Of Pots and Rocks

Papers in Honor of A. Helene Warren

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Regge N. Wiseman

The Archaeological Society of New Mexico: 21
Edited by Meliha S. Duran and David T. Kirkpatrick
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Statements and interpretations presented in the articles are those of the author or authors and do not necessarily reflect the opinions of the Archaeological Society of New Mexico or its individual members.
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Preface

Of Pots and Rocks recognizes A. Helene Warren’s many accomplishments in years of work doing petrographic analysis on ceramic and lithic assemblages from archaeological surveys and excavations. Helene’s studies include not only major projects such as the Chuska Valley Survey, the Cochiti Dam Project, the Chaco Project, and Salmon Ruins Excavation Project, but numerous smaller investigations.

Her lithic studies range from prehistoric and early Spanish Colonial use of mineral resources in New Mexico to mapping minerals important to native peoples. She developed a lithic-material coding system that continues to be used both for analysis of temper in ceramics and identification of stone-tool materials.

The Archaeological Society of New Mexico wishes to thank Helene posthumously for her contributions to the study of Southwestern ceramic and lithic technology.

David M. Brugge
President

Meliha S. Duran
David T. Kirkpatrick
Editors

March 1995

The editors wish to thank Bonnie E. Elder (Busy B.E.E.’s Typing, Las Cruces) for her assistance with and contributions to the desktop publishing for this volume.
A. HELENE WARREN, GEOARCHAEOLOGIST 1921–1994

Stewart Peckham

Over the years there have been relatively few geologists who have made significant contributions in the field of Southwestern archaeology. Early field workers like Kirk Bryan at Chaco Canyon, Ernst Antevs in the southern Southwest, and John T. Hack in the Hopi area certainly come to mind. Anna O. Shepard stands out because of her pioneer application of a geological method (petrographic analysis) to the study of tempering materials in prehistoric Southwestern pottery from Pecos Pueblo, the La Plata District, the Petrified Forest, and Awatovi. However, she was originally trained as an archaeologist. Although the breadth of her interest included many other aspects of pottery, including clay, her focus did not involve other branches of geological study.

Archaeologists’ site reports commonly devote space to brief descriptions of the local environmental features (i.e., flora, fauna, climate) that might have a bearing on prehistoric settlements. However, as if its impact was not as significant, the truly geological environment rarely receives more than token recognition. Students in archaeology usually take introductory courses in geology to enable them to identify rocks and minerals found in archaeological contexts, as if those rudimentary geological skills were the only ones they would need. That assumption was certainly proved wrong, sometimes vociferously, by an exceptional individual—A. Helene Warren—who combined the two professions, archaeology and geology, into a long and productive career.

Helene Warren was a true Geoarchaeologist, who lived most of her life in New Mexico and experienced almost every aspect of its geology first hand. She began her geological career late, about age 42, and almost simultaneously began her archaeological career. She saw how she could expand her knowledge and extend her geological skills to explaining some of the complexities of Southwestern archaeology. Her interests grew into a rare blend of professions, just as she herself was a rare blend of training, experience, creativity, and personality. As with the lives of so many innovative and dedicated people, her life of almost 73 years had a story behind it.

ORIGINS

Her parents-to-be—Oswald G. Schau and Aslaug Diesen—had separately immigrated to the United States from near Oslo, Norway, around the turn of the century. They met in this country, married, and bought a 9-acre farm near the town of Belvidere, the county seat of Warren County, in northwestern New Jersey. Of their several children, their youngest daughter, Aslaug Helene Schau, was born on September 12, 1921. Helene lived on the
farm until she was about 18 years old. The farm produced enough food for a reasonably comfortable life during the Depression days; her father sold poultry and eggs in the city and virtually cornered the cash-crop market with his excellent asparagus.

Helene was named after her mother, and she must have been more than a little sensitive about its conspicuous "foreignness" in a country where English given names were most common. Aware that first and second generation immigrant families of the late nineteenth and early twentieth centuries often changed their names or avoided using such old-country patronymics, she only used the initial of her given name. Even later in life she was still self-conscious about using her first name, so she was "Helene" to all who knew her—though she sometimes wrote papers as A. Helene Warren or used what she called her pen-name, A. H. Warren.

