores were often closed for months at a time because the brothers themselves did not have the cash needed to buy items to sell.

Discussion

An interesting contrast to the Garcia brothers' stores is found in the tienditas of Rosinaldo and Vicente Archuleta, brothers living in the Duranes area south of Ojo Caliente (Chapter 25). Both Archuleta stores opened about 1940, after the García stores closed, and apparently sold similar goods (although we do not have information on products in the Archuleta stores in the same detail as we have for the García stores). Rosinaldo closed his store in about 1950, when he moved to California. Vicente kept a store open until around 1990; his store also housed the South Ojo Caliente Post Office in the 1960s. Although we can't know with any certainty, we can speculate that the Archuleta brothers' tienditas continued to operate because they opened in the 1940s and because federal relief programs and the economic changes associated with World War II provided cash needed by such small stores to survive.

As Goodman (Chapter 25) points out, several larger stores were established in Ojo Caliente. One informant stated that the Lucero and Hernández stores extended credit to customers, and that the owners grew wealthy. One family, the Vigils, who bought the Lucero store, was from El Rito, where it already had extensive holdings. The Vigils were not considered "locals." This situation reflects the observations made by Kutsche and Van Ness. Valdez (1979) provides an interesting discussion of the sociocultural context of the animosity that can be directed towards the owners of large stores in his paper on *vergüenza* (literally, shame; more appropriately, modesty). Valdez (1979:104) states succinctly that "some professions are traditionally regarded as necessarily *sin vergüenza*," (without shame or modesty) because "the essence of *sin vergüenza* is using one's knowledge, customs and traditions, possessions or personal characteristics to put oneself ahead of others. The sense of 'at the expense of others' is always involved in the male *sin vergüenza*." The point is that a person sin vergüenza does not operate in the best interests of the community in which he lives; he increases himself at others' expense.

Among those professions that are, by definition, sin vergüenza are those having to do with lending and capitalist business. Valdez (1979:104) states,

> Usury has been *sin vergüenza* since medieval Spain, and of course *leyes* were enacted to limit the type of people who could get involved in these activities. One takes advantage of others by having money when they need it. . . . The businessman is another example of one trying to get ahead for himself and his immediate family. The very nature of all business activities, of buying low and selling high, of showing a profit, is *sin vergüenza*. And, those who need the businessman's service never hesitate to consider him such a man. It is assumed that he is sly.

In this context, we can see why their neighbors and customers in Gavilan were not suspicious of the García brothers. Although the brothers operated cash-based businesses, those businesses were very small, did not operate on credit, did not make much profit, and, although they did not necessarily aid others, they also did not impede others' participation in their subsistence-based activities. So, the García brothers were not sin vergüenza. The same was probably true of the Archuleta brothers and their stores, unlike the owners of the larger stores, who did extend credit, did (and do) make profit from the efforts of their neighbors, and were (and are) participants in the economic and sociocultural transformations of Hispanic village life. We would not want to say, in this context, that the owners of larger stores in the area were or are sin vergüenza, since that would be a judgment of social values that is not ours to make. Further, Goodman's research did not focus on gathering detailed information about goods or services provided by those stores or about their positions in the social dynamics of the Ojo Caliente area. However, her information does provide descriptions that suggest distinctions between those stores and the ones operated by the García brothers, both in terms of goods and services and in terms of local and regional social and economic contexts.

Conclusions

Comparative examination of the results of ethnohistorical and archaeological research about and at LA 105710 reveals that the two methods of data recovery have provided complementary information relevant to the eight research issues identified for the historic components of the site. Ethnohistorical research has provided a critical view of the site in the context of the whole community of Gavilan. It shows that the site figured importantly in the community and that the site's features can and must be understood as integrated aspects of the whole community. This is a fascinating result of the research, because the site, from an archaeological perspective, does not present a particularly imposing picture (although we did not conduct excavations of the morada, so we do not actually know what might be revealed there). Nonetheless, archaeologically the site consisted of the morada, the remains of the Candido García store, and the Archuleta corrals, represented primarily by stands of wolfberry bushes. Without the ethnohistorical research, we might not have known the extent to which LA 105710 represents religious, economic, and integrative aspects of the Gavilan community. On the other hand, without the archaeological research, we might not have known the degree to which the site represents changes in the religious, economic, and integrative aspects of the Gavilan community. Clearly, the focus in the project research design on ethnohistorical research was warranted. Just as clearly, the research design underestimated the potential for contributions that were made by archaeological investigations. This chapter demonstrates that ethnohistorical (Chapter 25) and archaeological (Chapters 14 and 21) investigations can profitably be combined to recover comparable and complementary information about a site that may appear to be of relatively minor significance but may, in fact, be of central importance in understanding local and regional community dynamics.

Chapter 27. Summary and Conclusions

James L. Moore

The Nature of Frontiers

Though this project examined in detail only a fairly narrow corridor through the middle of the Ojo Caliente Valley, the data that it generated provide a detailed look at several aspects of prehistoric and historic life in the region. The Ojo Caliente Valley has truly been on the frontier through most of the time that it was occupied by farmers and herders. However, the form taken by those frontiers varied in the prehistoric and historic periods. Though none of the sites examined by this study date to the initial periods of prehistoric or historic occupation, those earlier forms helped determine the trajectory that later settlements took.

Casagrande et al. (1964:284) define two major types of colonization, or movement onto a frontier. The first type is *external colonization*, in which a population expands into a distant or noncontiguous geographic region. This is the type of colonization represented by western European movement to the New World. The second type is *internal colonization*, in which population movement is into parts of a group's own territory that are not currently occupied, or into adjacent territory that is controlled by a different nation or group. In both the prehistoric and historic periods of occupation in the Ojo Caliente Valley, movement into that area represented internal colonization—the Ojo Caliente Valley was either within the territory controlled by the colonizing group or adjacent to their territory and considered to be open for settlement. At this rather gross level, both periods of settlement are similar in nature, but they differed considerably in specifics.

Frontiers can take many different forms and mean different things to different cultures. Billington (1963:25) defines a frontier as "a geographic region adjacent to the unsettled portions of the continent in which a low man-land ratio and unusually abundant, unexploited, natural resources provide an exceptional opportunity for social and economic betterment to the small-propertied individual." By this definition, movement onto a frontier is an economic process, where individuals who lack wealth seek a chance to improve their economic situation. A frontier is also "the process through which the socioeconomic-political experiences and standards of individuals were altered by an environment where a low man-land ratio and the presence of untapped natural resources provided an unusual opportunity for individual self-advancement" (Billington 1963:25). Steffen (1980) distinguishes between farming and expeditionary (mining and ranching) frontiers. While movement onto a farming frontier results in value transformations, this does not occur with movement onto expeditionary frontiers because they remain closely linked to the mainstream culture (Steffen 1980).

These views of frontiers can be applied to the Spanish colonization of New Mexico and the subsequent expansion of their settlements into areas that were not previously occupied, but they make little sense when the prehistoric occupation of the region is considered. Most discussions of frontiers are historical rather than anthropological in focus and tend to stress processes that can be observed in Western colonizing groups and rarely look at the effects of colonization on the indigenous, usually nonliterate population. But colonization affects both the settlers and the indigenous population, and frontier studies rarely detail both sides of the story (Waselkov and Paul 1981). Frontiers also occur among groups who left no written records that can be used to interpret how those frontiers formed and were used, and how that use affected their sociocultural and economic systems.

Thus, while there was usually an economic aspect to frontiers, as Billington's (1963) definition suggests, the form and meaning of frontiers can vary greatly. The simplest definition of a frontier is the zone that separates two disparate populations. When those populations are at the same economic, technological, and sociocultural level, the frontier between them might be very formal and carefully controlled. Thus, the frontiers between most modern nations tend to be distinctly defined borders that present obstacles to unrestricted population movement and economic transactions. This is also the form taken, historically, by the frontier between the United States and New Spain, in which the latter carefully limited emigration and trade to restrict foreign influences and protect trade monopolies. The frontiers between these nations and neighboring Indian tribes took a more traditional form that were attractive for the economic opportunities they represented, which could be exploited because of the "cultural superiority" of the Western nations who "owned" those lands but did not yet occupy them.

Frontiers between tribally organized groups can be very different from those that separate centrally organized nations from one another or from less centrally organized groups. For instance, the frontier between two pueblos may take the form of a "no-man's land." Under normal circumstances, this type of frontier might be available to both groups to use for temporary economic exploitation but remain free from settlement to prevent conflict between the groups, or simply because settling that zone would be too difficult or expensive. At other times, frontiers might simply have been areas that were not currently amenable to farming and so were left unsettled but were used to exploit other resources that they contained.

The Prehistoric Pueblo Frontier

There is no evidence of occupation of the Chama–Ojo Caliente Valleys by sedentary farmers before the Coalition period. The region was sporadically used by hunter-gatherers before that time, but there were no full-time residents. Movement into the region may have begun as early as the thirteenth century in the Rio del Oso (Anschuetz 1998). This date is based on the presence of large amounts of Santa Fe Black-on-white at Maestas Pueblo (LA 90844) and AR-03-10-06-1230 (Anschuetz 1998). However, farmers probably did not spread throughout the region until the early 1300s, as demonstrated by tree-ring dates from Palisade and Riana Ruins (Peckham 1981; Stallings 1937a). The few villages known from the Coalition period are medium-sized to fairly large, ranging from 24 rooms at Riana Ruin to between 100 and 200 rooms at Leafwater Pueblo, Maestas Pueblo, and AR-03-10-06-1230 in the Chama Valley and Rio del Oso (Anschuetz 1998; Hibben 1937; Luebben 1953). Though dwarfed by the much larger villages of the Classic period, these Coalition period villages argue for the presence of a fairly sizable fourteenth-century population. No single-component Coalition period villages have as yet been identified in the Ojo Caliente Valley, but many of the large Classic period villages in the region are underlain by late Coalition period remains including (at least) Te'ewi, Tsama, and Sapawe in the Rio Chama drainage, and Ponsipa'akeri and Hupobi in the Ojo Caliente Valley.

Thus, Pueblo occupation of the Ojo Caliente Valley probably began in the Coalition period. The lack of Coalition period pottery in our sample from Hilltop Pueblo may indicate that it was not built until the Early Classic period. Similarly, the atypical location of the nearby village of Nute could also indicate a strictly Classic period occupation, but this conclusion remains tentative because of the lack of investigations there.

The Chama–Ojo Caliente Valleys as an Internal Frontier

The Chama–Ojo Caliente Valleys may have acted as a safety valve for the population of the Northern Rio Grande during the late Coalition and Classic periods. Crown et al. (1996:195) note that there was a population explosion on the Pajarito Plateau during the late Coalition period that may have been the result of emigration. This influx probably reflects the general exodus from the San Juan region in the late 1200s and early 1300s, and movement of that population into adjacent regions. As new people emigrated into the Northern Rio Grande, they came into conflict with the indigenous inhabitants. On the Pajarito Plateau this eventually culminated in a dividing line between the Keres and Tewas—by tradition at Frijoles Canyon—the former to the south and the latter to the north. Crown et al. (1996) note that Coalition period population increase and aggregation were more marked in the northern Pajarito Plateau. During the Early Classic period there was a decrease in the population of the northern Pajarito Plateau, while population aggregation reached a peak in the southern Pajarito Plateau during that period (Crown et al. 1996:196).

Though Crown et al. (1996:196) attribute these trends to a partial population shift from the northern to the southern Pajarito Plateau, this makes little sense when the potential for ethnic conflict is considered. Why would Tewas from the northern plateau move in with Keres on the southern plateau, especially when there is plenty of evidence for competition, perhaps violent, between these groups? The continuing population buildup on the southern Pajarito Plateau is probably more attributable to the persistent movement of San Juan peoples into the region. Population loss on the northern Pajarito Plateau undoubtedly resulted from movement into the Ojo Caliente–Chama Valleys, accounting for both the population decline in the former and the appearance of numerous large villages in the latter.

Northern Rio Grande peoples began moving onto the Pajarito Plateau by at least the early Coalition period. This represented movement of a sedentary population into an unoccupied frontier zone, probably for economic reasons. Refugees from the San Juan seem to have been drawn to the Pajarito Plateau for similar reasons, but they were moving onto a different type of frontier—an area that was already sparsely occupied by an unrelated population that may not have been as well organized as they were. Initially, the region seems to have been shared with a minimum of strife. Conflicts over available resources eventually occurred as San Juan peoples continued to move into the region, culminating in the development of a boundary between the Keres and Tewas—a zone that separated the competing groups and probably limited access to the resource zones controlled by each.

During much of the Pueblo period, the Ojo Caliente–Chama Valleys were a convenient frontier for the Tewas. However, this region was not a traditional frontier like the one that separated the Keres from the Tewas on the Pajarito Plateau. Instead, it was an internal frontier, similar to those identified in parts of Africa. The African internal frontier "consists of politically open areas nestling between organized societies but 'internal' to the larger regions in which they are found" (Kopytoff 1987:9). Schlegel (1992:377) feels that this concept may be applicable to the prehistoric and early historic Pueblo inhabitants of the northern Southwest, and she tests this possibility by applying it to the Hopis of northeast Arizona. Africa and the prehistoric Southwest shared an attribute that predisposed them to similar social adaptations: large unsettled expanses of land between and adjacent to occupied zones were open to settlement and within colonizing distance of those occupied zones (Schlegel 1992:378). Internal frontiers are dynamic, especially those defined in Africa, and occur between organized societies rather than at their edges (Kopytoff 1987:9). New settlements in these zones are usually formed by groups of people rather than individuals. Fissioning can be for political, social, or economic reasons, and frontier settlements that survive without being reabsorbed or conquered may develop into a new nation or village. While the Hopi and African examples share several characteristics, they are also quite different, suggesting that this is a complex process that can assume many forms.

Schlegel (1992) discusses several features common to groups moving onto internal frontiers in Africa and Hopi, based on Kopytoff's (1987) model: (1) movement in groups; (2) social integration through kinship; (3) ranking according to the order of arrival; (4) shared backgrounds; and (5) the weak hold of authority (Schlegel 1992:388). In both areas, movement into internal frontiers appears to have been in groups who were integrated with other immigrants through kinship. Ranking was done in order of arrival in the origin stories, though groups may not have actually arrived in that specific order. Rather, this was a way to legitimize the ranking of groups with little real social differentiation. Most immigrants probably had shared backgrounds, having come from neighboring populations. Finally, the political heirarchy that developed under these conditions was weak, with little or no coersive power.

As noted above, movement into an internal frontier may take many different forms and probably varied from one area or group to another, sometimes radically. Not all of the features that Schlegel (1992) defined as common to groups moving into an internal frontier in Africa and Hopi can be evaluated for the prehistoric occupation of the Ojo Caliente Valley. For example, we cannot evaluate the prehistoric ranking of groups in villages, nor can we estimate the strength of the prehistoric political heirarchy from currently available data. However, we can look for some of these features in oral tradition and archaeological data.

Oral traditions can be used to suggest how different groups were integrated in a single village by the Tewas. Hopi oral traditions recognize the disparate origins of their various clans and clan groupings, essentially linking them to nearly all other parts of the Southwest. This is not the case with the Tewas, whose oral traditions see them as originating as a single group, splitting for the journey south, and then once again rejoining to form the modern Tewa population. Like that of the Hopis, the Tewa origin story suggests that different groups were integrated through the kinship system when they joined to form larger villages. In this case, that integration becomes the joining of the Summer and Winter people, and the assigning of various roles in the ritual and political heirarchy to each.

Archaeological information also sheds some light on this process. Using Palisade Ruin as a likely example of how frontier movement worked, new villages seem to have been founded by small groups of people living in shallow pit structures. They were soon joined by other people, and together they built a small planned village that continued to grow by accretion as more people continued to move into the village after the initial construction episode (Beal 1987). Some of these early, small Coalition period villages—Palisade and Riana in particular—failed fairly quickly, and their surviving residents either left the area or, as is more likely, joined another community. Some of the more successful villages attained a fairly large size, but eventually they also failed and were abandoned—for example, Leafwater, Maestas Pueblo, and Tsiping. A few villages were more successful, eventually growing into the large Classic period villages that are considered ancestral by the modern Tewas. This follows the models of movement onto internal frontiers discussed above. Some of the new villages founded in the frontier zone failed and were abandoned, while others survived. The populations of the failed villages may have been reabsorbed by the populations they were originally derived from, though they more likely simply joined another, more successful frontier village. The surviving villages grew into large, probably independent population centers.

Thus, several of the features discussed by Schlegel (1992) are visible in the admittedly insufficient archaeological record of the Chama–Ojo Caliente Valleys. Movement into the region appears to have been in groups rather than by individuals. Integration of those groups was undoubtedly accomplished through kinship ties. Culturally, the immigrants all appear to have had a common origin; indeed, in this case nearly all were probably members of the same linguistic and sociocultural community. How group ranking was accomplished is uncertain, though aspects of the origin story suggest that some differentiation was made between the people that were already in place and those who joined them. This suggests that movement into the study area was mostly consistent with models of emigration into an internal frontier.

But why do we define the Chama–Ojo Caliente Valleys as an internal frontier rather than another type of frontier? The distribution of tool types on Archaic sites documented in the Chama Valley suggests a differential pattern of seasonal use and exploitation from one end of the valley to the other (Anschuetz et al. 1985). This type of use appears to have continued through the Developmental period and into the early Coalition period (Anschuetz et al. 1985). Whether this indicates that the Chama–Ojo Caliente Valleys contained hunter-gatherers marginal to the Pueblo population living further to the south, or represented a zone exploited for its wild plant and animal resources by those Pueblos is unclear. Since the presence of late hunter-gatherers in the region remains undemonstrated, the latter possibility is more plausible at this time. Thus, we feel that the Chama–Ojo Caliente Valleys represented a zone that was exploited by the Pueblo occupants of the Northern Rio Grande but remained unsettled until necessitated by population pressure and/or allowed by climatic amelioration or advancements in farming technology. Since they were already part of the region used for subsistence by the Northern Rio Grande Pueblos, the Chama–Ojo Caliente Valleys represented an internal frontier.

A Model of Pueblo Movement into the Chama–Ojo Caliente Valleys

Three factors—population pressure, climatic amelioration, and advances in farming technology—may have led to the spread of Pueblo farmers into the Chama–Ojo Caliente Valleys. As discussed in Chapter 2, climatic reconstructions of this region suggest that precipitation levels were generally good for farming through much of the fourteenth century. In particular, all three climatic reconstructions discussed in that chapter indicate that the fourteenth century opened with fairly good precipitation levels, and that average or above-average precipitation prevailed into the mid to late 1330s (Maxwell 2000; Orcutt 1999a; Rose et al. 1981). Though precipitation levels during the rest of the fourteenth century varied quite a bit around the mean, the stage was set for population movement into the region.

As noted earlier, the Coalition period was marked by the movement of San Juan peoples into the Northern Rio Grande. This process is especially apparent on the Pajarito Plateau. Though there is no clear demarcation between competing populations in that area until the Classic period, by the late Coalition period there was a large-scale influx of population, which eventually culminated in an ethnic dividing line around Frijoles Canyon that was remembered by the historic Pueblos long after the Pajarito Plateau was abandoned. As people moved in from the south and west, the earlier occupants of the southern Pajarito Plateau were absorbed or, more likely, displaced. Needing a new place to live, many of these people probably emigrated into the Chama–Ojo Caliente Valleys, which were not densely populated at that time. At the same time, there appears to have been a new development in agricultural technology that expanded the range of acceptable farmlands. The earliest documented gravel-mulched fields are currently in the Rio del Oso Valley, where the Coalition period population first seems to have used this technological advance. Thus, by the early 1300s, the Pueblo occupants of the Northern Rio Grande were in need of new lands on which to live and farm. Most of the Chama–Ojo Caliente Valleys were previously unoccupied by sedentary farmers, but they were known to the occupants of the Northern Rio Grande, who sporadically exploited them for resources. Population pressure on the Pajarito Plateau provided the impetus for moving into this region, and that movement was facilitated by favorable precipitation levels and improvements in farming technology that allowed more efficient use of dry-farmed fields.

Numerous small- to medium-sized Coalition period villages probably acted as magnets for other occupants of the Northern Rio Grande during the Early Classic period, providing an outlet for excess population from the northern Pajarito Plateau as well as other areas that were now in conflict with San Juan peoples moving into the region. Since all of the large Classic period villages in the Chama–Ojo Caliente Valleys are considered ancestral by the Tewas, and their ceramic assemblages are dominated by biscuit wares, San Juan peoples never seem to have gained a foothold in that region.

The Transition of an Internal Frontier into Part of the Core

The Chama–Ojo Caliente Valleys seem to have made the transition from a frontier settlement area to part of the population core fairly rapidly. However, the speed of its development as a locus of ritual importance remains uncertain. This process may have been similarly rapid, or it could have taken somewhat more time. At least 14 large villages were occupied in the Chama–Ojo Caliente Valleys during the Classic period, most of which seem to have grown out of smaller Coalition period settlements. Some of these villages were quite sizable—for example, the village of Sapawe in the El Rito Valley (a tributary of the Rio Chama) is the largest known adobe village in New Mexico (Cordell 1978:52).

The Chama–Ojo Caliente Valleys seem to have rapidly become a center of Tewa settlement during the Classic period, perhaps containing a larger population than either the Pajarito Plateau or the Tewa Basin. While settlement of this region can be viewed as movement into an internal frontier, it also represents an expansion of the population and economic core. There is no evidence of attenuated contact between the Chama–Ojo Caliente region and the original core in the Tewa Basin, as might be expected on a classic farming frontier (Steffen 1980). Nor is there any evidence of a loss of sociocultural complexity due to a reduction in contact between frontier and core, as often occurs in the classic examples of this process (Doolittle 1973; Lewis 1973, 1977). Thus, this internal frontier seems to have made a fairly rapid transition into part of the core without suffering some of the sociocultural losses that are common in frontier settings.

The Ojo Caliente Valley also assumed quite a bit of ritual significance during its Pueblo occupation. The hot springs that give the valley its name are in the valley bottom on the west side of the Rio Ojo Caliente. Today they are the centerpiece of a resort, but to the Tewas they are a shrine of great importance, with significant connections to Poseyemu, the Tewa culture hero (Harrington 1916:164; Hewett and Dutton 1945:40). Morley (1910a:18–19) was told by residents of San Juan Pueblo that Poseyemu was born at the village of Howiri in the Ojo Caliente Valley, and people from Santa Clara, San Ildefonso, and Nambe agreed that Poseyemu lived in the vicinity of the historic village of Ojo Caliente. As noted in Chapter 24, Poseyemu is said to have occasionally entered the hot springs when he lived in the Ojo Caliente area. The spring is thought to be the home of his grandmother, and Poseyemu comes to visit her once a year (Harrington 1916:164). People at San Juan Pueblo told Harrington (1916:164) that the Tewas still drank water from the hot springs in the early twentieth century and, presumably, had done so in the past. Clearly the association of a major supernatural figure with the Ojo Caliente Valley is indicative of the ritual importance of this area to the modern Tewas, and to the Classic period Tewas as well.

Indeed, the Tewa name for the Ojo Caliente area refers to the sacred hot springs "from which the Tewa claim that they originally came" (Harrington 1916:165). Thus, even though there is no evidence of a sedentary Pueblo population in the Chama–Ojo Caliente Valleys before the Coalition period, that area is considered to be where the Tewas ended their southward journey after their emergence into this world.

This brings us to the prehistoric sites investigated during this project, and in particular the trail (LA 118549) and apparently related features adjacent to it but included as parts of farming sites. In our discussion of this site in Chapter 24, we noted that LA 118549 seems to have served two purposes: a pedestrian corridor and a ritual corridor. Evidence of use of the trail as a pedestrian corridor takes two forms: its articulation with large Classic period villages, and its connection to farming sites. LA 118549 passes two large Classic period villages on the east edge of the Ojo Caliente Valley: Ponsipa'akeri and Nute/Hilltop Pueblo. The trail passes Ponsipa'akeri on the terrace slope below that village and is connected to the village by two smaller paths that were documented by Bugé (1978). It may be significant that the trail does not ascend to the terrace top at Ponsipa'akeri. Had the trail passed through Ponsipa'akeri, the village might have been able to exert some control over traffic along that segment. The significance of the trail bypassing the village may have been in its common ownership and access. The trail belonged to everybody and nobody at the same time, and the access it provided to villages, fields, and ritually significant areas remained unobstructed.

LA 118549 also passes Nute and Hilltop Pueblo and does not directly articulate with either, instead passing between them. Rather than passing directly below Hilltop Pueblo on the terrace slope, the trail descended to the valley floor before it got to that village. Unfortunately, the route of the trail is lost between the point at which it reached the valley floor and where it next ascended the terrace slope on the north side of Arroyo de Gavilan, beyond Nute/Hilltop Pueblo. In bypassing both villages, this segment of the trail belonged to neither. The atypical descent onto the valley floor may have been meant to route the trail at an equal distance from the two villages, thereby ascribing no greater level of importance to either. If so, then by extension, both villages were occupied when the trail was initially built.

A second aspect of the route taken by LA 118549 probably related to land tenure patterns. No evidence of farming features has been found on the terrace slope traversed by the trail. Thus, that slope probably represented common lands that were not amenable to farming and were open to all for use. The valley bottom and terrace top on either side of the trail were probably held by various corporate groups belonging to local villages, and to route a trail through either of those zones would have meant traversing farmlands, both areas that were used as fields and areas that were not currently being used but could potentially be brought under cultivation. In either case, someone would most likely have objected. Routing the trail along the terrace slope was probably a good compromise—that area was unowned common land and unlikely to ever be used for farming. Bypassing occupied villages along the route taken by the trail kept outsiders from intruding on the private lives of those villages as well as preventing villagers from exerting control over traffic along the trail.

The trail did not directly articulate with the farming sites above it on the gravel terrace that forms the east edge of the Ojo Caliente Valley. Only four locations were noted where the trail ascended the slope to the top of the terrace—at LA 105705, LA 105707, LA 105708, and LA 105709. However, the configuration of the trail in those areas suggested that its main function was not to provide access to fields. Indeed, more ephemeral paths leading up to LA 105705 and LA 118547 from the trail may be examples of how foot traffic more commonly accessed fields. In all four locations where LA 118549 ascended to the top of the terrace, the downslope edge of the trail was bermed. Shrines were identified in two of these locations—an earth navel at LA 105709 and an elaborate borrow pit at LA 105708 that appears to have been modified into a ritually significant feature, unlike any others seen in the project area. No definite shrine was identified near the trail at LA 105705, though a possible ritually significant feature was noted there. This was Feature 12, which could have been a materials stockpile or a cobble pavement. If the latter is correct, then shrines were found at three of the locations where LA 118549 ascended to the terrace top. No shrine or other ritually significant feature was found adjacent to the trail at LA 105707, but this is not surprising because most Pueblo shrines are understated and inconspicuous (Swentzell 1997). In addition, the area directly adjacent to the section of trail that crosses the terrace top at LA 105707 was removed during an earlier highway construction episode, undoubtedly erasing any ritually significant feature that may have originally been there.

In two cases where the trail ascends to the terrace top adjacent to ritual features (LA 105708 and LA 105709), the berm along the outside edge of the path is to the south of those features. Berms may have been built through these areas as visual clues to inform travelers that they were approaching a location of ritual importance. If so, this suggests that the proper direction for pilgrims to travel along the path was south-to-north. As was the case with the villages noted earlier, the trail did not directly access these features, maintaining a degree of separation between the shrines and the pedestrian corridor. This was probably due to the dual nature of the trail, allowing it to function as a travel corridor for those who were not visiting the shrines and may not have been highly initiated enough to know their true significance, yet permit ready access to those who were.

The berm was configured somewhat differently at LA 105705, beginning as the trail approached the terrace top from the south, continuing across the terrace top, and extending downslope for a short distance as the trail began to descend the slope. However, the berm was much taller and more conspicuous on the southern approach at LA 105705, and the trail was wider through that area. This again suggests that the approach to the terrace top from the south may have been marked to indicate the proximity of a ritually important location. The segment of trail at LA 105707 seems to have originally been configured similarly to the segments at the other three sites, but damage from earlier construction episodes along U.S. 285 obscured the southern approach in that area. In this case, the section of trail that ascended the terrace slope from the south was gone, and the trail began near the terrace top, directly adjacent to the existing roadcut. A berm remained along the downslope side of the segment of trail that crossed the terrace top, disappearing as it began to descend the slope. Again, this suggests that the berm was built as a visual clue to northbound traffic that they were approaching a ritually important location.

Unfortunately, historic activities in and around the village of Ojo Caliente have eradicated any evidence of the trail north of LA 105713. Did it continue farther up the valley, or did it cross over the river to the hot springs below Posi'ouinge? The answer may never be known, though Bandelier (Lange et al. 1975:86) noted the presence of an "old trail" leading to a Pueblo village that was probably Posi'ouinge. Since LA

118549 seems to have served as a pedestrian corridor in addition to its ritual use, it probably continued up-canyon at least as far north as Howiri, joining all the villages on the east side of the Ojo Caliente Valley together. Most likely, a spur of the trail crossed the river and led to the hot springs, and perhaps Posi'ouinge, but this, too, must remain supposition. However, the ethnographic evidence presented earlier in this section on the sacred nature and use of the hot springs suggest that this is likely. Pilgrims from villages in the Tewa Basin may have stopped at several ritually significant locations on their journey to the sacred hot springs, including the two probable shrines identified along the trail as well as others that remain undefined.

If these suppositions are correct, then locations in the Ojo Caliente Valley could have assumed ritual importance at a fairly early date in the occupation of that area. Indeed, places like the hot springs may have been considered sacred even before farmers settled the valley, since there is evidence of sporadic Pueblo use of the region before the Coalition period (summarized in Maxwell 2000). Coalition period remains have been found in the lowest excavated levels at Ponsipa'akeri (Bugé 1978), so that village was founded during the earliest period of Pueblo occupation in the Ojo Caliente Valley. Fallon (1987:12) notes that Stallings (1937b) collected tree-ring samples from Hupobi dating between A.D. 1271 and 1367, though sample quality was poor. These dates suggest that Hupobi was also founded during the Coalition period. While it is likely that the other large villages in the valley (Posi'ouinge, Nute, and Howiri) were initially founded at about the same time, this has not yet been demonstrated.

Providing an initial date for the trail might give us an idea of when ritual features in the Ojo Caliente Valley assumed a general and widespread importance, drawing pilgrims from other population centers. It may also provide an idea of when the region became part of the core rather than an internal frontier. Did these events happen at a fairly early date in the farming occupation of the region, or did they develop over time? Did both occur at the same time, or were they sequential?

Good temporal control over the founding dates for villages adjacent to the trail might help determine just how early that corridor could have become formalized. Unfortunately, those dates are not available. As we noted earlier, Bugé (1978) encountered evidence of a Coalition period occupation at Ponsipa'akeri, and Beal (1987) suggests a similarly early founding date for Hupobi. Thus, we assume that Pueblo people began settling the Ojo Caliente Valley in the Coalition period, perhaps as early as the late 1200s, and certainly by the early 1300s. By extension, we can hypothesize that most of the large Classic period villages in the valley began as small Coalition period villages. Unfortunately, we cannot prove this point, and knowing when these villages were first settled is critical to our discussion.

If all of the large villages on the east side of the Ojo Caliente Valley developed out of a Coalition period occupation, then we might be able to argue a greater antiquity for the trail. However, if some of these villages instead reflect a Classic period inception, then the trail may have been built at a later date. The only temporal information generated by this study for the large villages in the region came from Hilltop Pueblo, but we unfortunately remain uncertain about the occupational dates for that village. In Chapter 6, Boyer suggests that radiocarbon dates recovered by this study indicate that Hilltop Pueblo was occupied in the Early Classic period and abandoned by ca. A.D. 1420. In Chapter 19, Wilson suggests a *late* Classic period affinity for the ceramic assemblage recovered from Hilltop Pueblo, though noting a possible range between ca. A.D. 1400 and 1550–1600. Without further excavation, this potential conflict cannot be resolved.

No sherds that predate the Classic period were recovered from Hilltop Pueblo, though it must be remembered that our pottery sample was not large. Thus, there currently is no reason to suppose that Hilltop Pueblo was initially founded during the Coalition period. As discussed earlier, Nute is the only large village in the Ojo Caliente Valley that is in the valley bottom, not on a mesa or terrace top. Could this indicate a wholly Classic period occupation? Because Nute is so poorly documented, we don't know.

Unfortunately, there is no way to accurately date a trail except by its association with residential sites and other features found along it. We have made several suppositions concerning the temporal relationship between the trail and the villages and features found along it. The fact that the trail primarily traverses the slope between the top of a gravel terrace and the valley bottom suggests that the land tenure system had already parceled out all of the arable land in the valley by the time the trail was built, restricting the potential routes that could be taken by a pedestrian corridor. This suggests that the villages and fields were present, in some form, when the trail developed. To summarize our discussion of the villages to this point, Ponsipa'akeri was initially founded during the Coalition period, Nute may have been founded at a similarly early date, though this is questionable, and Hilltop Pueblo was probably founded sometime during the Classic period.

The fields examined during this study all seem to have been built and used during the Classic period. In Chapter 19, Wilson concludes that the distribution of pottery types at the farming sites indicates they were used during the late part of this period, ca. A.D. 1450–1550. This was supported by excavational data from four sites, which also suggest that these fields were built and used during the Late Classic period (see Chapter 23). The beginning of this period coincided with a 30+ year interval of drought in the Northern Rio Grande (Maxwell 2000; Orcutt 1999a; Rose et al. 1981). Many, if not all, of these fields may have been built in response to the low precipitation levels that prevailed during that time. If these suppositions are correct, the top of the terrace that forms the east edge of the Ojo Caliente Valley may not have been extensively used for farming until the mid-1400s. Presumably, fields were built along the terrace edge to supplement those that already existed in the valley bottom. Most of the terrace top may have been considered common land before this time, except for locations amenable to dry farming within and along intermittent streams.

Taken together, these data suggest that formalization of the pedestrian corridor along the east edge of the Ojo Caliente Valley may not have occurred until the middle or late Classic period. All three villages that the trail bypasses were in existence by that time, as were the fields that rim the terrace edge. Though we can provide no date for the earth navel shrine at LA 105709, the elaborate borrow pit at LA 105708 that may have functioned as a shrine probably did not exist before construction of the adjacent fields. Currently available data suggest that this is the best time frame for construction of the trail, and some effort was certainly put into building and maintaining this corridor, considering that the trail was cleared of rocks and berms were built along approaches to ritual locations on top of the terrace.

This analysis indicates that development of the Chama–Ojo Caliente Valleys as part of the population core probably occurred before the area became a location of general ritual significance. If LA 118549 was used as a formal route for pilgrimages to ritually significant locations in the Ojo Caliente Valley, it probably wasn't built until fairly late in the Pueblo occupation. Thus, the Chama–Ojo Caliente Valleys first represented an internal frontier that was exploited for resources but remained unsettled. Population pressure caused by the movement of San Juan peoples into the Northern Rio Grande may have created the first impetus toward settlement of the Chama–Ojo Caliente Valleys, and that settlement may have been made possible by climatic amelioration and advances in farming technology that permitted sedentary farming villages to form in the region. Some of the villages founded during the early settlement period failed, while others succeeded. Continuing population movement off the northern Pajarito Plateau and, at least in part, into the Chama–Ojo Caliente Valleys caused the successful villages to continue growing until they became some of the largest pueblos in the Northern Rio Grande. This process transformed the region from a frontier into part of the population core and seems to have occurred fairly rapidly, with no apparent loss of sociocultural complexity. Eventually, the hot springs assumed a pan-Tewa importance, perhaps becoming the terminus of formal pilgrimages.

Ethnographic studies and Pueblo stories show that the Ojo Caliente hot springs were accorded this level of importance. Harrington (1916:164) refers to the hot springs as "one of the most sacred places known to the Tewa," as do Hewett and Dutton (1945:40). Ortiz (1969:16) notes that the Tewa origin story says that Posi'ouinge was founded when the two groups of Tewas, who had split soon after their emergence, rejoined there to form a new village. Thus, Posi'ouinge is (at least now) considered to be the first complete Tewa village. Poseyemu is associated with Posi'ouinge as well as the nearby villages of Hupobi and Howiri, and various Tewa stories associate him with other locations in the Ojo Caliente Valley as well. Grant (1925:123–126) presents a previously unpublished version of the Poseyemu story by Adolph Bandelier that was collected from the principal ritual leaders at San Juan Pueblo. This version stresses the importance of Posi'ouinge, which is attributed to its control over the sacred hot springs. In this account Poseyemu was born at Posi'ouinge and became its ritual leader. After bringing great prosperity to the village, he eventually left, at which point Posi'ouinge fell into decline and was abandoned.

Ponds and lakes, sacred in the Tewa religion, represent openings between this world and the underworld (Harrington 1916:164). Indeed, all waters are considered to be connected in Pueblo religion (Parsons 1939; Stevenson 1906). Though the Tewa place of emergence is considered to be a small lake in southeast Colorado, Harrington (1916:165) notes that the name "Posi'i'i" refers to the whole region around the Ojo Caliente hot springs, "from which the Tewa claim that they originally came." Hewett and Dutton (1945:39) state that the Tewas considered the area around Ojo Caliente to have been "the cradleland of their people." These statements can be interpreted in two ways. The Tewa origin story says that the village where the Summer and Winter people rejoined after their long journey south was Posi'ouinge (Ortiz 1969). Thus, Harrington's informant may simply have been referring to the area where the Tewas feel they originated as a complete group.

However, there is another, more esoteric interpretation of this statement that takes into account the principle of substitution, an important aspect of Pueblo religion (Parsons 1939). Substitutes will be found to replace an important religious society when it dies out, and for ritual materials when they are not available, and locations near villages may be substituted for distant shrines to preclude having to make a pilgrimage to the actual shrine location. As Parsons (1939:1148) notes, "The place of emergence in Zuni tradition was too far away for pilgrimage, so Kachina town was established within easy distance, for men and kachina. Similarly, to preclude having to make a trip to a distant shrine, Hopi will call a shrine near town by the name of the far shrine."

Ellis (1994:104) suggests, from conversations with Pueblo elders, that such a substitution only occurs when the group has moved a long distance from its former home. Thus, distance is an important principle in shrine substitution, with nearby ritual locales acting as proxies for the faraway originals. This type of substitution may be visible in Ortiz's (1969:140–141) discussion of the Tewas' sacred mountain of the north. Currently, this is Canjilon Peak, but earlier studies (Harrington 1916; Hewett 1930) recognized San Antonio Peak, 80 km farther north, as the sacred mountain of that direction. Canjilon Peak probably represents a twentieth-century substitute for San Antonio Peak, necessitated by distance and difficulty of access.

In many cases, substitution may not be the best way to refer to this principle. The substitution of Canjilon Peak for San Antonio Peak may be an actual replacement of one location of ritual significance for another. If so, then memory of San Antonio Peak as the original (or earlier) mountain of the north will disappear. Rather than a substitution, this would be a replacement that was perhaps occasioned by a shrinking of the Tewa world. Though the sacred mountain of the north is important in Tewa religion, it is also a boundary marker that may have been movable depending on distance, access, and danger or hardship involved in traveling there. In other cases where an actual replacement is not occasioned, *surrogate* may be a better term than *substitution*. For example, Kachina Town may have acted as a surrogate for the Zuni place of emergence, rather than replacing it. The important principal here is that the surrogate does not replace the original location of ritual importance, it simply acts in its place, and in doing so essentially becomes that original location when necessary.

This discussion of the principle of surrogacy in Pueblo religion combined with the extreme importance of the hot springs at Ojo Caliente in Tewa stories and religion suggest a possible reason for that importance. A pilgrimage to the Tewa lake of emergence in southeast Colorado would have been long and arduous, and probably was not undertaken very often. The Ojo Caliente hot springs may have been a convenient surrogate, and that surrogacy could be responsible for the statements mentioned above that consider the hot springs to be the place where the Tewas originated. Formal pilgrimages could be made more easily to a location in the Tewa core, and such a surrogacy represented a valid religious principle.