At an early age Helene developed an interest in things archaeological, when her father's plow occasionally brought prehistoric Indian stone tools to the surface in the fields surrounding her home. Sometimes on weekends her father liked to load the children into the family car and go off on picnics and camping trips to new and exciting places not too distant from Belvidere. From such excursions Helene developed an inquisitiveness about her natural surroundings. Just across the Delaware River in Pennsylvania was a prehistoric Indian quarry that was one of her favorite places to explore. The nearby Delaware Water Gap was rich in scenic beauty and spectacular geological formations. However, as she grew older, Helene must have realized that restricting her explorations to nearby areas and on foot would have kept her close to the farm.

In the 1930s Americans developed a "love affair with the automobile." Being able to drive would be essential if she were to see and learn more about the world around her. Her older stepsister Guri recalls that, when her parents were not looking, Helene learned to drive the family car by driving around in circles in a field on the farm. At first, Helene did not know how to stop the car, so she would continue her circular travel until the car ran out of gas and came to a stop. Her cousin Alice said that she always liked to visit and play with Helene because "she was always into something and was a bit of a prankster"; but it was always a gentle kind of humor.

A childhood illness delayed Helene's development somewhat, even to the point of school officials saying that they had grave doubts about her making it through school. They even thought that putting her in an institution might be best. However, her doubters were proved wrong when Helene was the Valedictorian of the Class of 1939 at Belvidere High School. Her mother took great relish at graduation by approaching the high school principal and saying, "And you were the one who thought my daughter Helene should be in an institution!"

Even before she graduated from high school Helene had plenty of initiative and showed promise in gathering information and writing. She wrote for the high school newspaper, and on a number of occasions she was a cub reporter for the local newspaper, which paid for the articles she wrote. One time, she and her cousin went to New York City to the American Museum of Natural History and chanced to meet the visiting Crown Prince of Norway. People in her community obviously were not accustomed to meeting royalty, and her
interesting newspaper account of the event made her a bit of a celebrity.

For a year or so following her graduation from high school, Helene lived in New York City, where she held a secretarial job and enrolled in night school. However, the city must have been too confining and far from the outdoors that she really loved. She left her city job in 1942 and joined her mother and father on a six-month trip out west to search for a new home in a totally different environment. Helene did most of the driving as they traveled to New Mexico, on to California, and eventually headed north to Canada before returning to New Jersey. They camped throughout the trip, further instilling in Helene a great enjoyment of the outdoors. Even having a moose trample through their camp in Canada did not dampen her enjoyment. Later in life, she went into the field frequently but not without the faithful companionship of a dog to warn her of such approaching guests.

COMING TO NEW MEXICO

Upon their return to New Jersey, Helene decided to venture back to the area that held the greatest attraction to her—the Southwest. In 1943, she gathered up her belongings, took a train to Albuquerque, and enrolled at the University of New Mexico, where she planned to major in geology. Arriving in Albuquerque with limited finances, she earned her keep by waiting on tables as a Harvey Girl at Albuquerque’s Alvarado Hotel. This was a very respectable, almost prestigious kind of a job that attracted many proper young ladies from the turn-of-the-century until the Fred Harvey hotel system ceased to operate in the 1950s. She waitressed several other times in her life and always held a long-lasting respect and admiration for the profession.

As a major in geology, she took a formidable curriculum strong in math and the physical sciences. The courses are worth listing: Mathematics: Mathematical Analysis, Descriptive Geometry, Calculus (2 courses), Theory of Equations; Physics: Analytical Mechanics; and Chemistry: Inorganic Chemistry, Quantitative Analysis. Most of her major courses were to come during her last three undergraduate semesters: Geology: Physical and Historical Geology, Mineralogy, Paleontology; Structural Geology, Advanced Mineralogy and Petrography, Ore Deposits, Advanced Petrography and Petrology, Field Geology, and an Honors paper. She took a variety of elective courses, some of which, during the War years, were geared toward Navy officer candidate students at the University: English: Navy and Engineering English, Major Poets in American Literature; Engineering Drawing; Spanish; Philosophy; History: Ancient Rome, Europe, American Frontier; Government: Comparative Economic and Political Systems; and Anthropology. For her, attending college was definitely to study and learn—not to socialize.

Her academic accomplishments in high school were matched at the University of New Mexico. Helene completed the four-year curriculum in just three years, graduating in 1946 and earning a Bachelor of Science with Distinction, with a major in Geology and minor in Mathematics. She ranked seventh in a class of 121. Following her graduation she continued her studies for another semester and took additional geology courses: Stratigraphy and two problems courses, one focusing on the formation of arroyos in New Mexico and the
other on the geology of the Capitan, New Mexico, area.