An interesting adjunct to the idea of surrogacy is the proper direction of pilgrimage along the trail. As discussed earlier, berms occurred along the southern approaches to ritually significant locales where the trail ascended to the top of the terrace, suggesting that the proper direction of ritual travel was south to north. A pilgrimage to the lake of emergence would also have been from south to north, so it is feasible that the direction of travel along the trail was part of the surrogacy, acting as a proxy for the actual long, arduous journey.

Surrogate ritual locations may be very important in Tewa ritual life. Swentzell (1988:15) indicates that Tewa plazas contain *nansipu*, or symbolic emergence holes that connect the underworld with the sky and all that lies in between. The plaza itself is "at the intersection of the horizontal and vertical regions of the physical and symbolic Pueblo universe" (Swentzell 1988:15). The creative energy of the universe flows out of the nansipu into the plaza, giving life to the physical, social, and religious community (Swentzell 1988:15–16). At a symbolic level, the hot springs at Ojo Caliente may have represented the ultimate nansipu, the center of the Tewa world rather than simply a single village, acting as a surrogate for the place of emergence directly adjacent to the first complete Tewa village. As such, it would have symbolically become where the Tewas originated.

The use of the hot springs as a surrogate for the actual lake of emergence would account for the highly sacred nature of the springs and the Ojo Caliente area in general. It would also account for the close association of a major Tewa deity with villages in the Ojo Caliente Valley, and the hot springs in particular. In any case, the formal nature of the trail (LA 118549), especially when it approaches the terrace top near probable shrines, and the fact that it does not directly articulate with any of the Classic period villages or fields that it passes, argue for a dual function as both a pedestrian and a ritual corridor. With the admittedly hazy date that can be assigned to this landscape feature, we can suggest that the Ojo Caliente Valley attained ritual importance in the Classic period, after the area had ceased being on the Tewa frontier and had become part of the population and sociocultural core.

The Historic Spanish Frontier

A Theoretical Perspective

Most frontier studies focus on post-medieval western European nations and their colonies throughout the world. This provides us with a somewhat firmer and better established theoretical platform for dealing with the historic period in New Mexico. But to simply focus on New Mexico would be to ignore the critical relationship between frontier and core, because the form taken by a frontier is based on its relationship with the core. Different levels of communication and different expectations result in different types of frontiers.

Two main types of frontiers have been defined and are relevant to this discussion: *cosmopolitan frontiers* and *insular frontiers*. Cosmopolitan frontiers "are economically specialized and often short term with their success based largely on the colonial policy of the parent state. As a result of direct manipulation in the colony's activities, there is a low degree of insularity and no opportunity for indigenous development. Consequently, no fundamental alteration in economic, political, and social institutions and behavior patterns are likely to arise on cosmopolitan frontiers" (Lewis 1984:16). In contrast, insular frontiers "are economically diverse and long term in nature. Their success requires a more extensive adaptation to local conditions, causing links with the socioeconomic system of the homeland to become fewer and more indirect" (Lewis 1984:16–17).

Contrary to the term used to describe them, cosmopolitan frontiers do not connote high population levels or industrial development. Rather, cosmopolitan frontiers represent areas of limited resource-extractive activities that remain almost completely economically dependent on the core.

Types of cosmopolitan frontiers that have been defined and discussed in the literature include military, industrial, exploitative plantation, ranching, trading, and transportation (Lewis 1984). Insular frontiers represent areas of permanent settlement with limited or attenuated contact with the core that are not completely economically dependent on the core. For the most part, insular frontiers are agricultural or farming frontiers.

The two main differences between cosmopolitan and insular frontiers are their duration and level of contact with the core. Insular frontiers tend to last much longer than do cosmopolitan frontiers, but they also have a much lower level of political, economic, and social contact with the core. Where fundamental social, economic, and political change is possible on an insular frontier, much closer ties to the core tend to prevent these types of changes from occurring on cosmopolitan frontiers (Lewis 1985:253).

Cosmopolitan frontiers are often, but not always, replaced by insular frontiers. In some instances, especially in areas lying beyond the zone of effective agricultural production, cosmopolitan frontiers may be long-term and remain unreplaced by insular frontiers (Lewis 1984:270). Frontiers also tend not to be static but undergo change as the economic focus and strength of interaction with the core vary. For example, Steffen (1980) defines the colonial Appalachian frontier as an insular frontier as long as the focus of agriculture was family-oriented self-sufficiency. As communication improved between the core and the Appalachian frontier, agricultural production became market-driven, and the form of the frontier was transformed (Steffen 1980:23–25). But transformed into what?

Using the concept of a world economy, as defined by Wallerstein (1974, 1980), Lewis (1984:14) notes,

> A world economy is composed of two basic parts based on the division of labor associated with production. The functional distinction is expressed geographically in the separation of the world economy into the core states of Europe at its center and peripheral areas at its boundaries. . . . The latter are distinguished as comprising "that geographic sector of (a world economy) wherein production is primarily of lower-ranking goods (that is goods whose labor is less well rewarded) but which is an integral part of the overall system of the division of labor, because the commodities involved are essential for daily use" (Wallerstein 1974:302). Exchange between peripheral areas and core states is characterized by a "vertical specialization" involving the movement of raw materials from the former to the latter and the movement of manufactures and services in the opposite direction.

Frontiers are a type of peripheral area, but all peripheral areas do not remain frontiers (Lewis 1984:297). Once a level of stable economic development is reached, a peripheral area is no longer a frontier, though not all frontiers reach this level (Lewis 1984:298). Insular frontier colonization begins the process of permanent occupation in a region and can ultimately lead to the achievement of core status in the world economy (Lewis 1984:298).

Another concept of relevance to this discussion, not as clearly presented, is that of *subfrontiers*. As Steffen (1980:232) notes,

> Whether early American development is viewed politically, economically, or socially, there are grounds for viewing it in terms of the frontier process, a process in which the pressures for change exerted by the New World environment are juxtaposed to the number of interacting links in existence between America and its Western European reference base. The interaction of the two forces constitutes a large and complex frontier process, a process which contains many subfrontiers represented by the themes just reviewed.

Thus, Steffen (1980:24) views the Appalachian frontier as a subfrontier of the more general American frontier.

To summarize the concepts examined in this discussion, the colonization of areas peripheral to economic cores results in two generalized types of frontiers: cosmopolitan and insular. Though cosmopolitan frontiers can be transformed into insular frontiers, this transformation does not necessarily always occur. Frontiers can eventually become an integral part of the peripheral area as a level of stable economic development is reached. Eventually, a peripheral area can become part of the economic core, though this does not always occur.

We now turn to a discussion of the New Mexican frontier in light of these ideas. However, it should be kept in mind that most of the preceding discussion developed out of examinations of the American frontier. Processes can certainly be different on the Spanish frontier, and in many instances were quite different because of different political policies.

The New Mexican Frontier

New Mexico was on various frontiers throughout its history. During the early Spanish Colonial period (1598–1680), the function of New Mexico as a frontier was mixed. Initially, settlers came to the province seeking economic opportunities, but those expectations were not satisfactorily fulfilled by what they found there. Rather than rich mines and wealthy Indian villages that could be easily exploited, they found a lack of mineral wealth that could be accessed at the level of technology available to them, and the Pueblo villages were certainly not wealthy in the Spanish sense of the term. Oñate's colony at San Gabriel was nearly destroyed by discontent and dissent, and for a time the Spanish government considered abandoning it (Espinosa 1988:8–9). The colony was saved when mass baptisms of Pueblo Indians and reports that many others were ready for baptism were used to argue for an alternative to economic colonization (Espinosa 1988:9). Thus, New Mexico became a missionizing frontier upon which the conversion of the indigenous population to Christianity was considered to be the main focus of Spanish settlement (Gutiérrez 1991:146).

In terms of our theoretical discussion, early Spanish Colonial period New Mexico was a cosmopolitan frontier primarily dependent on Mexico for nearly everything except basic food supplies to keep the colony going. The maintenance of New Mexico as a cosmopolitan frontier was political in nature, as was the maintenance of Mexico as a peripheral area to the economic core in Spain. Though Mexico was developing in the direction of the economic core, key industries were retained as monopolies by the Crown, most notably the production of steel. Thus, even though several industries developed in Mexico to fulfill local needs, for the most part that kingdom remained a locus of low-level production fulfilling the needs of the economic core. Political policy also kept New Mexico from developing into an insular frontier during this period by maintaining close economic, social, and political ties with the core.

In the official government and church view, the focus of settlement in New Mexico was the conversion of the Pueblos to Christianity. Since this type of frontier does not appear to have occurred elsewhere in North America, it has not previously been discussed as a type of cosmopolitan frontier and should be added to that list. Though the defense of New Mexico was entrusted to a group of upper-class citizens, New Mexico was not a true military frontier during this period. This is because of the way in which the defenders of New Mexico were funded. Rather than stationing a permanent professional military unit in New Mexico, 35 upper-class citizens were responsible for defending the province, and in return they received the right to economically exploit the Pueblos. This was the encomienda system, which represents an aspect of an exploitative plantation frontier. Thus, officially, New Mexico was a mixture of cosmopolitan frontier types: missionization and exploitative plantation.

However, these functions do not account for the ordinary settlers who had also moved to New Mexico. There was little economic, religious, or military support for these settlers. These factors, in addition to others, tended to set the settlers against the missionaries. Exacerbating this civil unrest was the economic exploitation of the Pueblo Indians by both the missionaries and the encomenderos. Slave raids against the surrounding Apaches (usually for economic gain by the governor) riled the non-Pueblo populations as well. Thus, there appears to have been momentum toward the development of an insular frontier in New Mexico, but this was stifled by official governmental policy, which effectively supported the church and its missionizing efforts but tended to ignore the secular population.

Conditions reached a boil in 1680 when the

Pueblo Indians and their Apachean allies forced the Spaniards out of New Mexico for 13 years. This event, in combination with the changing world scene, led to a major alteration in the focus of the New Mexican colony when it was reestablished in the final years of the seventeenth century. By the early 1700s New Mexico had metamorphosed from a missionizing and exploitative plantation frontier to an insular frontier with a dual focus. In addition to an agricultural function, New Mexico also became a defensive frontier (Bannon 1963; Gutiérrez 1991:146). Though a small, permanent professional military garrison was stationed at Santa Fe, it was insufficient for the defensive needs of the province and was supplemented by local militias and Pueblo and Genízaro auxiliaries. This, in addition to the development of agricultural self-sufficiency in the province, suggests that it was an insular frontier during the late Spanish Colonial period, and not a cosmopolitan military frontier.

Again, there is a disparity between the official function of the New Mexican frontier and the view of the settlers on that frontier. The Spanish government saw New Mexico's role as primarily a defensive buffer, protecting the inner silver-producing provinces from Indian attacks. However, the settlers themselves were there for the economic opportunities that existed on the Mexican periphery. Thus, New Mexico developed as an insular frontier even as it acted in its defensive role. New Mexico remained in this role throughout the late Spanish Colonial period and into the Mexican period, though the enemies it defended against changed several times. Areas on the local New Mexican frontier also metamorphosed from economic frontiers to defensive frontiers as the relationship between Spaniards and the surrounding nomadic Indians changed through time.

During the first half of the eighteenth century, the Spaniards were mainly concerned with the spreading influence of other European nations on their northern and northeastern flanks. In the case of New Mexico, the Spanish government was worried about the French along the Mississippi and on the Great Plains. By the 1760s the French were no longer much of a threat, but the nomadic Indians that ringed New Mexico had become an even bigger problem than they had been over the past one and a half centuries (Bannon 1963:169–171). In order to deal with this defensive problem, the northern provinces were reorganized in the 1770s and transformed into a unified command separate from that of the viceroy in Mexico City (Bannon 1963:182; Simmons 1968).

Peace was concluded between the Spaniards and the Comanches by 1786, and the Apaches were essentially neutralized by 1790 (Bannon 1963; Noyes 1993; Thomas 1932). For a short time after that date, New Mexico did not need to serve as a defensive line against the European and indigenous enemies of Spain. During this period of relative peace, New Mexicans began to expand the frontier of the province, occupying new lands as well as resettling lands that had been abandoned because of hostilities (Frank 2000:119). This time of relative peace also seems to have kicked off a period of economic expansion, which lasted through the rest of the Spanish Colonial period and into the Mexican period (Frank 2000). Migration into New Mexico from other parts of New Spain seems to have begun by the 1790s (Gutiérrez 1991:174). This was perhaps indicative of a perception that the northern frontier had become safer and once again represented a place of economic opportunity. Indeed, Spain began making an effort to more closely integrate New Mexico into the economy of New Spain during this period (Gutiérrez 1991:305–306). These factors combined to cause intense land pressure, relieved by grants of unoccupied lands (Gutiérrez 1991:306). Thus, New Mexico became part of the periphery of Mexico, which by this time was developing into an economic core. The frontier nature of New Mexico was beginning to fade, and New Mexico was beginning to be more closely tied to the core economically, socially, and politically.

Though the period of relative economic prosperity and movement onto the New Mexican frontier continued, New Mexico was soon forced back into its role as a defensive frontier (Bannon 1963). European politics had transferred the Louisiana Territory from French control to the Spaniards and back again. Spain lost and regained Florida. During the same time, the United States had begun turning covetous eyes toward the holdings of other nations on its borders. This ambition intensified after the Louisiana Purchase was completed in 1803, especially because no clear boundary existed between the Louisiana territory and the holdings of Spain in North America (Bannon 1963). This especially caused trouble in Texas and western Florida. Thus, New Mexico again became a defensive frontier, this time against the expansionist designs of the United States.

After Mexico won its independence from Spain in 1821, trade relations were opened with the United States across the Santa Fe Trail. During this period New Mexico served as a port-of-entry through which traders from the United States passed, initially to do business almost exclusively in Santa Fe, and later on their way to conduct their main business further south in the more prosperous Mexican provinces. The Santa Fe trade actually increased communication between New Mexico and New Spain and better defined New Mexico as part of the periphery to the Mexican core, continuing its transformation from frontier status. Though welcoming of the American merchants, the Mexican government remained suspicious of American settlers. Their fears were justified when the United States seized the northern provinces of Mexico during the Mexican War of 1846–1848.

When New Mexico became part of the United States it again became a frontier. The relationship of the United States with surrounding nomadic tribes was different from that of Spain and Mexico. Once again, raids from Plains tribes threatened the region, and New Mexico was a defensive frontier, a role it fulfilled until nearly the end of the nineteenth century.

The Historic Chama–Ojo Caliente Frontier

The historic Chama–Ojo Caliente frontier is much better known and documented than its prehistoric counterpart. As discussed in Chapters 4 and 25, the Chama–Ojo Caliente Valleys remained an unsettled frontier on the edge of Spanish New Mexico until the 1730s. There was probably some sporadic use of the area before that time, both by Spaniards and Pueblos, but there were no documented permanent settlements in the region between its abandonment at the end of the Classic period and the establishment of Spanish settlements in the Ojo Caliente and Chama Valleys in the mid-1730s. The only known exception was a temporary settlement of Tewas that was built during the Pueblo Revolt period, but that village did not last.

The Chama–Ojo Caliente Valleys were settled by people seeking economic opportunities and represent a subfrontier of the New Mexican frontier. Though the region may have been used as a cosmopolitan frontier before the first permanent settlements were founded, this type of use is not well documented and so remains questionable. By founding permanent settlements in the region, the Spaniards created an insular agricultural subfrontier. Like the New Mexican frontier in general, the Chama–Ojo Caliente subfrontier quickly assumed a defensive function in addition to its agricultural function.

The defensive nature of this subfrontier is typified by the number of times settlements in the Chama–Ojo Caliente Valleys were abandoned in response to raids by hostile nomadic Indians and then resettled by order of the government. The lands granted to settlers in the Chama–Ojo Caliente Valleys in the mid-1730s were abandoned in 1748 in response to massive raids by the Comanches (Adams and Chávez 1956; Carrillo 2004; Ebright 1994; Quintana and Snow 1980; Swadesh 1974). The Chama Valley was resettled by Spanish families in 1750 and augmented by a Genízaro settlement in 1754 (Carrillo 2004). That area was again experiencing a gradual abandonment by 1770, but the settlers were ordered to return and build a fortified plaza for defense (Carrillo 2004). Otherwise, the Chama Valley was not again abandoned for defensive reasons.

This was not the case with the Ojo Caliente Valley. Receiving the same order to resettle in 1750 as the Chama Valley settlers, few people returned to the Ojo Caliente Valley. By 1766 most of that area had not yet been resettled, and the land grants reverted to the Crown (Simmons 1968). New land grants were issued, and the Ojo Caliente Valley was resettled in 1768–69 (Adams and Chávez 1956:78; Frank 2000:43). By 1770 the settlers were again being attacked by Comanches and abandoned the region rather than comply with the governor's order to build a defensive plaza instead of living scattered through the valley (Frank 2000; Noyes 1993). It wasn't until after the defeat of the great Comanche war chief Cuerno Verde by Governor Anza and the peace treaty that he negotiated with the Comanches in

1786 that the Ojo Caliente Valley was finally settled by Spaniards on a permanent basis. There were almost certainly settlers at Ojo Caliente before 1790, though formal grants had apparently not been made. A land grant petition in 1790 was not acted upon, because the settlers did not want to leave the homes they had already established and move to an even more exposed location (see Chapter 25). In 1793 the settlers were successful in their efforts to establish a community grant. However, the region remained vulnerable to attack, and from time to time its protection was augmented by a detachment of troops (Simmons 1968:125).

Both valleys were on the Spanish Colonial frontier, and both were initially settled by the same type of people—families looking for new homes that would provide economic security. In both cases, the settlers preferred to live in small homesteads scattered throughout these valleys. They repeatedly failed to form defensive plazas because they preferred to remain near their own lands and livestock. So why were their histories of settlement so different? The main cause was the use of the Ojo Caliente Valley by nomadic Indians as a route for raids against Spanish and Pueblo settlements (Frank 2000:43). Both the Comanches and Kiowas used this route, and it was in their best interests not to allow successful settlement of the valley so that their entrances into and disappearances from Spanish New Mexico would remain unimpeded (Frank 2000:43; Swadesh 1974:40).

Settlements in the Chama and Ojo Caliente Valleys were initially formed because that region represented a chance for the settlers to improve their economic status. This changed after the Comanche attacks of 1747, and the Chama–Ojo Caliente Valley settlements were blatantly used as a defensive frontier, protecting the larger and more important villages in the territorial core (see Chapter 25). This replicated the official function of the New Mexican frontier on a subfrontier. The Chama–Ojo Caliente subfrontier remained defensive in nature until nearly 1790. It is probably no coincidence that permanent settlements again began to be founded in the Ojo Caliente Valley soon after peace was negotiated with the Comanches. The study area probably benefitted from the period of prosperity that accompanied this peace, and the government reforms that occurred at the same time helped expand the economy and attract migrants from elsewhere in New Spain. Reoccupation of the Ojo Caliente Valley was part of the process of expansion out from the core, which resulted in the opening of new frontiers as well as the resettlement of areas abandoned because of hostilities. Though this new frontier continued to have a defensive function, it was mainly economic in nature, providing opportunities for economic improvement to families from the population core.

By the mid-nineteenth century the Ojo Caliente Valley had been transformed from a frontier to a peripheral area, and it remained in that relationship to the core until well into the twentieth century, as can be seen from Goodman's discussion in Chapter 25. While this area no longer formed a defensive bulwark for the more important settlements of the inner province, it remained outside the population and commercial core. This provided some economic alternatives for locals wishing to supplement their income from agricultural pursuits. Thus, small mercantile establishments like the García store sprang up, usually offering a meager return for the effort and going out of business in a few years. A lack of economic choices led many residents to leave the area, some to return after retirement. This type of movement seems to have begun after World War II and has continued to the present day. These processes have led to the demise of the tightly knit Hispanic community of Ojo Caliente. New people are moving in and gentrifying these communities, finally bringing the area into the modern population and economic core.

Comparing the Prehistoric and Historic Frontiers

The Ojo Caliente area began as a frontier during both its prehistoric and historic occupations, but through time it underwent transformation from that function to another during both periods of occupation. The processes involved in each transformation and the trajectories followed during both periods were different and can be compared and contrasted. During both periods of occupation, the Ojo Caliente Valley initially represented an area of economic opportunity. Groups of

Pueblos established small farming communities during the Coalition period. The more successful of those communities continued to grow through the rest of the Coalition period and into the Classic period, which saw a large-scale population influx that quickly brought the region into the economic and population core.

The historic occupation began in a similar fashion—small groups of people looking for economic advantage. However, in this case the region soon metamorphosed into a defensive subfrontier, a line of communities considered more expendable than those in the provincial core. The defensive nature of the historic Chama–Ojo Caliente subfrontier is revealed in the establishment of Genízaro settlements in both valleys (Gutiérrez 1991:305; Quintana and Snow 1980). Traditionally, Genízaros (Christianized, detribalized Indians) were settled to provide a first line of defense against nomadic Indian raids. Thus, the presence of Genízaro settlements in addition to records of numerous nomadic Indian raiders passing through the study area attest to its defensive nature.

Though some of the early Pueblo settlements in the Chama Valley may have been placed in defensive locations, the defensive frontier during that period was on the Pajarito Plateau and in the Rio Grande Valley, as San Juan peoples who had abandoned their homelands moved into the Northern Rio Grande. There is no evidence for movement of these peoples into the Chama–Ojo Caliente region, so a defensive posture was mostly unnecessary in that area. The Chama–Ojo Caliente Valleys were an undisputed internal frontier to the Pueblo peoples who moved into that region. The population, economic, and ritual core was in adjacent areas to the south and southwest. This was completely unlike the historic situation, where settlement on the Chama–Ojo Caliente subfrontier was disputed, and the true population, economic, and ritual core was far distant in Mexico and ultimately Spain. A local core may have developed in the Santa Fe area in the late Spanish Colonial period but could provide little economic or military aid to settlements on its own frontier. During the prehistoric occupation, the Chama–Ojo Caliente area became a refuge for people abandoning the defensive frontier or simply seeking a location with better economic opportunities than their former homes. During the historic period, the core communities of New Mexico provided refuges against the onslaught of nomadic Indians along the Chama–Ojo Caliente frontier. Thus, the direction of population movement was mostly reversed. Prehistoric movement was from a former core into a newly developing core that had until recently been an internal frontier. Historic movement was from a defensive frontier back to the core in response to relentless raiding, then back to the frontier as the raiding tapered off.

Thus, in a 300-year period the prehistoric Chama–Ojo Caliente region went from a sparsely settled internal frontier to a population and ritual core, and was finally abandoned at about the time the Spaniards were establishing their first colony in New Mexico. The region remained empty of permanent settlements for nearly 150 years before Spanish settlers began moving in. However, rather than moving into an internal frontier, as had the prehistoric Pueblo settlers, the Spaniards were moving into a region that was used by nomadic Indians and soon came into conflict with them. In 250 years of historic settlement, the Chama–Ojo Caliente region still remains on the fringe of the population and economic core of New Mexico.

References Cited

Acklen, John C., G. M. Brown, D. G. Campbell, A. C. Earls, M. E. Harlan, S. C. Lent, G. McPherson, and W. N. Trierweiler
1990 *Archaeological Survey Results for the Ojo Line Extension Project.* Vol. 1. Public Service Company of New Mexico Archaeological Report No. 7. Albuquerque.

Acklen, John C., Christopher A. Turnbow, and Dorothy Larson
1997 Conclusions and Recommendations. In *Ole*, vol. 3, *Analysis*, edited by J. Acklen, pp. 285–342. TRC Mariah Associates and Public Service Company of New Mexico, Albuquerque.

Adams, E. Charles
1979 Cold Air Drainage and Length of Growing Season in the Hopi Mesas Area. *The Kiva* 44:285–296.

1991 *The Origin and Development of the Pueblo Katsina Cult*. University of Arizona Press, Tucson.

Adams, Eleanor B., and Fray Angélico Chávez (translators)
1956 *The Missions of New Mexico, 1776: A Description by Fray Francisco Atanasio Domínguez*. University of New Mexico Press, Albuquerque.

Adler, Michael
1994 Population Aggregation and the Anasazi Social Landscape: A View from the Four Corners. In *The Ancient Southwestern Community*, edited by W. Wills and R. Leonard, pp. 85–101. University of New Mexico Press, Albuquerque.

Ahlborn, Richard E.
1968 *The Penitente Moradas of Abiquiu*. Contributions from the Museum of History and Technology, Paper 63. Smithsonian Institution Press, Washington, D.C.

Ahlstrom, Richard V.
1985 *The Interpretations of Archaeological Tree-Ring Dates*. Ph.D. diss., Department of Anthropology, University of Arizona, Tucson.

Albert, Lillian Smith, and Kathryn Kent
1949 *The Complete Button Book*. Doubleday, New York.

Alexander, Robert K.
1964 *Highway Cultural Inventory Project Final Report, 1961–1964*. New Mexico State Highway Department and Museum of New Mexico, Santa Fe.

Allen, Joseph W.
1972 *The Tsogue Highway Salvage Excavations near Tesuque, New Mexico*. Laboratory of Anthropology Notes 73. Museum of New Mexico, Santa Fe.

Allen, Joseph W., and Charles H. McNutt
1955 A Pit House Site near Santa Ana Pueblo, New Mexico. *American Antiquity* 20:241–255.

Anderson, Adrienne
1968 The Archaeology of Mass-Produced Footwear. *Historical Archaeology* 2:56–65.

Anderson, Duane
1999 *All that Glitters: The Emergence of Native American Micaceous Art Pottery in Northern New Mexico*. School of American Research Press, Santa Fe, New Mexico.

Anderson, H. Allen
1985 The Encomienda in New Mexico, 1598–1680. *New Mexico Historical Review* 60:353–377.

Anschuetz, Kurt F.
1998 Not Waiting for the Rain: Integrated Systems of Water Management by Pre-Columbian Pueblo Farmers in North Central New Mexico. Ph.D. diss.,

Department of Anthropology, University of Michigan, Ann Arbor.

Anschuetz, Kurt F., John C. Acklen, and David V. Hill
1997 Prehistoric Overview. In *Ole*, vol. 1, *Context*, edited by J. Acklen, pp. 71–118. TRC Mariah Associates and Public Service Company of New Mexico, Albuquerque.

Anschuetz Kurt F., and Timothy D. Maxwell
1987 Agricultural Intensification and Diversification in the Northern Rio Grande. Paper presented at the Fifty-second Annual Meeting of the Society for American Archaeology, Toronto, Canada.

Anschuetz, Kurt F., Timothy D. Maxwell, and John A. Ware
1985 *Testing Report and Research Design for the Medanales North Project, Rio Arriba County, New Mexico*. Laboratory of Anthropology Notes 347. Museum of New Mexico, Santa Fe.

Anschuetz, Kurt F., and Lonyta Viklund
1996 *A Cultural Resources Inventory Survey of the Proposed College Hills Subdivision, Northwest of Santa Fe, Santa Fe County, New Mexico*. Southwest Archaeological Consultants, Research Series 414. Santa Fe, New Mexico.

Archaeological Conservancy
1996 New Mexico Pueblo Donated. *Archaeological Conservancy Newsletter* (Summer):3.

Athearn, Frederic J.
1974 *Life and Society in Eighteenth-Century New Mexico, 1692–1776*. Ph.D. diss., Department of History, University of Texas at Austin. University Microfilms International No. 74-24, 825, Ann Arbor, Michigan.

Ayer, Mrs. Edward E. (editor)
1916 *The Memorial of Fray Alonso de Benavides, 1630*. Privately printed, Edward E. Ayer, Chicago.

Bailey, Vernon
1971 *Mammals of the Southwestern United States*. Dover Publications, New York.

Bandelier, Adolph F.
1892 *Final Report of Investigations among the Indians of the Southwestern United States, Carried on Mainly in the Years from 1880 to 1885.* Part 2. Papers of the Archaeological Institute of America 4. Cambridge University Press, Cambridge, Massachusetts.

Bannon, John F.
1963 *The Spanish Borderlands Frontier, 1513–1821*. Holt, Rinehart, and Winston, New York. 1974 edition by University of New Mexico Press, Albuquerque.

Barnes, Frank C.
1985 *Cartridges of the World*. Rev. 5th ed. DBI Books, Northfield, Illinois.

Batkin, Jonathan
1987 *Pottery of the Pueblos of New Mexico, 1700 to 1900*. Colorado Springs Fine Arts Center, Colorado Springs.

Baxter, John O.
1987 *Las Carneradas: Sheep Trade in New Mexico, 1700–1860*. University of New Mexico Press, Albuquerque.

1993 Livestock on the Camino Real. In *El Camino Real de Tierra Adentro*, edited by G. Palmer, pp. 101–111. Cultural Resource Series No. 11. New Mexico Bureau of Land Management, Santa Fe.

Beal, John D.
1987 *Foundations of the Rio Grande Classic: The Lower Chama River, A.D. 1300–1500*. Southwest Project No. 137. Southwest Archaeological Consultants, Santa Fe.

Beckner, Morton
1959 *The Biological Way of Thought*. Columbia University, New York.

Berry, Michael S.
1982 *Time, Space, and Transition in Anasazi Prehistory*. University of Utah Press, Salt Lake City.

Bertram, Jack B.
1989 The Abiquiu Obsidian Hydration Study: Its Implications for the Abiquiu Area and for Archaeological Methods and Analytical Techniques. In *Report of Surface Collection and Testing at 18 Sites near Abiquiu Reservoir, Northern New Mexico*, by J. Bertram, J. Schutt, S. Kuhn, A. Earls, W. Trierweiler, C. Lintz, J. Acklen, C. Carrillo, and J. Elyea, pp. 263–304. Mariah Associates, Albuquerque, New Mexico.

Bertram, Jack B., Jeanne A. Schutt, Steven Kuhn, Amy C. Earls, W. Nicholas Trierweiler, Christopher Lintz, John C. Acklen, Charles M. Carrillo, and Janette Elyea
1989 *Report of Surface Collection and Testing at 18 Sites near Abiquiu Reservoir, Northern New Mexico*. Mariah Associates, Albuquerque, New Mexico.

Billington, Ray A.
1963 *America's Frontier Heritage*. Holt, Rinehart, and Winston, New York. 1974 edition by University of New Mexico Press, Albuquerque.

Binford, Lewis R.
1981 *Bones, Ancient Men and Modern Myths*. Academic Press, Albuquerque, New Mexico.

Blee, Catherine
1988 *The Moore Cabin and House: Klondike Gold Rush National Park*. Archaeological Investigations in Skagway, Alaska, vol. 2. USDI National Park Service, Denver.

Blinman, Eric
1988 The Interpretation of Ceramic Variability: A Case Study from the Dolores Anasazi. Ph.D. diss., Department of Anthropology, Washington State University, Pullman.

Boas, Franz
1928 *Keresan Texts*. Publications of the American Ethnological Society 8(1). G. E. Stechert, New York.

Bohrer, Vorsila L., and Karen R. Adams
1977 *Ethnobotanical Techniques and Approaches at Salmon Ruin, New Mexico*. Eastern New Mexico University, Contributions in Anthropology 8(1). Portales.

Bossneck, J.
1970 Osteological Differences between Sheep and Goats. In *Science in Archaeology: A Survey of Progress and Research*, 2nd ed., edited by D. Brothwell and E. Higgs, pp. 331–358. Praeger, New York.

Bowden, J. J.
1969 Private Land Claims in the U.S. M.A. thesis, Southern Methodist University. On file at the Laboratory of Anthropology Library, Museum of New Mexico, Santa Fe.

Boyd, E.
1957 Troubles at Ojo Caliente, a Frontier Post. *El Palacio* 64:347–360.

Boyer, Jeffrey L.
1985 *Plains Electric Cooperative's Hernandez-Taos 115 kV Transmission Line: An Archaeological Inventory Survey*. Contract Archaeology Report No. 8. Kit Carson Memorial Foundation, Taos, New Mexico.

1987 *Frijoles Timber Sale: Cultural Resources Inventory Survey*. Cultural Resources Report No. 1987-02-079-B. Carson National Forest, Taos, New Mexico.

1988 *A Mitigation Plan for Archaeological Sites at Colorado Aggregate Company's Planned Red Hill Scoria Mine*. Report 88-04. Taos, New Mexico.

1997 *Dating the Valdez Phase: Chronometric Re-evaluation of the Initial Anasazi Occupation of North-Central New Mexico*. Archaeology Notes 164. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Boyer, Jeffrey L., Charles A. Hannaford, Guadalupe Martinez, and Adisa Willmer
1994 *Historic Artifact Analysis Standardized Variable and Attribute Codes*. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Boyer, Jeffrey L., and Steven A. Lakatos
1997 Archaeological clearance letter for the Pojoaque South Project, U.S. 84/285, Santa Fe County, New Mexico. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Breternitz, David A.
1966 *An Appraisal of Tree-Ring Dated Pottery in the Southwest*. Anthropological Papers of the University of Arizona No. 10. Tucson.

Brodo, Irwin M., Sylvia D. Sharnoff, and Stephen Sharnoff
2001 *Lichens of North America*. Yale University Press, New Haven.

Brown, David E., editor
1994 *Biotic Communities: Southwestern United States and Northwestern Mexico*. University of Utah Press, Salt Lake City.

Bryan, Kirk
1939 Stone Cultures near Cerro Pedernal and Their Geological Antiquity. *Texas Archeological and Paleontological Society Bulletin* 11:9–45.

Bryan, Kirk, and Julian H. Toulouse Jr.
1943 The San Jose Non-Ceramic Culture and Its Relation to a Puebloan Culture in New Mexico. *American Antiquity* 8:269– 290.

Bugé, David E.
1978 Preliminary Report: 1978 excavations at NM-01-1407, Ojo Caliente, New Mexico. Ms. on file, Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

1979 Preliminary Report: 1979 excavations at Ponsipa-akeri, Ojo Caliente, New Mexico. Ms. on file, Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

1981 Subsistence Strategies in the Chama Region, Northern New Mexico. Paper presented at the 46th Annual Meeting of the Society for American Archaeology, San Diego, California.

1984 Prehistoric Subsistence Strategies in the Ojo Caliente Valley, New Mexico. In *Prehistoric Agricultural Strategies in the Southwest*, edited by S. Fish and P. Fish, pp. 27–34. Arizona State University Anthropological Research Papers No. 33. Tempe.

Bunting, Bainbridge, Thomas Lyons, and Margil Lyons
1983 Penitente Brotherhood Moradas and Their Architecture. In *Hispanic Arts and Ethnohistory in the Southwest*, edited by M. Weigle, pp. 31–79. Ancient City Press, Santa Fe.

Campa, Arthur L.
1979 *Hispanic Culture in the Southwest*. University of Oklahoma Press, Norman.

Carlson, Alvar Ward
1969 New Mexico's Sheep Industry, 1850–1900: Its Role in the History of the Territory. *New Mexico Historical Review* 44:25–49.

Carrillo, Charles M.
1997 *Hispanic New Mexican Pottery: Evidence of Craft Specialization 1790–1890*. LPD Press, Albuquerque.

2004 A History of Santa Rosa de Lima de Abiquiu. In *Adaptations on the Anasazi and Spanish Frontiers: Excavations at Five Sites near Abiquiu, Rio Arriba County, New Mexico*, by J. Moore, J. Boyer, and D. Levine. Archaeology Notes 187. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Casagrande, Joseph B., Stephen I. Thompson, and Philip D. Young
1964 Colonization as a Research Frontier: The Ecuadorian Case. In *Process and Pattern in Culture: Essays in Honor of Julian H. Steward*, edited by R. Manners, pp. 281–325. Aldine Publishing, Chicago.

Champe, Flavia Waters
1983 *The Matachines Dance of the Upper Rio Grande*. University of Nebraska Press, Lincoln.

Chance, David H., and Jennifer V. Chance
1976 *Kanaka Village/Vancouver Barracks, 1974*. Office of Public Archeology Reports in Highway Archaeology No. 3. University of Washington, Seattle.

Chapman, Richard C.
1979 The Archaic Occupation of White Rock Canyon. In *Archeological Investigations in Cochiti Reservoir, New Mexico,* vol. 4, *Adaptive Change in the Northern Rio Grande Valley*, edited by J. Biella and R. Chapman, pp. 61–73. Office of Contract Archeology, University of New Mexico, Albuquerque.

Chapman, Richard C., and Jan V. Biella
1979 A Review of Research Results. In *Archeological Investigations in Cochiti Reservoir, New Mexico,* vol. 4, *Adaptive Change in the Northern Rio Grande Valley*, edited by J. Biella and R. Chapman, pp. 385–406. Office of Contract Archeology, University of New Mexico, Albuquerque.

Chávez, Fray Angélico
1954 The Penitentes of New Mexico. *New Mexico Historical Review* 29:97–123.

Coleman, Sherrard
1895 Plat of the Ojo Caliente Grant, No. 77. Map and field notes on file at the USDI Bureau of Land Management, Santa Fe.

Condie, Carol J.
1987 The Nighthawk Site (LA 5685), a Pithouse Site on Sandia Pueblo Land, Sandoval County, New Mexico. In *Secrets of a City: Papers on Albuquerque Area Archaeology in Honor of Richard A. Bice,* edited by A. Poore and J. Montgomery, pp. 63–76. Archaeological Society of New Mexico Papers No. 13. Albuquerque.

1996 The Third Pithouse at the Nighthawk Site (LA 5685). In *La Jornada: Papers in Honor of William F. Turney*, edited by M. Duran and D. Kirkpatrick, pp. 109–227. Archaeological Society of New Mexico Papers No. 22. Albuquerque.

Condie, Carol J., and Landon D. Smith
1989 *Data Recovery from Seven Archaeological Sites at a Proposed Scoria Mine on Red Hill, Rio Arriba County, New Mexico, for Colorado Aggregate Company*. Quivira Research Center Publications 148. Quivira Research Center, Albuquerque.

Connor, Seymour V., and Jimmy M. Skaggs
1977 *Broadcloth and Britches: The Santa Fe Trade*. Texas A&M University Press, College Station.

Cordell, Linda S.
1975 Predicting Site Abandonment at Wetherill Mesa. *The Kiva* 40:189–202.

1978 *Cultural Resources Overview: Middle Rio Grande Valley, New Mexico*. Government Printing Office, Washington, D.C.

1979 Prehistory: Eastern Anasazi. In *Handbook of North American Indians*, vol. 9, edited by A. Ortiz, pp. 131–151. Smithsonian Institution, Washington, D.C.

Corey, A. T., and W. D. Kemper
1968 *Conservation of Soil Water by Gravel Mulches*. Hydrology Papers No. 30. Colorado State University, Fort Collins.

Covey, Cyclone (editor)
1990 *Adventures in the Unknown Interior of America*. University of New Mexico Press, Albuquerque. Originally published in 1961.

Cox, G. W.
1975 *Laboratory Manual of General Ecology*. William C. Brown, Dubuque, Iowa.

Crabtree, Don E.
1972 *An Invitation to Flintworking*. Occasional Papers of the Idaho State Museum No. 28. Pocatello.

Crown, Patricia L., Janet D. Orcutt, and Timothy A. Kohler
1996 Pueblo Cultures in Transition: The Northern Rio Grande. In *The Prehistoric Pueblo World, A.D. 1150–1350*, edited by M.

Adler, pp. 188–204. University of Arizona Press, Tucson.

Curry, David, and (no name) Jones
1882 Field notes of survey of Ojo Caliente Grant. On file at USDI Bureau of Land Management, Santa Fe.

DeBruin, Ellen
2000 Lichen collection from El Malpais National Monument, USDI National Park Service. University of New Mexico Herbarium, Albuquerque.

de Cordova, Lorenzo
1972 *Echoes of the Flute*. Ancient City Press, Santa Fe.

Deiss, Ronald William
1981 *The Development and Application of a Chronology for American Glass*. Midwestern Archaeological Research Center, Illinois State University, New Holland.

Devereaux, Don
1966 The Re-Location of a Pueblo Emergence Shrine. *El Palacio* 73(4):21–26.

Dick, Herbert W.
1968 Six Historic Pottery Types from Spanish Sites in New Mexico. In *Collected Papers in Honor of Lyndon L. Hargrave*, edited by A. Schroeder, pp. 77–94. Papers of the Archaeological Society of New Mexico No. 1. Museum of New Mexico Press, Santa Fe.

Dickson, Bruce D.
1979 *Prehistoric Pueblo Settlement Patterns: The Arroyo Hondo, New Mexico, Site Survey*. Arroyo Hondo Archaeological Series, vol. 2. School of American Research Press, Santa Fe.

Dittert, Alfred E., Jr., Jim J. Hester, and Frank W. Eddy
1961 *An Archaeological Survey of the Navajo Reservoir District, Northwestern New Mexico*. Monographs of the School of American Research and the Museum of New Mexico 23. Santa Fe.

Doleman, William H.
1996 *Archeological Survey of the Southern Caja del Rio: Class III Inventory of a Portion of the Camel Tracks Training Area*. OCA/UNM Report No. 185-548. Office of Contract Archeology, University of New Mexico, Albuquerque.

Doolittle, Grayson
1973 Culture and Environment in the Cumberland Frontier. In *Papers in Anthropology* 14(1):31–43. University of Oklahoma, Norman.

Douglass, William B.
1912 A World-Quarter Shrine of the Tewa Indians. *Records of the Past* 11(4):159–173.

1917 Notes on the Shrines of the Tewa and Other Pueblo Indians of New Mexico. In *Proceedings of the Nineteenth International Congress of Americanists*, pp. 344–378. Washington, D.C.

1922 Boundary Survey of the Ojo Caliente Grant (map includes section subdivisions made by Curry and Jones in 1882). Map and field notes on file at the USDI Bureau of Land Management, Santa Fe.

Duffus, R. L.
1930 *The Santa Fe Trail*. Reprint, 1972, University of New Mexico Press, Albuquerque.

Dutton, Bertha P.
1963 *Sun Father's Way: The Kiva Murals of Kuaua, a Pueblo Ruin, Coronado State Monument, New Mexico*. University of New Mexico Press, Albuquerque.

Ebright, Malcolm
1994 *Land Grants and Lawsuits in Northern New Mexico*. University of New Mexico Press, Albuquerque.

Edwards, Frank S.
1847 *A Campaign in New Mexico with Colonel Doniphan*. Reprint, 1996, University of New Mexico Press, Albuquerque.

Ellis, Florence H.
1969 Differential Pueblo Specialization in Fetishes and Shrines. *Anales del Instituto Nacional de Anthropología e Historia, 1967–1968*, pp. 159–180. Septima Epocha, Mexico City.

1970 Irrigation and Water Works in the Rio Grande. Paper presented at the Water Control Symposium, 1970 Pecos Conference.

1975 Life in the Tesuque Valley and Elsewhere in the Santa Fe Area during the Pueblo II Stage of Development. *Awanyu* 3(2):27–49.

1987 The Long Lost "City" of San Gabriel del Yunque, Second Oldest European Settlement in the United States. In *When Cultures Meet: Remembering San Gabriel del Yunque Oweenge*, pp. 10–38. Sunstone Press, Santa Fe.

1994 Pueblo Religious Patterns, Especially Types of Shrines and Areas for Collecting Herbs and Other Religious Necessities. In *Artifacts, Shrines, and Pueblos: Papers in Honor of Gordon Page*, edited by M. Duran and D. Kirkpatrick, pp. 101–112. Archaeological Society of New Mexico 20. Albuquerque.

Ellis, Richard N. (editor)
1971 *New Mexico Past and Present*. University of New Mexico Press, Albuquerque.

Elmore, Francis H., and Jeanne R. Janish
1976 *Shrubs and Trees of the Southwest Uplands*. Southwest Parks and Monuments Association, Tucson.

Espinosa, J. Manuel
1988 *The Pueblo Indian Revolt of 1696*. University of Oklahoma Press, Norman.

Evaskovich, John A., R. W. Coleman, R. A. Anduze, E. T. Crollett, R. Dello-Russo, J. C. Acklen, K. J. Roxlau, R. W. Lang, M. F. Kemrer, D. J. Larson, R. Loehman, and D. G. Campbell
1997 Cañones Mesa Geoarchaeological Unit. In *Ole*, vol. 1, *Context*, edited by J. Acklen, pp. 199–462. TRC Mariah Associates and Public Service Company of New Mexico, Albuquerque.

Fairbourn, Merle
1973 Effect of Gravel Mulch on Crop Yields. *Agronomy Journal* 65:925–928.

Fallon, Denise
1987 Archaeological History of the Northern Rio Grande. In *Howiri: Excavation at a Northern Rio Grande Biscuit Ware Site*, by D. Fallon and K. Wening, pp. 9–12. Laboratory of Anthropology Notes 261b. Museum of New Mexico, Santa Fe.

Fallon, Denise, and Karen Wening
1987 *Howiri: Excavation at a Northern Rio Grande Biscuit Ware Site*. Laboratory of Anthropology Notes 261b. Museum of New Mexico, Santa Fe.

Fenneman, Nevin M.
1931 *Physiography of the Western United States*. McGraw-Hill, New York.

Fewkes, Jesse W.
1906 Hopi Shrines near the East Mesa, Arizona. *American Anthropologist* 8:346–375.

Fiedel, Stuart J.
1999 Older than We Thought: Implications of Corrected Dates for Paleoindians. *American Antiquity* 64:95–115.

Fiero, Kathleen
1978 *Prehistoric Garden Plots along the Lower Rio Chama Valley: Archeological Investigations at Sites LA 11830, LA 11831, and LA 11832, Rio Arriba County, New Mexico*. Laboratory of Anthropology Notes 111E. Museum of New Mexico, Santa Fe.

Findley, James S., Arthur H. Harris, Don E. Wilson, and Clyde Jones
1975 *Mammals of New Mexico*. University of New Mexico Press, Albuquerque.

Fisher, John W.
1995 Bone Surface Modifications in Zooarchaeology. *Journal of Archaeological*

Method and Theory 2:7–68.

Forbes, Jack D.
1960 *Apache, Navajo, and Spaniard*. University of Oklahoma Press, Norman.

Frank, Ross H.
1992 *From Settler to Citizen: Economic Development and Cultural Change in Late Colonial New Mexico, 1750–1820*. Ph.D. diss., Department of History, University of California at Berkeley. University Microfilms International, Ann Arbor, Michigan.

2000 *From Settler to Citizen: New Mexican Economic Development and the Creation of Vecino Society, 1750–1820*. University of California Press, Berkeley.

Franklin, Hayward H.
1992 Survey and Testing Ceramics from Tesuque Pueblo. Ms. on file at Quivira Research Center, Albuquerque, New Mexico.

1997 Valencia Pueblo Ceramics. In *Excavations at Valencia Pueblo (LA 953) and a Nearby Hispanic Settlement (LA 67321), Valencia County, New Mexico*, edited by K. Brown and B. Vierra, pp. 125–257. Office of Contract Archeology Report No. 185-400F. University of New Mexico, Albuquerque.

Gabin, Vickie L., and Lee E. Lesperance
1977 *New Mexico Climatological Data: Precipitation, Temperature, Evaporation, and Wind, Monthly and Annual Means, 1850–1975*. W. K. Summers, Socorro.

Galusha, Ted
1974 Dating Rocks of the Santa Fe Group: Programs and Problems. In *Silver Anniversary Guidebook, Ghost Ranch: Twenty-fifth Field Conference of the New Mexico Geological Society*, edited by C. Siemers, L. Woodward, and J. Callender, pp. 283–286. New Mexico Geological Society.

Gladwin, H. S.
1945 The Chaco Branch Excavations at White Mound and in the Red Meas Valley. *Medallion Paper* 38. Gila Pueblo, Arizona.

Glover, Vernon J., and John McCall
1988 The Santa Fe Railway. In *Pecos: Gateway to Pueblos and Plains*, edited by J. Bezy and J. Sanchez, pp. 112–117. Southwest Parks and Monuments Association, Tucson.

Goldfrank, Ester S.
1927 *The Social and Ceremonial Organization of Cochiti*. Memoirs of the Society for American Archaeology 33. Menasha, Wisconsin.

González, Nancie L.
1969 *The Spanish-Americans of New Mexico: A Heritage of Pride*. University of New Mexico Press, Albuquerque.

Goodman, Linda
1993 The Ethnohistory Program. In *Archaeological Tests and Ethnohistoric Research at LA 74220, an Early Twentieth-Century Sheep Camp near Ocate, Mora County, New Mexico*. Archaeology Notes 95. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1996 Ethnohistorical field notes for Gavilan Project (41.6131), on file at the Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1998 Ethnohistorical field notes for Gavilan Project (41.6131), on file at the Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2000 Ethnohistorical field notes for Gavilan Project (41.6131), on file at the Office of Archaeological Studies. Museum of New Mexico, Santa Fe.

Gottfried, Gerald J., Thomas W. Swetnam, Craig D. Allen, Julio L. Betancourt, and Alice L. Chung-MacCoubrey
1995 Pinyon-Juniper Woodlands. In *Ecology, Diversity, and Sustainability of the Middle Rio*

Grande Basin, edited by D. Finch and J. Tainter, pp. 95–132. Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-GTR-268. USDA Forest Service, Fort Collins, Colorado.

Grant, Blanche C.
1925 *The Taos Indians*. Reprint, 1976. Rio Grande Press, Glorieta, New Mexico.

Greenlee, Robert
n.d. Archaeological Sites in the Chama Valley and Report on Excavations at Tsama, 1929–1933. Ms. on file, Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

Gregg, Josiah
1844 *The Commerce of the Prairies*. 1954 edition, edited by M. Moorhead. University of Oklahoma Press, Norman.

Griffin, William W., and William McMullen
1878 Original Survey and Supplemental Survey of Private Land Claim No. 77, the Ojo Caliente Grant. Map and field notes on file at the USDI Bureau of Land Management, Santa Fe, New Mexico.

Gutiérrez, Ramón A.
1991 *When Jesus Came, the Corn Mothers Went Away*. Stanford University Press, Stanford, California.

Habicht-Mauche, Judith A.
1993 *The Pottery from Arroyo Hondo Pueblo, New Mexico: Tribalization and Trade in the Northern Rio Grande*. School of American Research Press, Santa Fe.

Hacker, Leroy W., and Joseph O. Carleton
1982 *Soil Survey of Taos County and Parts of Rio Arriba and Mora Counties, New Mexico*. USDA Soil Conservation Service and Forest Service and USDI Bureau of Indian Affairs and Bureau of Land Management in cooperation with the New Mexico Agricultural Experiment Station. Government Printing Office, Washington, D.C.

Hackett, Charles W. (editor)
1937 *Historical Documents relating to New Mexico, Nueva Vizcaya, and Approaches Thereto, to 1773*. Vol. 3. Translated by A. Bandelier and F. Bandelier. Carnegie Institution, Washington, D.C.

Hammack, Nancy S., Alan Ferg, and Bruce Bradley
1983 *Excavations at Three Developmental Period Sites near Zia and Santa Ana Pueblos, New Mexico*. CASA Papers No. 2. Complete Archaeological Service Associates, Cortez, Colorado.

Hammond, George P., and Agapito Rey
1953 *Don Juan de Oñate, Colonizer of New Mexico, 1595–1628*. Vols. 1 and 2. University of New Mexico Press, Albuquerque.

1966 *The Rediscovery of New Mexico, 1580–1594: The Explorations of Chamuscado, Espejo, Castaño de Sosa, Morlete, and Leyva de Bonilla and Humana*. University of New Mexico Press, Albuquerque.

Hargrave, Lyndon L.
1972 *Comparative Osteology of the Chicken and American Grouse*. Prescott College Studies in Biology, No. 1. Prescott College Press, Prescott, Arizona.

Harlow, Francis H.
1973 *Matte-Paint Pottery of the Tewa, Keres, and Zuni Pueblos*. Museum of New Mexico Press, Santa Fe.

Harrington, John P.
1916 *The Ethnogeography of the Tewa Indians*. Twenty-ninth Annual Report of the Bureau of American Ethnology. Government Printing Office, Washington, D.C.

n.d. Handwritten notes. Box 46, Hewett Collection. Angélico Chávez History Library, Museum of New Mexico, Santa Fe.

Hayes, Alden C.
1964 *The Archeological Survey of Wetherill Mesa, Mesa Verde National Park, Colorado*. USDI

National Park Service, Washington, D.C.

1981 A Survey of Chaco Canyon Archeology. In *Archeological Surveys of Chaco Canyon*, by A. Hayes, D. Brugge, and W. Judge, pp. 1–68. Publications in Archeology 18A. USDI National Park Service, Washington, D.C.

Hayes, Alden C., Jon N. Young, and A. Helene Warren
1981 *Excavation of Mound 7, Gran Quivira National Monument, New Mexico*. USDI National Park Service, Publications in Archaeology 16. Government Printing Office, Washington, D.C.

Haynes, C. Vance, Jr.
1980 The Clovis Culture. *Canadian Journal of Anthropology* 1(1):115–121.

Hendricks, Rick, and John P. Wilson
1996 *The Navajos in 1705: Roque Madrid's Campaign Journal*. University of New Mexico Press, Albuquerque.

Hewett, Edgar L.
1905 Field notes of Edgar Lee Hewett, New Mexico, 1905, expedition for Smithsonian Institution: Santa Fe, Otowi, Chama Valley. Ms. on file at the Hewett Collection, Box 46, Fray Angélico Chávez History Library, Santa Fe.

1906 *Antiquities of the Jemez Plateau, New Mexico*. Bureau of American Ethnology Bulletin 32. Smithsonian Institution, Washington, D.C.

1930 *Ancient Life in the American Southwest*. Bobbs-Merrill, Indianapolis.

1938 *Pajarito Plateau and Its Ancient People*. Handbooks of Archaeological History. University of New Mexico Press, Albuquerque.

1953 *Pajarito Plateau and Its Ancient People*. School of American Research and University of New Mexico Press, Albuquerque.

Hewett, Edgar L., and Bertha P. Dutton
1945 *The Pueblo Indian World*. University of New Mexico and School of American Research, Albuquerque and Santa Fe.

Hibben, Frank C.
1937 Excavation of the Riana Ruin and Chama Valley Survey. *University of New Mexico Bulletin,* Anthropological Series 2(1):1–50. University of New Mexico, Albuquerque.

Hodge, Frederick W., George P. Hammond, and Agapito Rey
1945 *Fray Alonso de Benavides' Revised Memorial of 1634*. University of New Mexico Press, Albuquerque.

Holliday, Vance T.
1997 *Paleoindian Geoarchaeology of the Southern High Plains*. University of Texas Press, Austin.

Holmes, Barbara E.
1989 *American Indian Use of El Malpais*. Zuni Archaeological Program Report No. 302. Zuni, New Mexico.

Honea, Kenneth H.
1971 LA 356: La Bolsa Site. In *Salvage Archaeology in the Galisteo Dam and Reservoir Area, New Mexico*. Museum of New Mexico, Santa Fe.

Hurt, Wesley R., and Herbert Dick
1946 Spanish-American Pottery from New Mexico. *El Palacio* 53:280–288, 307–312.

Irwin-Williams, Cynthia
1973 *The Oshara Tradition: Origins of Anasazi Culture*. Eastern New Mexico University, Contributions in Anthropology 5(1). Portales.

1979 Post-Pleistocene Archeology, 7000–2000 B.C. In *Handbook of North American Indians*, vol. 9, edited by A. Ortiz, pp. 31–42. Smithsonian Institution Press, Washington, D.C.

Irwin-Williams, Cynthia, and S. Tompkins
1968 *Excavations at En Medio Rock Shelter, New*

Mexico. Eastern New Mexico University, Contributions in Anthropology 1(2). Portales.

Israel, Fred L. (editor)
1968 *1897 Sears Roebuck Catalog*. Chelsea House Publishers, New York.

Ivey, James E.
1993 Seventeenth Century Mission Trade on the Camino Real. In *El Camino Real de Tierra Adentro*, compiled by G. Palmer, J. Piper, and L. Jacobson, pp. 41–67. New Mexico Bureau of Land Management Cultural Resources Series No. 11. Albuquerque.

Jeançon, Jean A.
1911 Explorations in Chama Basin, New Mexico. *Records of the Past* 10:92–100.

1923 *Excavations in the Chama Valley, New Mexico*. Bureau of American Ethnography Bulletin 81. Washington, D.C.

Jenkins, Myra Ellen
n.d. Land Tenure and Irrigation in the Rio Ojo Caliente System to 1850. Ca. 1991. Ms. held by John Ware.

Kelley, Klara
1988 *Archeological Investigations in West-Central New Mexico*. Vol. 2, *Historic Cultural Resources*. New Mexico Bureau of Land Management, Cultural Resources Series No. 4. Santa Fe.

Kelley, Vincent C.
1979 Geomorphology of Española Basin. In *Guidebook of Santa Fe Country: Thirtieth Field Conference of the New Mexico Geological Society*, edited by R. Ingersoll, L. Woodward, and H. James, pp. 281–288. New Mexico Geological Society.

Kelly, Robert L.
1988 The Three Sides of a Biface. *American Antiquity* 53:717–734.

Kennedy, Michael D.
1998 *Archaeological Investigations of Five Sites in the Santa Fe National Cemetery, Santa Fe, New Mexico*. Rio Grande Consultants, Albuquerque.

Kessell, John L., Rick Hendricks, and Meredith D. Dodge
1998 *Blood on the Boulders: The Journals of don Diego de Vargas, New Mexico, 1694–97*. Vol. 1. University of New Mexico Press, Albuquerque.

Kidder, Alfred V., and Charles A. Amsden
1931 *The Pottery of Pecos*. Vol. 1, *The Dull-Paint Wares*. Papers of the Southwestern Expedition, No. 5. Yale University Press, New Haven.

Kidder, Alfred V., and Anna O. Shepard
1936 *The Pottery of Pecos*. Vol. 2, *Glaze Paint, Culinary, and Other Wares*. Papers of the Phillips Academy No. 7. New Haven.

Kincaid, Chris (editor)
1983 *Chaco Roads Project, Phase 1: A Reappraisal of Prehistoric Roads in the San Juan Basin, 1983*. USDI Bureau of Land Management, Albuquerque.

Kincaid, Chris, John R. Stein, and Daisy F. Levine
1983 Road Verification Summary. In *Chaco Roads Project, Phase 1: A Reappraisal of Prehistoric Roads in the San Juan Basin, 1983*, edited by C. Kincaid, pp. 9-1 to 9-78. USDI Bureau of Land Management, Albuquerque.

Kinnaird, Lawrence
1958 *The Frontiers of New Spain, Nicolas de Lafora's Description, 1766–1768*. Quivira Society Publications 13. Berkeley, California.

Knowlton, Clark S.
1969 Changing Spanish-American Villages of Northern New Mexico. *Sociology and Research Journal* 53:455–474.

Kohler, Timothy A. (editor)
1990 *Bandelier Archaeological Excavation Project: Summer 1989 Excavations at Burnt Mesa Pueblo*. Reports of Investigations 62. Department of Anthropology, Washington

State University, Pullman.

Kopytoff, Igor
1987 The Internal African Frontier: The Making of African Political Culture. In *The African Frontier: The Reproduction of Traditional African Societies*, edited by I. Kopytoff, pp. 3–84. Indiana University Press, Bloomington.

Kutsche, Paul, and Dennis Gallegos
1979 Community Functions of the Cofradía de Nuestro Padre Jesús Nazareno. In *The Survival of Spanish American Villages*, edited by Paul Kutsche, pp. 91–98. Colorado College Studies, No. 15. Colorado Springs.

Kutsche, Paul, and John R. Van Ness
1981 *Cañones: Values, Crisis, and Survival in a Northern New Mexico Village*. Sheffield Publishing, Salem, Wisconsin.

Lang, Richard W.
1977 *Archaeological Survey of the Upper San Cristobal Arroyo Drainage, Galisteo Basin, Santa Fe County, New Mexico*. School of American Research, Santa Fe.

1979 *An Archaeological Survey near the Confluence of the Chama and Ojo Caliente Rivers, Rio Arriba County, New Mexico*. Contract Archeology Division, Report 065. School of American Research, Santa Fe.

1980 *Archeological Investigations at a Pueblo Agricultural Site, and Archaic and Puebloan Encampments on the Rio Ojo Caliente, Rio Arriba County, New Mexico*. Contract Archeology Division, Report 007. School of American Research, Santa Fe.

1992 *Archaeological Excavations at Dos Gregios, Upper Cañada de los Alamos, Santa Fe County, New Mexico: Archaic through Pueblo V*. Southwest Archaeological Consultants, Research Series 283. Santa Fe.

1993 *The Sierra del Norte Sites: Processing and Use at Flint Quarries of the Lower Santa Fe Range, New Mexico.* Southwest Archaeological Consultants, Research Series 241. Santa Fe.

1995 *Investigations of Limited Activity Sites at Bishop's Lodge in the Santa Fe Foothills*. Southwest Archaeological Consultants, Research Series 284. Santa Fe.

1997 Ceramics from Archaeological Sites in the Vicinity of the Jemez Mountains: The Ole Corridor. In *Ole,* vol. 2, *Artifacts*, edited by J. Acklen, pp. 231–276. TRC Mariah Associates, Albuquerque.

Lang, Richard W., and Cherie L. Scheick
1989 *Limited Excavations at LA 2, the Agua Fria Schoolhouse Site, Agua Fria Village, Santa Fe County, New Mexico*. Southwest Archaeological Consultants, Research Series 216. Santa Fe.

Lange, Charles H.
1968 *Cochiti Dam Archaeological Salvage Project, Part 1: Report on the 1963 Season*. Museum of New Mexico Research Records No. 6. Santa Fe.

Lange, Charles H., Carroll L. Riley, and Elizabeth M. Lange (editors)
1975 *The Southwestern Journals of Adolph F. Bandelier: 1885–1888*. University of New Mexico Press, Albuquerque.

Larson, Dorothy L., and Robert Dello-Russo
1997 Site Structure. In *Ole*, vol. 3, *Analysis*, edited by J. Acklen, pp. 1–76. TRC Mariah Associates and Public Service Company of New Mexico, Albuquerque.

Laumbach, Karl W.
1980 Lithic Artifacts. In *Prehistory and History of the Ojo Amarillo*, vol. 3, edited by D. Kirkpatrick, pp. 849–958. New Mexico State University Cultural Resources Management Division Report No. 276. Las Cruces.

Lent, Stephen C.
1991 *The Excavation of a Late Archaic Pit Structure near Otowi, San Ildefonso Pueblo, New Mexico.* Archaeology Notes 52. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Lent, Stephen C., and Linda J. Goodman
1992 *Archaeological Testing and a Brief Ethnohistory of San Gabriel de Yunge Owinge, San Juan Pueblo, New Mexico*. Archaeology Notes 102. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Levine, Daisy F.
1997 *A Cultural Resource Inventory of Additional Right of Way along U.S. 285 South of Ojo Caliente*. NMSHTD Report 97-23. Environmental Section/Preliminary Design Bureau, New Mexico State Highway and Transportation Department, Santa Fe.

Levine, Frances E., John C. Acklen, Jack B. Bertram, Stephen C. Lent, and Gale McPherson
1985 *Archeological Excavations at LA 16769*. Archeological Report No. 5. Public Service Company of New Mexico, Albuquerque.

Lewis, Kenneth E.
1973 An Archaeological Consideration of the Frontier. In *Papers in Anthropology* 14(1):84–103. University of Oklahoma, Norman.

1977 Sampling the Archeological Frontier: Regional Models in Historical Archeology. In *Research Strategies in Historical Archeology*, edited by S. South, pp. 151–201. Academic Press, New York.

1984 *The American Frontier: An Archaeological Study of Settlement Pattern and Process*. Academic Press, Orlando.

1985 Functional Variation among Settlements on the South Carolina Frontier: An Archaeological Perspective. In *The Archaeology of Frontiers and Boundaries*, edited by S. Green and S. Perlman, pp. 251–274. Academic Press, San Diego.

Lief, Alfred
1965 *A Close-Up of Closures: History and Progress*. Glass Container Manufacturers Institute, New York.

Lightfoot, Dale R.
1990 The Prehistoric Pebble-Mulched Fields of the Galisteo Anasazi: Agricultural Innovation and Adaptation to Environment. Ph.D. diss., Department of Geography, University of Colorado, Boulder.

1993 The Cultural Ecology of Puebloan Pebble-Mulch Gardens. *Human Ecology* 21(2):115–143.

Luebben, Ralph A.
1951 The Leaf Water Site, Chama Valley, New Mexico. M.A. thesis, Department of Anthropology, University of New Mexico, Albuquerque.

1953 Leaf Water Site. In *Salvage Archaeology in the Chama Valley*, assembled by F. Wendorf, pp. 9–33. Monographs of the School of American Research 17. Santa Fe, New Mexico.

Lyman, Lee
1994 *Vertebrate Taphonomy*. Cambridge University Press, Cambridge, Massachusetts.

Marshall, Larry G.
1989 Bone Modification and the Laws of Burial. In *Bone Modification,* edited by R. Bonnichsen and M. Sorg, pp.7–24. Center for the Study of the First Americans, Institute for Quaternary Studies, University of Maine, Orno.

Marshall, Michael P.
1995 *A Cultural Resource Survey for the U.S. Highway 285 Improvement Projects in the Ojo Caliente Valley, Rio Arriba and Taos Counties, New Mexico*. Cibola Research Report No. 111. Cibola Research Consultants, Albuquerque.

1997 The Chaco Roads: A Cosmological Interpretation. In *Anasazi Architecture and American Design*, edited by B. Morrow and V. Price, pp. 62–74. University of New Mexico Press, Albuquerque.

Marshall, Michael P., John R. Stein, Richard W. Loose, and Judith E. Novotny
1979 *Anasazi Communities of the San Juan Basin*.

Public Service Company of New Mexico and New Mexico State Historic Preservation Division, Albuquerque.

Marshall, Michael P., and Henry J. Walt
1984 *Rio Abajo: Prehistory and History of a Rio Grande Province*. New Mexico State Historic Preservation Division, Santa Fe.

Matson, R. G.
1991 *The Origins of Southwestern Agriculture*. University of Arizona Press, Tucson.

Maxwell, Timothy D.
2000 Looking for Adaptation: Engineering Analysis of Prehistoric Agricultural Technologies and Techniques in the Southwest. Ph.D. diss., Department of Anthropology, University of New Mexico, Albuquerque.

Maxwell, Timothy D., and Kurt F. Anschuetz
1992 The Southwestern Ethnographic Record and Prehistoric Agricultural Diversity. In *Gardens in Prehistory: The Archaeology of Settlement Agriculture in Greater Mesoamerica*, edited by T. Killon, pp. 35–68. University of Alabama Press, Tuscaloosa.

May, S. Judson
1979 Neogene Stratigraphy and Structure of the Ojo Caliente–Rio Chama Area, Española Basin, New Mexico. In *Guidebook of Santa Fe Country: Thirtieth Field Conference of the New Mexico Geological Society*, edited by R. Ingersoll, L. Woodward, and H. James, pp. 83–88. New Mexico Geological Society.

McKenna, Peter J., and Judith Miles
1990 Ceramic Manual for the Bandelier Archaeological Survey. Ms. on file, Bandelier National Park, New Mexico.

McNutt, Charles H.
1969 *Early Puebloan Occupations at Tesuque Bypass and in the Upper Rio Grande Valley*. Anthropological Papers No. 40. Museum of Anthropology, University of Michigan, Ann Arbor.

Mensel, Macy
in prep.
Ceramics. In Ojo Caliente report, edited by John Ware. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Mera, H. P.
1932 *Wares Ancestral to Tewa Polychrome*. Laboratory of Anthropology Technical Series, Bulletin No. 4. Museum of New Mexico, Santa Fe.

1933 *A Proposed Revision of the Rio Grande Paint Sequence*. Laboratory of Anthropology Technical Series, Bulletin No. 5. Museum of New Mexico, Santa Fe.

1934 *A Survey of the Biscuit Ware Area in Northern New Mexico*. Laboratory of Anthropology Technical Series, Bulletin No. 6. Museum of New Mexico, Santa Fe.

1935 *Ceramic Clues to the Prehistory of North Central New Mexico*. Laboratory of Anthropology Technical Series, Bulletin No. 8. Santa Fe, New Mexico.

1940 *Population Changes in the Rio Grande Glaze Paint Area*. Laboratory of Anthropology Technical Series, Bulletin No. 19. Santa Fe, New Mexico.

Miller, John P., and Fred Wendorf
1955 Alluvial Chronology of the Tesuque Valley, New Mexico. *Journal of Geology* 66.

Miller, Robert Ryan (translator)
1975 New Mexico in Mid-Eighteenth Century: A Report Based on Governor Vélez Cachupín's Inspection. *Southwestern Historical Quarterly* 79:166–181.

Mindeleff, Victor
1891 *A Study of Pueblo Architecture in Tusayan and Cibola*. Eighth Annual Report of the Bureau of American Ethnology, pp. 3–228. Reprint, 1989, Smithsonian Institution, Washington, D.C.

Moore, James L.
1980 Archaic Settlement and Subsistence. In

Human Adaptations in a Marginal Environment: The UII Mitigation Project, edited by J. Moore and J. Winter, pp. 358–381. Office of Contract Archeology, University of New Mexico, Albuquerque.

1981 *Prehistoric Water and Soil Conservation in the Middle Puerco River Valley*. Laboratory of Anthropology Notes 501. Museum of New Mexico, Santa Fe.

1992 *Archaeological Testing at Three Sites West of Abiquiu, Rio Arriba County, New Mexico*. Archaeology Notes 33. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1994 Chipped Stone Artifact Analysis. In *Studying the Taos Frontier: The Pot Creek Data Recovery Project*, by J. Boyer, J. Moore, D. Levine, L. Mick-O'Hara, and M. Toll, pp. 287–338. Archaeology Notes 68. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1999a Projectile Points. In *Archaeology of the Mogollon Highlands: Settlement Systems and Their Adaptations*, vol. 3, *Analysis of Chipped and Ground Stone Artifacts*, edited by Y. Oakes and D. Zamora, pp. 25–82. Archaeology Notes 232. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1999b Chipped Stone Reduction: Debitage and Cores. In *Archaeology of the Mogollon Highlands: Settlement Systems and Their Adaptations*, vol. 3, *Analysis of Chipped and Ground Stone Artifacts*, edited by Y. Oakes and D. Zamora, pp. 129–176. Archaeology Notes 232. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2001a *Prehistoric and Historic Occupation of Los Alamos and Guaje Canyons: Data Recovery at Three Sites near the Pueblo of San Ildefonso*. Archaeology Notes 244. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2001b Analysis of the Chipped Stone Assemblages. In *Chipped Stone Material Procurement and Use: Data Recovery Investigations along NM 522, Taos County, New Mexico*, by J. Boyer and J. Moore, pp. 47–72. Archaeology Notes 292. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2003 *Historic Occupation of the Glorieta Valley in the Seventeenth and Nineteenth Centuries: Excavations at LA 76138, LA 76140, and LA 99029*. Archaeology Notes 262. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moore, James L., Jeffrey L. Boyer, and Daisy F. Levine

2004 Trujillo House (LA 59658). In *Adaptations on the Anasazi and Spanish Frontiers: Excavations at Five Sites near Abiquiu, Rio Arriba County, New Mexico*. Archaeology Notes 187. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moore, James L., and Daisy F. Levine

1987 *An Archaeological Survey of Proposed Adjustments and Realignments to State Road 4, Santa Fe County, New Mexico*. Laboratory of Anthropology Notes 408. Museum of New Mexico, Santa Fe.

1994 LA 71189. In *Studying the Taos Frontier: The Pot Creek Data Recovery Project*, vol. 1, *Excavation*, by J. Boyer, J. Moore, D. Levine, L. Mick-O'Hara, and M. Toll, pp. 231–240. Archaeology Notes 68. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Moorhead, Max L.

1958 *New Mexico's Royal Road: Trade and Travel on the Chihuahua Trail*. University of Oklahoma Press, Norman.

Morley, Sylvanus G.

1910a Ojo Caliente Journal: Rio Grande Expedition, June 1910. Ms. on file, Hewett Collection Box 45, Fray Angélico Chávez History Library, Santa Fe.

1910b Journal. Rio Grande Expedition. 1910. Ms.

on file, Hewett Collection Box 46, Fray Angélico Chávez History Library, Santa Fe.

Nelson, Nels C.
1914 *Pueblo Ruins of the Galisteo Basin, New Mexico*. Anthropological Papers of the American Museum of Natural History 15(1). New York.

Nials, Fred, John Stein, and John Roney
1987 *Chacoan Roads in the Southern Periphery: Results of Phase II of the BLM Chaco Roads Project*. Cultural Resource Series 1. USDI Bureau of Land Management, New Mexico State Office, Santa Fe.

NMSHTD (New Mexico State Highway and Transportation Department)
1939 WPA Project 13. Construction plans on file at the New Mexico State Highway and Transportation Department, Santa Fe.

Noel-Hume, Ivor
1972 *A Guide to Artifacts of Colonial America*. Alfred A. Knopf, New York.

Noyes, Stanley
1993 *Los Comanches*. University of New Mexico Press, Albuquerque.

NPS (National Park Service)
1990 *Santa Fe National Historic Trail Comprehensive Management and Use Plan*. USDI National Park Service. Government Printing Office, Washington, D.C.

Oakes, Yvonne
1983 *The Ontiberos Site: A Hispanic Homestead near Roswell, NM.* Laboratory of Anthropology Notes 311. Museum of New Mexico, Santa Fe.

OAS (Office of Archaeological Studies)
1994 *Standardized Lithic Artifact Analysis: Attributes and Variable Code Lists*. Archaeology Notes 24b. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Odum, Eugene P.
1971 *Fundamentals of Ecology*. 3rd ed. W. B. Saunders, Philadelphia.

Orcutt, Janet D.
1991 Environmental Variability and Settlement Changes on the Pajarito Plateau, New Mexico. *American Antiquity* 56:315–332.

1999a Demography, Settlement, and Agriculture. In *The Bandelier Archeological Survey*, vol. 1, edited by R. Powers and J. Orcutt, pp. 219–308. Intermountain Cultural Resources Management Anthropology Program Professional Paper No. 57. USDI National Park Service, Santa Fe.

1999b Chronology. In *The Bandolier Archaeological Survey*, vol. 1, edited by R. Powers and J. Orcutt, pp. 85–116. Intermountain Cultural Resource Management Professional Papers No. 57. USDI National Park Service, Santa Fe.

Ortiz, Alfonso
1969 *The Tewa World*. University of Chicago Press, Chicago.

1979 San Juan Pueblo. In *Handbook of North American Indians*, vol. 9, edited by A. Ortiz, pp. 278–295. Smithsonian Institution, Washington, D.C.

Page, Susanne, and Jake Page
1982 *Hopi*. Harry N. Abrahms, New York.

Parsons, Elsie C.
1926 *Tewa Tales*. Memoirs of the American Society of Folklore 19. Reprint, 1994, University of Arizona Press, Tucson.

1929 *The Social Organization of the Tewa of New Mexico*. Memoirs of the American Anthropological Association No. 36. Collegiate Press, Menasha, Wisconsin.

1936 *Taos Pueblo*. General Series in Anthropology No. 2. George Banta Publishing, Menasha, Wisconsin. Reprint, 1970, Johnson Reprint, New York.

1939 *Pueblo Indian Religion*. Vols. 1 and 2. University of Chicago Press, Chicago. Reprint, 1996, University of Nebraska Press, Lincoln.

Peckham, Stewart
1954 A Pueblo I Site near San Felipe Pueblo, New Mexico. In *New Mexico Highway Salvage Archaeology* 1(4):41–51. Museum of New Mexico, Santa Fe.

1957 Three Pithouse Sites near Albuquerque, New Mexico. In *New Mexico Highway Salvage Archaeology* 3(12):39–70. Museum of New Mexico, Santa Fe.

1981 The Palisade Ruin (LA 3505): A Coalition Period Pueblo near Abiquiu Dam, New Mexico. In *Collected Papers in Honor of Erik Kellerman Reed*, edited by A. Schroeder, pp. 113–147. Papers of the Archaeological Society of New Mexico No. 6. Albuquerque.

1984 The Anasazi Culture of the Northern Rio Grande Rift. In *New Mexico Geological Society Guidebook, 35th Field Conference: Rio Grande Rift, Northern New Mexico*, pp. 275–281. New Mexico Bureau of Mines and Mineral Resources, Socorro.

Pike, Zebulon
1810 *An Account of Expeditions to the Sources of the Mississippi*. C. & A. Conrad, Philadelphia.

Pool, Christopher A.
1992 Integrating Ceramic Production and Distribution. In *Ceramic Production and Distribution: An Integrated Approach*, edited by G. Bey III and C. Pool, pp. 275–314. Westview Press, Boulder, Colorado.

Pool, Juliann C.
1991 An Overview of Nineteenth and Twentieth Century Buttons. *Research Notes, Historic Sites and Materials* 1. Texas Parks and Wildlife Department, Austin.

Post, Stephen S.
1996 *Las Campanas de Santa Fe Sunset Golf Course, and Estates IV, Estates V, and Estates VII Excavations: Small Sites in the Piñon-Juniper Piedmont North of the Santa Fe River, Santa Fe County, New Mexico*. Archaeology Notes 193. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1997 Archaeological Clearance Letter for Phase 2 of the Northwest Santa Fe Relief Route, Santa Fe County, New Mexico. On file, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

1999 Excavation of LA 61315 and LA 61321 along the Northwest Santa Fe Relief Route (State Road 599), Phase 3, Santa Fe, New Mexico. On file, Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

2004 *Excavation of LA 61282, the Airport Road Site: Late Archaic and Classic Period Occupation near the Santa Fe River, Santa Fe, New Mexico*. Archaeology Notes 274. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Powers, Robert P., and Tineke Van Zandt
1999 An Introduction to Bandelier. In *The Bandelier Archaeological Survey*, vol. 1, edited by R. Powers and J. Orcutt, pp. 1–31. Intermountain Cultural Resources Management Professional Paper No. 57. USDI National Park Service, Santa Fe.

Pratt, Boyd C., and David H. Snow
1988 *The North Central Regional Overview: Strategies for the Comprehensive Survey of the Architectural and Historic Archaeological Resources of North Central New Mexico* Vol. 1. New Mexico Historic Preservation Division, Santa Fe.

Preucel, Robert W.
1987 Settlement Succession on the Pajarito Plateau, New Mexico. *The Kiva* 53:3–33.

Pringle, Dolph
1993 United Methodist Church, Vallecitos. In *La Iglesia de Santa Cruz, Ojo Caliente, New Mexico*, compiled by La Iglesia de Santa Cruz, Ojo Caliente, New Mexico

Restoration Committee, pp. 69-79. ACCU Blueprint and Copy Center, Española.

Quintana, Frances L., and David H. Snow
1980 Historical Archeology of the Rito Colorado Valley, New Mexico. In *Spanish and Mexican Land Grants in New Mexico and Colorado*, edited by J. Van Ness and C. Van Ness, pp. 40–50. Center for Land Grant Studies and the Colorado Humanities Program, Santa Fe.

Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn
1986 *Biology of Plants*. 4th ed. Worth Publishers, New York.

Read, Benjamin M.
1912 *Illustrated History of New Mexico*. Santa Fe New Mexican Printing Company, Santa Fe.

Reed, Erik K.
1949 Sources of Upper Rio Grande Pueblo Culture and Population. *El Palacio* 56:163–184.

Reeve, Frank D.
1960 Navajo-Spanish Diplomacy, 1770–1790. *New Mexico Historical Review* 35:200–235.