In 1944, her parents sold their New Jersey farm, and Helene convinced them to join her in New Mexico. Over the next few years her father built at least two stout rock houses, one near Placitas, north of Albuquerque, and the other in Tijeras Canyon, east of that city. The latter lay in the path of Interstate 40 and had to be razed.

She met James L. Warren in a geology class at UNM, and in 1946 they were married. With her graduation behind her, she and James moved to Bayard, New Mexico, where he worked for U.S. Smelting and Refining. In June 1947, Helene and James joined her parents in their home in Tijeras Canyon, where they stayed until after their first son, Michael, was born. Then, Helene and Jim returned to Bayard, staying there until 1948, when they went to Arkansas to be with James’ parents. In 1949 they moved again, this time to Bristol, in southeastern Colorado, drawn there by the promise of good money harvesting wheat and, eventually, a teaching job for Jim. Their second son, David, was born in November 1949 in nearby Lamar, Colorado. Needing but a few classes to finish his masters degree, James returned to the University of New Mexico in Albuquerque, but rather unexpectedly he was offered a teaching job in Gallup, New Mexico. They moved there in 1951, and shortly thereafter, their third son, Daniel, was born in March of 1952.

Moving from place to place while also trying to raise a family must have severely limited whatever opportunities Helene might have had to get a job in geology. In those days there were very few professional jobs for women in geology, or any other professional field, even for ones with her qualifications. However, a compensating factor was just being in the Gallup area, which for her was in the middle of a wonderland of geologic formations sprinkled with archaeological sites. At every opportunity, she would load her young boys into the car to explore the mesas, canyons, and prairies.

For several years in the mid-1950s, while she was still in Gallup, Helene served nearly full-time as the manager and treasurer of the Fort Wingate Credit Union, as its only paid employee. She also found time to organize the Gallup chapter of the League of Women Voters. Perhaps as a political activist of her day, she gained familiarity with the workings of State government. Thus, in July 1960, when James took a position with the State School Bus Transportation Department in Santa Fe, she applied for employment at the State Capitol. What specific jobs she held for the next two years are not known, but by 1962, Helene had advanced to the very responsible position as Chief of Personnel Actions, Payroll, and Records with the newly reorganized State Personnel Department. Until that time, the State government had no unified administrative structure for its employees. The challenge to establish a new personnel system was immense, and Helene played an important role in drafting regulations and procedures that would guide State employees in the future.

In 1964, she lost her job at State Personnel. She was obviously disappointed and determined to find a position commensurate with her educational background. She went to the Museum of New Mexico’s Laboratory of Anthropology and
inquired if there might be an archaeological project on which she could serve as a geologist—even as a volunteer.

**MUSEUM OF NEW MEXICO**

Serendipitously, in 1962 the Museum of New Mexico had contracted with the National Park Service to conduct an archaeological survey of 110,000 acres of the proposed Navajo Indian Irrigation Project, on the Navajo Indian Reservation, midway between Gallup and Shiprock. A major part of the project was to be constructed in the western San Juan Basin, near Newcomb and Two Grey Hills. This seemingly inhospitable area between the Chuska Mountains and the Chaco River had been referred to as the Chuska Valley by the pioneer geologist, H. E. Gregory. In spite of the large and complex sites that were known to be there, the Chuska Valley was still largely a terra incognita, even as late as the 1960s. It had received some attention by Earl H. Morris in the late 1920s and early 1930s, and Harold S. Gladwin, of the Gila Pueblo foundation, had also directed field surveys in the area. As the Museum’s archaeological survey of the Chuska Valley progressed, we could see that geology would play an important role in the analysis and interpretation of the prehistoric Anasazi use of the Chuska Valley.

When Helene Warren came to the Museum in 1964, John P. Wilson and I were in the midst of analyzing thousands of potsherds and lithic artifacts that we had collected from over 1,600 sites or site components from 19 separate site clusters or localities in the Chuska Valley. In those days, taking representative sherd and lithic collections from each recorded site was still standard procedure.

Pottery assemblages on Chuska sites were complex and included types decorated with either iron or vegetal pigments, as well as locally made utility types. All periods from Basketmaker III to late Pueblo III, as well as nineteenth- and twentieth-century Navajo, were represented. Intrusive pottery types showed varying influences from the Chaco and Mesa Verde areas, with lesser contact from the Kayenta, White Mountain, and Little Colorado areas. With a huge and varied pottery sample to work with, there was tremendous potential for linking pottery technology, design, and distribution to a wide range of settlement and land-use studies. We needed a geological perspective and were delighted by Helene’s offer to help us.