Renaud, Etienne B.
1942 *Reconnaissance Work in the Rio Grande Valley, Colorado and New Mexico*. University of Denver, Department of Anthropology Archaeological Series No. 3. Denver.

1946 *Archaeology of the Upper Rio Grande Basin in Southern Colorado and Northern New Mexico*. University of Denver, Department of Anthropology Archaeological Series No. 6. Denver.

Ridings, Rosanna
1991 Obsidian Hydration Dating: The Effects of Mean Exponential Ground Temperature and Depth of Artifact Recovery. *Journal of Field Archaeology* 18(1):77–85.

Roenke, Karl G.
1978 *Flat Glass: Its Use as a Dating Tool for Nineteenth Century Archaeological Sites in the Pacific Northwest and Elsewhere*. Northwest Anthropological Research Notes Memoir No. 4. Moscow, Idaho.

Rohn, Arthur H.
1977 *Cultural Change and Continuity on Chapin Mesa*. Regents Press of Kansas, Lawrence.

Root, Matthew J., and Douglas R. Harro
1993 Stone Artifacts from Casa del Rito and Burnt Mesa Pueblo. In *Bandelier Archaeological Excavation Project: Summer 1990 Excavations at Burnt Mesa Pueblo and Casa del Rito*, edited by T. Kohler and M. Root, pp. 107–134. Reports of Investigations No. 64. Department of Anthropology, Washington State University, Pullman.

Rose, Martin R., Jeffrey S. Dean, and William J. Robinson
1981 *The Past Climate of Arroyo Hondo, New Mexico, Reconstructed from Tree Rings*. Arroyo Hondo Archaeological Series 4. School of American Research Press, Santa Fe, New Mexico.

Roth, Barbara J. (editor)
1996 *Early Formative Adaptations in the Southern Southwest*. Monographs in World Archaeology No. 25. Prehistory Press, Madison, Wisconsin.

Sando, Joe S.
1979 The Pueblo Revolt. In *Handbook of North American Indians*, vol. 9, edited by A. Ortiz, pp. 194–197. Smithsonian Institution Press, Washington, D.C.

SANM (Spanish Archives of New Mexico)
1735 Suit over Land in Ojo Caliente, Sept. 30, 1735. Works Project Administration Translation, series 1, no. 20. On file, New Mexico State Archives and Research Center, Santa Fe.

1748 Petition by Settlers of Ojo Caliente, Abiquiu, and Pueblo Quemado for Permission to Remove to Places of Greater Security. Works Project Administration Translation, series 1, no. 28. On file, New

Mexico State Archives and Research Center, Santa Fe.

1753 Resettlement of Ojo Caliente. Works Project Administration Translation, series 1, no. 650. On file, New Mexico State Archives and Research Center, Santa Fe.

1768 Resettlement of Town of Ojo Caliente. Works Project Administration Translation, series 1, no. 655. On file, New Mexico State Archives and Research Center, Santa Fe.

1769 Resettlement of Town of Ojo Caliente. Works Project Administration Translation, series 1, no. 656. On file, New Mexico State Archives and Research Center, Santa Fe.

1793 Grant, Town of Ojo Caliente, Claim No. 77. Works Project Administration Translation, series 1, no. 664. On file, New Mexico State Archives and Research Center, Santa Fe.

Schaafsma, Curtis F.

1976 *Archaeological Survey of Maximum Pool and Navajo Excavations at Abiquiu Reservoir, Rio Arriba County, New Mexico*. School of American Research Contract Archaeology Program, Santa Fe.

1978 Archaeological Studies in the Abiquiu Reservoir District. *Discovery* 1978:41–69. School of American Research, Santa Fe.

1979 *The Cerrito Site (AR-4): A Piedra Lumbre Phase Settlement at Abiquiu Reservoir*. School of American Research, Santa Fe.

1999 Tewas. In *Apaches de Navajo*, by C. Schaafsma. University of Utah Press, Salt Lake City.

Schaafsma, Polly

1990 The Pine Tree Site: A Galisteo Basin Pueblo IV Shrine. In *Clues to the Past: Papers in Honor of William M. Sundt*, edited by M. Duran and D. Kirkpatrick, pp. 239–257. Archaeological Society of New Mexico 16. Albuquerque.

1992 *Rock Art in New Mexico*. Museum of New Mexico Press, Santa Fe.

Schaafsma, Polly, and Curtis F. Schaafsma

1974 Evidence for the Origins of the Pueblo Katchina Cult as Suggested by Southwestern Rock Art. *American Antiquity* 39:535–545.

Scheick, Cherie L.

1991 *A Research Design for the Investigation of Limited Activity Sites at Las Campanas de Santa Fe*. Southwest Archaeological Consultants, Research Series 287. Santa Fe.

Schlegel, Alice

1992 African Political Models in the American Southwest: Hopi as an Internal Frontier Society. *American Anthropologist* 94:376–397.

Schmader, Matthew F.

1994 *Archaic Occupations of the Santa Fe Area: Results of the Tierra Contenta Archaeological Project*. Rio Grande Consultants, Albuquerque.

Schmader, Matthew F., and John D. Hays

1988 *Las Imagines: The Archaeology of Albuquerque's West Mesa Escarpment*. Open Spaces Division, City of Albuquerque; and New Mexico State Historic Preservation Division, Albuquerque and Santa Fe.

Scholes, Frances V.

1930 The Supply Service of the New Mexico Mission in the Seventeenth Century. *New Mexico Historical Review* 5:93–115, 186–210, 386–404.

1935 Civil Government and Society in New Mexico in the Seventeenth Century. *New Mexico Historical Review* 10:71–111.

Schroeder, Albert H.

1979 Pueblos Abandoned in Historic Times. In *Handbook of North American Indians*, vol. 9, edited by A. Ortiz, pp. 236–254. Smithsonian Institution Press, Washington, D.C.

1984 The Tewa Indians of the Rio Grande and Their Neighbors: A.D. 1450–1680. In *Rio*

Grande Rift: Northern New Mexico, pp. 283–286. New Mexico Geological Society Guidebook, 35th Field Conference. New Mexico Bureau of Mines and Mineral Resources, Socorro.

Schroeder, Albert H., and Don S. Matson
1965 *A Colony on the Move: Gaspar Castaño de Sosa's Journal (1590–1591)*. School of American Research, Santa Fe.

Schutt, Jeanne A., Steven Kuhn, Janette Elyea, Jack B. Bertram, and Amy C. Earls
1989 Site Descriptions. In *Report of Surface Collection and Testing at 18 Sites near Abiquiu Reservoir, Northern New Mexico*, by J. Bertram, J. Schutt, S. Kuhn, A. Earls, W. Trierweiler, C. Lintz, J. Acklen, C. Carrillo, and J. Elyea, pp. 49–262. Mariah Associates, Albuquerque.

Seaman, Timothy J.
1983 *Archeological Investigations on Guadalupe Mountain, Taos County, New Mexico*. Laboratory of Anthropology Notes 309. Museum of New Mexico, Santa Fe.

Sears catalogue
1969 *1902 Edition of the Sears Roebuck Catalog*. Crown Publishing, New York.

Severence, Owen
1999 Prehistoric Roads in Southeastern Utah. In *La Frontera: Papers in Honor of Patrick H. Beckett*, edited by M. Duran and D. Kirkpatrick, pp. 185–195. Archaeological Society of New Mexico 25. Albuquerque.

Simmons, Marc
1968 *Spanish Government in New Mexico*. 1990 edition. University of New Mexico Press, Albuquerque.

1969 Settlement Patterns and Village Plans in Colonial New Mexico. *Journal of the West* 8(1):7–21.

1977 *Father Juan Augustín de Morfi's Account of Disorders in New Mexico, 1778* (translator and editor). Historical Society of New Mexico, Isleta.

1979 History of Pueblo-Spanish Relations to 1821. In *Handbook of North American Indians*, vol. 9, edited by A. Ortiz, pp. 178–193. Smithsonian Institution Press, Washington, D.C.

Simmons, Marc, and Frank Turley
1980 *Southwestern Colonial Ironworking*. Museum of New Mexico Press, Santa Fe.

Skinner, S. Alan
1965 A Survey of Field Houses at Sapawe, North Central New Mexico. *Southwestern Lore* 31(1):18–24.

Skinner, S. Alan, C. Shaw, C. Carter, M. Cliff, and C. Heathington
1980 *Archaeological Investigations at Nambe Falls*. Archaeological Research Program, Research Report 121. Department of Anthropology, Southern Methodist University, Dallas.

Smiley, Terah L.
1951 *A Summary of Tree-Ring Dates from Some Southwestern Sites*. Laboratory of Tree-Ring Research Bulletin No. 5. University of Arizona Bulletin No. 22. Tucson.

Snow, David H.
1983 A Note on Encomienda Economics in Seventeenth Century New Mexico. In *Hispanic Arts and Ethnohistory in the Southwest*, edited by M. Weigle, pp. 347–357. Ancient City Press, Santa Fe.

1993 Purchased in Chihuahua for Feasts. In *El Camino Real de Tierra Adentro*, compiled by G. Palmer, J. Piper, and L. Jacobson, pp. 133–146. New Mexico Bureau of Land Management Cultural Resource Series No. 11. Albuquerque.

Sollberger, J. B.
1986 Lithic Fracture Analysis: A Better Way. *Lithic Technology* 15:101–105.

Stallings, W. S.
1937a The Tree Ring Material from the Riana Ruin. *University of New Mexico Bulletin, Anthropological Series* 2(1):51–60. University

of New Mexico, Albuquerque.

1937b *Southwestern Dated Ruins*. Pt. 1. Tree-Ring Bulletin 4(2). Tree-Ring Society, University of Arizona, Tucson.

Starr, Frederick
1900 Shrines near Cochiti, New Mexico. *American Antiquarian* 22:219–223.

Steele, Thomas J.
1983 Naming of Places in Spanish New Mexico. In *Hispanic Arts and Ethnohistory in the Southwest*, edited by Marta Weigle et al., pp. 293-302. Ancient City Press, Santa Fe.

Steele, Thomas J., and Rowena A. Rivera
1985 *Penitente Self-Government: Brotherhoods and Councils, 1797–1947*. Ancient City Press, Santa Fe.

Steen, Charlie R.
1977 *Pajarito Plateau Archaeological Survey and Excavations*. Los Alamos Scientific Laboratory, Report LASL-77-4. Los Alamos, New Mexico.

1982 *Pajarito Plateau Archaeological Survey and Excavations*. Pt. 2. Los Alamos National Laboratory, Report LA-8860-NERP. Los Alamos, New Mexico.

Steen, Charlie R., and Frederick C. V. Worman
1978 *Excavations on Mesita de los Alamos*. Los Alamos Scientific Laboratory, Report LA-7043-MS. Los Alamos, New Mexico.

Steffen, Jerome O.
1980 *Comparative Frontiers: A Proposal for Studying the American West*. University of Oklahoma Press, Norman.

Stevenson, Matilda C.
1904 *The Zuñi Indians: Their Mythology, Esoteric Societies, and Ceremonies*. Twenty-third Annual Report of the Bureau of American Ethnology. Government Printing Office, Washington, D.C.

1906 Notes on the History of Taos. File 4842, Folders 1–4, National Anthropological Archives, Smithsonian Institution, Washington, D.C.

Stuart, David E., and Rory P. Gauthier
1981 *Prehistoric New Mexico: A Background for Survey*. New Mexico State Historic Preservation Bureau, Santa Fe.

Stubbs, Stanley A.
1954 Summary Report on an Early Pueblo Site in the Tesuque Valley, New Mexico. *El Palacio* 61(2):43–45.

Stubbs, Stanley A., and William S. Stallings, Jr.
1953 *The Excavation of Pindi Pueblo, New Mexico*. Monographs of the School of American Research No. 18. Museum of New Mexico Press, Santa Fe.

Swadesh, Frances Leon
1974 *Los Primeros Pobladores*. University of Notre Dame Press, Notre Dame, Indiana.

Swentzell, Rina
1988 Bupingeh: The Pueblo Plaza. *El Palacio* 94(2):14–19.

1997 An Understated Sacredness. In *Anasazi Architecture and American Design*, edited by B. Morrow and V. Price, pp. 186–189. University of New Mexico Press, Albuquerque.

Teague, George, Lynette O. Shenk, and Vincent Morgan
1977 *Excavations at the Harmony Borax Works, Death Valley, California*. United States Park Service Publications in Anthropology No. 6. Western Archaeology and Conservation Center, Tucson.

Thomas, Alfred B.
1932 *Forgotten Frontiers: A Study of the Spanish Indian Policy of Don Juan Bautista de Anza, Governor of New Mexico, 1777–1787*. University of Oklahoma Press, Norman.

1940 *The Plains Indians and New Mexico, 1751–1778*. University of New Mexico Press, Albuquerque.

Tjaden, Rex L.
1979 Bordered Garden Plots and Field Houses near Sapawe, North Central New Mexico: A Dry Farming Strategy. M.A. thesis, Department of Anthropology, Arizona State University, Tempe.

Toulouse, Julian H.
1971 *Bottle Makers and Their Marks*. Thomas Nelson, New York.

Traylor, Diane, Lyndi Hubbell, Nancy Wood, and Barbara Fiedler
1990 *The 1977 La Mesa Fire Study: An Investigation of Fire and Fire Suppression Impact on Cultural Resources in Bandelier National Monument*. Southwest Cultural Resources Center Professional Paper No. 28. Branch of Cultural Resources Management, Division of Anthropology, National Park Service, Santa Fe.

Tuan, Yi Fu, Cyril E. Everard, Jerold G. Widdison, and Ivan Bennett
1973 *The Climate of New Mexico*. Rev. ed. New Mexico State Planning Office, Santa Fe.

Turnbow, Christopher A.
1997 Projectile Points as Chronological Indicators. In *Ole*, vol. 2, *Artifacts*, edited by J. Acklen, pp. 161–230. TRC Mariah Associates and Public Service Company of New Mexico, Albuquerque.

Twitchell, Ralph E.
1911 *The Leading Facts of New Mexican History*. Vol. 1. Torch Press, Cedar Rapids, Iowa.

Valdez, Facundo
1979 Vergüenza. In *The Survival of Spanish American Villages*, edited by Paul Kutsche, pp. 99-106. Colorado College Studies, No. 15. Colorado College, Colorado Springs.

Viklund, Lonyta
1988 *A Predictive Model for Archaeological Remains in Santa Fe*. Southwest Archaeological Consultants, Research Series 211. Santa Fe.

Vierra, Bradley J.
1980 A Preliminary Ethnographic Model of the Southwestern Archaic Settlement System. In *Human Adaptations in a Marginal Environment: The UII Mitigation Project*, edited by J. Moore and J. Winter, pp. 351–357. Office of Contract Archeology, University of New Mexico, Albuquerque.

1990 Archaic Hunter-Gatherer Archaeology in Northwestern New Mexico. In *Perspectives on Southwestern Prehistory*, edited by P. Minnis and C. Redman, pp. 57–67. Westview Press, Boulder, Colorado.

Wallerstein, Immanuel
1974 *The Modern World System, Capitalist Agriculture, and the Origins of the European World Economy in the Sixteenth Century*. Academic Press, New York.

1980 Theories, Research Designs, and Empirical Measures. In *History and Underdevelopment: Essays on Underdevelopment and European Expansion in Asia and Africa*, edited by Blussé et al. *Itinerario* 4(1):21–28.

Ware, John A.
1995 Gravel-Mulch Agriculture: Late Prehistoric Agricultural Systems in the Northern Rio Grande Valley. Paper presented at the 60th annual meeting of the Society for American Archaeology, Minneapolis.

Ware, John A., and Macy Mensel
1992 *The Ojo Caliente Project: Archaeological Test Excavations and a Data Recovery Plan for Cultural Resources along U.S. 285, Rio Arriba County, New Mexico*. Archaeology Notes 99. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Warren, A. Helene
1979 The Micaceous Pottery of the Rio Grande. In *Collected Papers In Honor of Eric Kellerman Reed*, edited by A. Schroeder, pp. 148–166. Papers of the Archaeological Society of New Mexico 6. Albuquerque.

1980 Prehistoric Pottery of Tijeras Canyon. In *Tijeras Canyon: Analyses of the Past*, edited by L. Cordell, pp. 149–168. University of New Mexico Press, Albuquerque.

Waselkov, Gregory A., and R. Eli Paul
1981 Frontiers and Archaeology. *North American Archaeologist* 2:309–328.

Weber, Kenneth
1979 Rural Hispanic Village Viability from an Economic and Historic Perspective. In *The Survival of Spanish American Villages*, edited by P. Kutsche, pp. 79–89. Colorado College Studies, No. 15. Colorado Springs.

Weigle, Marta
1976 *Brothers of Light, Brothers of Blood*. University of New Mexico Press, Albuquerque.

Weigle, Marta, and Thomas R. Lyons
1982 Brothers and Neighbors: The Celebration of Community in Penitente Villages. In *Celebration: Studies in Festivity and Ritual*, edited by V. Turner, pp. 231–251. Smithsonian Institution Press, Washington, D.C.

Wendorf, Fred
1953a Excavations at Te'ewi. In *Salvage Archaeology in the Chama Valley*, assembled by F. Wendorf, pp. 34–93. Monographs of the School of American Research 17. Santa Fe.

1953b *Salvage Archaeology in the Chama Valley, New Mexico*. Monographs of the School of American Research 17. Santa Fe.

Wendorf, Fred, and Erik Reed
1955 An Alternative Reconstruction of Northern Rio Grande Prehistory. *El Palacio* 62:131–173.

Wetherington, Ronald K.
1968 *Excavations at Pot Creek Pueblo*. Fort Burgwin Research Center Report No. 6. Taos, New Mexico.

White, Courtney
2001 A New Environmentalism. Pt. 1. *Quivira Coalition* 4(4):1, 24–30.

White, Leslie A.
1935 *The Pueblo of Santo Domingo, New Mexico*. Memoirs of the American Anthropological Association 43. Menasha, Wisconsin.

1962 *The Pueblo of Sia, New Mexico*. Smithsonian Institution, Bureau of American Ethnology Bulletin 184. Government Printing Office, Washington, D.C.

White, William G.
1990 A Window to the Past: Analysis of Flat Glass Recovered from West Point, Nevada. M.A. thesis, University of Nevada, Las Vegas.

Williams, Paul
1988 Laboratory of Anthropology Site Form for LA 66288. Archeological Records Management Section, New Mexico Historic Preservation Division, Santa Fe.

Wills, Wirt H.
1988 *Early Prehistoric Agriculture in the American Southwest*. School of American Research Press, Santa Fe.

Wilmsen, Edwin N.
1974 *Lindenmeier: A Pleistocene Hunting Society*. Harper and Row, New York.

Wilson, C. Dean
in prep.
Ceramic Analysis. In *The Medanales North Project: Final Report on the 1986 Excavations*, edited by L. Wallace. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Wilson, C. Dean, David V. Hill, Yvonne R. Oakes, Linda Mick-O'Hara, Patrick Severts, and Sonya O. Urban
1999 *Archaeology of the Mogollon Highlands: Settlement Systems and Their Adaptation*. Vol. 4, *Ceramics, Miscellaneous Artifacts, Bioarchaeology, Bone Tools, and Faunal Analysis*. Edited by Y. Oakes and D. Zamora. Archaeology Notes 232. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Windes, Thomas C.
1978 *Stone Circles of Chaco Canyon, Northwestern*

New Mexico. Reports of the Chaco Center No. 5. USDI National Park Service, Albuquerque.

Winship, George P.
1896 *The Journey of Coronado, 1540–1542*. Reprint, 1990, Fulcrum Publishing, Golden, Colorado.

Wiseman, Regge N., and Bart Olinger
1991 Initial Production of Painted Pottery in the Rio Grande: The Perspective from LA 835, the Pojoaque Grant Site. In *Puebloan Past and Present: Papers in Honor of Stewart Peckham*, edited by M. Duran and D. Kirkpatrick, pp. 209–217. Archaeological Society of New Mexico 17. Albuquerque.

Wiseman, Regge N., and John A. Ware
1996 *The Gavilan Project: Testing Results and a Data Recovery Plan for Eleven Prehistoric and Historic Sites along U.S. 285 near Ojo Caliente, Rio Arriba County, New Mexico*. Archaeology Notes 194. Office of Archaeological Studies, Museum of New Mexico, Santa Fe.

Wood, Nancy, and Oliver C. McCrary
1981 *A Cultural Resource Inventory of the 23.36 Mile Taos–Black Lake Transmission Line and Proposed Access Routes: Taos and Colfax Counties, New Mexico*. School of American Research Report No. 060. Santa Fe.

Woodward, Lee A.
1974 Tectonics of Central-Northern New Mexico. In *Silver Anniversary Guidebook, Ghost Ranch: Twenty-fifth Field Conference of the New Mexico Geological Society*, edited by C. Siemers, L. Woodward, and J. Callender, pp. 123–129. New Mexico Geological Society.

Worman, Frederick C. V.
1967 *Archaeological Salvage Excavations on the Mesita del Buey, Los Alamos County, New Mexico*. Los Alamos Scientific Laboratory, Report LA-3636. Los Alamos, New Mexico.

Young Investigators in Santa Fe, New Mexico
1999 Rockin' Gardens. *Dragonfly*, May/June, 26–27. National Science Teachers Association, Washington D.C.

Appendix 1. Pollen Analysis of a Sedimentary Column from LA 105710 and Intensive Scan Microscopy Analysis of Five Agricultural Sites

Richard G. Holloway, Ph.D.

A total of 13 pollen samples were submitted for full count microscopy from LA 105710. This column was taken from a profile through dunal deposits. LA 105710 dated to the Classic period (A.D. 1325–1500), and all deposits are thought to postdate the occupation. At this time, no radiocarbon dates are available from this deposit.

Also, 45 samples were taken from gravel mulch agricultural fields associated with five other sites. All sites date to the Classic period (A.D. 1325–1500). All 45 samples were analyzed using intensive scan microscopy (ISM), and counting was continued until target taxa were present in levels below 1 grains/g. Multiple fields were sampled from each site.

LA 105703, the northernmost site, is a large farming site dating to the Classic period. Eight gravel-mulched fields were identified, and five of them were sampled.

LA 105704 is a small farming site. Four features were recorded, including two gravel-mulched fields and two cobble alignments. Both gravel-mulched fields were sampled.

LA 105708 is a large farming site. Two systems of gravel-mulched fields were sampled in addition to four borrow pits, which were not submitted for analysis.

LA 105709 is a large farming site in Rio Arriba County. Two gravel-mulched fields were sampled from this site. Also present was a possible temporary shelter, a hearth, and a collection of farming features, which were not submitted for analysis.

LA 118547 is a large farming site at the south end of the project area. Nine gravel-mulched fields, 16 terrace-edge borrow pits, two terrace-interior borrow pits, and a possible historic grave were identified. Samples were submitted from one mulched field and two terrace-edge borrow pits.

The sites are between 6,150 and 6,250 feet in elevation. The modern vegetation consists of a piñon-juniper community with a typical associated understory. Higher elevations support a more heavily forested environment including additional conifer species such as *Picea* and *Abies*.

Methods and Materials

Chemical extraction of pollen samples was conducted at the Palynology Laboratory at Texas A&M University, using a procedure designed for semiarid Southwestern sediments. The method detailed below specifically avoids use of such reagents as nitric acid and bleach, which are destructive to pollen grains (Holloway 1981).

From each pollen sample submitted, 25 g of soil were subsampled. Prior to chemical extraction, three tablets of concentrated *Lycopodium* spores (Batch 307862, Department of Quaternary Geology, Lund, Sweden; 13,500 ± 500 marker grains per tablet) were added to each subsample. The addition of marker grains permits calculation of pollen concentration values and provides an indicator for accidental destruction of pollen during the laboratory procedure.

The samples were treated with 35-percent hydrochloric acid (HCl) overnight to remove carbonates and release the *Lycopodium* spores from their matrix. After neutralizing the acid with distilled water, the samples were allowed to settle for at least three hours before the supernatant liquid was removed. Additional distilled water was added to the supernatant, and the mixture was swirled and then allowed to settle for five seconds. The suspended fine fraction was decanted through 150µ mesh screen into a second beaker. This procedure, repeated at least three times, removed lighter materials, including pollen grains, from the heavier fractions. The fine material was concentrated by centrifugation at 2,000 rpm.

The fine fraction was treated with concentrated hydrofluoric acid (HF) overnight to remove silicates. After the acid was completely neutralized with distilled water, the samples were treated with a solution of darvan and sonicated in a Delta D-9 Sonicator for 30 seconds. The darvan solution was removed by repeated washing with distilled water and centrifuged (2,000 rpm) until the supernatant liquid was clear and neutral. This procedure removed fine charcoal and other associated organic matter and effectively deflocculated the sample.

The samples were dehydrated in glacial acetic acid in preparation for acetolyis. Following Erdtman (1960), acetolysis solution (acetic anhydride, concentrated sulfuric acid in 9:1 ratio) was added to each sample. Centrifuge tubes containing the solution were heated in a boiling water bath for approximately eight minutes and then cooled for an additional eight minutes before centrifugation and removal of the acetolysis solution with glacial acetic acid, followed by distilled water. Centrifugation at 2,000 rpm for 90 seconds dramatically reduced the size of the sample but did not remove fossil palynomorphs.

Heavy-density separation ensued using zinc bromide ($ZnBr_2$), with a specific gravity of 2.00, to remove much of the remaining detritus from the pollen. The light fraction was diluted with distilled water (10:1) and concentrated by centrifugation. The samples were washed repeatedly in distilled water until neutral. The residues were rinsed in a 1-percent solution of potassium hydroxide (KOH) for less than one minute, which was effective in removing the majority of the unwanted alkaline soluble humates.

The material was rinsed in ethanol (ETOH) stained with safranin-O, rinsed twice with ETOH, and transferred to 1-dram vials with tertiary butyl alcohol (TBA). The samples were mixed with a small quantity of glycerine and allowed to stand overnight for evaporation of the TBA. The storage vials were capped and returned to the Office of Archaeological Studies at the completion of the project. Because of the nature of the analyses conducted, all microscope slides used in this project were also returned.

A drop of the polliniferous residue was mounted on a microscope slide for examination under an 18 by 18 mm cover slip sealed with fingernail polish. The slide was examined using 200x or 100x magnification under an aus-Jena Laboval 4 compound microscope. Occasionally, pollen grains were examined using 400x or 1,000x oil immersion to obtain a positive identification to the family or genus level.

Abbreviated microscopy was performed on each sample in which either 20 percent of the slide (approximately four transects at 200x magnification) or a minimum of 50 marker grains were counted. If warranted, full counts were conducted by counting to a minimum of 200 fossil grains. Regardless of which method was used, the uncounted portion of each slide was completely scanned at a magnification of 100x for larger grains of cultivated plants such as *Zea mays* and *Cucurbita*, two types of cactus (*Platyopuntia* and *Cylindropuntia*), and other large pollen types such as members of the Malvaceae or Nyctaginaceae families. Because corn pollen was very common in many of these samples, corn grains were tabulated during the scans only if an unequal distribution of this taxon on the microscope slide was observed.

For those samples warranting full microscopy, a minimum of 200 pollen grains per sample were counted as suggested by Barkley (1934), which allows the analyst to inventory the most common taxa in the sample. All transects were counted completely, resulting in various numbers of grains counted beyond 200. Pollen taxa encountered on the uncounted portion of the slide during the low-magnification scan are tabulated separately.

Total pollen concentration values were computed for all taxa. In addition, the percentage of indeterminate pollen was also computed. Statistically, pollen concentration values provide a more reliable estimate of species composition within the assemblage. Traditionally, results have been presented by relative frequencies (percentages), where the abundance of each taxon is expressed in relation to the total pollen sum (200+ grains) per sample. With this method, rare pollen types tend to constitute less than 1 percent of the total assemblage. Pollen concentration values provide a more precise measurement of the abundance of even these rare types. The pollen data are reported here as pollen concentration values using the following formula:

$$PC = \frac{K^* \sum_p}{\sum_L {}^* S}$$

where: PC = pollen concentration
K = *Lycopodium* spores added
$\sum_p$ = fossil pollen counted
$\sum_L$ = *Lycopodium* spores counted
S = sediment weight

The following example should clarify this approach. Taxon X may be represented by a total of 10 grains (1 percent) in a sample consisting of 1,000 grains, and by 100 grains (1 percent) in a second sample consisting of 10,000 grains. Taxon X is 1 percent of each sample, but the difference in actual occurrence of the taxon is obscured when pollen frequencies are used. Pollen concentration values are preferred because they accentuate the variability between samples in the occurrence of the taxon. The variability, therefore, is more readily interpretable when comparing cultural activity to noncultural distribution of the pollen rain.

Variability in pollen concentration values can also be attributed to deterioration of the grains through natural processes. In his study of sediment samples collected from a rockshelter, Hall (1981) developed the "1,000 grains/g" rule to assess the degree of pollen destruction. This approach has been used by many palynologists working in other contexts as a guide to determine the degree of preservation of a pollen assemblage and, ultimately, to aid in the selection of samples to be examined in greater detail. According to Hall, a pollen concentration value below 1000 grains/g indicates that forces of degradation may have severely altered the original assemblage. However, a pollen concentration value of fewer than 1,000 grains/g can indicate the restriction of the natural pollen rain. Samples from pit structures or floors within enclosed rooms, for example, often yield pollen concentration values below 1,000 grains/g.

Pollen degradation also modifies the pollen assemblage because pollen grains of different taxa degrade at variable rates (Holloway 1981, 1989). Some taxa are more resistant to deterioration than others and remain in assemblages after other types have deteriorated completely. Many commonly occurring taxa degrade beyond recognition in only a short time. For example, most (ca. 70 percent) angiosperm pollen has tricolpate (three furrows) or tricolporate (three furrows each with pores) morphology. Because surfaces erode rather easily, once deteriorated, these grains tend to resemble each other and are not readily distinguishable. Other pollen types (e.g., cheno-am) are so distinctive that they remain identifiable even when almost completely degraded.

Pollen grains were identified to the lowest taxonomic level whenever possible. The majority of these identifications conformed to existing levels of taxonomy with a few exceptions. For example, cheno-am is an artificial, pollen-morphological category including pollen of the family Chenopodiaceae (goosefoot) and the genus *Amaranthus* (pigweed), which are indistinguishable from each other (Martin 1963). All members are wind pollinated (anemophilous) and produce very large quantities of pollen. In many sediment samples from the American Southwest, this taxon often dominates the assemblage.

Pollen of the Asteraceae (sunflower) family was divided into four groups. The high-spine and low-spine groups were identified on the basis of spine length. High-spine Asteraceae contain grains with spine length greater than or equal to 2.5μ, while the low-spine group have spines less than 2.5μ long (Bryant 1969; Martin 1963). *Artemisia* pollen is identifiable to the genus level because of its unique morphology, a double tectum in the mesocopial (between furrows) region of the pollen grain. Pollen grains of the Liguliflorae are also distinguished by their fenestrate morphology. Grains of this type are restricted to the tribe Cichoreae, which include such genera as *Taraxacum* (dandelion) and *Lactuca* (lettuce).

Pollen of the Poaceae (grass) family are generally indistinguishable below the family level, with the single exception of *Zea mays*, identifiable by its large size (ca. 80μ), relatively large pore annulus, and the internal morphology of the exine. All members of the family contain a single pore, are spherical, and have simple wall architecture. Identification of noncorn pollen depends on the presence of the single pore. Only complete or fragmented grains containing this pore were tabulated as Poaceae.

Clumps of four or more pollen grains (anther fragments) were tabulated as single grains to avoid skewing the counts. Clumps of pollen grains (anther fragments) from archaeological contexts are interpreted as evidence of flowers at the sampling locale (Bohrer 1981). This enables the analyst to infer human behavior.

Pollen grains in the final stages of disintegration but retaining identifiable features, such as furrows, pores, complex wall architecture, or a combination of these attributes, were assigned to the indeterminate category. The potential exists to miss counting pollen grains without identifiable characteristics. For example, a grain that is so severely deteriorated that no distinguishing features exist closely resembles many spores. Pollen grains and spores are similar in size and are composed of the same material (sporopollenin). So that spores are not counted as deteriorated pollen, only those grains containing identifiable pollen characteristics are assigned to the indeterminate category. Thus, the indeterminate category contains a minimum estimate of degradation for any assemblage. If the percentage of indeterminate pollen is between 10 and 20 percent, relatively poor preservation of the assemblage is indicated, whereas indeterminate pollen in excess of 20 percent indicates severe deterioration to the assemblage.

In samples where the total pollen concentration values are at or below 1,000 grains/g and the percentage of indeterminate pollen is 20 percent or greater, counting was terminated at the completion of the abbreviated microscopy phase. In some cases, the assemblage was so deteriorated that only a small number of taxa remained. Statistically, the concentration values may have exceeded 1,000 grains/g. If the species diversity was low (generally these samples contained only pine, cheno-am, members of the Asteraceae (sunflower) family, and pollen of the indeterminate category), counting was also terminated after abbreviated microscopy, even if the pollen concentration values slightly exceeded 1,000 grains/g.

ISM (Dean 1998) was requested for all 45 samples from the agricultural fields. This technique allows the analyst to examine sufficient pollen residue to reach a predetermined pollen concentration value. For the purposes of this study, it was determined that analysis would cease once the estimated maximum potential concentration value was 1 grain/g or less. Based on the pollen concentration formula above, and using 1.0 for the pollen concentration value, the equation was solved for the number of marker grains counted, which was 1,620. After the initial slide, additional slides were examined until an estimated 1,620 marker grains had been counted. The counts upon which the pollen concentration values are based were conducted only on the initial slide. The remainder of that slide was examined using low-power magnification, and the estimated number of marker grains present on that slide was computed using the average number of marker grains per transect counted and multiplying this by the total number of transects present on that slide. On each subsequent slide, a minimum of four transects were examined and counted for marker grains. These provided the baseline data for estimating the number of marker grains on that slide. This was repeated until the level of 1,620 marker grains had been attained. For this study, a maximum of three slides was necessary to obtain less than 1.0 grains/g estimated potential concentration values. In most samples, however, only two slides were necessary. Entire slides were examined during this process, which is why in numerous samples the estimated potential concentration values fall to significantly below 1 grain/g. Once this level had been attained, microscopy was terminated.