Jack Wilson and I had recognized 23 locally made, previously undescribed, pottery types that could be readily distinguished from the pottery of eastern and southern San Juan Basin and Mesa Verde areas, as well as from Kayenta and general Zuni areas. Predominant in all the localities of the Shiprock Project area was pottery tempered with a distinctive dark crystalline rock that Anna O. Shepard had termed sanidine basalt. Shepard had recognized the igneous rock temper in intrusive pottery collections among largely Mesa Verde ceramics during her research in the La Plata River Valley. She was ultimately able to pinpoint the general source of the rock in Washington Pass (recently and appropriately renamed Narbona Pass, after a famous Navajo leader) in the Chuska Mountains, west of Sheep Springs Trading Post.

We introduced Helene to Shepard’s La Plata work, as well as her monumental book, *Ceramics for the Archaeologist*. In no time Helene was reacquainting herself with the
geology of the San Juan Basin and considering how it might be related to Chuska Valley archaeology. She worked a few months as a volunteer, but we quickly recognized her contribution to the project and placed her on the payroll as a full-time staff member of the Museum.

In the beginning, the only laboratory equipment she had to work with was a vintage Spencer binocular microscope of relatively low power. It must have been bought when the Laboratory of Anthropology was founded in 1931—and was probably the same one used by earlier staff members, Anna O. Shepard, H. P. Mera, and Stanley Stubbs. Fortunately, Helene had good rapport with her former professors at UNM’s Geology Department and before long had borrowed a polarizing microscope from the student laboratory to analyze the temper of the local and intrusive pottery. Although making thin-sections of potsherds would have been preferred, such time-consuming and labor-intensive preparation of specimens was more than the Chuska Survey budget could afford. As an alternate method, Helene proposed an efficient technique that involved crushing a potsherd specimen, placing the powder-like sample on a microscope slide, and then immersing it in a series of specially prepared oils having different indices of refraction, in order to distinguish the minerals in the temper. A disadvantage of the technique was that the actual specimens could not be preserved, but it allowed her to examine a much larger sample of specimens. Chemical analyses and refiring studies were beyond the scope of the survey project and would have to be done at a later.

She found that in recent years geologists had assigned a variety of names to the rock that Shepard had called sanidine basalt. Anticipating that the rock would figure repeatedly in oral and written discussions, she suggested the term trachyte as more in step with current geological research in the area, less space-consuming in print than sanidine basalt or trachybasalt, and an adequate term for archaeological generalists.

Our survey collections from the Chuska area yielded more than just distinctive ceramics. Lithic debris from silicate rocks—chalcedony, chert, siltstone, orthoquartzite, and silicified wood—had a variety of attributes of color, texture, fracture, and distribution. Many of them were in demand throughout the prehistoric Chuska Valley and beyond. The prehistoric inhabitants had acquired some of the materials locally, but others came through various forms of exchange—trade, gifts, and importation. Knowing the specific geologic sources of these lithic materials could provide information about the early economic system of the area, its population dynamics, and its link to the cultural sequence in the Chuska Valley.

To document and interpret these resources, Helene devised a systematic four-digit Lithic Code to describe and categorize each lithic material in detail using more scientifically based and accepted geological terminology. From the site-by-site tabulation of each lithic type, she could see that some types tended to concentrate on sites in just one part of the Chuska Valley. Using these clues, she would then go into the field to seek out possible source areas of the specific rocks and minerals.

Besides being the probable source of trachyte temper, she found that Narbona Pass was also the source area for a distinctive pink to orange chert that was
conspicuous on many sites. Orthoquartzite and green, gray, and black siltstone were most common in the Mitten Rock locality in the northwestern part of the Chuska Valley, and a mustard-colored silicified wood was favored along the lower Chaco River to the northeast. Silicified wood seemed to occur almost everywhere in the valley lowlands.

Although developed first for the Chuska area, the Lithic Code proved to be sufficiently systematic, open-ended, and almost universally adaptable. It permits archaeologists to classify lithic materials almost wherever they occur in the Southwest and beyond, although not all have recognized the utility of the system. Throughout her career, Helene continued to compile detailed descriptions of the Lithic Types, their associations, and provenances, and to add new specimens to the growing reference collection housed in the Laboratory of Anthropology.

The results of her Chuska research were published as two concise chapters in An Archaeological Survey of the Chuska Valley and the Chaco Plateau, New Mexico, Part I: Natural Science Studies (1967a).

She had barely gotten trachyte-tempered potsherds from under her microscope lens when a new project came her way. This involved the analysis of pottery and lithic material from the Museum of New Mexico’s 1963–1966 excavations of sites in the Cochiti Dam and Reservoir area, along the Rio Grande, about 48 km (30 mi) west of Santa Fe. She found that, based on temper, potters from just a few large pueblos in the area manufactured and supplied much pottery to other pueblos that made little or no pottery themselves.

Perhaps most significant were her papers resulting from her work in the Cochiti district, especially New Dimensions in the Study of Prehistoric Pottery: A Preliminary Report Relating to the Excavations at Cochiti Dam, 1964–1966 by the Museum of New Mexico. Unfortunately it remained unpublished for 10 years. She requested and received permission to have it included as an appendix in a report of additional Cochiti Dam investigations conducted by the Office of Contract Archaeology of the University of New Mexico (1977:362–374). Usually she saw to it that her reports received separate citation, lest they be buried unnoticed in more voluminous archaeological data.

Through her work on Chuska pottery and lithic artifacts, Helene developed a new and exciting direction to her own life, devoting many of the next 20 years to hovering over a microscope conducting thousands of petrographic analyses of prehistoric pottery tempers or to data-gathering in the field. As Curator of Geology at the Laboratory of Anthropology of the Museum of New Mexico, she continued to apply her knowledge and skills to other Museum archaeological projects until 1974. Areas of her research during the 1970s and middle 1980s, as shown in the titles of her principal writings, read like an archaeological travelogue of New Mexico and include Apache Creek, Gran Quivira, Tularosa Basin, Ruidoso Valley, Dry Cimarron Valley, Las Vegas area, Galisteo Basin, Chama Valley, Santa Fe area, Cochiti Dam area, Middle and Lower Rio Grande Valley, Elena Gallegos land exchange, Middle Rio Puerco, Grand Canyon in Arizona, Ridges Basin in Colorado, Gobernador area, La Plata Valley, Salmon Ruins in the San Juan Valley, Chaco Canyon, and of course, the Chuska Valley.
OTHER EMPLOYMENT

As her work became more widely recognized, other institutions, agencies, and individual archaeologists contracted with the Museum for her services. She resigned from the Museum in 1974 to take salaried or contractual positions of varying duration with a number of agencies and institutions:

1967 Petrographic studies of ceramics from Mound 7, Gran Quivira National Monument, for the National Park Service, Santa Fe.

1968 Analyses of Unkar Delta ceramics, Grand Canyon, Arizona, for the School of American Research, Santa Fe.

1974, 1975 Laboratory supervisor and ceramic analyses at the Salmon Ruin, San Juan County, New Mexico, for Eastern New Mexico University.

1974 Archaeological survey of turquoise and lead mines, Cerrillos District, New Mexico, for Rocky Mountain Center on Environment and Occidental Minerals Corp. (Oxy-Min), Denver.


1975–1980 Ceramic analyst, National Park Service (Chaco Center), Albuquerque, New Mexico.

1979 Teaching assistant, Archaeological Field School, Tijeras Canyon, New Mexico, and archaeological survey in the Manzano Mountains, for the University of New Mexico.


Whether she was in the laboratory or in the field, she seems to have been most productive when she worked alone, and she may have preferred it that way. She set her own demanding pace, which was almost unrelenting. Besides relating her petrographic analyses to temper sources, through her field trips she became more familiar with the geomorphology and natural stratigraphy of project areas, as well as supplementing the archaeological collections with rock, mineral, and soil samples from specific geologic provenances. She developed a painstaking and systematic set of procedures and documents for observing and recording. She gave each project area and its excavated sites similar systematic scrutiny, ranging out in all directions on foot to determine which rock and mineral resources would have been locally available and which ones came from more distant sources.
Helene was not just an outside specialist intruding on the domain of archaeologists who had their own research interests; she became one of them. From 1965 to 1982 she took advanced courses in anthropology, especially in archaeological theory. Additionally, she took more courses in geology, completing the curriculum (18 hours of anthropology and 31 hours in geology) for a Master of Science degree.