Results

For ease of comparison, Table A1.1 contains a list of scientific and common names of the plant taxa used in this report. Table A1.2 contains the raw pollen counts and calculated pollen concentration values from LA 105710. Tables A1.3 and A1.4 contain the raw pollen counts and calculated pollen concentration values, respectively, from the gravel-mulched agricultural fields, including the results of ISM. The samples from LA 105710 were counted using full counts with a pollen sum in excess of 200 grains. The remaining samples were analyzed using ISM to obtain an estimated

Table A1.1. Scientific and common names

Family	Scientific Name	Common Name
Amaranthaceae	*Amaranthus*	pigweed
Asteraceae		composite family
	Artemisia	sagebrush
	Helianthus	sunflower
	Lactuca	lettuce
	Taraxacum	dandelion
	Chichoreae	tribe of Asteraceae, heads comprised entirely of ligulate flowers
	Liguliflorae	pollen morphological group, fenestrate pollen
	low-spine	pollen morphological group, spines <2.5μ height
	high-spine	pollen morphological group, spines >2.5μ height
Cactaceae		cactus family
	Opuntia	prickly pear or cholla cactus
	Cylindropuntia	subgenus of *Opuntia* , cholla cactus
	Platyopuntia	subgenus of *Opuntia* , prickly pear cactus
Capparidaceae	*Cleome*	spider flower
Chenopodiaceae		goosefoot family
	Atriplex canescens	saltbush
	Chenopodium	goosefoot, lamb's-quarters
	Sarcobatus	greasewood
	cheno-am	pollen morphological group, members of the family Chenopodiaceae and the genus *Amaranthus*
Cucurbitaceae		gourd family
	Cucurbita sp.	gourd, pumpkin
Cupressaceae	*Juniperus*	juniper
Ephedraceae	*Ephedra*	Mormon tea
Fabaceae		bean family
	Acacia greggii	cat's-claw acacia
	Phaseolus sp.	domesticated bean
	Prosopis	mesquite
Fagaceae	*Quercus*	oak
Juglandaceae	*Carya*	hickory, pecan
Malvaceae		cotton family
	Gossypium	cotton
	Sphaeralcea	globemallow
Nyctaginaceae		desert four o'clock family
Onagraceae		evening primrose family
Pinaceae		pine family
	Abies sp.	fir
	Picea sp.	spruce
	Pinus	pine
	Pinus edulis	piñon pine
	Pinus ponderosa	ponderosa pine
Poaceae		grass family
	Zea mays	corn
Polygonaceae		buckwheat family
	Eriogonum	wild buckwheat
	Polygonum	knotweed, smartweed
Rosaceae		rose family
	Shepherdia sp.	
Salicaceae		willow family
	Salix	willow
Typhaceae		cattail family
	Typha angustifolia	cattail

Table A1.2a. Raw pollen counts and concentration values, LA 105710

Site	FS No.	Provenience	Stratum	*Pinus* undifferentiated	*Pinus ponderosa*	*Pinus edulis*	*Juniperus*	*Picea*	*Abies*	*Salix*	*Acacia*
Raw Counts											
LA 105710	108	BT-1	0	103	29	30	2	1	-	1	-
LA 105710	109	BT-1	1	77	10	2	5	2	1	-	-
LA 105710	110	BT-1	3	42	2	-	4	-	-	-	-
LA 105710	111	BT-1	6	34	1	-	3	-	-	-	-
LA 105710	112	BT-1	25	38	2	3	4	-	-	-	-
LA 105710	113	BT-1	17	32	1	-	1	-	-	-	-
LA 105710	114	BT-1	18	8	-	-	1	-	-	-	-
LA 105710	115	BT-1	19	11	1	-	-	-	-	-	-
LA 105710	116	BT-1	22	19	3	-	1	-	-	-	1
LA 105710	117	BT-1	21	21	-	-	-	-	-	-	1
LA 105710	118	BT-1	33	26	4	5	-	-	-	-	-
LA 105710	119	BT-1	36	27	1	3	-	-	-	-	-
LA 105710	120	BT-1	38	37	7	7	-	-	-	-	-
Concentration Values											
LA 105710	108	BT-1	0	2196	618	639	43	21	0	21	0
LA 105710	109	BT-1	0	630	82	16	41	16	8	0	0
LA 105710	110	BT-1	3	126	6	0	12	0	0	0	0
LA 105710	111	BT-1	6	111	3	0	10	0	0	0	0
LA 105710	112	BT-1	25	112	6	9	12	0	0	0	0
LA 105710	113	BT-1	17	257	8	0	8	0	0	0	0
LA 105710	114	BT-1	18	62	0	0	8	0	0	0	0
LA 105710	115	BT-1	19	66	6	0	0	0	0	0	0
LA 105710	116	BT-1	22	49	8	0	3	0	0	0	3
LA 105710	117	BT-1	21	118	0	0	0	0	0	0	6
LA 105710	118	BT-1	33	63	10	12	0	0	0	0	0
LA 105710	119	BT-1	36	144	5	16	0	0	0	0	0
LA 105710	120	BT-1	38	108	20	20	0	0	0	0	0

Table A1.2b. Raw pollen counts and concentration values, LA 105710

Site	FS No.	*Shepherdia*	*Eriogonum*	*Sarcobatus*	Poaceae	Cheno-am	Cheno-am af.	High-spine Asteraceae	Low-spine Asteraceae
Raw Counts									
LA 105710	108	1	13	1	1	176	-	32	37
LA 105710	109	-	-	-	-	153	1	9	22
LA 105710	110	-	-	-	3	125	-	3	34
LA 105710	111	-	1	-	19	103	-	29	12
LA 105710	112	-	-	2	2	134	2	25	10
LA 105710	113	-	1	-	6	333	-	43	9
LA 105710	114	-	-	-	5	160	1	36	7
LA 105710	115	-	-	-	2	233	-	9	6
LA 105710	116	-	-	-	7	168	1	23	4
LA 105710	117	-	-	-	5	84	-	65	2
LA 105710	118	-	-	-	5	104	-	55	8
LA 105710	119	-	-	-	9	130	-	30	9
LA 105710	120	-	-	-	2	130	-	28	3
Concentration Values									
LA 105710	108	21	277	21	21	3752	0	682	789
LA 105710	109	0	0	0	0	1252	8	74	180
LA 105710	110	0	0	0	9	376	0	9	102
LA 105710	111	0	3	0	62	336	0	95	39
LA 105710	112	0	0	6	6	395	6	74	29
LA 105710	113	0	8	0	48	2671	0	345	72
LA 105710	114	0	0	0	39	1234	8	278	54
LA 105710	115	0	0	0	12	1388	0	54	36
LA 105710	116	0	0	0	18	435	3	60	10
LA 105710	117	0	0	0	28	473	0	366	11
LA 105710	118	0	0	0	12	253	0	134	19
LA 105710	119	0	0	0	48	693	0	160	48
LA 105710	120	0	0	0	6	380	0	82	9

Table A1.2c. Raw pollen counts and concentration values, LA 105710

Site	FS No.	*Artemisia*	Cactaceae	*Cylindropuntia*	*Platyopuntia*	*Ephedra*	Nyctagninaceae	Indeterminate	Unknown Triporate
Raw Counts									
LA 105710	108	6	1	-	-	2	-	5	-
LA 105710	109	-	-	1	-	1	-	-	-
LA 105710	110	-	-	-	-	1	-	7	-
LA 105710	111	-	-	1	-	1	1	7	-
LA 105710	112	-	-	-	-	1	-	13	-
LA 105710	113	1	-	-	-	1	-	14	-
LA 105710	114	-	-	-	-	-	-	6	1
LA 105710	115	-	-	-	-	1	-	3	-
LA 105710	116	-	-	-	-	2	-	13	-
LA 105710	117	-	9	2	-	1	-	14	-
LA 105710	118	-	-	-	-	1	-	10	-
LA 105710	119	-	-	2	-	-	-	11	-
LA 105710	120	-	-	-	-	-	-	4	-
Concentration Values									
LA 105710	108	128	21	0	0	43	0	107	0
LA 105710	109	0	0	8	0	8	0	0	0
LA 105710	110	0	0	0	0	3	0	21	0
LA 105710	111	0	0	3	0	3	3	23	0
LA 105710	112	0	0	0	0	3	0	38	0
LA 105710	113	8	0	0	0	8	0	112	0
LA 105710	114	0	0	0	0	0	0	46	8
LA 105710	115	0	0	0	0	6	0	18	0
LA 105710	116	0	0	0	0	5	0	34	0
LA 105710	117	0	51	11	0	6	0	79	0
LA 105710	118	0	0	0	0	2	0	24	0
LA 105710	119	0	0	11	0	0	0	59	0
LA 105710	120	0	0	0	0	0	0	12	0

Table A1.2d. Raw pollen counts and concentration values, LA 105710

Site	FS No.	*Zea mays*	Sum	Total	Marker	Percent Indeterminate	Transects	Total Transects	Markers / Slide	*Lycopodium* Added	Weight / Area
Raw Counts											
LA 105710	108	2	443	9443	76	1.13	2	26	988	40500	25
LA 105710	109	2	286	2340	198	0	6	26	858	40500	25
LA 105710	110	1	222	668	538	3.15	10	24	1291	40500	25
LA 105710	111	-	212	691	497	3.3	6	25	2071	40500	25
LA 105710	112	1	237	698	550	5.49	8	24	1650	40500	25
LA 105710	113	-	442	3545	202	3.17	4	23	1162	40500	25
LA 105710	114	-	225	1736	210	2.67	4	24	1260	40500	25
LA 105710	115	-	266	1584	272	1.13	4	24	1632	40500	25
LA 105710	116	-	242	627	625	5.37	8	23	1797	40500	25
LA 105710	117	1	205	1153	288	6.83	4	24	1728	40500	25
LA 105710	118	-	218	530	666	4.59	11	24	1453	40500	25
LA 105710	119	1	223	1188	304	4.93	6	24	1216	40500	25
LA 105710	120	-	218	637	554	1.83	5	25	2770	40500	25
Concentration Values											
LA 105710	108	43	443	9443	76	1.13	2	26	988	40500	25
LA 105710	109	16	286	2340	198	0	6	26	858	40500	25
LA 105710	110	3	222	668	538	3.15	10	24	1291	40500	25
LA 105710	111	0	212	691	497	3.3	6	25	2071	40500	25
LA 105710	112	3	237	698	550	5.49	8	24	1650	40500	25
LA 105710	113	0	442	3545	202	3.17	4	23	1162	40500	25
LA 105710	114	0	225	1736	210	2.67	4	24	1260	40500	25
LA 105710	115	0	266	1584	272	1.13	4	24	1632	40500	25
LA 105710	116	0	242	627	625	5.37	8	23	1797	40500	25
LA 105710	117	6	205	1153	288	6.83	4	24	1728	40500	25
LA 105710	118	0	218	530	666	4.59	11	24	1453	40500	25
LA 105710	119	5	223	1188	304	4.93	6	24	1216	40500	25
LA 105710	120	0	218	637	554	1.83	5	25	2770	40500	25

Table A1.2e. Numbers including counts and low-magnification scan of the slides, LA 105710

Site	FS No.	*Abies*	*Zea mays*	Cactaceae	*Cylindropuntia*	*Platyopuntia*	Onagraceae	*Acacia*	Cheno-am af
Raw Counts									
LA 105710	108	3	11	-	-	-	1	-	-
LA 105710	109	-	9	-	-	-	-	-	-
LA 105710	110	-	4	-	-	-	-	-	-
LA 105710	111	-	-	-	1	-	-	-	-
LA 105710	112	-	1	-	2	-	-	-	-
LA 105710	113	-	-	1	1	-	-	-	-
LA 105710	114	-	-	-	-	-	-	-	1
LA 105710	115	-	-	-	-	-	-	-	-
LA 105710	116	-	-	-	3	-	-	-	-
LA 105710	117	-	1	10	7	-	-	2	-
LA 105710	118	-	-	-	-	-	-	-	-
LA 105710	119	-	1	-	3	-	-	-	-
LA 105710	120	-	1	-	-	1	-	-	-
Concentration Values									
LA 105710	108	5	18	0	0	0	2	0	0
LA 105710	109	0	17	0	0	0	0	0	0
LA 105710	110	0	5	0	0	0	0	0	0
LA 105710	111	0	0	0	1	0	0	0	0
LA 105710	112	0	1	0	2	0	0	0	0
LA 105710	113	0	0	1	1	0	0	0	0
LA 105710	114	0	0	0	0	0	0	0	1
LA 105710	115	0	0	0	0	0	0	0	0
LA 105710	116	0	0	0	3	0	0	0	0
LA 105710	117	0	1	9	7	0	0	2	0
LA 105710	118	0	0	0	0	0	0	0	0
LA 105710	119	0	1	0	4	0	0	0	0
LA 105710	120	0	1	0	0	1	0	0	0

Table A1.3a. Raw pollen counts, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	EU	Grid	Stratum	Level	Elevation (ft)	Feature	Type
LA 105703	24	A	2	2	2	6150	8	gravel mulch
LA 105703	25	B	3	2	2	6150	2	gravel mulch
LA 105703	18	C	3	2	2	6150	2	gravel mulch
LA 105703	5	D	4	2	2	6150	2	gravel mulch
LA 105703	31	E	1	2	2	6150	18	gravel mulch
LA 105703	56	E	3	4	3	6150	18	cobble-mulch field
LA 105703	33	F	1	2	2	6150	18	gravel mulch
LA 105703	51	F	3-4	4	4	6150	18	cobble-mulch field
LA 105703	35	G	2	2	2	6150	18	gravel mulch
LA 105703	44	H	3	2	2	6150	18	gravel mulch
LA 105703	45	H	1	4	3	6150	18	cobble-mulch field
LA 105703	65	I	1	4	3	6150	18	cobble-mulch field
LA 105703	83	J	3	2	2	6150	22	gravel mulch
LA 105703	88	J	2	4	3	6150	22	cobble-mulch field
LA 105703	79	K	2	2	2	6150	22	gravel mulch
LA 105703	84	K	2	4	4	6150	22	cobble-mulch field
LA 105703	71	M	3	2	2	6150	21	gravel mulch
LA 105703	91	N	2	2	2	6150	18	gravel mulch
LA 105703	90	O	3	2	2	6150	18	gravel mulch
LA 105704	3	A	2	2	1	6250	1	gravel mulch
LA 105704	8	B	1	2	1	6250	1	gravel mulch
LA 105704	1	C	3	2	1	6250	2	gravel mulch
LA 105708	22	A	3	3	3	6200	9	gravel mulch
LA 105708	8	B	3	2	2	6200	9	gravel mulch
LA 105708	11	C	3	2	2	6200	9	gravel mulch
LA 105708	26	D	4	2	2	6200	3	gravel mulch
LA 105708	21	E	2	2	2	6200	3	gravel mulch
LA 105708	29	F	4	2	2	6200	3	gravel mulch
LA 105709	433	A	2	2	1	6150	1	gravel mulch
LA 105709	430	C	3	2	1	6150	4	gravel mulch
LA 118547	473	A	2	2	2	6165	15	gravel mulch
LA 118547	459	B	1	2	2	6165	15	gravel mulch
LA 118547	456	C	2	2	2	6165	15	gravel mulch
LA 118547	465	D	2	2	2	6165	15	gravel mulch
LA 118547	461	E	3	2	2	6165	15	gravel mulch
LA 118547	497	F	1-4	2	2	6165	15	gravel mulch
LA 118547	472	G	1	2	2	6165	15	gravel mulch
LA 118547	470	H	2	3	3	6165	15	gravel mulch
LA 118547	487	I	1	2	2	6165	15	gravel mulch
LA 118547	492	J	4	2	2	6165	15	gravel mulch
LA 118547	494	K	3	2	2	6165	15	gravel mulch
LA 118547	499	L	4	2	2	6165	15	gravel mulch
LA 118547	482	BT-1	-	-	-	6165	1	borrow pit
LA 118547	483	BT-2	-	-	-	6165	2	borrow pit

Table A1.3b. Raw pollen counts, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

LA 105703	24	64	Classic	1325-1500	172	3	-	-	-
LA 105703	25	3479	Classic	1325-1500	108	2	-	-	-
LA 105703	18	3479	Classic	1325-1500	170	1	2	1	-
LA 105703	5	3479	Classic	1325-1500	202	3	2	-	1
LA 105703	31	2715	Classic	1325-1500	55	-	-	-	-
LA 105703	56	2715	Classic	1325-1500	60	1	-	-	-
LA 105703	33	2715	Classic	1325-1500	214	2	3	2	-
LA 105703	51	2715	Classic	1325-1500	77	-	2	-	-
LA 105703	35	2715	Classic	1325-1500	159	5	1	1	-
LA 105703	44	2715	Classic	1325-1500	63	3	1	-	-
LA 105703	45	2715	Classic	1325-1500	28	-	-	-	-
LA 105703	65	2715	Classic	1325-1500	28	1	-	-	-
LA 105703	83	936	Classic	1325-1500	44	2	-	-	-
LA 105703	88	936	Classic	1325-1500	142	-	-	-	-
LA 105703	79	936	Classic	1325-1500	193	2	2	1	
LA 105703	84	936	Classic	1325-1500	33	1	-	-	1
LA 105703	73	2715	Classic	1325-1500	18	-	-	-	-
LA 105703	71	820	Classic	1325-1500	104	1	1	-	2
LA 105703	91	2715	Classic	1325-1500	101	-	-	-	-
LA 105703	90	2715	Classic	1325-1500	54	1	-	-	-
LA 105704	3	180	Classic	1325-1500	319	4	2	-	-
LA 105704	8	180	Classic	1325-1500	145	2	-	-	-
LA 105704	1	48	Classic	1325-1500	123	2	-	-	-
LA 105708	22	971	Classic	1325-1500	82	-	-	-	-
LA 105708	8	971	Classic	1325-1500	180	1	2	-	-
LA 105708	11	971	Classic	1325-1500	80	3	-	-	-
LA 105708	26	225	Classic	1325-1500	121	-	1	-	1
LA 105708	21	225	Classic	1325-1500	187	9	4	-	1
LA 105708	29	225	Classic	1325-1500	220	-	2	1	-
LA 105709	433	444	Classic	1325-1500	210	2	3	-	1
LA 105709	430	47	Classic	1325-1500	229	1	1	1	-
LA 118547	473	3911	Classic	1325-1500	217	5	2	-	1
LA 118547	459	3911	Classic	1325-1500	162	1	-	-	-
LA 118547	456	3911	Classic	1325-1500	202	-	2	-	-
LA 118547	465	3911	Classic	1325-1500	92	1	-	-	-
LA 118547	461	3911	Classic	1325-1500	125	2	-	1	-
LA 118547	497	3911	Classic	1325-1500	135	4	-	1	-
LA 118547	472	3911	Classic	1325-1500	66	1	-	-	-
LA 118547	470	3911	Classic	1325-1500	156	2	-	-	-
LA 118547	487	3911	Classic	1325-1500	24	-	-	-	-
LA 118547	492	3911	Classic	1325-1500	32	-	-	-	-
LA 118547	494	3911	Classic	1325-1500	86	2	-	-	-
LA 118547	499	3911	Classic	1325-1500	103	1	-	-	-
LA 118547	482	125	Classic	1325-1500	129	1	-	-	-
LA 118547	483	184	Classic	1325-1500	110	-	-	-	-

Table A1.3c. Raw pollen counts, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Onagraceae	Fabaceae	*Polygonum*	*Eriogonum*	*Sarcobatus*	Poaceae	Cheno-am
LA 105703	24	-	-	-	-	-	-	34
LA 105703	25	-	-	1	-	-	5	63
LA 105703	18	-	-	-	-	3	7	37
LA 105703	5	-	-	2	-	1	-	76
LA 105703	31	-	-	-	-	-	-	29
LA 105703	56	-	-	-	-	1	1	35
LA 105703	33	-	-	-	-	3	3	51
LA 105703	51	-	-	1	-	2	-	19
LA 105703	35	-	-	-	-	1	4	16
LA 105703	44	1	-	-	-	2	3	44
LA 105703	45	-	-	-	-	-	1	55
LA 105703	65	-	-	-	-	1	2	19
LA 105703	83	-	-	-	-	2	-	27
LA 105703	88	-	-	-	-	-	1	35
LA 105703	79	-	-	-	-	2	6	51
LA 105703	84	-	-	-	-	3	1	43
LA 105703	73	-	-	1	-	-	1	14
LA 105703	71	-	-	-	-	4	2	53
LA 105703	91	-	-	-	-	-	1	27
LA 105703	90	-	-	-	-	-	-	26
LA 105704	3	1	-	-	-	2	1	44
LA 105704	8	-	-	-	1	1	2	28
LA 105704	1	-	-	-	-	-	4	22
LA 105708	22	-	-	-	-	-	1	36
LA 105708	8	-	-	-	1	-	4	35
LA 105708	11	-	-	-	-	-	-	46
LA 105708	26	-	-	-	-	-	1	42
LA 105708	21	-	-	-	-	2	2	62
LA 105708	29	-	-	-	-	-	1	51
LA 105709	433	-	-	-	-	-	6	70
LA 105709	430	-	-	-	-	1	1	42
LA 118547	473	-	-	-	-	-	-	75
LA 118547	459	-	-	-	-	2	8	96
LA 118547	456	-	-	-	-	2	4	102
LA 118547	465	-	-	-	-	-	-	50
LA 118547	461	-	-	-	-	-	3	84
LA 118547	497	-	-	-	-	1	4	47
LA 118547	472	-	-	-	-	-	2	40
LA 118547	470	-	-	-	-	1	6	53
LA 118547	487	-	-	-	-	-	1	23
LA 118547	492	-	-	-	-	-	3	25
LA 118547	494	-	1	-	-	-	1	43
LA 118547	499	-	-	-	-	-	1	27
LA 118547	482	-	-	-	-	-	-	51
LA 118547	483	-	-	-	-	-	5	46

Table A1.3d. Raw pollen counts, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Cheno-am af	Asteraceae High-Spine	Asteraceae Low-Spine	Liguliflorae	*Artemisia*	Cactaceae
LA 105703	24	-	6	8	-	-	-
LA 105703	25	-	5	4	-	-	-
LA 105703	18	-	6	11	-	-	1
LA 105703	5	-	3	9	-	5	-
LA 105703	31	-	1	1	-	1	-
LA 105703	56	-	3	2	-	2	1
LA 105703	33	-	2	5	-	5	-
LA 105703	51	-	5	5	-	2	-
LA 105703	35	-	1	3	-	3	-
LA 105703	44	-	3	21	-	1	-
LA 105703	45	-	3	1	-	1	-
LA 105703	65	-	1	1	-	-	-
LA 105703	83	-	1	2	-	-	-
LA 105703	88	-	7	3	-	1	-
LA 105703	79	-	6	7	-	1	-
LA 105703	84	-	-	4	-	-	-
LA 105703	73	-	1	1	-	-	-
LA 105703	71	1	2	2	-	-	-
LA 105703	91	-	3	3	-	-	-
LA 105703	90	-	2	1	-	1	-
LA 105704	3	-	4	8	-	-	-
LA 105704	8	-	1	2	1	1	-
LA 105704	1	-	-	5	-	-	-
LA 105708	22	-	4	2	-	-	-
LA 105708	8	1	3	3	-	6	-
LA 105708	11	-	2	1	-	1	-
LA 105708	26	-	2	4	-	2	-
LA 105708	21	1	7	5	-	4	-
LA 105708	29	-	2	4	-	1	-
LA 105709	433	-	6	10	-	11	1
LA 105709	430	-	4	9	-	2	-
LA 118547	473	2	7	8	-	3	-
LA 118547	459	1	9	18	-	2	-
LA 118547	456	1	21	23	-	6	-
LA 118547	465	1	1	9	-	3	-
LA 118547	461	-	10	10	-	1	-
LA 118547	497	-	4	27	-	2	-
LA 118547	472	-	6	4	-	1	-
LA 118547	470	1	9	16	-	1	1
LA 118547	487	-	1	1	-	-	-
LA 118547	492	-	3	1	-	-	-
LA 118547	494	1	6	6	1	1	-
LA 118547	499	-	1	-	-	1	-
LA 118547	482	1	2	8	-	-	-
LA 118547	483	1	5	6	-	-	-

Table A1.3e. Raw pollen counts, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	*Cylindropuntia*	*Ephedra*	Nyctagninaceae	Indeterminate	*Typha angustifolia*
LA 105703	24	-	-	-	8	-
LA 105703	25	-	1	-	1	-
LA 105703	18	1	4	-	5	-
LA 105703	5	-	1	-	3	-
LA 105703	31	-	-	-	3	-
LA 105703	56	1	-	-		-
LA 105703	33	1	1	-	5	-
LA 105703	51	-	1	-	1	-
LA 105703	35	-	1	-	2	-
LA 105703	44	1	4	-	9	-
LA 105703	45	1	-	2	3	-
LA 105703	65	-	2	-	1	-
LA 105703	83	-	-	-	3	-
LA 105703	88	-	-	-	2	-
LA 105703	79	-	2	-	3	-
LA 105703	84	1	-	-	2	-
LA 105703	73	-	1	-	1	-
LA 105703	71	-	-	-	3	-
LA 105703	91	-	-	-	2	-
LA 105703	90	2	-	-	1	-
LA 105704	3	-	4	-	12	-
LA 105704	8	-	-	-	-	-
LA 105704	1	-	1	-	1	-
LA 105708	22	2	-	-	1	-
LA 105708	8	-	1	-	1	-
LA 105708	11	-	2	-	3	-
LA 105708	26	1	-	-	5	-
LA 105708	21	-	2	-	3	-
LA 105708	29	78	2	-	2	-
LA 105709	433	-	4	-	9	-
LA 105709	430	1	1	-	4	-
LA 118547	473	1	3	-	9	-
LA 118547	459	1	7	-	6	-
LA 118547	456	-	4	-	8	-
LA 118547	465	1	2	-	4	-
LA 118547	461	-	1	-	2	-
LA 118547	497	2	4	-	5	-
LA 118547	472	-	2	-	4	-
LA 118547	470	2	-	-	4	-
LA 118547	487	-	-	-	1	-
LA 118547	492	-	-	-	1	1
LA 118547	494	-	-	-	7	-
LA 118547	499	1	-	-	-	-
LA 118547	482	1	3	-	2	-
LA 118547	483	-	-	1	3	-

Table A1.3f. Raw pollen counts, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Unknown Triporate	Malvaceae	*Sphaeralcea*	*Zea mays*	Sum	Percent Indeterminate
LA 105703	24	-	-	-	4	235	3.4
LA 105703	25	-	1	-	2	193	0.52
LA 105703	18	-	1	-	6	256	1.95
LA 105703	5	-	-	-	-	308	0.97
LA 105703	31	-	-	-	2	92	3.26
LA 105703	56	-	1	-	1	109	0
LA 105703	33	-	-	-	3	300	1.67
LA 105703	51	-	-	-	1	116	0.86
LA 105703	35	-	-	-	1	198	1.01
LA 105703	44	1	-	-	1	158	5.7
LA 105703	45	-	-	-	-	95	3.16
LA 105703	65	-	-	-	2	58	1.72
LA 105703	83	-	-	-	-	81	3.7
LA 105703	88	-	-	-	2	193	1.04
LA 105703	79	-	-	-	6	282	1.06
LA 105703	84	-	-	-	1	90	2.22
LA 105703	73	-	-	-	-	38	2.63
LA 105703	71	-	-	-	2	177	1.69
LA 105703	91	-	-	-	1	138	1.45
LA 105703	90	-	-	-	-	88	1.14
LA 105704	3	-	-	-	1	402	2.99
LA 105704	8	-	-	-	2	186	0
LA 105704	1	-	-	-	2	160	0.63
LA 105708	22	-	-	-	-	128	0.78
LA 105708	8	-	-	1	3	242	0.41
LA 105708	11	-	-	-	2	140	2.14
LA 105708	26	-	-	-	3	183	2.73
LA 105708	21	-	-	-	2	291	1.03
LA 105708	29	-	-	-	-	364	0.55
LA 105709	433	-	-	-	2	335	2.69
LA 105709	430	-	-	-	7	304	1.32
LA 118547	473	-	-	-	1	334	2.69
LA 118547	459	-	1	-	4	318	1.89
LA 118547	456	-	-	-	3	378	2.12
LA 118547	465	-	-	-	2	166	2.41
LA 118547	461	-	1	-	6	246	0.81
LA 118547	497	-	-	-	1	237	2.11
LA 118547	472	-	-	-	-	126	3.17
LA 118547	470	-	-	1	2	255	1.57
LA 118547	487	-	1	-	2	54	1.85
LA 118547	492	-	-	-	1	67	1.49
LA 118547	494	-	-	-	1	156	4.49
LA 118547	499	-	-	-	3	138	0
LA 118547	482	-	-	-	4	202	0.99
LA 118547	483	-	-	-	2	179	1.68

Table A1.3g. Numbers including counts and low-magnification scan of slides, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	*Abies*	*Zea mays*	*Sphaeralcea*	Cactaceae	*Cylindropuntia*	*Platyopuntia*
LA 105703	24	1	41	-	3	-	-
LA 105703	25	-	16	-	2	-	-
LA 105703	18	-	49	-	1	3	-
LA 105703	5	1	31	-	2	6	-
LA 105703	31	-	11	-	-	2	3
LA 105703	56	-	5	-	1	2	-
LA 105703	33	4	34	-	2	4	-
LA 105703	51	-	14	-	-	2	-
LA 105703	35	7	37	-	1	5	-
LA 105703	44	-	19	-	5	2	-
LA 105703	45	-	8	-	1	7	-
LA 105703	65	-	8	-	1	2	-
LA 105703	83	-	11	-	-	3	-
LA 105703	88	-	20	-	-	4	-
LA 105703	79	6	51	-	-	18	-
LA 105703	84	-	21	-	1	31	1
LA 105703	73	-	2	-	-	2	-
LA 105703	71	-	26	-	-	3	-
LA 105703	91	-	18	-	1	2	-
LA 105703	90	-	2	-	2	4	-
LA 105704	3	6	37	-	2	2	-
LA 105704	8	1	15	-	-	1	-
LA 105704	1	2	15	-	-	8	-
LA 105708	22	-	13	-	-	8	-
LA 105708	8	-	26	-	-	3	-
LA 105708	11	-	21	-	-	4	-
LA 105708	26	-	26	-	2	6	-
LA 105708	21	16	65	-	3	8	-
LA 105708	29	-	33	-	-	963	-
LA 105709	433	3	44	-	-	7	-
LA 105709	430	-	66	-	-	12	-
LA 118547	473	6	71	2	3	13	-
LA 118547	459	-	43	-	2	3	-
LA 118547	456	1	89	-	-	7	-
LA 118547	465	2	10	-	-	7	-
LA 118547	461	1	17	-	-	-	-
LA 118547	497	2	24	-	-	10	-
LA 118547	472	-	10	-	-	3	-
LA 118547	470	1	26	2	4	7	-
LA 118547	487	-	5	-	-	1	-
LA 118547	492	-	6	-	1	1	-
LA 118547	494	5	34	-	1	10	-
LA 118547	499	-	24	-	-	4	-
LA 118547	482	-	27	-	-	7	-
LA 118547	483	-	28	-	-	9	-

Table A1.3h. Numbers including counts and low-magnification scan of LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Onagraceae	*Prosopis*	*Carya*	Nyctaginaceae	Malvaceae	Cucurbitaceae
LA 105703	24	-	-	-	-	-	-
LA 105703	25	-	-	-	-	-	-
LA 105703	18	-	-	-	-	2	1
LA 105703	5	1	-	-	-	1	-
LA 105703	31	1	-	-	-	2	-
LA 105703	56	-	-	-	-	-	-
LA 105703	33	1	-	-	1	13	-
LA 105703	51	-	-	-	-	-	-
LA 105703	35	-	1	1	-	1	-
LA 105703	44	-	-	-	-	-	-
LA 105703	45	1	-	-	5	5	-
LA 105703	65	1	-	-	3	3	-
LA 105703	83	-	-	-	1	-	-
LA 105703	88	-	-	-	2	-	1
LA 105703	79	1	-	-	4	-	-
LA 105703	84	-	-	-	-	9	-
LA 105703	73	-	-	-	-	2	-
LA 105703	71	-	-	-	-	-	-
LA 105703	91	1	-	-	-	1	-
LA 105703	90	-	-	-	1	-	-
LA 105704	3	1	-	-	1	1	-
LA 105704	8	1	-	-	1	5	-
LA 105704	1	-	-	-	-	-	-
LA 105708	22	1	-	-	2	-	-
LA 105708	8	-	-	-	1	-	-
LA 105708	11	1	-	-	-	-	-
LA 105708	26	-	-	-	-	5	-
LA 105708	21	1	-	1	-	-	-
LA 105708	29	1	-	-	1	-	1
LA 105709	433	-	-	-	1	-	-
LA 105709	430	2	-	-	-	-	-
LA 118547	473	1	-	-	-	1	-
LA 118547	459	2	-	-	-	3	-
LA 118547	456	2	-	-	2	3	-
LA 118547	465	-	-	1	-	14	-
LA 118547	461	1	-	-	-	2	-
LA 118547	497	2	-	-	-	14	-
LA 118547	472	-	-	-	-	1	-
LA 118547	470	1	-	-	-	2	-
LA 118547	487	-	-	-	-	1	1
LA 118547	492	-	-	-	-	2	-
LA 118547	494	-	-	-	-	-	-
LA 118547	499	-	-	-	-	2	-
LA 118547	482	1	-	-	2	1	-
LA 118547	483	1	-	-	1	-	-

Table A1.3i. Numbers including counts and low-magnification scan of LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Cheno-am af	Unknown	*Picea*	*Shepherdia*
LA 105703	24	-	-	-	-
LA 105703	25	-	-	8	-
LA 105703	18	-	-	3	-
LA 105703	5	-	-	25	-
LA 105703	31	-	1	12	-
LA 105703	56	-	-	2	-
LA 105703	33	-	-	-	-
LA 105703	51	-	-	15	-
LA 105703	35	-	-	6	-
LA 105703	44	-	-	28	1
LA 105703	45	-	-	4	-
LA 105703	65	-	-	1	-
LA 105703	83	-	-	-	-
LA 105703	88	-	-	3	-
LA 105703	79	1	-	17	-
LA 105703	84	-	-	37	-
LA 105703	73	-	-	-	-
LA 105703	71	-	-	-	-
LA 105703	91	-	-	6	1
LA 105703	90	-	-	8	-
LA 105704	3	-	-	4	-
LA 105704	8	-	-	35	-
LA 105704	1	-	-	13	-
LA 105708	22	-	-	19	-
LA 105708	8	-	-	3	-
LA 105708	11	-	-	22	-
LA 105708	26	-	-	24	-
LA 105708	21	-	-	28	-
LA 105708	29	-	-	117	-
LA 105709	433	-	-	25	-
LA 105709	430	-	-	98	-
LA 118547	473	-	-	42	-
LA 118547	459	-	-	77	-
LA 118547	456	-	-	11	1
LA 118547	465	-	-	17	-
LA 118547	461	-	-	2	-
LA 118547	497	-	-	3	-
LA 118547	472	-	-	7	-
LA 118547	470	-	-	6	-
LA 118547	487	-	-	21	-
LA 118547	492	-	-	3	-
LA 118547	494	-	-	4	-
LA 118547	499	-	-	16	-
LA 118547	482	-	-	9	-
LA 118547	483	-	-	6	-

Table A1.4a. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	EU	Grid	Stratum	Level	Elevation (ft)	Feature	Type
LA 105703	24	A	2	2	2	6150	8	gravel-mulch field
LA 105703	25	B	3	2	2	6150	2	gravel-mulch field
LA 105703	18	C	3	2	2	6150	2	gravel-mulch field
LA 105703	5	D	4	2	2	6150	2	gravel-mulch field
LA 105703	31	E	1	2	2	6150	18	gravel-mulch field
LA 105703	56	E	3	4	3	6150	18	cobble-mulch field
LA 105703	33	F	1	2	2	6150	18	gravel-mulch field
LA 105703	51	F	3-4	4	4	6150	18	cobble-mulch field
LA 105703	35	G	2	2	2	6150	18	gravel-mulch field
LA 105703	44	H	3	2	2	6150	18	gravel-mulch field
LA 105703	45	H	1	4	3	6150	18	cobble-mulch field
LA 105703	65	I	1	4	3	6150	18	gravel-mulch field
LA 105703	83	J	3	2	2	6150	22	gravel-mulch field
LA 105703	88	J	2	4	3	6150	22	cobble-mulch field
LA 105703	79	K	2	2	2	6150	22	gravel-mulch field
LA 105703	84	K	2	4	4	6150	22	cobble-mulch field
LA 105703	73	L	1	4	3	6150	18	gravel-mulch field
LA 105703	71	M	3	2	2	6150	21	gravel-mulch field
LA 105703	91	N	2	2	2	6150	18	gravel-mulch field
LA 105703	90	O	3	2	2	6150	18	gravel-mulch field
LA 105704	3	A	2	2	1	6250	1	gravel-mulch field
LA 105704	8	B	1	2	1	6250	1	gravel-mulch field
LA 105704	1	C	3	2	1	6250	2	gravel-mulch field
LA 105708	22	A	3	3	3	6200	9	gravel-mulch field
LA 105708	8	B	3	2	2	6200	9	gravel-mulch field
LA 105708	11	C	3	2	2	6200	9	gravel-mulch field
LA 105708	26	D	4	2	2	6200	3	gravel-mulch field
LA 105708	21	E	2	2	2	6200	3	gravel-mulch field
LA 105708	29	F	4	2	2	6200	3	gravel-mulch field
LA 105709	433	A	2	2	1	6150	1	gravel-mulch field
LA 105709	430	C	3	2	1	6150	4	gravel-mulch field
LA 118547	473	A	2	2	2	6165	15	gravel-mulch field
LA 118547	459	B	1	2	2	6165	15	gravel-mulch field
LA 118547	456	C	2	2	2	6165	15	gravel-mulch field
LA 118547	465	D	2	2	2	6165	15	gravel-mulch field
LA 118547	461	E	3	2	2	6165	15	gravel-mulch field
LA 118547	497	F	1-4	2	2	6165	15	gravel-mulch field
LA 118547	472	G	1	2	2	6165	15	gravel-mulch field
LA 118547	470	H	2	3	3	6165	15	gravel-mulch field
LA 118547	487	I	1	2	2	6165	15	gravel-mulch field
LA 118547	492	J	4	2	2	6165	15	gravel-mulch field
LA 118547	494	K	3	2	2	6165	15	gravel-mulch field
LA 118547	499	L	4	2	2	6165	15	gravel-mulch field
LA 118547	482	BT-1	0	0	0	6165	1	borrow pit
LA 118547	483	BT-2	0	0	0	6165	2	borrow pit

Table A1.4b. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Size	Period	Age (A.D.)	*Pinus*	*Juniperus*	*Picea*	*Abies*	*Quercus*
LA 105703	24	64	Classic	1325-1500	2964	52	0	0	0
LA 105703	25	3479	Classic	1325-1500	2108	39	0	0	0
LA 105703	18	3479	Classic	1325-1500	5508	32	65	32	0
LA 105703	5	3479	Classic	1325-1500	3177	47	31	0	16
LA 105703	31	2715	Classic	1325-1500	707	0	0	0	0
LA 105703	56	2715	Classic	1325-1500	661	11	0	0	0
LA 105703	33	2715	Classic	1325-1500	3041	28	43	28	0
LA 105703	51	2715	Classic	1325-1500	1327	0	34	0	0
LA 105703	35	2715	Classic	1325-1500	11708	368	74	74	0
LA 105703	44	2715	Classic	1325-1500	1398	67	22	0	0
LA 105703	45	2715	Classic	1325-1500	540	0	0	0	0
LA 105703	65	2715	Classic	1325-1500	331	12	0	0	0
LA 105703	83	936	Classic	1325-1500	1584	72	0	0	0
LA 105703	88	936	Classic	1325-1500	2474	0	0	0	0
LA 105703	79	936	Classic	1325-1500	4810	50	50	25	0
LA 105703	84	936	Classic	1325-1500	563	17	0	0	17
LA 105703	73	2715	Classic	1325-1500	213	0	0	0	0
LA 105703	71	820	Classic	1325-1500	1652	16	16	0	32
LA 105703	91	2715	Classic	1325-1500	2773	0	0	0	0
LA 105703	90	2715	Classic	1325-1500	587	11	0	0	0
LA 105704	3	180	Classic	1325-1500	4741	59	30	0	0
LA 105704	8	180	Classic	1325-1500	1515	21	0	0	0
LA 105704	1	48	Classic	1325-1500	2657	43	0	0	0
LA 105708	22	971	Classic	1325-1500	999	0	0	0	0
LA 105708	8	971	Classic	1325-1500	2976	17	33	0	0
LA 105708	11	971	Classic	1325-1500	1878	70	0	0	0
LA 105708	26	225	Classic	1325-1500	2253	0	19	0	19
LA 105708	21	225	Classic	1325-1500	8188	394	175	0	44
LA 105708	29	225	Classic	1325-1500	2640	0	24	12	0
LA 105709	433	444	Classic	1325-1500	3910	37	56	0	19
LA 105709	430	47	Classic	1325-1500	3500	15	15	15	0
LA 118547	473	3911	Classic	1325-1500	5763	133	53	0	27
LA 118547	459	3911	Classic	1325-1500	1715	11	0	0	0
LA 118547	456	3911	Classic	1325-1500	4040	0	40	0	0
LA 118547	465	3911	Classic	1325-1500	618	7	0	0	0
LA 118547	461	3911	Classic	1325-1500	854	14	0	7	0
LA 118547	497	3911	Classic	1325-1500	2514	74	0	19	0
LA 118547	472	3911	Classic	1325-1500	708	11	0	0	0
LA 118547	470	3911	Classic	1325-1500	3663	47	0	0	0
LA 118547	487	3911	Classic	1325-1500	185	0	0	0	0
LA 118547	492	3911	Classic	1325-1500	305	0	0	0	0
LA 118547	494	3911	Classic	1325-1500	3317	77	0	0	0
LA 118547	499	3911	Classic	1325-1500	1236	12	0	0	0
LA 118547	482	125	Classic	1325-1500	2750	21	0	0	0
LA 118547	483	184	Classic	1325-1500	1856	0	0	0	0

Table A1.4c. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Onagraceae	Fabaceae	*Polygonum*	*Eriogonum*	*Sarcobatus*	Poaceae	Cheno-am
LA 105703	24	0	0	0	0	0	0	586
LA 105703	25	0	0	20	0	0	98	1230
LA 105703	18	0	0	0	0	97	227	1199
LA 105703	5	0	0	31	0	16	0	1195
LA 105703	31	0	0	0	0	0	0	373
LA 105703	56	0	0	0	0	11	11	386
LA 105703	33	0	0	0	0	43	43	725
LA 105703	51	0	0	17	0	34	0	327
LA 105703	35	0	0	0	0	74	295	1178
LA 105703	44	22	0	0	0	44	67	976
LA 105703	45	0	0	0	0	0	19	1061
LA 105703	65	0	0	0	0	12	24	225
LA 105703	83	0	0	0	0	72	0	972
LA 105703	88	0	0	0	0	0	17	610
LA 105703	79	0	0	0	0	50	150	1271
LA 105703	84	0	0	0	0	51	17	733
LA 105703	73	0	0	12	0	0	12	166
LA 105703	71	0	0	0	0	64	32	842
LA 105703	91	0	0	0	0	0	27	741
LA 105703	90	0	0	0	0	0	0	283
LA 105704	3	15	0	0	0	30	15	654
LA 105704	8	0	0	0	10	10	21	293
LA 105704	1	0	0	0	0	0	86	475
LA 105708	22	0	0	0	0	0	12	438
LA 105708	8	0	0	0	17	0	66	579
LA 105708	11	0	0	0	0	0	0	1080
LA 105708	26	0	0	0	0	0	19	782
LA 105708	21	0	0	0	0	88	88	2715
LA 105708	29	0	0	0	0	0	12	612
LA 105709	433	0	0	0	0	0	112	1303
LA 105709	430	0	0	0	0	15	15	642
LA 118547	473	0	0	0	0	0	0	1992
LA 118547	459	0	0	0	0	21	85	1016
LA 118547	456	0	0	0	0	40	80	2040
LA 118547	465	0	0	0	0	0	0	336
LA 118547	461	0	0	0	0	0	21	574
LA 118547	497	0	0	0	0	19	74	875
LA 118547	472	0	0	0	0	0	21	429
LA 118547	470	0	0	0	0	23	141	1244
LA 118547	487	0	0	0	0	0	8	177
LA 118547	492	0	0	0	0	0	29	238
LA 118547	494	0	39	0	0	0	39	1659
LA 118547	499	0	0	0	0	0	12	324
LA 118547	482	0	0	0	0	0	0	1087
LA 118547	483	0	0	0	0	0	84	776