**RESEARCH INTERESTS**

Beginning with her early work in the Chuska Valley, Helene developed strong opinions about pottery classification and its utility and application. She was not reluctant to express these opinions verbally and in print—sometimes to the consternation of some of her coworkers. Many years earlier, her Norwegian grandmother had cautioned her, "Don't worship authority." In other words, do not accept everything at face value because someone else says it is so; think and speak for yourself. She took those words to heart and was always an outspoken and independent thinker whose primary research orientation was guided by her strong founding in science. That she did not always agree with those who had more purely anthropological backgrounds is not altogether surprising.

As she came to understand the goals of archaeologists for whom she conducted geological studies, she saw that prevalent archaeological terminology was often imprecise, almost colloquial. She felt that if she were to apply her scientific knowledge to archaeology, it was incumbent upon the archaeologists to become more conversant with some of the very basic geological terminologies, as well as the geological environment in which they worked. She made a special effort to distinguish the terms *provenance* and *provenience*. The former is a geological term referring to the original source deposit or formation from which a rock or mineral is derived. The commonly used archaeological term, *provenience*, usually refers to the archaeological context or location in which an archaeological specimen is found. From the geological perspective, her primary concerns were with *provenance*, whether it was pottery temper or lithic artifacts.

She also questioned the archaeologist's use of the term *sand temper*. She found that pottery was rarely if ever tempered with just sand that could be dug from any arroyo bottom. She saw that, with magnification, the sand temper was usually sandstone. Prehistoric potters either crushed the stone for temper, or possibly gathered it from the base of weathered outcrops of sandstone. She saw under magnification that grains of sand temper often revealed differences in shape, color, opacity, pitting, staining, and adhering matrix that might be characteristic of specific geological formations. With her knowledge of regional and local field geology, it often took only shoe leather to seek out sandstone outcrops near archaeological sites that were possible temper sources. Sand (sandstone) temper was widely used in many parts of the Anasazi area, and she proved that the distinctiveness of the sand grains could permit the localization of some pottery production areas.

Her projects for the National Park Service, Chaco Center, were the most challenging. To each archaeologist, Chaco Canyon is a unique archaeological area that continues to be like a gauntlet thrown down as a challenge to a duel. Its large stratified sites are similar but different and seemingly both complex and simple, with patterned...
architectural forms that occur on scales rarely found elsewhere.

Archaeologists still do not agree on how the Chaco Canyon sites functioned in the greater Anasazi area. In the last 20 years, there has been a parade of archaeologists, each espousing a somewhat different view of how Chaco Canyon worked, often drawing on faddish interpretations originating in university seminars. Such explanations are interesting but rarely give more than token attention to the pottery associated with sites at Chaco Canyon. No class of artifacts has thrown more monkey wrenches into the archaeological machinery than Chaco ceramics. Almost every archaeologist has felt that Chaco ceramics have not been classified correctly. The proper classificatory criteria were not used, some important trait was overlooked, or somehow the approach was flawed. Each new researcher has proposed his or her own new objective sampling approach or has paid greater attention to specific details in hopes of resolving what, so far, is unresolvable.

Helene's ambitious approach to Chaco ceramics was to determine what kinds of tempers were associated with which decorative styles, even though they were not always assignable to a named pottery type. She carried her investigation beyond Chaco Canyon to sites in other districts, even beyond (except east of) the perimeter of the San Juan Basin. Unlike her study in the Cochiti Dam area, where the pottery of individual sites could be distinguished, she found that "instead of determining local manufacture on a site basis, it was necessary to consider temper usage on a locality basis" (Warren 1980a:84).

The results of her research were mixed. She stated that "there seems little doubt that the bulk of the ceramics found in Chaco Canyon was imported from other localities and that production areas changed through time. It is also apparent that at any one time, pottery was obtained from different sources. One pottery type may be produced in several different areas with the source areas changing through time. Also, some pottery types that had previously been considered related culturally or spatially were found to have been made in different areas" (Warren 1980a:84).

Although some pottery was made in the Chaco Canyon area, it had been known for some time that a large portion of the pottery came from other areas. Beyond that, she found evidence that "any changes in settlement patterns outside of Chaco Canyon in areas of pottery production would necessarily be reflected in the ceramic imports into the canyon, as well. Throughout the current studies, attention has been brought to the apparent frequent shifts of prehistoric populations throughout the area and, in turn to the possible implications of such mobility" (Warren 1980a:85). Such "mobility among prehistoric groups is a factor that must be considered in attempting to understand the nature of ceramic distribution and diffusion, in establishing pottery classifications, and in assigning a time period to a site or ceramic assemblage" (Warren 1980a:86).

She had to admit that "the continuum that had been established for pottery development in various areas of the Southwest, including Chaco Canyon, was not confirmed in the current constituent analyses of Chacoan ceramics. Gaps in the ceramic record were frequent and especially noticeable among small site assemblages. In such cases cross-dating of pottery types is on
very shaky ground, as are established 'local' ceramic sequences" (Warren 1980a:86).

In spite of having analyzed over 8,000 sherds from 116 sites representing 9 reasonably separate areas, she found that her samples were often too small to provide statistically valid data on sources of temper types. In view of such uncertainties, Helene must have recalled her grandmother's admonition and concluded that, "questioning the adequacy of data resulting from scientific investigations is always necessary and judicious. It is in fact wise to question on a continued basis all archaeological evidence, the new or the old, until sufficient lines of evidence are explored that few questions remain and patterns become repetitious" (Warren 1980a:89).

In spite of the inconclusive results of her Chaco research, her unpublished report, *Production and Distribution of Pottery in Chaco Canyon and Northwestern New Mexico* (1980a), is an important contribution that should foster more intensive study along the lines that she proposed. She continued to feel that her approach was valid and that field evaluation of the relationship of geology to archaeological sites was, or should be, integral to all archaeological research. To ignore or gloss over potentially significant geological associations was tantamount to denying that the prehistoric Indians also had basic geological knowledge that served them well.

Many of her reports were epitomes of conciseness and often were reduced to a few pages in much larger archaeological reports. She was well aware that, to some, her geologic data might seem even less comprehensible than the ubiquitous pottery and artifact type descriptions and tabulations. However, she felt a need to demonstrate to archaeologists that geological studies were important to any archaeological project; by her example, others would come to appreciate the value she saw.

Archaeological interpretation relies heavily on the accumulation of information from many proveniences. Thus, her files preserve for future researchers data from virtually every project on which she worked. For each project or site she prepared analysis sheets documenting each sherd she examined, a listing of the lithic types she recorded, and geomorphologic observations on the site areas she visited. That data has been preserved in the archives of the Museum of New Mexico's Laboratory of Anthropology.

Although she was happy to be paid for her work, she often continued fieldwork at her own expense, apparently just to be in the field. One of her "hobbies" was the investigation of prehistoric and early historic mines and mining techniques (see Mathien's article, this volume). She was particularly interested in the Cerrillos Mining District south of Santa Fe, where prehistoric Pueblo Indians had mined for turquoise and lead ore. She inventoried a part of the mining area for the mining firm, Oxy-Min (Occidental Minerals), which proposed to develop, and thereby destroy, some areas with prehistoric mines. She worked closely with the Albuquerque Archaeological Society, which excavated a segment of a worked out vein in the same area that prehistoric (Pueblo IV) Pueblo Indians had mined for the lead ore glaze in glaze-decorated pottery. Fortunately, the Oxy-Min venture was aborted. One of her last trips into the field was a camping trip with her son Daniel to visit early Spanish mines near Creel, in Chihuahua, Mexico.

Stewart Peckham
Helene Warren died on August 12, 1994, of Alzheimer’s disease—certainly the crudest way for someone with such a keen mind to go. By 1988, her illness was having an increasing impact on her mental functions, when she did her last work on what she called the Chamisal Project. This was a deeply buried Pueblo IV ruin on the property of Mr. and Mrs. Arnold K. Sargeant, in the Rio Grande Valley in northern Albuquerque. Kathryn "Kit" Sargeant recalls that Helene was often driven to tears because she could no longer remember and apply the detailed scientific knowledge that had served her so well during her professional career.

Although Helene Warren preferred to work alone, she was always ready to share her knowledge and views with others, and she hoped that other researchers would also combine their interests and skills in geology and archaeology. One such researcher was Elizabeth Garrett, of Albuquerque, who profited from the examples set by Warren and Shepard and applied her own geologic knowledge and skills to the petrographic analysis to Southwestern pottery. Sadly, she succumbed to cancer within a month or two of Helene Warren’s death. At present, they have no successors. The deaths of these two dedicated women leave a huge void that definitely needs to be filled.

Her profession was her life. Her fieldwork allowed her to reexamine the interaction of geology and archaeology. Probably few field archaeologists get as much mileage out of their feet and their minds as did Helene from hers. She also used those times alone to compose poetry, much of it inspired by the Southwestern landscape she loved. It reveals a hitherto unknown talent, as well as a bit of her personal world and how she felt she fitted into it.