Table A1.4d. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Cheno-am af	High-Spine Asteraceae	Low-Spine Asteraceae	Liguliflorae	*Artemisia*	Cactaceae
LA 105703	24	0	103	138	0	0	0
LA 105703	25	0	98	78	0	0	0
LA 105703	18	0	194	356	0	0	32
LA 105703	5	0	47	142	0	79	0
LA 105703	31	0	13	13	0	13	0
LA 105703	56	0	33	22	0	22	11
LA 105703	33	0	28	71	0	71	0
LA 105703	51	0	86	86	0	34	0
LA 105703	35	0	74	221	0	221	0
LA 105703	44	0	67	466	0	22	0
LA 105703	45	0	58	19	0	19	0
LA 105703	65	0	12	12	0	0	0
LA 105703	83	0	36	72	0	0	0
LA 105703	88	0	122	52	0	17	0
LA 105703	79	0	150	174	0	25	0
LA 105703	84	0	0	68	0	0	0
LA 105703	73	0	12	12	0	0	0
LA 105703	71	16	32	32	0	0	0
LA 105703	91	0	82	82	0	0	0
LA 105703	90	0	22	11	0	11	0
LA 105704	3	0	59	119	0	0	0
LA 105704	8	0	10	21	10	10	0
LA 105704	1	0	0	108	0	0	0
LA 105708	22	0	49	24	0	0	0
LA 105708	8	17	50	50	0	99	0
LA 105708	11	0	47	23	0	23	0
LA 105708	26	0	37	74	0	37	0
LA 105708	21	44	306	219	0	175	0
LA 105708	29	0	24	48	0	12	0
LA 105709	433	0	112	186	0	205	19
LA 105709	430	0	61	138	0	31	0
LA 118547	473	53	186	212	0	80	0
LA 118547	459	11	95	191	0	21	0
LA 118547	456	20	420	460	0	120	0
LA 118547	465	7	7	60	0	20	0
LA 118547	461	0	68	68	0	7	0
LA 118547	497	0	74	503	0	37	0
LA 118547	472	0	64	43	0	11	0
LA 118547	470	23	211	376	0	23	23
LA 118547	487	0	8	8	0	0	0
LA 118547	492	0	29	10	0	0	0
LA 118547	494	39	231	231	39	39	0
LA 118547	499	0	12	0	0	12	0
LA 118547	482	21	43	171	0	0	0
LA 118547	483	17	84	101	0	0	0

Table A1.4e. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	*Cylindropuntia*	*Ephedra*	Nyctagninaceae	Indeterminate	*Typha angustifolia*
LA 105703	24	0	0	0	138	0
LA 105703	25	0	20	0	20	0
LA 105703	18	32	130	0	162	0
LA 105703	5	0	16	0	47	0
LA 105703	31	0	0	0	39	0
LA 105703	56	11	0	0	0	0
LA 105703	33	14	14	0	71	0
LA 105703	51	0	17	0	17	0
LA 105703	35	0	74	0	147	0
LA 105703	44	22	89	0	200	0
LA 105703	45	19	0	39	58	0
LA 105703	65	0	24	0	12	0
LA 105703	83	0	0	0	108	0
LA 105703	88	0	0	0	35	0
LA 105703	79	0	50	0	75	0
LA 105703	84	17	0	0	34	0
LA 105703	73	0	12	0	12	0
LA 105703	71	0	0	0	48	0
LA 105703	91	0	0	0	55	0
LA 105703	90	22	0	0	11	0
LA 105704	3	0	59	0	178	0
LA 105704	8	0	0	0	0	0
LA 105704	1	0	22	0	22	0
LA 105708	22	24	0	0	12	0
LA 105708	8	0	17	0	17	0
LA 105708	11	0	47	0	70	0
LA 105708	26	19	0	0	93	0
LA 105708	21	0	88	0	131	0
LA 105708	29	936	24	0	24	0
LA 105709	433	0	74	0	168	0
LA 105709	430	15	15	0	61	0
LA 118547	473	27	80	0	239	0
LA 118547	459	11	74	0	64	0
LA 118547	456	0	80	0	160	0
LA 118547	465	7	13	0	27	0
LA 118547	461	0	7	0	14	0
LA 118547	497	37	74	0	93	0
LA 118547	472	0	21	0	43	0
LA 118547	470	47	0	0	94	0
LA 118547	487	0	0	0	8	0
LA 118547	492	0	0	0	10	10
LA 118547	494	0	0	0	270	0
LA 118547	499	12	0	0	0	0
LA 118547	482	21	64	0	43	0
LA 118547	483	0	0	17	51	0

Table A1.4f. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Unknown Triporate	Malvaceae	*Sphaeralcea*	*Zea mays*	Sum	Total Concentration
LA 105703	24	0	0	0	69	235	4050
LA 105703	25	0	20	0	39	193	3767
LA 105703	18	0	32	0	194	256	8294
LA 105703	5	0	0	0	0	308	4844
LA 105703	31	0	0	0	26	92	1183
LA 105703	56	0	11	0	11	109	1201
LA 105703	33	0	0	0	43	300	4263
LA 105703	51	0	0	0	17	116	1999
LA 105703	35	0	0	0	74	198	14580
LA 105703	44	22	0	0	22	158	3506
LA 105703	45	0	0	0	0	95	1832
LA 105703	65	0	0	0	24	58	686
LA 105703	83	0	0	0	0	81	2916
LA 105703	88	0	0	0	35	193	3362
LA 105703	79	0	0	0	150	282	7028
LA 105703	84	0	0	0	17	90	1535
LA 105703	73	0	0	0	0	38	449
LA 105703	71	0	0	0	32	177	2811
LA 105703	91	0	0	0	27	138	3789
LA 105703	90	0	0	0	0	88	957
LA 105704	3	0	0	0	15	402	5975
LA 105704	8	0	0	0	21	186	1944
LA 105704	1	0	0	0	43	160	3456
LA 105708	22	0	0	0	0	128	1559
LA 105708	8	0	0	17	50	242	4000
LA 105708	11	0	0	0	47	140	3287
LA 105708	26	0	0	0	56	183	3408
LA 105708	21	0	0	0	88	291	12741
LA 105708	29	0	0	0	0	364	4368
LA 105709	433	0	0	0	37	335	6238
LA 105709	430	0	0	0	107	304	4646
LA 118547	473	0	0	0	27	334	8870
LA 118547	459	0	11	0	42	318	3367
LA 118547	456	0	0	0	60	378	7560
LA 118547	465	0	0	0	13	166	1116
LA 118547	461	0	7	0	41	246	1682
LA 118547	497	0	0	0	19	237	4413
LA 118547	472	0	0	0	0	126	1352
LA 118547	470	0	0	23	47	255	5987
LA 118547	487	0	8	0	15	54	417
LA 118547	492	0	0	0	10	67	638
LA 118547	494	0	0	0	39	156	6017
LA 118547	499	0	0	0	36	138	1656
LA 118547	482	0	0	0	85	202	4306
LA 118547	483	0	0	0	34	179	3021

Table A1.4g. Pollen concentration values, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Marker	Transects	Total Transects	Markers / Slide	Markers / Slides 1-2	Markers / Slides 1-3	Total Markers	*Lycopodium* Added
LA 105703	24	94	4	26	611	793	937.5	2341.5	40500
LA 105703	25	83	4	24	498	1209	-	1707	40500
LA 105703	18	50	4	24	300	1075	737.5	2112.5	40500
LA 105703	5	103	3	25	858.3	1755	-	2613.3	40500
LA 105703	31	126	4	24	756	1365	-	2121	40500
LA 105703	56	147	6	27	661.5	1610	-	2271.5	40500
LA 105703	33	114	4	24	684	1196	-	1880	40500
LA 105703	51	94	4	23	540.5	1118	-	1658.5	40500
LA 105703	35	22	1	22	484	864	871	2219	40500
LA 105703	44	73	4	26	474.5	871	845	2190.5	40500
LA 105703	45	84	4	24	504	1066	292.5	1862.5	40500
LA 105703	65	137	4	24	822	2093	-	2915	40500
LA 105703	83	45	4	26	292.5	1078	342	1712.5	40500
LA 105703	88	93	4	24	558	1330	-	1888	40500
LA 105703	79	65	4	24	390	1162	385	1937	40500
LA 105703	84	95	6	26	411.7	784	612	1807.7	40500
LA 105703	73	137	4	24	822	1768	-	2590	40500
LA 105703	71	102	4	25	637.5	1358	-	1995.5	40500
LA 105703	91	59	4	28	413	1087.5	162.5	1663	40500
LA 105703	90	149	4	28	1043	1344	-	2387	40500
LA 105704	3	109	4	28	763	1092	-	1855	40500
LA 105704	8	155	4	26	1007.5	952	-	1959.5	40500
LA 105704	1	75	4	27	506.2	1204	-	1710.3	40500
LA 105708	22	133	4	24	798	840	-	1638	40500
LA 105708	8	98	4	28	686	1134	-	1820	40500
LA 105708	11	69	4	24	414	560	767	1741	40500
LA 105708	26	87	4	26	565.5	754	1296	2615.5	40500
LA 105708	21	37	2	24	444	754	1012.5	2210.5	40500
LA 105708	29	135	4	24	810	1274	-	2084	40500
LA 105709	433	87	2	24	1044	1174.5	-	2218.5	40500
LA 105709	430	106	4	25	662.5	1246	-	1908.5	40500
LA 118547	473	61	2	26	793	1605	-	2398	40500
LA 118547	459	153	4	22	841.5	2079	-	2920.5	40500
LA 118547	456	81	2	24	972	1417.5	-	2389.5	40500
LA 118547	465	241	4	28	1687	-	-	1687	40500
LA 118547	461	237	4	28	1659	-	-	1659	40500
LA 118547	497	87	4	26	565.5	1323	-	1888.5	40500
LA 118547	472	151	4	26	981.5	2038.5	-	3020	40500
LA 118547	470	69	2	24	828	1050	-	1878	40500
LA 118547	487	210	4	26	1365	2856	-	4221	40500
LA 118547	492	170	4	25	1062.5	1890	-	2952.5	40500
LA 118547	494	42	4	28	294	1120.5	585	1999.5	40500
LA 118547	499	135	2	24	1620	-	-	1620	40500
LA 118547	482	76	2	26	988	1386	-	2374	40500
LA 118547	483	96	2	25	1200	1391	-	2591	40500

Table A1.4h. Numbers including counts and low-magnification scan of slides, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Weight / Area	*Abies*	*Zea mays*	*Sphaeralcea*	Cactaceae	*Cylindropuntia*	*Platyopuntia*
LA 105703	24	25	0.7	28.4	0	2.1	0	0
LA 105703	25	25	0	15.2	0	1.9	0	0
LA 105703	18	25	0	37.6	0	0.8	2.3	0
LA 105703	5	25	0.6	19.2	0	1.2	3.7	0
LA 105703	31	25	0	8.4	0	0	1.5	2.3
LA 105703	56	25	0	3.6	0	0.7	1.4	0
LA 105703	33	25	3.4	29.3	0	1.7	3.4	0
LA 105703	51	25	0	13.7	0	0	2	0
LA 105703	35	25	5.1	27	0	0.7	3.7	0
LA 105703	44	25	0	14.1	0	3.7	1.5	0
LA 105703	45	25	0	7	0	0.9	6.1	0
LA 105703	65	25	0	4.4	0	0.6	1.1	0
LA 105703	83	25	0	10.4	0	0	2.8	0
LA 105703	88	25	0	17.2	0	0	3.4	0
LA 105703	79	25	5	42.7	0	0	15.1	0
LA 105703	84	25	0	18.8	0	0.9	27.8	0.9
LA 105703	73	25	0	1.3	0	0	1.3	0
LA 105703	71	25	0	21.1	0	0	2.4	0
LA 105703	91	25	0	17.5	0	1	1.9	0
LA 105703	90	25	0	1.4	0	1.4	2.7	0
LA 105704	3	25	5.2	32.3	0	1.7	1.7	0
LA 105704	8	25	0.8	12.4	0	0	0.8	0
LA 105704	1	25	1.9	14.2	0	0	7.6	0
LA 105708	22	25	0	12.9	0	0	7.9	0
LA 105708	8	25	0	23.1	0	0	2.7	0
LA 105708	11	25	0	19.5	0	0	3.7	0
LA 105708	26	25	0	16.1	0	1.2	3.7	0
LA 105708	21	25	11.7	47.6	0	2.2	5.9	0
LA 105708	29	25	0	25.7	0	0	748.6	0
LA 105709	433	25	2.2	32.1	0	0	5.1	0
LA 105709	430	25	0	56	0	0	10.2	0
LA 118547	473	25	4.1	48	1.4	2	8.8	0
LA 118547	459	25	0	23.9	0	1.1	1.7	0
LA 118547	456	25	0.7	60.3	0	0	4.7	0
LA 118547	465	25	1.9	9.6	0	0	6.7	0
LA 118547	461	25	1	16.6	0	0	0	0
LA 118547	497	25	1.7	20.6	0	0	8.6	0
LA 118547	472	25	0	5.4	0	0	1.6	0
LA 118547	470	25	0.9	22.4	1.7	3.5	6	0
LA 118547	487	25	0	1.9	0	0	0.4	0
LA 118547	492	25	0	3.3	0	0.5	0.5	0
LA 118547	494	25	4.1	27.5	0	0.8	8.1	0
LA 118547	499	25	0	24	0	0	4	0
LA 118547	482	25	0	18.4	0	0	4.8	0
LA 118547	483	25	0	17.5	0	0	5.6	0

Table A1.4i. Numbers including counts and low-magnification scan of LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Onagraceae	*Prosopis*	*Carya*	Nyctaginaceae	Malvaceae	Cucurbitaceae	Unknown
LA 105703	24	0	0	0	0	0	0	0
LA 105703	25	0	0	0	0	1.9	0.9	0
LA 105703	18	0	0	0	0	0.8	0	0
LA 105703	5	0.6	0	0	0	1.2	0	0.6
LA 105703	31	0.8	0	0	0	0	0	0
LA 105703	56	0	0	0	0	9.3	0	0
LA 105703	33	0.9	0	0	0.9	0	0	0
LA 105703	51	0	0	0	0	1	0	0
LA 105703	35	0	0.7	0.7	0	0	0	0
LA 105703	44	0	0	0	0	3.7	0	0
LA 105703	45	0.9	0	0	4.3	2.6	0	0
LA 105703	65	0.6	0	0	1.7	0	0	0
LA 105703	83	0	0	0	0.9	0	0.9	0
LA 105703	88	0	0	0	1.7	0	0	0
LA 105703	79	0.8	0	0	3.3	7.5	0	0
LA 105703	84	0	0	0	0	1.8	0	0
LA 105703	73	0	0	0	0	0	0	0
LA 105703	71	0	0	0	0	0.8	0	0
LA 105703	91	1	0	0	0	0	0	0
LA 105703	90	0	0	0	0.7	0.7	0	0
LA 105704	3	0.9	0	0	0.9	4.4	0	0
LA 105704	8	0.8	0	0	0.8	0	0	0
LA 105704	1	0	0	0	0	0	0	0
LA 105708	22	1	0	0	2	0	0	0
LA 105708	8	0	0	0	0.9	0	0	0
LA 105708	11	0.9	0	0	0	4.7	0	0
LA 105708	26	0	0	0	0	0	0	0
LA 105708	21	0.7	0	0.7	0	0	0.7	0
LA 105708	29	0.8	0	0	0.8	0	0	0
LA 105709	433	0	0	0	0.7	0	0	0
LA 105709	430	1.7	0	0	0	0.8	0	0
LA 118547	473	0.7	0	0	0	2	0	0
LA 118547	459	1.1	0	0	0	1.7	0	0
LA 118547	456	1.4	0	0	1.4	9.5	0	0
LA 118547	465	0	0	1	0	1.9	0	0
LA 118547	461	1	0	0	0	13.7	0	0
LA 118547	497	1.7	0	0	0	0.9	0	0
LA 118547	472	0	0	0	0	1.1	0	0
LA 118547	470	0.9	0	0	0	0.9	0.9	0
LA 118547	487	0	0	0	0	0.8	0	0
LA 118547	492	0	0	0	0	0	0	0
LA 118547	494	0	0	0	0	1.6	0	0
LA 118547	499	0	0	0	0	1	0	0
LA 118547	482	0.7	0	0	1.4	0	0	0
LA 118547	483	0.6	0	0	0.6	0	0	0

Table A1.4j. Numbers including counts and low-magnification scan of slides, LA 105703, LA 105704, LA 105708, LA 105709, and LA 118547

Site	FS No.	Cheno-am af	*Picea*	*Shepherdia*	Maximum Estimated Potential Concentration
LA 105703	24	0	5.5	0	0.692
LA 105703	25	0	2.8	0	0.949
LA 105703	18	0	19.2	0	0.767
LA 105703	5	0	7.4	0	0.620
LA 105703	31	0	1.5	0	0.764
LA 105703	56	0	0	0	0.713
LA 105703	33	0	12.9	0	0.862
LA 105703	51	0	5.9	0	0.977
LA 105703	35	0	20.4	0.7	0.730
LA 105703	44	0	3	0	0.740
LA 105703	45	0	0.9	0	0.870
LA 105703	65	0	0	0	0.556
LA 105703	83	0	2.8	0	0.946
LA 105703	88	0.9	14.6	0	0.858
LA 105703	79	0	30.9	0	0.836
LA 105703	84	0	0	0	0.896
LA 105703	73	0	0	0	0.625
LA 105703	71	0	4.9	0.8	0.812
LA 105703	91	0	7.8	0	0.974
LA 105703	90	0	2.7	0	0.679
LA 105704	3	0	30.6	0	0.873
LA 105704	8	0	10.7	0	0.827
LA 105704	1	0	18	0	0.947
LA 105708	22	0	3	0	0.989
LA 105708	8	0	19.6	0	0.890
LA 105708	11	0	22.3	0	0.930
LA 105708	26	0	17.3	0	0.619
LA 105708	21	0	85.7	0	0.733
LA 105708	29	0	19.4	0	0.777
LA 105709	433	0	71.6	0	0.730
LA 105709	430	0	35.7	0	0.849
LA 118547	473	0	52	0	0.676
LA 118547	459	0	6.1	0.6	0.555
LA 118547	456	0	11.5	0	0.678
LA 118547	465	0	1.9	0	0.960
LA 118547	461	0	2.9	0	0.976
LA 118547	497	0	6	0	0.858
LA 118547	472	0	3.2	0	0.536
LA 118547	470	0	18.1	0	0.863
LA 118547	487	0	1.2	0	0.384
LA 118547	492	0	2.2	0	0.549
LA 118547	494	0	13	0	0.810
LA 118547	499	0	9	0	1.000
LA 118547	482	0	4.1	0	0.682
LA 118547	483	0	4.4	0	0.625

maximum potential-concentration value of 1 grain/g or less to maximize the number of potential economic taxa recovered. Since the objectives of both investigations are different, the results are reported separately. The samples from LA 105710 were all collected from Backhoe Trench 1 and provide a stratigraphic sequence. The individual results from this site are presented by stratum in descending order.

LA 105710

Stratum 0. FS 108 contained 9,443 grains/g total pollen concentration values with 1.14 percent indeterminate pollen. *Pinus* undifferentiated (2,196 grains/g), *Pinus ponderosa* (618 grains/g), and *Pinus edulis* (639 grains/g) clearly dominated the assemblage. *Juniperus, Picea*, and *Salix* were present in small amounts. Cheno-am (3,752 grains/g) pollen was high, with low to moderate amounts of both Poaceae and *Sarcobatus* (21 grains/g each). High-spine (682 grains/g) and low-spine (789 grains/g) Asteraceae were both high, with high amounts of *Artemisia* (238 grains/g). *Shepherdia*, Cactaceae (21 grains/g each), *Eriogonum* (277 grains/g), and *Zea mays* (43 grains/g) were also present. *Abies* (5 grains/g) and Onagraceae (2 grains/g) were observed only in the low-magnification scan of the slide.

Strata 1–2. FS 109 contained 2,340 grains/g total pollen concentration values. *Pinus* undifferentiated decreased to 630 grains/g. *Pinus ponderosa* (82 grains/g) and *Pinus edulis* (16 grains/g) also decreased. *Juniperus*, *Picea*, and *Abies* were also present in trace amounts. Cheno-am (1,252 grains/g) pollen was moderate, with high amounts of both high-spine (74 grains/g) and low-spine (180 grains/g) Asteraceae pollen. A small number of cheno-am clumps (8/g) were also present. *Cylindropuntia* and *Ephedra* (8 grains/g each) were present in addition to *Zea mays* (16 grains/g).
An unknown species (2 grains/g) was observed only in the low-magnification scan of the slide.

Stratum 3. FS 110 contained 668 grains/g total pollen concentration values with 3.15 percent indeterminate pollen. *Pinus* (126 grains/g) was very low, with only a trace (6 grains/g) of *Pinus ponderosa* and *Juniperus* (12 grains/g) pollen. Cheno-am (376 grains/g), Poaceae (9 grains/g), and high-spine Asteraceae (9 grains/g) were present in very low amounts, with higher amounts of low-spine Asteraceae (109 grains/g). *Zea mays* (3 grains/g) was present in very low amounts.

Stratum 6. FS 111 contained 691 grains/g total pollen concentration values with 3.3 percent indeterminate pollen. *Pinus* undifferentiated (111 grains/g) and *Pinus ponderosa* (3 grains/g) were present in trace amounts along with *Juniperus* (10 grains/g) pollen. Cheno-am (336 grains/g) and Poaceae (62 grains/g) were present in low and moderate amounts, with moderate to high amounts of low-spine (39 grains/g) and high-spine (95 grains/g) Asteraceae. *Eriogonum* and *Cylindropuntia* were present in trace amounts (3 grains/g each). A single grain of *Picea* was observed only in the low-magnification scan of the slide.

Stratum 25. FS 112 contained 698 grains/g total pollen concentration values with 5.49 percent indeterminate pollen. *Pinus* undifferentiated (112 grains/g), *Pinus ponderosa* (6 grains/g), and *Pinus edulis* (9 grains/g) were present in trace amounts along with *Juniperus* (12 grains/g). Traces of *Sarcobatus*, Poaceae, and cheno-am clumps (6 grains/g each) were present along with low amounts of cheno-am (395 grains/g) and low-spine Asteraceae (29 grains/g). High-spine Asteraceae (74 grains/g) were present in moderate to high amounts. *Zea mays* (3 grains/g) was present in low to trace amounts. *Cylindropuntia* (2 grains/g) was observed only in the low-magnification scan of the slide.

Stratum 17. FS 113 contained 3,545 grains/g total pollen concentration values with 3.17 percent indeterminate pollen. *Pinus* undifferentiated (257 grains/g) and *Pinus ponderosa* (8 grains/g) were present in trace amounts along with *Juniperus* (8 grains/g) pollen. Cheno-am (2,671 grains/g) dominated the assemblage, with moderate amounts of Poaceae (48 grains/g) and high amounts of high-spine (345 grains/g) and low-spine (72 grains/g) Asteraceae. A trace of *Artemisia* and *Ephedra* (8 grains/g each) were present. Cactaceae and *Cylindropuntia* (1 grain/g each) were observed only in the low-magnification scan of the slide.

Stratum 18. FS 114 contained 1,736 grains/g total pollen concentration values with 2.67 percent indeterminate pollen. *Pinus* undifferentiated (62 grains/g) was present in trace amounts, with only a trace of *Juniperus* (8 grains/g). Cheno-am (1,234 grains/g) and Poaceae (39 grains/g) were moderate, with high amounts of high-spine (278 grains/g) and low-spine (54 grains/g) Asteraceae. A small number of cheno-am clumps (8/g) were also present.

Stratum 19. FS 115 contained 1,584 grains/g total pollen concentration values with 1.13 percent indeterminate pollen. *Pinus* undifferentiated (66 grains/g) and *Pinus ponderosa* (6 grains/g) were present in trace amounts only, along with a small amount of Poaceae (12 grains/g). High-spine (54 grains/g) and low-spine (36 grains/g) Asteraceae were moderate.

Stratum 22. FS 116 contained 627 grains/g total pollen concentration values with 5.37 percent indeterminate pollen. *Pinus* undifferentiated (49 grains/g), *Pinus ponderosa* (8 grains/g), *Juniperus*, and *Acacia* (3 grains/g each) were present in trace amounts only. Cheno-am (435 grains/g) and Poaceae (18 grains/g) were very low, with moderate amounts of high-spine Asteraceae (60 grains/g) and low amounts (10 grains/g) of low-spine Asteraceae. *Cylindropuntia* was observed only in the low-magnification scan of the slide.

Stratum 21. FS 117 contained 1,153 grains/g total pollen concentration values with 6.83 percent indeterminate pollen. *Pinus* undifferentiated (118 grains/g) was very low, as was *Acacia* (6 grains/g). Cheno-am (473 grains/g) and Poaceae (28 grains/g) were both low, as were high-spine (366 grains/g) and low-spine (11 grains/g) Asteraceae. Cactaceae (51 grains/g) was high, and *Cylindropuntia* (11 grains/g) contained moderate concentration values. A small amount (6 grains/g) of *Zea mays* was also present.

Stratum 33. FS 118 contained 530 grains/g total pollen concentration values with 4.59 percent indeterminate pollen. *Pinus* undifferentiated (63 grains/g), *Pinus ponderosa* (10 grains/g), and *Pinus edulis* (12 grains/g) were present in trace amounts. Cheno-am (253 grains/g) and Poaceae (12 grains/g) were both low. High-spine Asteraceae (134 grains/g) was high, and low-spine (19 grains/g) Asteraceae was low.

Stratum 36. FS 119 contained 1,188 grains/g total pollen concentration values with 4.93 percent indeterminate pollen. *Pinus* undifferentiated (144 grains/g), *Pinus ponderosa* (5 grains/g), and *Pinus edulis* (16 grains/g) were present in trace amounts. Cheno-am (693 grains/g) was low, and Poaceae (48 grains/g) was moderate. High-spine (168 grains/g) and low-spine (48 grains/g) Asteraceae were high to moderate. *Cylindropuntia* (11 grains/g) was moderate, with a small amount of *Zea mays* (5 grains/g).

Stratum 38. FS 120 contained 637 grains/g total pollen concentration values with 1.83 percent indeterminate pollen. *Pinus* undifferentiated (108 grains/g), *Pinus ponderosa* (20 grains/g), and *Pinus edulis* (20 grains/g) were present in trace amounts. Cheno-am (380 grains/g) and Poaceae (6 grains/g) were both present in very small to trace amounts. Small amounts of both high-spine (82 grains/g) and low-spine (9 grains/g) Asteraceae pollen were present. *Zea mays* and *Platyopuntia* (1 grain/g each) were observed only in the low-magnification scan of the slide.

LA 105703

LA 105703 was at an elevation of 6,150 ft. Five features were sampled in 14 excavation units.

Feature 2. FS 25 was taken from EU-B and contained 3,767 grains/g total pollen concentration values with 0.52 percent indeterminate pollen. This field covered 3,479 sq m. *Pinus* (2,108 grains/g) pollen was high, with moderate amounts of *Juniperus* (39 grains/g). Cheno-am (1,230 grains/g) was moderate with high amounts of Poaceae (98 grains/g), high-spine Asteraceae (98 grains/g), and low-spine Asteraceae (78 grains/g). *Polygonum*, Malvaceae (20 grains/g each) and *Zea mays* (39 grains/g) were also present.

FS 18 was taken from EU-C and contained 8,294 grains/g total pollen concentration values with 1.95 percent indeterminate pollen. *Pinus* (5,508 grains/g) dominated the assemblage, with small amounts of *Juniperus, Abies* (32 grains/g), and *Picea* (65 grains/g). Cheno-am (1,199 grains/g) was moderate, with high amounts of *Sarcobatus* (97 grains/g) and Poaceae (227 grains/g). High-spine (194 grains/g) and low-spine (356 grains/g) Asteraceae were high, along with high amounts of *Ephedra* (130 grains/g). Cactaceae, *Cylindropuntia*, Malvaceae (32 grains/g each), and *Zea mays* (194 grains/g) were all present in high amounts.

FS 5 was taken from EU-D and contained 4,844 grains/g total pollen concentration values with 0.97 percent indeterminate pollen. *Pinus* (3,177 grains/g) was very high, with small to moderate amounts of *Juniperus* (47 grains/g), *Picea* (31 grains/g), and *Quercus* (16 grains/g). Cheno-am (1,195 grains/g) was moderate, with low amounts of *Sarcobatus* (16 grains/g). High-spine Asteraceae (47 grains/g) was moderate, with high amounts of low-spine Asteraceae (142 grains/g) and *Artemisia* (79 grains/g). *Polygonum* (31 grains/g) was moderate to high.

Feature 8. FS 24 was taken from EU-A and contained 4,050 grains/g total pollen concentration values with 3.4 percent indeterminate pollen. This field covered 64 sq m. *Pinus* (2,964 grains/g) was high, with moderate to high amounts of *Juniperus* (54 grains/g). Cheno-am (586 grains/g) was very low, with high amounts of high-spine (103 grains/g) and low-spine (138 grains/g) Asteraceae. *Zea mays* pollen (69 grains/g) was also high.

Feature 18. FS 31 was taken from EU-E and contained 1,183 grains/g total pollen concentration values with 3.26 percent indeterminate pollen. This field covered 2,715 sq m. This sample, like the majority of samples, was taken from the gravel-mulch layer (Stratum 2). *Pinus* (707 grains/g) was very low, with low amounts of cheno-am (373 grains/g). Both high-spine and low-spine Asteraceae and *Artemisia* (13 grains/g each) were very low. *Zea mays* (26 grains/g) was also present but in moderate to low amounts.

FS 56 was taken from EU-E and contained 1,201 grains/g total pollen concentration values with no indeterminate pollen. This sample was taken from the cobble mulch layer (Stratum 4). *Pinus* (661 grains/g) was very low, with low amounts of *Juniperus* (11 grains/g). Cheno-am (386 grains/g) was low, with small amounts of *Sarcobatus* and Poaceae (11 grains/g each). High-spine (33 grains/g) and low-spine Asteraceae and *Artemisia* (22 grains/g each) were also very low. Cactaceae, Malvaceae, and *Zea mays* (11 grains/g each) were also present.

FS 33 was taken from EU-F and contained 4,263 grains/g total pollen concentration values with 1.67 percent indeterminate pollen. *Pinus* (3041 grains/g) dominated the assemblage, with smaller amounts of *Juniperus, Abies* (28 grains/g each), and *Picea* (43 grains/g). Cheno-am (725 grains/g) was low, with moderate amounts of Poaceae and *Sarcobatus* (43 grains/g each). High-spine Asteraceae (28 grains/g) was low, with high amounts of low-spine Asteraceae and *Artemisia* (71 grains/g each). *Cylindropuntia* (11 grains/g) and *Zea mays* (43 grains/g) were also present.

FS 51 was taken from EU-F and contained 1,999 grains/g total pollen concentration values with 0.86 percent indeterminate pollen. This sample was taken from the cobble mulch layer (Stratum 4). *Pinus* (1327 grains/g) was low to moderate, with a small amount of *Picea* (34 grains/g). Cheno-am (327 grains/g) was very low, with moderate amounts of *Sarcobatus* (34 grains/g). High- and low-spine Asteraceae (86 grains/g each) were high, with moderate to low amounts of *Artemisia* (34 grains/g). *Polygonum* and *Zea mays* (17 grains/g each) were also present.

FS 35 was taken from EU-G and contained 14,580 grains/g total pollen concentration values with 1.01 percent indeterminate pollen. *Pinus* (11,708 grains/g) clearly dominated the assemblage with high amounts of *Juniperus* (368 grains/g), *Picea*, and *Abies* (74 grains/g each). Cheno-am (1,178 grains/g) was moderate, with high amounts of Poaceae (295 grains/g), *Sarcobatus* (74 grains/g), high-spine Asteraceae (74 grains/g), and low-spine Asteraceae and *Artemisia* (221 grains/g each). *Zea mays* (74 grains/g) was also high.

FS 44 was taken from EU-H and contained 3,506 grains/g total pollen concentration values with 5.70 percent indeterminate pollen. *Pinus* (1398 grains/g) was moderate, with *Juniperus* (67 grains/g) and *Picea* (22 grains/g) present. Cheno-am (976 grains/g) was low, with moderate amounts of Poaceae (67 grains/g) and *Sarcobatus* (44 grains/g). Low-spine Asteraceae was very high (466 grains/g), with moderate amounts of high-spine Asteraceae (67 grains/g) and *Artemisia* (22 grains/g). *Cylindropuntia*, Onagraceae, an unknown triporate, and *Zea mays* (22 grains/g each) were also present.

FS 45 was taken from EU-H and contained 1,832 grains/g total pollen concentration values with 3.16 percent indeterminate pollen. This sample was taken from the cobble mulch layer (Stratum 4). *Pinus* (540 grains/g) was very low, with low to moderate amounts of cheno-am (1,061 grains/g) and Poaceae (19 grains/g). High-spine Asteraceae (58 grains/g) was moderate, with low amounts of low-spine Asteraceae and *Artemisia* (19 grains/g). *Cylindropuntia* (19 grains/g) and Nyctaginaceae (39 grains/g) pollen were also present.

FS 65 was taken from EU-I and contained 686 grains/g total pollen concentration values with 1.72 percent indeterminate pollen. *Pinus, Juniperus, Sarcobatus*, Poaceae, cheno-am, high-spine and low-spine Asteraceae, *Ephedra*, and *Zea mays* were present in small amounts.

FS 73 was taken from EU-L and contained 449 grains/g total pollen concentration values with 2.63 percent indeterminate pollen. *Pinus, Polygonum*, Poaceae, cheno-am, high-spine and low-spine Asteraceae, and *Ephedra* were present in low amounts.

FS 91 was taken from EU-N and contained 3,789 grains/g total pollen concentration values with 1.45 percent indeterminate pollen. *Pinus* (2773 grains/g) dominated the assemblage. Cheno-am (741 grains/g) and Poaceae (27 grains/g) were very low, with high amounts of both high-spine and low-spine Asteraceae (82 grains/g each). *Zea mays* (32 grains/g) was also present.

FS 90 was taken from EU-O and contained 957 grains/g total pollen concentration values with 1.14 percent indeterminate pollen. *Pinus* (587 grains/g) was low, with low *Juniperus* (11 grains/g). Cheno-am (283 grains/g) was low, with low amounts of high-spine Asteraceae (22 grains/g) and low-spine Asteraceae and *Artemisia* (11 grains/g). *Cylindropuntia* (22 grains/g) was also present.

Feature 21. FS 71 was taken from EU-M and contained 2,811 grains/g total pollen concentration values with 1.69 percent indeterminate pollen. This field covered 820 sq m. *Pinus* (1,652 grains/g) was moderate to high, with low amounts of *Juniperus, Picea* (16 grains/g), and *Quercus* (32 grains/g). Cheno-am (842 grains/g) was low, with low Poaceae (32 grains/g) and high *Sarcobatus* (64 grains/g). Cheno-am clumps (16/g) were present, along with high-spine and low-spine Asteraceae (32 grains/g each). *Zea mays* (32 grains/g) was also present.

Feature 22. FS 83 was taken from EU-J and contained 2,916 grains/g total pollen concentration values with 3.7 percent indeterminate pollen. This field covered 936 sq m. *Pinus* (1,584 grains/g) was low, with moderate to high amounts of *Juniperus* (72 grains/g). Cheno-am (972 grains/g) was low, with high amounts of *Sarcobatus* (72 grains/g). High-spine (36 grains/g) and low-spine (72 grains/g) Asteraceae were also present.

FS 88 was taken from EU-J and contained 3,362 grains/g total pollen concentration values with 1.04 percent indeterminate pollen. This sample was taken from the cobble mulch layer (Stratum 4). *Pinus* (2,474 grains/g) was high, but no other arboreal taxa were present. Cheno-am (610 grains/g) and Poaceae (17 grains/g) pollen were very low. High-spine (122 grains/g) and low-spine Asteraceae (52 grains/g) were high, with low amounts of *Artemisia* (17 grains/g). *Zea mays* (35 grains/g) pollen was present in moderate to high amounts.

FS 79 was taken from EU-K and contained 7,028 grains/g total pollen concentration values with 1.06 percent indeterminate pollen. *Pinus* (4,810 grains/g) clearly dominated the assemblage, with high amounts of *Juniperus, Picea* (50 grains/g) and *Abies* (25 grains/g). Cheno-am (1,271 grains/g) was moderate, with high amounts of Poaceae (150 grains/g) and *Sarcobatus* (50 grains/g). High-spine (150 grains/g) and low-spine (174 grains/g) Asteraceae were high, with small amounts (25 grains/g) of *Artemisia*. *Zea mays* (150 grains/g) was quite high.

FS 84 was taken from EU-K and contained 1,535 grains/g total pollen concentration values with 2.22 percent indeterminate pollen. This sample was taken from the cobble mulch layer (Stratum 4). *Pinus* (563 grains/g) was very low, with traces of *Juniperus* and *Quercus* (17 grains/g each). Cheno-am (733 grains/g) was low, with high *Sarcobatus* (51 grains/g) and low Poaceae (17 grains/g). Low-spine (68 grains/g) Asteraceae was moderate, with small amounts of *Cylindropuntia* and *Zea mays* (17 grains/g each).

LA 105704

LA 105704 was at an elevation of 6,250 ft. Samples were taken from two features and three excavation units.

Feature 1. FS 3 was taken from EU-A and contained 5,975 grains/g total pollen concentration values with 2.99 percent indeterminate pollen. This field covered 180 sq m. *Pinus* (4,741 grains/g) was high and dominated the assemblage, along with high amounts of *Juniperus* (59 grains/g) and *Picea* (30 grains/g). Cheno-am (654 grains/g) was low, with low to moderate amounts of Poaceae (15 grains/g) and *Sarcobatus* (30 grains/g). High-spine (59 grains/g) and low-spine Asteraceae (115 grains/g) were present, along with *Ephedra* (59 grains/g) and a small amount of *Zea mays* (15 grains/g).

FS 8 was taken from EU-B and contained 1,944 grains/g total pollen concentration values with no indeterminate pollen. *Pinus* (1,515 grains/g) was low, with low *Juniperus* (21 grains/g). Cheno-am (293 grains/g) was very low, with small amounts of Poaceae (21 grains/g), *Eriogonum*, and *Sarcobatus* (10 grains/g each). Low-spine Asteraceae (21 grains/g), high-spine Asteraceae, Liguliflorae, and *Artemisia* (10 grains/g each) were present but in low amounts. A small amount of *Zea mays* (21 grains/g) was also present.

Feature 2. FS 1 was taken from EU-C and contained 3,456 grains/g total pollen concentration values with 0.63 percent indeterminate pollen. This field covered 48 sq m. *Pinus* (2,657 grains/g) was high, with high *Juniperus* (43 grains/g). Cheno-am (475 grains/g) was low, with high Poaceae (86 grains/g). Low-spine (108 grains/g) Asteraceae was high, with high (43 grains/g) amounts of *Zea mays*.

LA 105708

LA 105708 was at an elevation of 6,200 ft. Samples were taken from two features and six excavation units.

Feature 9. FS 22 was taken from EU-A and contained 1,559 grains/g total pollen concentration values with 0.78 percent indeterminate pollen. This field covered 971 sq m. *Pinus* (999 grains/g) was very low, with low cheno-am (438 grains/g) and Poaceae (12 grains/g). High-spine (49 grains/g) and low-spine (24 grains/g) Asteraceae were moderate to low. *Cylindropuntia* (24 grains/g) was also present.

FS 8 was taken from EU-B and contained 4,000 grains/g total pollen concentration values with 0.41 percent indeterminate pollen. *Pinus* (2976 grains/g) was high, with low amounts of *Juniperus* (17 grains/g) and Picea (33 grains/g). Cheno-am (579 grains/g) was low, with moderate Poaceae (66 grains/g) and low *Eriogonum* (17 grains/g). *Artemisia* (99 grains/g) and high-spine and low-spine Asteraceae (50 grains/g each) were present. *Zea mays* (50 grains/g), *Sphaeralcea* (17 grains/g), and *Cylindropuntia* (24 grains/g) were also present.

FS 11 was taken from EU-C and contained 3,287 grains/g total pollen concentration values with 2.14 percent indeterminate pollen. *Pinus* (1,878 grains/g) was moderate, with high *Juniperus* (80 grains/g). Cheno-am (1,080 grains/g) was moderate, with low amounts of high-spine (47 grains/g) and low-spine Asteraceae and *Artemisia* (23 grains/g each). *Zea mays* (47 grains/g) was high.

Feature 3. FS 26 was taken from EU-D and contained 3,408 grains/g total pollen concentration values with 2.73 percent indeterminate pollen. This field covered 225 sq m. *Pinus* (2,253 grains/g) was high, with small amounts of *Picea* and *Quercus* (19 grains/g each). Cheno-am (782 grains/g) and Poaceae (19 grains/g) were low, with moderate to high values of low-spine (74 grains/g) and high-spine Asteraceae and *Artemisia* (37 grains/g each). *Cylindropuntia* (19 grains/g) and *Zea mays* (56 grains/g) were also present.

FS 21 was taken from EU-E and contained 12,741 grains/g total pollen concentration values with 1.03 percent indeterminate pollen. *Pinus* (8188 grains/g) was very high, with high amounts of *Juniperus* (394 grains/g), *Picea* (175 grains/g), and *Quercus* (44 grains/g). Cheno-am (2,715 grains/g) was high, along with Poaceae and *Sarcobatus* (88 grains/g). A large number of cheno-am clumps (44/g) were also present. High-spine (306 grains/g) and low-spine (219 grains/g) Asteraceae and *Artemisia* (175 grains/g) were all high. *Zea mays* was also high (88 grains/g).

FS 29 was taken from EU-F and contained 4,368 grains/g total pollen concentration values with 0.55 percent indeterminate pollen. Pinus (2,640 grains/g) was high, with small amounts of Picea (24 grains/g) and Abies (12 grains/g). Cheno-am (612 grains/g) was low, with low Poaceae (12 grains/g). High-spine (24 grains/g) and low-spine (48 grains/g) Asteraceae and *Artemisia* (12 grains/g) were moderate to low. *Cylindropuntia* (936 grains/g) was extremely high.

LA 105709

LA 105709 was at an elevation of 6,150 ft. Samples were taken from two features and two excavation units.

Feature 1. FS 433 was taken from EU-A and contained 6,238 grains/g total pollen concentration values with 2.69 percent indeterminate pollen. This field covered 444 sq m. *Pinus* (3,910 grains/g) was high, with *Juniperus* (37 grains/g), *Picea* (56 grains/g) and *Quercus* (19 grains/g) also present. Cheno-am (1,303 grains/g) was moderate, with high Poaceae (112 grains/g). High-spine (112 grains/g) and low-spine (186 grains/g) Asteraceae and *Artemisia* (205 grains/g) were also high. *Zea mays* (37 grains/g) and Cactaceae were also present.

Feature 4. FS 430 was taken from EU-C and contained 4,646 grains/g total pollen concentration values with 1.32 percent indeterminate pollen. This field covered 47 sq m. *Pinus* (3,500 grains/g) was high, with traces of *Juniperus, Picea*, and *Abies* (15 grains/g each). Cheno-am (642 grains/g), Poaceae, and *Sarcobatus* (15 grains/g each) were all low. High-spine (61 grains/g) and low-spine (138 grains/g) Asteraceae and *Artemisia* (31 grains/g) were also present. *Cylindropuntia* (15 grains/g) and *Zea mays* (107 grains/g) were present.

LA 118547

LA 118547 was at an elevation of 6,165 ft. Samples were taken from one feature and 12 excavation units.

Feature 15. FS 473 was taken from EU-A and contained 8,870 grains/g total pollen concentration values with 2.69 percent indeterminate pollen. This field covered 3,911 sq m. *Pinus* (5,763 grains/g) was very high, with high to moderate amounts of *Juniperus* (133 grains/g), *Picea* (53 grains/g), and *Quercus* (27 grains/g). Cheno-am (1992 grains/g) was high, with a large amount (53/g) of cheno-am clumps. High-spine (186 grains/g) and low-spine (212 grains/g) Asteraceae and *Artemisia* (80 grains/g) were high. *Cylindropuntia* and *Zea mays* (27 grains/g) were both high.

FS 459 was taken from EU-B and contained 3,367 grains/g total pollen concentration values with 1.89 percent indeterminate pollen. *Pinus* (1715 grains/g) was moderate, with a trace of *Juniperus* (11 grains/g). Cheno-am (1,016 grains/g) was moderate, with high Poaceae (85 grains/g) and moderate *Sarcobatus* (21 grains/g). A small number of cheno-am clumps (11 grains/g) were also present. High-spine (95 grains/g) and low-spine (191 grains/g) Asteraceae were high, with low *Artemisia* (21 grains/g). *Cylindropuntia* and Malvaceae (11 grains/g) and *Zea mays* (42 grains/g) were also present.

FS 456 was taken from EU-C and contained 7,560 grains/g total pollen concentration values with 2.12 percent indeterminate pollen. *Pinus* (4040 grains/g) was high, with high *Picea* (40 grains/g). Cheno-am (2,040 grains/g) was high, with high Poaceae (80 grains/g) and *Sarcobatus* (40 grains/g). Cheno-am clumps were also high (20/g). High-spine (420 grains/g) and low-spine (460 grains/g) Asteraceae were high, as was *Artemisia* (120 grains/g) and *Zea mays* (60 grains/g).

FS 465 was taken from EU-D and contained 1,116 grains/g total pollen concentration values with 2.41 percent indeterminate pollen. *Pinus* (618 grains/g) was low, with a trace (7/g) of *Juniperus* pollen. Cheno-am (336 grains/g) was very low, with low to moderate amounts of high-spine (7 grains/g) and low-spine (60 grains/g) Asteraceae and *Artemisia* (20 grains/g). A small number of cheno-am clumps (7/g) were also present. *Cylindropuntia* (7 grains/g)and *Zea mays* (13 grains/g) were also present.

FS 461 was taken from EU-E and contained 1,682 grains/g total pollen concentration values with 0.81 percent indeterminate pollen. *Pinus* (854 grains/g) was low, with traces of *Juniperus* (14 grains/g) and *Abies* (7 grains/g). Cheno-am (574 grains/g) and Poaceae (21 grains/g) were low, with moderate amounts of both high-spine and low-spine Asteraceae (68 grains/g) and low amounts of Artemisia (7 grains/g). Malvaceae (7 grains/g) and *Zea mays* (41 grains/g) were also present.

FS 497 was taken from EU-F and contained 4,413 grains/g total pollen concentration values with 2.11 percent indeterminate pollen. *Pinus* (2514 grains/g) was high, with *Juniperus* (74 grains/g) and *Abies* (19 grains/g). Cheno-am (875 grains/g) was low, with high Poaceae (74 grains/g) and low *Sarcobatus* (19 grains/g).

High-spine Asteraceae (74 grains/g) and low-spine (503 grains/g) Asteraceae and *Artemisia* (37 grains/g) were present in addition to *Cylindropuntia* (37 grains/g) and *Zea mays* (19 grains/g).

FS 472 was taken from EU-G and contained 1,352 grains/g total pollen concentration values with 3.17 percent indeterminate pollen. *Pinus* (708 grains/g) was low, with a trace of *Juniperus* (11 grains/g). Cheno-am (429 grains/g) and Poaceae (21 grains/g) were low, with low *Artemisia* (11 grains/g) and moderate high-spine (64 grains/g) and low-spine (43 grains/g) Asteraceae.

FS 470 was taken from EU-H and contained 5,987 grains/g total pollen concentration values with 1.57 percent indeterminate pollen. *Pinus* (3663 grains/g) was high, with high *Juniperus* (47 grains/g). Cheno-am (1244 grains/g) was moderate, with high Poaceae (144 grains/g) and moderate *Sarcobatus* (21 grains/g). Cheno-am clumps (23/g) were high. High-spine (211 grains/g) and low-spine Asteraceae (376 grains/g) were high, with moderate *Artemisia* (23 grains/g). Cactaceae (23 grains/g) and *Cylindropuntia* (47 grains/g) were present in addition to *Sphaeralcea* (23 grains/g) and *Zea mays* (47 grains/g).

FS 487 was taken from EU-I and contained 417 grains/g total pollen concentration values with 1.85 percent indeterminate pollen. *Pinus*, Poaceae, cheno-am, high-spine and low-spine Asteraceae, Malvaceae, and *Zea mays* were present in addition to the indeterminate pollen.

FS 492 was taken from EU-J and contained 638 grains/g total pollen concentration values with 1.49 percent indeterminate pollen. *Pinus*, Poaceae, cheno-am, high- and low-spine Asteraceae, *Typha angustifolia*, and *Zea mays* were the only taxa present in addition to indeterminate pollen.

FS 494 was taken from EU-K and contained 6,017 grains/g total pollen concentration values with 4.49 percent indeterminate pollen. *Pinus* (3317 grains/g) was high, with high *Juniperus* (77 grains/g). Cheno-am (1659 grains/g) was moderate, with moderate Poaceae and Fabaceae (39 grains/g each). A large number of cheno-am clumps (39 /g) was present. High-spine and low-spine Asteraceae (231 grains/g each) were high, with moderate *Artemisia* and high Liguliflorae (39 grains/g each). *Zea mays* (39 grains/g) was moderate.

FS 499 was taken from EU-L and contained 1,656 grains/g total pollen concentration values with no indeterminate pollen. *Pinus* (1236 grains/g) was moderate, with a trace (12 grains/g) of *Juniperus*. Cheno-am (324 grains/g) and Poaceae (12 grains/g) were very low. High-spine Asteraceae and *Artemisia* (12 grains/g each) were low. *Cylindropuntia* (12 grains/g) and *Zea mays* (36 grains/g) were also present.

Two additional samples were taken from backhoe trenches from this site. FS 482 was from Trench 1 and contained 4,306 grains/g total pollen concentration values with 0.99 percent indeterminate pollen. *Pinus* (2750 grains/g) was high, with small amounts of *Juniperus* (21 grains/g). Cheno-am (1,087 grains/g) was low, with a moderate number of cheno-am clumps (21/g). High-spine (43 grains/g) and low-spine (171 grains/g) Asteraceae were moderate to high. *Cylindropuntia* (21 grains/g) and *Zea mays* (85 grains/g) were high.

FS 483 was from Trench 2 and contained 3,021 grains/g total pollen concentration values with 1.68 percent indeterminate pollen. *Pinus* (1856 grains/g) was moderate to high, with high Poaceae (84 grains/g) and low cheno-am (776 grains/g). Cheno-am clumps (17/g) were moderate. High-spine (84 grains/g) and low-spine (101 grains/g) Asteraceae were high, with a small amount of Nyctaginaceae (17 grains/g) pollen. *Zea mays* pollen (34 grains/g) was moderate.

Discussion

LA 105710

The pollen column from LA 105710 contained relatively low pollen concentration values, particularly from an area which is now heavily forested. The highest concentration values were obtained from the modern surface, which is to be expected. Only from this level do *Pinus* concentration values reflect the forested environment. *Pinus* values decrease to below 1,000 grains/g in all remaining strata, which normally suggests long-distance transport of pine pollen and a more open or grassland environment. However, in this case, the lowered pollen concentration values are more likely a result of pollen preservation than the absence of these taxa in the local flora. The upper levels also contain small amounts of other arboreal taxa such as *Picea, Abies*, and *Salix*, which were undoubtedly introduced by long-distance transport.

The upper strata (0–25) contain a consistent presence of *Juniperus* pollen. While the concentration values are only moderate to low, the consistent presence indicates its dominance in the local vegetation. *Juniperus* pollen is thin walled and does not preserve well under optimal conditions. Holloway (1981, 1989) demonstrated that over 80 percent of fresh *Juniperus* pollen was altered after only 25 alternating cycles of wet-dry and/or freeze-thaw conditions. *Juniperus* also contains a low percentage of the organic compound sporopollenin in the pollen wall, which has been shown to positively correlate with preservation (Brooks 1971). Thus the moderate to low pollen concentration values for this taxon belie its composition within the local plant community. Low-spine Asteraceae is also much higher in these upper strata, suggesting a rather large component of this taxon was present. Based on these data, I infer that a juniper-dominated assemblage in association with *Pinus* was likely present during the time period represented by Strata 1–25.

Total pollen concentration values and the percentage of indeterminate pollen are plotted against strata in Figure A1.1. The concentration values decrease to below 1,000 grains/g in the upper strata (through Stratum 25). The concentration values increase in Stratum 17, which is expected given the interpretation of this stratum as a buried A horizon. These again decrease gradually and remain below 1,000 grains/g from Stratum 22 through the bottom. Thus, there are apparently two sections of the profile containing very low pollen concentration values separated by increased values in the area of the buried A horizon. Both of these correlate with increased percentages of indeterminate pollen. While the indeterminate pollen percentages remain below 7 percent, they probably indicate that severe weathering has occurred within these strata. It is likely that large components of the assemblage have been lost, thus decreasing the percentage of indeterminate pollen observed.

In Strata 17–19 the assemblages reflect a slightly higher grassland component dominated by higher levels of cheno-am and high-spine Asteraceae, with moderate amounts of Poaceae and low-spine Asteraceae. The general trends of taxa within this area are increasing toward the surface, which is consistent with normal soil development. Thus, these three levels appear to represent a developmental sequence associated with the buried A horizon and not, specifically, with a climate change. Again, the plant community was likely dominated by a piñon-juniper association, which is not reflected in the pollen concentration values.

The number of economic taxa present in this column were fairly low but included *Zea mays, Eriogonum*, Cactaceae, *Cylindropuntia*, and a single occurrence of *Platyopuntia* from Stratum 38. *Zea mays* and *Eriogonum* contained high concentration values from the uppermost strata, which is not totally unexpected. *Eriogonum* was likely present in the area, and this high value corresponds to a naturally occurring deposition.

There appear to be three additional clusters of economic taxa within this column. *Zea mays* and *Cylindropuntia* show slight increases in Strata 25, 21, and 36, with slight increases in Cactaceae at Strata 17 and 21. *Platyopuntia* is present only from Stratum 38. This suggests that the three strata may have been occupational surfaces. The presence of Cactaceae pollen from Stratum 17 is possibly natural, since this level was defined as a buried A horizon.

Based on the pollen data from this profile, I suspect that an open woodland dominated by a piñon-juniper plant association was present throughout the time period represented by these deposits. The profile is thought to date more recently than the associated archaeological site, which is Classic period in age. Thus the profile is likely younger than A.D. 1325–1500.

Agricultural Field Sites

The arboreal pollen is completely dominated by *Pinus*. This taxon is present in fairly high concentration values throughout the sites and features, even in the samples with the lowest pollen concentration values. *Pinus* mean values are present in excess of 1,500 grains/g. This suggests that pines were likely in the immediate vicinity of these sites during the occupation. Both *Picea* and *Abies* pollen was likely introduced via long-distance transport, since neither of these taxa are

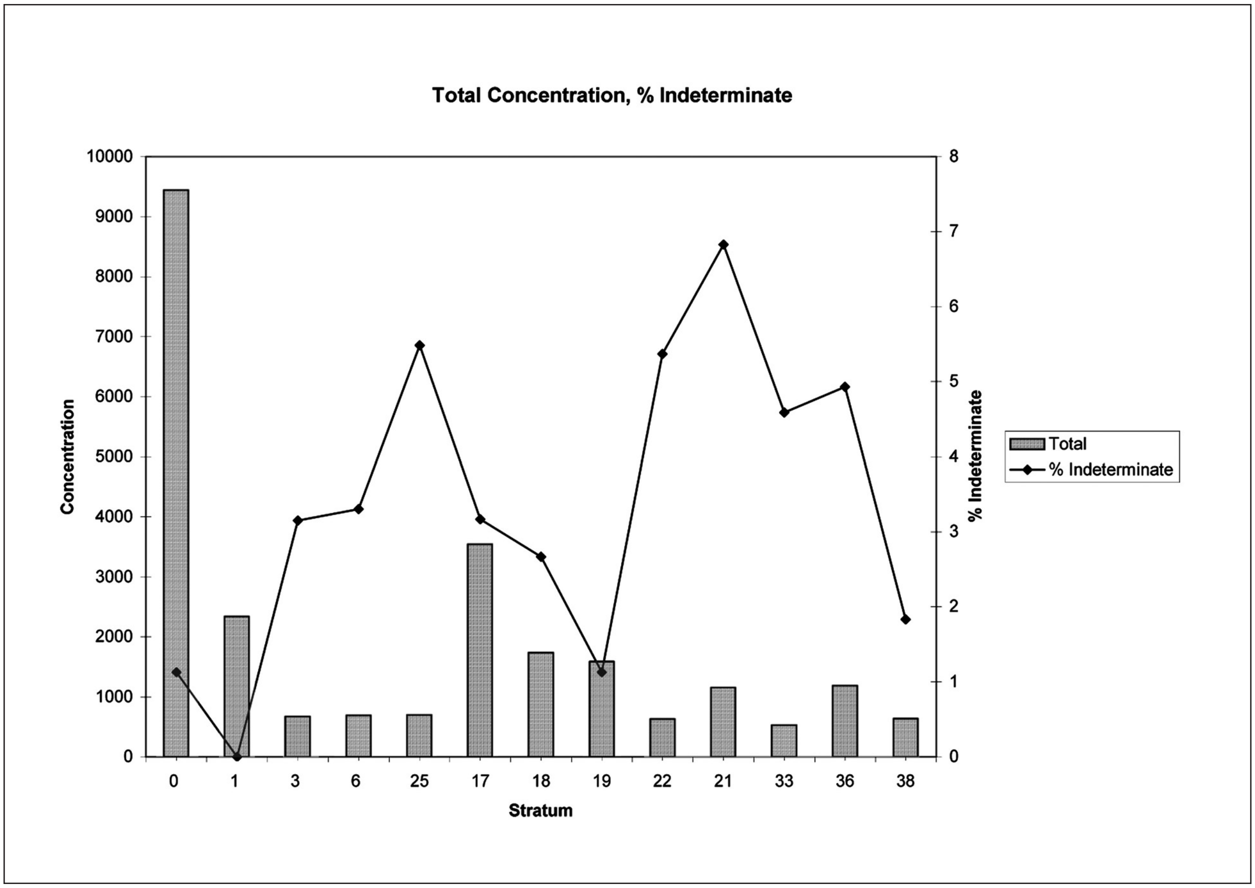


Figure A1.1. Total pollen concentration values and the percentage of indeterminate pollen plotted against strata, LA 105710.

present in the local plant community today. *Abies* is present in three of the four features from LA 105703, the northernmost site. Picea is present at all five sites, but again the concentration values are slightly higher in the northern sites.

The nonarboreal pollen is somewhat wider in distribution. Cheno-am pollen tends to increase in concentration values toward the south, but the difference is minor. The presence of both high-spine and low-spine Asteraceae, Poaceae, *Artemisia*, and Nyctaginaceae pollen is consistent with open field areas such as these. These background pollen types reflect the open character of the vegetation, which is expected given that they are interpreted as agricultural fields.

Principal Components Analysis (PCA)

In order to analyze the data sets from the agricultural field sites and LA 105710, the pollen concentration values were used in a principal components analysis procedure (Kovach 1998). The data from LA 105710 was analyzed separately, since this column was taken primarily for environmental interpretations and was counted using full microscopy instead of ISM. The data set from the agricultural field sites was adjusted prior to using PCA. Economic taxa and some additional arboreal taxa (*Picea* and *Abies*) were observed in the low-magnification scan of the slide. These concentration values were adjusted by using the total number of selected economic taxa grains present on all slides and the total of estimated marker grains per sample. In this study, this may represent a maximum of the total of three slides. Since pollen grains are not evenly distributed over the surface of the microscope slide (Brookes and Thomas 1967), these adjusted pollen concentration values generally result in slightly lowered pollen concentration values. However, these same taxa are present in a greater number of samples. Thus the adjusted pollen concentration values of the economic and arboreal taxa were substituted for the concentration values obtained solely from the actual counts before running the PCA procedure. This eliminated the necessity for explaining why duplicate sets of taxa were used in the PCA, which also would have unnecessarily biased the data by artificially increasing the proportion of economic pollen. Also, I felt that it was more accurate to include the increased number of occurrences of these taxa to obtain more reliable results from the PCA.

LA 105710. Table A1.5 contains the results of the PCA from LA 105710. Table A1.5a contains the results of the Eigenvalue analysis. Axis 1 accounted for 58.6742 percent of the variation, while Axis 2 added an additional 16.7299 percent. Over 92 percent of the total variation in the pollen concentration values was explained by the first five axes. Table A1.5b contains the variable loadings from this analysis; those higher than 0.2250 are indicated in boldface. Axis 1 was dominated by the effects of *Pinus, Juniperus*, cheno-am, high-spine and low-spine Asteraceae, and indeterminate pollen, the dominant pollen taxa recovered from these samples. Axis 2 is dominated by *Acacia*, Poaceae, Cactaceae, *Cylindropuntia*, and indeterminate pollen, which reflects more of the economic taxa along with the variation in grasses. Given the dominance of background pollen types, the results of PCA have really not

Table A1.5a. Eigenvalues, LA 105710
(uncentered, standardized, tolerance of eigenanalysis set at 1E-8)

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7
Eigenvalues	21.0703	6.0078	2.7772	2.1159	1.3024	1.0848	0.7356
Percentage	58.6742	16.7299	7.7335	5.8921	3.6267	3.0208	2.0483
Cumulative Percentage	58.6742	75.4042	83.1377	89.0298	92.6565	95.6772	97.725

	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13
Eigenvalues	0.3625	0.2122	0.1371	0.0619	0.0342	0.0088
Percentage	1.0094	0.591	0.3818	0.1725	0.0953	0.0245
Cumulative Percentage	98.7349	99.3259	99.7077	99.8802	99.9755	100

Table A1.5b. Variable loadings, LA 105710

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
Pinus undifferentiated	0.2439	-0.0828	0.0104	0.0237	0.0504	0.0478
P. ponderosa	0.2186	-0.1357	-0.0516	-0.0045	0.0077	0.0086
P. edulis	0.2117	-0.1377	-0.0928	-0.0420	-0.0274	-0.0119
Juniperus	0.2283	-0.0198	0.3083	0.1593	0.2558	0.0799
Picea	0.2046	-0.1096	0.1562	0.1798	0.2086	0.0780
Abies	0.2171	-0.1337	0.0458	0.0967	0.0983	0.0244
Salix	0.2074	-0.1422	-0.1026	-0.0462	-0.0269	-0.0455
Acacia	0.0392	0.2826	-0.2917	0.3721	0.0803	0.0056
Onagraceae	0.2074	-0.1422	-0.1026	-0.0462	-0.0269	-0.0455
Shepherdia	0.2074	-0.1422	-0.1026	-0.0462	-0.0269	-0.0455
Eriogonum	0.2095	-0.1366	-0.1020	-0.0572	-0.0274	-0.0460
Sarcobatus	0.2094	-0.1239	-0.0703	-0.0182	-0.0325	-0.0488
Poaceae	0.1656	0.4916	0.1099	-0.4699	0.1528	-0.0171
Cheno-am	0.2817	0.1212	0.1218	-0.1283	-0.2173	0.0106
Cheno-am af	0.0666	0.1543	0.5522	0.2990	-0.0699	-0.0437
Asteraceae (hs)	0.2826	0.2094	-0.0650	-0.0434	-0.2115	-0.0170
Asteraceae (ls)	0.2406	-0.0944	0.0168	-0.0092	0.0284	-0.0060
Artemisia	0.2109	-0.1327	-0.1028	-0.0607	-0.0429	-0.0483
Cactaceae	0.0858	0.2394	-0.3299	0.3092	0.0317	-0.0076
Cylindropuntia	0.0766	0.4015	-0.1606	0.3439	0.2162	0.0535
Platyopuntia	0.0076	0.0212	0.0054	-0.0633	-0.2333	0.9498
Ephedra	0.2513	-0.0466	-0.0627	0.0074	0.0345	-0.0148
Nyctaginaceae	0.0199	0.1249	0.0752	-0.3888	0.6370	0.0784
Indeterminate	0.2738	0.3718	-0.1048	-0.1358	-0.2653	-0.0517
Triporate	0.0396	0.1370	0.4402	0.0430	-0.3405	-0.1835
Zea mays	0.2041	-0.0823	0.1976	0.2458	0.2221	0.1448

	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12
Pinus undifferentiated	-0.0289	0.0168	-0.0711	-0.0128	-0.0226	-0.0582
P. ponderosa	0.0872	-0.0448	-0.0741	0.0616	-0.0348	-0.0527
P. edulis	0.1286	-0.1040	-0.0959	0.0127	-0.0065	0.0021
Juniperus	-0.1701	0.0711	0.1786	-0.1555	0.3769	-0.0125
Picea	-0.0780	0.1897	-0.1559	0.0403	-0.3716	-0.3469
Abies	0.0095	0.0762	-0.1292	0.0440	-0.2142	-0.1906
Salix	0.1422	-0.0816	-0.0595	0.0413	0.0162	0.0397
Acacia	0.2474	0.0195	0.1972	0.6146	0.2723	-0.1656
Onagraceae	0.1422	-0.0816	-0.0595	0.0414	0.0163	0.0397
Shepherdia	0.1422	-0.0816	-0.0595	0.0413	0.0163	0.0397
Eriogonum	0.1263	-0.0689	-0.0377	0.0376	0.0126	-0.0021
Sarcobatus	0.1031	-0.4263	0.2267	-0.2915	-0.0443	0.2590
Poaceae	0.0158	-0.0336	-0.3552	0.0931	0.0702	0.0768
Cheno-am	-0.3626	0.2615	0.2734	0.3214	-0.4029	0.3949
Cheno-am af	0.1345	-0.4372	0.3039	-0.0003	-0.1521	-0.0885
Asteraceae (hs)	0.0979	0.1603	0.0252	-0.2338	-0.1447	-0.4929
Asteraceae (ls)	-0.0003	0.0216	-0.0894	0.0116	0.2749	0.2385
Artemisia	0.0995	-0.0549	-0.0202	0.0338	0.0106	-0.0505
Cactaceae	0.2300	0.4129	0.2026	-0.4639	-0.1221	0.2733
Cylindropuntia	-0.0935	-0.3749	-0.4145	-0.0393	-0.2650	0.2270
Platyopuntia	0.1657	-0.0554	0.0050	0.0082	0.0079	0.0343
Ephedra	-0.0554	0.0152	0.2310	0.2671	-0.0073	0.1423
Nyctaginaceae	0.3382	0.0483	0.3409	-0.0362	-0.1011	-0.0214
Indeterminate	-0.2957	-0.1219	0.1608	-0.1842	0.3116	-0.2535
Triporate	0.5419	0.2550	-0.2257	0.0341	0.0824	0.1829
Zea mays	-0.1856	0.2163	-0.2087	-0.0803	0.3298	0.1408

Table A1.5c. Case scores, Backhoe Trench 1, LA 105710

FS No.	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
108	4.1989	-0.8208	-0.2738	-0.0938	-0.0336	-0.0475
109	0.9909	0.0354	1.0037	0.7487	0.4056	0.1853
110	0.2714	0.0973	0.1228	-0.0057	0.0697	0.0422
111	0.4025	0.7207	0.2006	-0.7904	0.7971	0.0817
112	0.3900	0.3279	0.2908	0.1966	-0.0272	-0.0148
113	0.9061	0.9199	0.0045	-0.4662	-0.3175	-0.0433
114	0.5621	0.7899	0.9358	-0.0988	-0.5318	-0.2396
115	0.2600	0.1884	0.0358	-0.1536	-0.1032	-0.0089
116	0.3049	0.5968	-0.0399	0.2305	0.0520	-0.0021
117	0.7049	1.4635	-0.8209	0.7018	0.0825	0.0074
118	0.1948	0.1982	-0.0111	-0.1272	-0.0795	-0.0154
119	0.4625	0.7991	-0.0457	-0.2323	0.0212	-0.0004
120	0.1535	0.1221	0.0144	-0.1287	-0.2920	0.9899

FS No.	Axis 7	Axis 8	Axis 9	Axis 10	Axis 11	Axis 12
108	0.1005	-0.0284	-0.0121	0.0054	0.001	0.0013
109	-0.2337	0.1404	-0.0385	0.0015	-0.0357	-0.0197
110	-0.1711	0.0740	0.0038	-0.0219	0.2180	0.0696
111	0.2390	0.0168	0.0695	-0.0048	-0.0060	-0.0007
112	-0.0924	-0.4289	0.2070	-0.1557	-0.0128	0.0258
113	-0.4864	0.1495	0.1284	-0.0161	-0.0055	-0.0474
114	0.4454	0.0546	-0.0369	0.0042	0.0139	0.0110
115	-0.1782	0.0921	0.0944	0.1337	-0.0953	0.1165
116	-0.0112	-0.2526	0.0273	0.2961	0.0488	-0.0397
117	0.1944	0.1337	0.0298	-0.0606	-0.0069	0.0140
118	-0.0594	0.0204	-0.0032	-0.0304	0.0209	-0.0991
119	-0.2325	-0.1896	-0.3668	-0.0435	-0.0273	0.0285
120	0.1171	-0.0193	0.0010	0.0011	0.0005	0.0011

effectively separated the data. Table A1.5c provides the sample loadings from this analysis.

Agricultural Fields. Table A1.6 contains the results of the PCA from the agricultural sites. Table A1.6a contains the results of the Eigenvalue analysis. Axis 1 accounts for 48.2461 percent of the total variation, and Axis 2 accounts for an additional 7.1713 percent. Axis 5 accounts for a cumulative percentage of only 70.0952, while 90 percent is not attained until Axis 14. Table A1.6b contains the variable loadings from this analysis, with those above 0.2550 in boldface. Axis 1 is dominated by *Pinus*, high-spine and low-spine Asteraceae, indeterminate, and *Zea mays*. Axis 2 is dominated by negative loadings of *Juniperus, Prosopis*, and *Shepherdia*. Table A1.6c provides the sample loadings. The first component is again dominated by the background taxa. A plot of the first and second principal component (not provided) revealed that there was no separation of samples. This is to be expected, since the important aspect of these samples is the presence or absence of selected economic taxa. While I believe that it was important to conduct these analyses, they provided very little information and will not be considered further.

Economic Taxa

The presence or absence of economic taxa is probably the most important aspect in the analysis of these samples. Therefore it was decided initially that these samples would be analyzed using ISM (Dean 1998). Based on the pollen taxa recovered, the question always arises: Are economic taxa absent from these assemblages because they are truly not present, or are they present in such small amounts that they were missed during sampling? To assess the likelihood of their being missed, the estimated maximum potential concentration values of target taxa was computed. It was decided that examination of the pollen residue would cease once the estimated maximum potential concentration value was 1 grain/g or less. Since the entire slide was examined (either by count or low-magnification scan of the slide), the estimated number of marker grains per slide was computed by averaging the number of marker grains per transect and multiplying this by the total number of transects examined. Based on the number of marker grains added, a concentration value of 1.0 grains/g necessitated counting a total of 1,620 marker grains. This necessitated counting a maximum of three slides in some cases, but primarily only two slides were necessary. The raw counts (Table A1.3) are based on the initial count of the first slide. Four transects of each subsequent slide were counted for marker grains, and the estimated mean number of markers per slide was computed separately for each slide examined (Table A1.4). The entire area of these subsequent slides was scanned at low magnification for target taxa. This procedure assumes that the first grain observed on the next hypothetical slide is one of the target taxa, and thus the maximum potential concentration value can be computed. The number of the fossil grains is one, and the estimated number of marker grains (>1,620) observed is substituted for the number of marker grains counted in the pollen concentration formula (Table A1.4). Using this procedure, the estimated maximum potential concentration values for all samples is 1.0 grains/g or less. Without examining the total of the pollen residues, we can never be absolutely sure that target taxa are indeed absent from the assemblage. However, 1 grain/g is sufficiently low to confidently assume that if taxa were not observed, they are likely absent from these assemblages.

Table A1.7 shows the number of samples containing the economic taxa recovered from the initial raw count and the use of ISM. The number of samples containing economic taxa increased dramatically using ISM. Only three taxa—Fabaceae, *Polygonum*, and *Eriogonum*—remained the same. While some members of these taxa are economic, others are naturally occurring members of the local flora. The rare occurrence of these three taxa suggests that they were simply members of the local plant community and will not be considered as economically important for the purposes of this investigation.

There was no apparent correlation between the size of the plot and the total pollen concentration values. The economic taxa recovered are discussed below by site and feature number. The mean concentration values of economic taxa by site and feature number are presented in Table A1.8. The parenthetic values in the following discussion refer to mean concentration.

LA 105703. This was the northernmost site.

Table A1.6a. Eigenvalues, agricultural field sites

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Eigenvalues	22.7235	3.3776	2.6445	2.1554	2.1132	1.3462	1.2542	1.1901
Percentage	48.2461	7.1713	5.6148	4.5762	4.4867	2.8582	2.6628	2.5268
Cumulative Percentage	48.2461	55.4174	61.0323	65.6085	70.0952	72.9534	75.6162	78.143

	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16
Eigenvalues	1.1451	1.0688	1.0428	1.0311	0.9339	0.8607	0.7617	0.6345
Percentage	2.4313	2.2693	2.2141	2.1893	1.9828	1.8275	1.6172	1.3472
Cumulative Percentage	80.5743	82.8436	85.0577	87.247	89.2298	91.0573	92.6745	94.0217

	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
Eigenvalues	0.5600	0.3969	0.3706	0.2902	0.2721	0.2319	0.1949	0.1598
Percentage	1.1891	0.8427	0.7868	0.6162	0.5777	0.4924	0.4138	0.3393
Cumulative Percentage	95.2107	96.0534	96.8402	97.4565	98.0341	98.5265	98.9403	99.2796

	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32
Eigenvalues	0.1074	0.0801	0.0521	0.0331	0.0261	0.0231	0.0121	0.0052
Percentage	0.2281	0.1700	0.1107	0.0704	0.0554	0.0490	0.0256	0.0111
Cumulative Percentage	99.5077	99.6777	99.7884	99.8588	99.9142	99.9633	99.9889	100.0000

Table A1.6b. Variable loadings, agricultural field sites (1 of 4)

	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6	Axis 7	Axis 8
Pinus	0.3014	-0.1765	0.0607	-0.0984	0.0051	-0.0963	0.0988	0.0013
Juniperus	0.1823	-0.3196	-0.1030	0.0224	-0.0289	0.0055	-0.0199	-0.0166
Picea	0.2192	-0.0598	-0.0823	-0.0653	-0.3095	0.2420	0.0675	-0.1479
Abies	0.1792	-0.1687	-0.1733	-0.0914	-0.1400	0.1224	-0.0727	-0.0718
Quercus	0.1247	-0.1240	-0.1905	0.1098	-0.3448	0.2245	-0.2702	0.0318
Prosopis	0.0654	-0.4005	0.1039	-0.1186	0.2250	-0.1756	0.1294	0.1375
Carya	0.0875	-0.3350	-0.0516	-0.0491	-0.0549	0.0274	-0.0679	-0.0107
Onagraceae	0.1822	0.2960	0.2750	-0.1458	-0.1670	-0.0676	0.0476	0.2834
Fabaceae	0.0456	0.1247	-0.4343	-0.2677	0.3174	-0.0996	-0.0958	0.0233
Shepherdia	0.0686	-0.2762	0.0972	-0.0672	0.1499	-0.1068	-0.0492	0.3524
Polygonum	0.0379	0.0284	0.0204	0.1664	-0.0569	-0.4438	-0.4596	-0.3100
Eriogonum	0.0241	0.0144	0.0128	-0.1852	-0.0719	-0.0999	0.3726	-0.4246
Sarcobatus	0.1868	-0.1675	0.1445	0.1161	0.0964	-0.0431	-0.2152	0.0239
Poaceae	0.2021	-0.1934	0.1865	-0.0064	0.2362	-0.2185	0.1932	-0.0142
Cheno-am	0.3780	0.1297	-0.0491	0.0075	-0.0761	-0.1083	-0.1527	-0.0240
Cheno-am af	0.1565	0.0691	-0.3644	-0.0114	-0.1406	0.0543	0.1449	0.1263
Asteraceae (hs)	0.2579	0.1715	-0.0730	-0.0197	0.0109	-0.0921	-0.0121	-0.0159
Asteraceae (ls)	0.2504	0.1422	0.0956	0.1668	0.2675	0.0637	0.0876	0.0274
Liguliflorae	0.0473	0.1292	-0.4217	-0.2924	0.3036	-0.1188	-0.0532	-0.0207
Artemisia	0.1933	-0.2268	-0.0029	-0.1321	-0.0788	0.0550	0.0209	-0.1815
Cactaceae	0.1738	0.0805	-0.0920	0.4647	0.0972	-0.0470	0.0872	-0.0359
Cylindropuntia	0.0261	0.0628	0.0916	-0.1215	-0.0995	0.0338	0.1120	0.1193
Platyopuntia	0.0133	0.0406	0.0396	-0.0124	-0.0455	0.0080	-0.2640	0.4555
Ephedra	0.2235	-0.0277	0.1896	0.0617	0.1124	0.2890	0.0086	-0.0849
Nyctaginaceae	0.0927	0.1995	0.2503	-0.2535	-0.0889	-0.1611	0.0937	-0.2173
Indeterminate	0.2737	0.1074	-0.1438	0.0204	0.2371	0.1678	0.0067	0.0395
Typha angustifolia	0.0046	0.0067	0.0006	0.0266	0.0174	-0.0716	0.0590	-0.0358
Unknown triporate	0.0375	0.0608	0.0622	0.3325	0.3519	0.3594	-0.0083	-0.2193
Malvaceae	0.1142	0.2343	0.2040	-0.0691	0.0909	0.0001	-0.2586	-0.0009
Cucurbitaceae	0.0866	-0.0168	-0.1225	0.3392	-0.1628	-0.4611	0.0247	-0.0480
Sphaeralcea	0.0762	0.0981	-0.1666	0.3014	-0.1482	-0.1370	0.4608	0.2939
Zea mays	0.3493	0.1694	0.1257	-0.1518	-0.1098	0.0395	-0.0231	0.0507

Table A1.6b. Variable loadings, agricultural field sites (2 of 4)

	Axis 9	Axis 10	Axis 11	Axis 12	Axis 13	Axis 14	Axis 15	Axis 16
Pinus	-0.0811	-0.0706	-0.0391	-0.0146	0.0875	-0.0288	-0.1068	0.0420
Juniperus	0.0982	-0.1211	0.1247	-0.0541	0.0866	0.0607	0.0202	-0.1096
Picea	-0.0546	-0.0672	-0.0318	0.0357	0.0485	-0.1394	-0.0959	0.1285
Abies	0.2401	-0.1612	0.1708	-0.0245	0.0739	0.0017	-0.0164	-0.1125
Quercus	-0.1393	0.1633	-0.0575	0.0643	-0.2626	0.1675	-0.0610	0.0702
Prosopis	0.0043	-0.0551	0.0036	-0.0342	0.1889	0.1658	-0.1477	0.1173
Carya	0.2259	-0.1668	0.1740	-0.0451	0.1958	0.1471	0.2785	-0.2341
Onagraceae	0.0201	-0.0545	0.0512	-0.0593	0.1945	0.1377	-0.0100	-0.5826
Fabaceae	-0.0242	-0.0938	0.0050	-0.0124	-0.0272	-0.0155	-0.0070	-0.0167
Shepherdia	-0.1246	0.2502	-0.1788	0.0535	-0.3800	0.3937	-0.0057	-0.1105
Polygonum	-0.3099	-0.0093	-0.2755	-0.0217	0.2637	0.1305	-0.1521	-0.0877
Eriogonum	-0.3677	0.3896	0.2489	-0.1207	-0.0139	0.1455	0.3729	-0.0629
Sarcobatus	0.0334	0.0554	0.1134	-0.0202	-0.4409	-0.2231	0.2080	-0.0516
Poaceae	-0.0026	0.0525	-0.0251	0.0439	-0.0412	-0.2405	0.0147	0.1761
Cheno-am	-0.0313	0.0119	0.0222	0.0270	-0.0998	0.0715	-0.0207	0.0330
Cheno-am af	0.0500	0.1769	-0.0609	0.0002	-0.0793	0.1578	0.1264	-0.0777
Asteraceae (hs)	0.1763	0.0979	-0.1064	0.0654	-0.0008	-0.1648	0.1121	0.1251
Asteraceae (ls)	-0.0209	0.0480	-0.1189	-0.0278	0.1044	-0.1620	0.0958	-0.1938
Liguliflorae	-0.0662	-0.0566	0.0515	-0.0332	-0.0329	0.0101	0.0398	-0.0806
Artemisia	-0.0976	0.0930	-0.0327	-0.0111	0.2521	0.0597	-0.1160	0.1941
Cactaceae	-0.0683	-0.1325	0.2053	-0.0231	0.0217	0.2888	-0.1669	-0.0253
Cylindropuntia	-0.3742	-0.6990	-0.1838	-0.0341	-0.1451	0.1452	0.3456	0.2336
Platyopuntia	-0.3743	0.1219	0.5902	-0.0988	0.2241	-0.2107	0.0091	0.2186
Ephedra	-0.0222	0.0307	-0.1694	0.0198	0.0257	-0.2026	0.0364	-0.0966
Nyctaginaceae	0.1872	-0.1419	0.3458	-0.0654	-0.3711	0.1535	-0.4543	0.0830
Indeterminate	-0.0680	-0.0320	0.0076	0.0020	-0.0123	-0.0458	-0.2279	0.0982
Typha angustifolia	-0.0656	-0.0592	0.1930	0.9589	0.0508	0.0352	0.0535	-0.0576
Unknown triporate	-0.1291	-0.0960	0.2131	-0.0872	-0.0334	0.2662	0.0549	-0.0418
Malvaceae	0.4125	0.1342	0.0078	0.0200	0.1924	0.3781	0.3569	0.4521
Cucurbitaceae	0.1349	-0.1453	0.1475	-0.1016	-0.1587	-0.2098	0.2513	-0.0043
Sphaeralcea	0.0583	0.0892	-0.0994	-0.0345	0.1314	0.1192	-0.1021	0.2079
Zea mays	-0.1311	0.0459	-0.1135	0.0408	-0.0030	-0.0542	0.0507	-0.0112

Table A1.6b. Variable loadings, agricultural field sites (3 of 4)

	Axis 17	Axis 18	Axis 19	Axis 20	Axis 21	Axis 22	Axis 23	Axis 24
Pinus	-0.1891	-0.1821	-0.0159	-0.1082	0.1393	-0.0920	-0.0939	-0.1776
Juniperus	-0.0959	0.2031	-0.2236	-0.2376	0.1416	-0.1536	-0.0456	-0.1727
Picea	-0.2170	0.1577	0.0476	0.2899	0.0061	0.2054	-0.2060	0.1390
Abies	-0.2270	-0.0719	-0.3305	0.091	-0.1825	-0.1163	-0.0706	0.2722
Quercus	0.0277	0.0840	-0.0226	0.0387	-0.2640	0.0673	0.1481	-0.4187
Prosopis	-0.0018	0.0886	0.0003	-0.3200	0.0871	-0.0115	-0.0445	-0.1378
Carya	0.3828	-0.4161	0.3205	0.2210	-0.0209	0.2518	0.0674	-0.0142
Onagraceae	-0.1412	0.2713	-0.0543	0.0019	-0.1355	0.0566	0.0483	-0.0198
Fabaceae	-0.0423	0.0513	-0.0296	0.0920	-0.0771	0.0772	-0.0255	0.0118
Shepherdia	-0.0083	0.1288	0.0769	0.2752	0.0980	-0.0054	-0.0518	0.3585
Polygonum	0.0955	-0.1698	-0.2264	-0.0121	-0.0330	0.1149	-0.1373	0.1325
Eriogonum	-0.1001	-0.0719	-0.0752	-0.0307	0.0524	-0.0013	0.1644	-0.0005
Sarcobatus	-0.1773	-0.1978	-0.1406	-0.3863	-0.2792	0.1943	0.0845	0.1563
Poaceae	0.0095	-0.0005	-0.1220	0.4940	-0.2451	-0.0725	-0.1738	-0.2708
Cheno-am	0.1995	0.1245	0.0549	0.0545	0.2429	-0.0340	0.0775	-0.3415
Cheno-am af	0.3199	-0.0804	-0.2299	-0.1432	0.1504	-0.1786	-0.2359	0.0163
Asteraceae (hs)	0.2616	0.0089	0.1637	-0.1472	-0.1716	-0.4808	-0.0808	0.2632
Asteraceae (ls)	0.2094	0.0966	0.0001	-0.0444	-0.3091	0.0956	0.1702	-0.1704
Liguliflorae	-0.1027	0.0529	-0.0674	0.0946	-0.1204	0.1405	0.0051	-0.0316
Artemisia	0.1787	0.3874	0.2178	-0.1148	-0.2879	0.0469	0.2205	0.3209
Cactaceae	-0.2520	-0.2001	0.1122	0.2121	-0.0807	-0.4125	0.2984	0.0823
Cylindropuntia	0.1040	0.0075	-0.1039	-0.0342	-0.0767	-0.0657	0.1061	0.0473
Platyopuntia	0.1487	-0.0235	-0.0972	0.0702	0.0297	-0.0467	-0.0571	0.0873
Ephedra	0.1962	-0.0198	-0.4304	0.1958	0.3739	0.0313	0.1678	0.1895
Nyctaginaceae	0.3002	-0.0668	-0.1063	-0.0068	-0.0450	0.0977	-0.0271	0.0454
Indeterminate	-0.0753	-0.0936	0.1571	-0.1331	0.3119	0.2741	0.3345	0.1078
Typha angustifolia	0.0177	0.0310	-0.0464	-0.0608	0.0106	0.0707	-0.0041	0.0260
Unknown triporate	0.0999	0.2047	0.0570	-0.0789	-0.0535	0.1088	-0.5372	0.0126
Malvaceae	-0.1961	0.0482	-0.1402	0.0579	0.0444	0.1026	0.0718	-0.0412
Cucurbitaceae	-0.0396	0.3851	0.1694	0.0570	0.2731	0.1717	-0.0294	0.1037
Sphaeralcea	0.0360	-0.1638	-0.2122	-0.0737	-0.1841	0.4046	-0.0741	0.0865
Zea mays	-0.2395	-0.2876	0.3824	-0.0993	0.0617	0.0251	-0.3661	0.0109

Table A1.6b. Variable loadings, agricultural field sites (4 of 4)

	Axis 25	Axis 26	Axis 27	Axis 28	Axis 29	Axis 30	Axis 31	Axis 32
Pinus	0.1345	0.0802	0.0471	-0.3096	-0.4871	-0.3363	-0.1821	0.3942
Juniperus	-0.0040	0.1609	-0.2849	-0.1416	0.3069	0.4810	0.1208	0.2929
Picea	-0.1140	0.2329	-0.0913	-0.2328	-0.2648	0.1632	0.2692	-0.3715
Abies	0.4349	-0.1521	0.1323	0.1004	0.2424	-0.2670	-0.1561	-0.1727
Quercus	0.0745	0.1658	-0.0090	0.3850	-0.1365	-0.0022	-0.1702	0.0891
Prosopis	-0.0773	0.0589	-0.0408	0.3731	-0.1339	-0.0923	0.0173	-0.5238
Carya	-0.0792	0.1145	0.0067	-0.0138	-0.0347	0.0417	-0.0122	0.0231
Onagraceae	-0.1903	0.1204	0.2690	0.0791	-0.0733	0.0477	-0.0553	0.0253
Fabaceae	-0.1141	-0.1606	-0.0748	-0.0842	-0.2027	0.3633	-0.5708	-0.1183
Shepherdia	0.1984	0.0775	-0.1123	-0.1444	0.0389	0.0050	0.0072	0.0219
Polygonum	0.0641	0.0678	0.0689	0.0130	-0.0012	0.1085	0.0763	-0.0307
Eriogonum	0.0973	0.1210	0.0136	0.0205	0.0457	0.0526	-0.1043	-0.1028
Sarcobatus	-0.3109	-0.0517	0.0963	-0.1544	-0.0576	0.0107	0.0676	-0.0988
Poaceae	-0.0645	-0.0655	0.3564	0.1258	0.1462	0.1763	0.0794	0.1091
Cheno-am	-0.1576	-0.0994	0.0386	-0.3817	0.3902	-0.3042	-0.1084	-0.3081
Cheno-am af	-0.0491	-0.3587	0.2615	0.0396	-0.2635	0.1118	0.3341	-0.0121
Asteraceae (hs)	-0.0041	0.5497	0.0263	0.0691	0.0095	0.0062	-0.1227	-0.0381
Asteraceae (ls)	0.4955	-0.1341	-0.3386	-0.1244	-0.1621	0.0511	0.1737	-0.1549
Liguliflorae	-0.1745	0.1959	-0.2034	0.1681	0.0795	-0.3984	0.4289	0.1950
Artemisia	-0.1866	-0.3523	0.0463	-0.0328	0.0398	-0.0743	-0.0086	0.2547
Cactaceae	-0.2193	-0.1154	-0.1230	0.0469	-0.1157	0.0487	0.0941	-0.0641
Cylindropuntia	0.0537	0.0077	0.0453	0.0112	0.0349	0.0311	0.0274	-0.0014
Platyopuntia	0.0599	0.0124	-0.0676	-0.0095	-0.0389	0.0099	0.0239	0.0089
Ephedra	-0.2596	0.0016	-0.2391	0.2823	-0.0611	-0.1003	-0.1815	0.0703
Nyctaginaceae	0.0790	-0.0034	-0.1617	0.0680	-0.0911	0.0987	0.0463	0.0616
Indeterminate	0.2544	0.1645	0.4592	0.1040	0.1172	0.2032	0.1107	0.0586
Typha angustifolia	0.0226	-0.0065	-0.0158	0.0082	-0.0215	-0.0007	-0.0044	0.0166
Unknown triporate	-0.0255	0.0932	0.1308	0.0042	0.0118	-0.1106	-0.1267	0.0627
Malvaceae	0.0267	-0.0241	-0.0188	0.0002	-0.1239	0.0562	0.0679	0.0461
Cucurbitaceae	0.1302	-0.0779	-0.0243	0.2422	-0.1559	-0.0626	-0.0552	0.0721
Sphaeralcea	-0.0958	0.1274	-0.1278	-0.0687	0.2030	-0.0572	-0.1873	0.0623
Zea mays	0.0057	-0.2835	-0.2791	0.3161	0.2186	0.0911	-0.0217	0.0688

Table A1.7. Samples containing economic taxa

Site	Feature	Size	*Zea mays*		*Sphaeralcea*		Malvaceae		Cucurbitaceae		Cactaceae		*Cylindropuntia*		Onograceae		Fabaceae		*Polygonum*		*Eriogonum*	
		(sq m)	Count	ISM	Count	ISM	Count	ISM	Count	ISM	Count	ISM	Count	ISM	Count	ISM	Count	ISM	Count	ISM	Count	ISM
LA 105703	2	3479	2	3	0	0	2	3	0	1	1	3	1	2	0	1	0	0	2	2	0	0
	8	64	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	18	2715	8	11	0	0	1	5	0	0	1	8	5	11	1	4	0	0	2	2	0	0
	21	820	1	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	22	936	3	4	0	0	0	2	0	1	0	1	1	1	0	1	0	0	0	0	0	0
LA 105704	1	180	2	2	0	0	0	1	0	0	0	1	0	2	1	2	0	0	0	0	1	1
	2	48	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
LA 105708	3	225	2	3	0	0	0	0	0	1	0	2	2	3	0	2	0	0	0	0	0	0
	9	971	2	3	1	1	0	1	0	0	0	0	1	3	0	2	0	0	0	0	1	1
LA 105709	1	444	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	4	47	1	1	0	0	0	1	0	0	0	0	1	1	0	1	0	0	0	0	0	0
LA 118547	1	125	1	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0
	2	184	1	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0
	15	3911	12	12	1	2	3	11	0	1	1	5	6	11	0	6	1	1	0	0	0	0
Total			38	45	2	3	7	26	0	4	4	21	18	39	2	21	1	1	4	4	2	2

Table A1.8. Mean concentration values of selected economic taxa

Site	Feature	Size (sq m)	*Zea mays*	Malvaceae	Sphaeralcea	Cucurbitaceae	Cactaceae	*Cylindropuntia*
LA 105703	2	3479	23.99	1.30	0.00	0.32	1.30	2.01
	8	64	28.37	0.00	0.00	0.00	2.08	0.00
	18	2715	11.60	1.57	0.00	0.00	0.97	2.42
	21	820	21.11	0.81	0.00	0.00	0.00	2.44
	22	936	22.26	2.33	0.00	0.24	0.22	12.28
LA 105704	1	180	22.36	2.18	0.00	0.00	0.87	1.29
	2	48	14.21	0.00	0.00	0.00	0.00	7.58
LA 105708	3	225	29.80	0.00	0.00	0.24	1.15	252.72
	9	971	18.51	1.55	0.30	0.00	0.00	4.77
LA 105709	1	444	32.13	0.00	0.00	0.00	0.00	5.11
	4	47	56.02	0.85	0.00	0.00	0.00	10.19
LA 118547	1	125	18.42	0.00	0.00	0.00	0.00	4.78
	2	184	17.51	0.00	0.00	0.00	0.00	5.63
	15	3911	21.96	2.91	0.26	0.07	0.66	4.26

Five features (fields) were sampled.

Feature 8 was the smallest plot at this site. Non-*Opuntia* Cactaceae (2.08 grains/g) pollen and *Zea mays* (28.37 grains/g) were the only economic taxa present from this plot, but they were present in all three samples taken from this feature.

Feature 21 measured 820 sq m, but only a single pollen sample was submitted from this feature. *Zea mays* (21.11 grains/g), *Cylindropuntia* (2.44 grains/g), and Malvaceae (0.81 grains/g) pollen were all present.

Feature 22 measured 936 sq m and provided four samples, all of which contained *Zea mays* (22.26 grains/g) and *Cylindropuntia* (12.28 grains/g). Two samples contained Malvaceae (2.33 grains/g), while single samples contained Cucurbitaceae (0.24 grains/g), Onagraceae (0.21 grains/g), non-*Opuntia* Cactaceae (0.22 grains/g), and *Platyopuntia* (0.22 grains/g).

Feature 18 measured 2,715 sq m and provided 11 samples, all of which contained both *Zea mays* (11.60 grains/g) and *Cylindropuntia* (2.42 grains/g) pollen. Five of the samples contained Malvaceae (1.57 grains/g), while eight samples contained non-*Opuntia* Cactaceae (0.97 grains/g). A single sample contained *Platyopuntia* (0.21 grains/g).

Feature 2 measured 3,479 sq m and contained three samples, all of which contained *Zea mays* (23.99 grains/g), Malvaceae (1.30 grains/g), and non-*Opuntia* Cactaceae (1.30 grains/g) pollen. Two samples contained *Cylindropuntia* (2.01 grains/g), while single samples contained Cucurbitaceae (0.32 grains/g) and Onagraceae (0.21 grains/g) pollen.

LA 105704. This site was south of LA 105703. Only three samples, two from Feature 1 and one from Feature 2, were submitted. Feature 1 measured 180 sq m; Feature 2, 48 sq m. *Zea mays* (22.36 grains/g), Malvaceae (2.18 grains/g), *Cylindropuntia* (1.29 grains/g), non-*Opuntia* Cactaceae (0.87 grains/g), Onagraceae (0.85 grains/g), and *Eriogonum* (5.23 grains/g) were all present in Feature 1. Feature 2 contained *Zea mays* (14.21 grains/g) and *Cylindropuntia* (7.58 grains/g).

LA 105708. Six samples were provided from this site, three each from Features 3 and 9.

Feature 3 measured 225 sq m. All three samples from this feature contained both *Zea mays* (29.80 grains/g) and *Cylindropuntia* (252.72 grains/g). *Cylindropuntia* pollen was extraordinarily high (748.59 grains/g) in one sample, which acted to artificially increase the mean in the other two samples. The significance of this will be discussed later. Non-*Opuntia* Cactaceae (1.15 grains/g) and Onagraceae (0.50 grains/g) were present in two samples, while Cucurbitaceae (0.24 grains/g) was present in one sample.

Feature 9 measured 971 sq m. Again, all three samples from Feature 9 contained *Zea mays* (18.51 grains/g) and *Cylindropuntia* (4.77 grains/g).

Onagraceae (0.64 grains/g) was present in two of the samples. Malvaceae (1.55 grains/g), *Sphaeralcea* (0.3 grains/g), and *Eriogonum* (5.51 grains/g) were present in single samples.

LA 105709. Single samples were submitted from Features 1 and 4.

Feature 1 measured 444 sq m. *Zea mays* (32.33 grains/g) and *Cylindropuntia* (5.11 grains/g) were present in the sample from this feature.

Feature 4 measured 47 sq m in area. *Zea mays* (56.02 grains/g), Malvaceae (0.85 grains/g), *Cylindropuntia* (10.19 grains/g), and Onagraceae (1.70 grains/g) pollen were present from this feature.

LA 118547. Features 1 and 2 were identified as borrow pits (one sample each). Feature 15 (12 samples) was a gravel-mulched field.

Feature 1 measured 125 sq m. *Zea mays* (18.42 grains/g), *Cylindropuntia* (4.78 grains/g), and Onagraceae (0.68 grains/g) were present from this feature.

Feature 2 measured 184 sq m. *Zea mays* (17.51 grains/g), *Cylindropuntia* (5.61 grains/g), and Onagraceae (0.63 grains/g) were present from this feature.

Feature 15 measured 3,911 sq m. *Zea mays* (21.96 grains/g) was present in all 12 samples, and *Cylindropuntia* (4.26 grains/g) and Malvaceae (2.91 grains/g) were present in 11 samples. Onagraceae (0.56 grains/g) was present in 6 samples, and non-*Opuntia* Cactaceae (0.66 grains/g) was present in 5 samples. *Sphaeralcea* (0.26 grains/g) was present in 2 samples.

Only a relatively few economic pollen types are present within these agricultural fields. These taxa are discussed individually, below.

Zea mays. Pollen of *Zea mays* was recovered from all of these agricultural field samples. Remarkably, the pollen concentration values and the mean concentration values from these fields are quite similar. Commonly, the average concentration value ranged between 20 and 23 grains/g. While certain features contained slightly higher average concentration values, even the mean of all samples was between 20 and 21 grains/g. This might indicate that similar agricultural practices were being conducted at all field locations. The consistent presence of *Zea mays* pollen from these features indicates that all of these fields were being used in corn agriculture.

Cactaceae. All features contained *Cylindropuntia* pollen. Of the 45 samples examined, 42, or 93.3 percent, contained *Cylindropuntia*. Like all members of the Cactaceae family, *Cylindropuntia* are insect pollinated. These plants produce relatively fewer pollen grains per flower than other taxa, and the pollen is only rarely incorporated into the sediments. In a study of the surface sediments obtained from the middle of a prickly pear cactus in flower, Bryant (pers. comm., 1987) obtained less than 1 percent *Opuntia* pollen. Thus, the consistent presence of *Cylindropuntia* from these fields indicates a local presence in the vegetation. These plants are extremely slow growing, and I suspect that they were at least encouraged within these fields by the prehistoric farmers, since their fruits (*tunas*) were routinely harvested and roasted for consumption. A large amount of *Cylindropuntia* pollen was obtained from a prehistoric pueblo near Petroglyph National Monument, in Albuquerque, New Mexico. This site dated between A.D. 1 and 500 and contained grinding stones but no evidence of pottery or corn. It was concluded that the people were subsisting on wild plant foods, including *Cylindropuntia*. Cholla contains few calories, but a two-tablespoon serving contains as much calcium as a glass of milk (Dunmire and Tierney 1995). Whiting (1939) and Moerman (1986) have indicated at least one medicinal use for cholla cactus among the Hopis, which may help explain why it was not removed. The one sample from Feature 3, LA 105708, contained a pollen concentration value of 748.59 grains/g for this taxon, which is extremely high. This may reflect recent contamination from large numbers of plants growing in the immediate area.

Platyopuntia was fairly rare at these sites. It was present in only two samples, one each from Features 18 and 22, LA 105703. While it is certainly likely that these represent naturally occurring components of the local flora, I feel this is unlikely because of its restricted distribution. If these occurrences were a result of the natural pollen rain, I would expect a more equitable distribution among these sites, rather than their being restricted to only a single site. Rather, like the *Cylindropuntia*, these plants may have been encouraged, if not cultivated, in these fields. Members of the *Platyopuntia* are edible in this region of the state, and the flowers, fruits, and stems were all prepared and eaten. Moerman (1986) reports the medicinal use of these plants by the Navajos and Hopis, but not among Pueblo groups in this area.

Non-Opuntia Cactaceae. This taxon was not as ubiquitous as other economically important taxa. Twenty one of the 45 samples (46.6 percent) were positive for non-*Opuntia* Cactaceae. This taxon was absent from LA 105709 and from the borrow pit features at LA 118547. It was present in one feature each at LA 105704 and LA 105708, and in Feature 15, LA 118547, but it was present in four of the five features at LA 105703. Again, plants of this type were probably encouraged within the fields but were probably not cultivated. The elevations of these sites are all fairly similar, ranging from 6,150 to 6,200 ft. This is not sufficiently different to infer an altitudinal gradient, and in fact there is no correlation between the presence of non-*Opuntia* Cactaceae and site elevation. Various components of these plants have routinely been used as food. A combination of cactus and cleome have been used as a dye for thread or weaving fiber at Zuni (Dunmire and Tierney 1995).

Malvaceae. The family Malvaceae has several genera that are native to New Mexico. *Sphaeralcea* is probably the most common member of this family. However, the pollen morphology of *Sphaeralcea* is sufficiently different to allow a determination of this pollen grain to the genus level, and these are treated separately. The pollen grains included within the category Malvaceae all contained well-developed spine bases and compared favorably to the morphology of the genus *Gossypium*. While these grains were less ubiquitous than *Zea mays* or *Cylindropuntia*, they were fairly common. Twenty-five of the 45 samples (55.5 percent) were positive for this taxon. Malvaceae pollen was present in the samples from four of the five fields at LA 105703 and from single features at LA 105704, LA 105708, and LA 105709. The taxon was absent from the borrow pits at LA 118547 but present in the agricultural field (Feature 15) at that site. Malvaceae is insect pollinated and produces relatively few pollen grains. Pollen grains of this taxon are only rarely incorporated into archaeological deposits. The relatively high concentration values obtained for this taxon suggest strongly that members of this taxon were being intentionally cultivated within these fields. While the majority of uses of this taxon, particularly *Gossypium*, are utilitarian, Robbins et al. (1916) and Moerman (1986) have documented its medicinal use among the Tewas.

Sphaeralcea. This taxon was present in only 3 of the 45 samples. The pollen was recovered from Feature 9, LA 105708; and from Feature 15, LA 118547 (two samples). *Sphaeralcea* is usually much more common in archaeological deposits than these samples indicate. The sporadic occurrence of *Sphaeralcea* may simply reflect its presence in these areas as a naturally occurring component of the vegetation. Alternatively, its presence may represent sites in which *Sphaeralcea* was intentionally cultivated. *Sphaeralcea* is known to have been used as a condiment and a medicine (Moerman 1986) among the Navajos (Wyman and Harris 1951), Hopis (Whiting 1939), and Tewas (Robbins et al. 1916). This plant is very common in disturbed habitats in northern and central New Mexico. The fruits of all species are edible. Its pollen and seeds have been recovered from Chaco Canyon, and from Pecos, Zia, and Santa Ana Pueblos from archaeological contexts. Santo Domingo residents boiled the plant, adding it to gypsum as a glue for calcimine house paint. The pulp of *Sphaeralcea* was mixed with mud at Taos Pueblo to make very hard floors, and the root was pounded and mixed with saltwater as a poultice for sores and boils. At Santa Clara, the leaves were rubbed on sore muscles. The peltate trichomes probably irritate the skin and thus bring blood to the infected area (Dunmire and Tierney 1995).

Cucurbitaceae. This family contains cultivated and wild plant forms in several genera. In fact, many of the cultivated varieties of squash and pumpkin, as well as the common wild form, *Cucurbita foetidissima*, belong to the same genus. It is not possible, therefore, to differentiate palynologically among the various varieties of this genus. The pollen grains of all members of this family are very large and fragile. They are easily broken and rarely become incorporated into archaeological samples. Members of the Cucurbitaceae are insect pollinated and thus produce fewer pollen grains than the arboreal taxa. The members of this family are vines and produce male and female flowers separately and at different times. Male flowers are produced initially, and only later are the female flowers produced. This mechanism promotes cross-pollination. Given the context of these samples in agricultural fields dating to the Classic period, I suspect that the majority of them represent the cultivated varieties.

Cucurbitaceae pollen was present in only 4 of the 45 (8.8 percent) samples. It was present in Features 2 and 22, LA 105703; Feature 3, LA 105708; and Feature 15, LA 118547. Again, there was no correlation among field size and the presence of this taxon, and it was present in sites at both extremes of the study area.

Cucurbita, particularly the cultivated varieties, was commonly used for food, often belying its trace presence in the pollen assemblages. *Curcurbita* has been long used by native populations of the Southwest. The flowers were eaten as a soup by the Hopis (Beaglehole 1937) and Navajos (Bailey 1940; Vestal 1952) and as a seasoning by several of the Rio Grande Pueblos (Bailey 1940; Hughes 1972). The blossoms were also utilized medicinally by the Zunis (Stevenson 1915). Wild relatives of cultivated squash, such as *Cucurbita foetidissima* (buffalo gourd), were also utilized. The gourd was crushed and mixed with water at Cochiti and then sprinkled on plants as an insect repellent. The compound cucurbitacin is known to be an effective insecticide. At Isleta, the roots were boiled to extract a compound used to treat chest pains, and the ground root was used by the Tewas as a laxative (Dunmire and Tierney 1995; Robbins et al. 1916). The Hopis used the flowers as baking containers (Cutler and Whitaker (1961). The Zunis used the seeds and flowers as a medicine for cactus scratches (Moerman 1986; Whiting 1939) and as an ingredient in "schumaakwe cakes," used in the treatment of rheumatism and swelling.

Onagraceae. Pollen of this family was recovered from 22 of the 45 samples (48.8 percent). It was recovered from three of the five features at LA 105703, both features from LA 105708, one feature from LA 105704 and LA 105709, and all three features at LA 118547. Onagraceae are insect pollinated and thus produce relatively little pollen. It is possible that this taxon is a naturally occurring component of the vegetation, but more likely it was cultivated. This plant is normally used medicinally or ceremonially (Castetter 1935; Wyman and Harris 1951; Elmore 1944; Moerman 1986). *Oenothera caespitosa* pollen was used by the Kayenta Navajo singers in sand paintings (Wyman and Harris 1951). *Oenothera pallida* was used with other medicinal plants as an infusion for kidney disease (Wyman and Harris 1951). *Oenothera albicaulis* fruits were eaten by the Mescalero Apaches (Castetter 1935).

Polygonaceae. Polygonum pollen was present in only 4 of the 45 samples (8.8 percent) examined. This taxon was restricted to LA 105703, where it was present in two of the five features. While this taxon can be used economically, its presence may also be attributed to local flora. Again, if this presence reflects a natural component to the pollen rain, I would expect a more equitable dispersion. This taxon could have been grown or at least encouraged as part of the agricultural system.

Wild dock was semicultivated by the Hopis and the Kayenta Navajos for food and medicine (Winter 1974). It was also taken internally by the Navajos (Vestal 1952) and Zunis (Whiting 1939)

Eriogonum, another member of this family, was also sparsely represented. This taxon was present at only two sites, but when present, its occurrence was quite high (10 and 17 grains/g). It was present in a single field each at LA 105704 and LA 105708. Winter (1974) has reported that the Hopis cultivated this plant as a tobacco substitute. This plant was used both internally and externally as a medicine for a variety of complaints among the Navajos (Elmore 1944; Wyman and Harris 1952; Vestal 1952), Zunis (Stevenson 1915), and Hopis (Whiting 1939).

Based on the above, it is at least possible, and probably likely, that these fields were used to grow a wide variety of crops in addition to *Zea mays*. LA 105703 contained evidence of eight of these taxa, including corn. Cucurbitaceae (Features 2 and 22) and *Platyopuntia* (Features 18 and 22) were present in only two features. This may reflect intentional use, or, more likely, factors related to pollen production, dispersion, and preservation. LA 105709 contained only four taxa, LA 105704 contained five taxa, and LA 105708 contained six taxa. LA 118547 contained seven taxa from the agricultural field but only three from the borrow pits.

While a weak case could be made for agricultural specialization, the variation in both the concentration values and the presence/absence of particular economic taxa is better explained by a combination of factors including pollen production, dispersion, and preservation. With the exception of *Zea mays*, all of the economic taxa are insect pollinated. This adaptation was a later development in the history of the angiosperms and correlated with a marked decrease in the amount of pollen produced. If the dispersion mechanism is effective, as it is with insect-pollinated types, then production of large quantities of pollen is unnecessary and a drain on the biological reserves of the plant. Thus, insect-pollinated plants produce only a fraction of the pollen grains produced by taxa relying upon wind pollination, but delivery is absolutely more assured. Several taxa, including *Platyopuntia* and *Cylindropuntia,* produce very large, massive grains that resist deterioration. However, other taxa, such as Cucurbitaceae, produce very fragile grains. The pollen grains of Cucurbitaceae, while being heavily ornamented, also have the tendency to break apart very quickly after being released from the anther. If these fragments do not contain an aperture, there is really no positive means of identification. It is rare that the pollen of members of this family preserve in sufficiently large pieces to be identifiable. The presence of even a single grain from this family indicates a presence in the immediate flora far exceeding its numbers.

Based on these factors, I suspect that the people who cared for these agricultural fields grew a variety of crops, including most, if not all, of these economic taxa in each field. The agricultural practices inferred from these sites are far more reminiscent of "kitchen gardens" than of the modern practice of monoculture. This might also explain why food and medicinal plants were both grown in the same fields.

The samples taken from LA 118547 were somewhat unusual in that two of the features were identified as terrace-edge borrow pits. It was hoped that the pollen analysis of these features would provide clues to additional functions of these borrow pits besides the obvious. The pollen assemblages examined from this site are quite different, particularly in the type and number of taxa recovered. The concentration values of *Zea mays* pollen are slightly lower in the borrow pits but certainly no lower than those from field areas in other sites. Therefore, it is fairly obvious that these borrow pits also functioned in corn agriculture. *Cylindropuntia* and Onagraceae were the only other economic taxa present from these borrow pits. Both of these taxa *could* have been present as part of the natural pollen rain. While I do not conclude that *Cylindropuntia* and Onagraceae were intentionally planted in these features, had they been present naturally, they would in all likelihood have been encouraged to grow. While the prepared fields contained a much larger variety of species, it is very likely that corn was planted, that the other crops occurred naturally, and that the naturally occurring species were coincidentally exploited.

Most of the samples from this investigation were taken from Stratum 2, which was identified as a gravel-mulched agricultural field. However, several samples were taken from Stratum 4, which was identified as a cobble mulch deposit underlying the gravel mulch. In each case, paired samples consisting of a sample from Stratum 2 and Stratum 4 were analyzed to compare the pollen assemblages.

The one-way Anova test was conducted using Microsoft Data Analysis. As expected, the means of the two samples were not statistically different. In spite of this statistical argument, there did appear to be differences in the distribution of the economic taxa. For example, Malvaceae was recovered from six of the ten samples, yet four of them were from the cobble mulch, while only two samples of the gravel mulch contained this taxon. Onagraceae pollen had the opposite distribution. Only a single sample from the cobble mulch contained this taxon, while three samples of the gravel mulch were positive for Onagraceae. Cucurbitaceae may have had a similar distribution, but it was present in only a single sample and was in the gravel-mulched layer. *Zea mays* was present in all ten samples. However, the mean concentration value for the gravel mulch was 20.95, whereas that from the cobble mulch was 11.9, an increase of almost 100 percent in the gravel-mulched levels. This suggests that the gravel-mulched layers retain higher concentration values of economic taxa and a higher number of these taxa. But, particularly in the case of Malvaceae, some taxa in these fields may well be underrepresented because their pollen grains have migrated downward into the underlying cobble layer.

Malvaceae pollen is similar in size to the other taxa; therefore, all or none should migrate. Alternatively, the features containing these underlying cobble mulch layers may be more complex than originally thought. Perhaps the cobble mulch was initially used for growing cotton, and later the field was altered for other crops by the addition of a gravel-mulched layer. If so, then Malvaceae pollen might be more common in this area than originally thought. Unfortunately, we have only five paired samples with which to investigate this phenomenon. These data are intriguing, and it would be useful to obtain additional paired samples to investigate them further.

CONCLUSIONS

Except for the surface sample, the pollen column from LA 105710 contained very low pollen concentration values. This is somewhat expected, since the column was taken through dune deposits. Pollen of the more resistant taxa, such as grass, forbs, and herbaceous plants, dominated the assemblages. However, given the time range inferred for the deposition of these sediments and the modern vegetational community, I suspect that the prehistoric plant community was dominated by piñon and juniper and that the low pollen concentration values for these taxa are the result of weathering, not absence from the communities.

The samples from the suspected agricultural fields were dominated by arboreal taxa, but this is somewhat expected given their proximity to the surface. Pollen of Poaceae, cheno-am, high-spine and low-spine Asteraceae, *Artemisia,* and Nyctaginaceae are present in generally high levels, indicating the open nature of these field areas.

The fields examined differ in size, and no correlation was found between the size or elevation of the plot and the pollen concentration values or number of economic taxa recovered. All 45 samples from these fields were analyzed using the ISM method (Dean 1998). The increased number of economic taxa recovered using this procedure demonstrates its utility. This methodology is highly recommended for the analysis of suspected agricultural fields.

A variety of statistical analyses were performed on the data set, including Principal Components Analysis and the Anova test. These analyses were inconclusive in identifying the source of the variation among the pollen types present, probably because each plot contained several crops.

The agricultural fields were interpreted as "kitchen gardens" in which multiple crops were grown within each field. Although direct evidence was absent, I suspect that other crops, such as *Phaseolus*, were also present in these fields. Besides cultivated crops, other economically important plants used for food and medicine were at least encouraged, if not cultivated in these areas.

One sample from LA 105708 contained exceedingly large concentration values for *Cylindropuntia* pollen. The sample was so heavily dominated by pollen of this taxon that it looked like a reference slide. I suspect that much of this pollen was the result of downward movement of the pollen from more recent deposits, but it is impossible to distinguish between modern and prehistoric pollen in such a situation. Alternatively, the high concentration values may be prehistoric and reflect an overrepresentation of this taxon by a fortuitous deposition of floral material.

Five sets of paired samples were taken from fields characterized by a gravel-mulched layer underlain by a cobble mulch zone. The pollen analysis demonstrated that the upper gravel-mulched layer contained much higher (almost 100 percent) values of *Zea mays* pollen and consistently contained greater numbers of economic taxa. At the same time, Malvaceae pollen occurred in a greater number of samples from the cobble layer than from the gravel layer. While it is possible that this reflects downward percolation of this taxon, this explanation is dubious. The size of Malvaceae pollen is similar to that of other taxa present in higher amounts in the gravel layer. Grains of similar size should all be susceptible to this movement. If one accepts that the higher values of Malvaceae are due to environmental factors, then the purpose of the underlying cobble layer remains unexplained. Rather, it is possible that we are dealing with a multipurpose agricultural field. If the field were initially prepared with cobble mulch, this practice may have been a requisite for growing cotton at these altitudes. Later, when the field was to be used for other crops, rather than removing the cobbles, a layer of gravel mulch was simply added. These data are very intriguing as an indication of prehistoric farming practices. Based on only five paired samples, however, this explanation may not apply to the general area. In order to make a more precise interpretation of these farming methods, I would like to see as many additional paired samples analyzed as possible from contexts involving a gravel mulch over a cobble mulch.

References Cited

Bailey, F. L.
1940 Navajo Foods and Cooking Methods. *American Anthropologist* 42:270–290.

Barkley, F. A.
1934 The Statistical Theory of Pollen Analysis. *Ecology* 15:283–289.

Beaglehole, E.
1937 *Hopi Hunting and Hunting Ritual*. Yale University Publications in Anthropology No. 4.

Bohrer, V. L.
1981 Methods of Recognizing Cultural Activity from Pollen in Archaeological Sites. *The Kiva* 46:135–142.

Brooks, J.
1971 Some Chemical and Geochemical Studies on Sporopollenin. In *Sporopollenin*, edited by J. Brooks et al., pp. 351–407. Academic Press, New York.

Brookes, D., and K. W. Thomas
1967 The Distribution of Pollen Grains on Microscope Slides. Part 1: The Non-Randomness of the Distribution. *Pollen et Spores* 9:621–629.

Bryant, V. M.
1969 Pollen Analysis of Late-Glacial and Post-Glacial Texas Sediments. Ph.D. diss., University of Texas, Austin.

Castetter, E. F.
1935 Uncultivated Native Plants as Sources of Food. Ethnobotanical Series 1. *University of New Mexico Bulletin* 266.

Cutler, H. C., and T. W. Whittaker
1961 History and Distribution of the Cultivated Cucurbits in the Americas. *American Antiquity* 26:469–485.

Dean, G.
1998 Finding a Needle in a Palynological Haystack: A Comparison of Methods. In *New Developments in Palynomorph Sampling, Extraction, and Analysis*, edited by V. M. Bryant and J. H. Wrenn. Contributions Series 33:53–59. American Association of Stratigraphic Palynologists Foundation.

Dunmire, William W., and Gail D. Tierney
1995 *Wild Plants of the Pueblo Province*. Museum of New Mexico Press, Santa Fe.

Elmore, F. H.
1944 *Ethnobotany of the Navajo*. Monograph of the University of New Mexico and the School of American Research No. 8. Santa Fe.

Erdtman, G.
1960 The Acetolysis Method: A Revised Description. *Svensk. Botanisk Tidskrift* 54:561–564.

Hall, S. A.
1981 Deteriorated Pollen Grains and the Interpretation of Quaternary Pollen Diagrams. *Review of Paleobotany and Palynology* 32:193–206.

Holloway, R. G.
1981 Preservation and Experimental Diagenesis of the Pollen Exine. Ph.D. diss., Texas A&M University, College Station.

1989 Experimental Mechanical Pollen Degradation and Its Application to Quaternary Age Deposits. *Texas Journal of Science* 41:131–145.

Hughes, P. E.
1972 *Pueblo Indian Cookbook*. Museum of New Mexico Press, Santa Fe.

Kovach, W. L.
1998 *MVSP: A MultiVariate Statistical Package for Windows, ver. 3.1*. Kovach Computing Services, Pentraeth, Wales.

Martin, P. S.
1963 The Last 10,000 Years. University of Arizona Press, Tucson.

Moermann, D. E.
1986 *Medicinal Plants of Native America*. Vols. 1 and 2. Technical Reports No. 19. University of Michigan Museum of Anthropology, Ann Arbor.

Robbins, W. W., J. P. Harrington, and B. Freire-Marreco
1916 *Ethnobotany of the Tewa Indians*. Bureau of American Ethnology Bulletin 55. Smithsonian Institution, Washington, D.C.

Stevenson, M. C.
1915 *Ethnobotany of the Zuni Indians*. 30th Annual Report of the Bureau of American Ethnology. Government Printing Office, Washington. D.C.

Vestal, P. A.
1952 Ethnobotany of the Ramah Navajo. *Papers of the Peabody Museum of American Archaeology and Ethnology* 40(4).

Whiting, A. F.
1939 *Ethnobotany of the Hopi*. Museum of Northern Arizona Bulletin No. 15.

Winter, Joseph, C.
1974 Aboriginal Agriculture in the Southwest and Great Basin. Ph.D. diss., Department of Anthropology, University of Utah.

Wyman, Leland C., and Stuart K. Harris
1951 *The Ethnobotany of the Kayenta Navajo*. University of New Mexico Publications in Biology 5.