Our paths have crossed
But only for one delightful moment.
We know now as we knew then
That we will continue on our way
Until the hills will hide
Each other from view.

These moments come and go
as evening and dawn.
Let there be not tears, only joy.
Go into your world as I in mine.
Only a fool could believe that the two are the same,
And he too would know in time what we know now.

Of all the times that in a year
I meet misfortune and despair,
I stop to think of who I am
And raise my eyes to lesser care.

There is no sadness that haunts me,
No madness that haunts me.
My heart is gay,
My soul is free.
The world holds no fear for me.

I do not acknowledge defeat;
I will not retreat.
I stand apart from other men.
Where I fall, I rise again.
ACKNOWLEDGEMENTS

Helene Warren left behind an invaluable legacy that could only have been compiled by one of the few truly scientific minds to grace Southwestern archaeology. This brief summary of some important aspects of her life could not have been written without the help of her son, Daniel Warren, of Albuquerque, who shared many of his personal memories, contacted relatives for their recollections, and provided the photograph of her on one of her last trips to the Rio Puerco. Other information and the poetry came from her sons David and Michael Warren, through the loving recollections of their mother that they shared at a memorial observance in August 1994 at one of her favorite places in the field, overlooking the shores of Cochiti Lake. Much help came from longtime colleague, John P. Wilson, of Las Cruces, and Kathryn Sargeant, of Albuquerque, who provided an insight on one of Helene’s last projects. At the Laboratory of Anthropology, valuable assistance came from Anita McNeece, Pat Neufeld, Laura Holt, Tracey Kimball, Willow Powers, and Doty Fugate. To all of them I am deeply grateful.

Daniel Warren donated Helene’s data, manuscript, and correspondence files to the archives of the Museum of New Mexico’s Laboratory of Anthropology, where they will remain accessible to interested researchers. The accompanying bibliography includes most of her writings, though still others may yet come to light.

—Santa Fe, New Mexico

PRINCIPAL WRITINGS OF A. H. WARREN

1965  Geologic Studies in Largo Canyon, San Juan County, New Mexico. Laboratory of Anthropology Notes No. 36. Museum of New Mexico, Santa Fe.

1966a  Petrographic Notes on Lithic Materials in the Cochiti Area, New Mexico: First Report: A Preliminary Report Relating to the Excavations at Cochiti Dam, and the Alfred Herrera Site (LA 6455), the Red Snake Hill Site (LA 6461), and the North Bank Site (LA 6462). Laboratory of Anthropology Notes No. 91. Museum of New Mexico, Santa Fe.

1966b  Lithic Materials in the Cochiti Area, Cochiti Dam Project: 2nd Report: Petrographic Examination of Geologic Materials from the Dead Horse Site (LA 272), La Sita del Capitan Francisco Lujan (LA 34), and LA 9154. Laboratory of Anthropology Notes No. 92. Museum of New Mexico, Santa Fe.


1967e The Pottery of Las Majadas. Laboratory of Anthropology Notes No. 75a. Museum of New Mexico, Santa Fe.

1967f The Pottery of the Torreon Site, Cochiti Dam, New Mexico. Laboratory of Anthropology Notes No. 76a. Museum of New Mexico, Santa Fe.


1968b Petrographic Study of Ceramics of the Unkar Sites. Ms. on file, School of American Research, Santa Fe.

1969a Notes on the Geology of the Twin Hills Site, Santa Fe County, New Mexico. Laboratory of Anthropology Notes No. 46. Museum of New Mexico, Santa Fe.

1969b Notes on the General Geology of the Fossil Camel Track Area, Cieneguilla, New Mexico. Laboratory of Anthropology Notes No. 65. Museum of New Mexico, Santa Fe.

1969c The Nambe Project: Archaeological Salvage at Nambe Pueblo, Santa Fe County, New Mexico, Notes on Ceramics and Lithics of the Nambe Pueblo. Laboratory of Anthropology Notes No. 100. Museum of New Mexico, Santa Fe.


1969e Miscellaneous Notes on the Pottery of the Middle Rio Grande (with John P. Wilson). Ms. on file, Laboratory of Anthropology, Santa Fe.


1970c Geology and Resources of the Manuelito Area, McKinley County, New Mexico. Laboratory of Anthropology Notes No. 58a. Museum of New Mexico, Santa Fe.

1970d A Petrographic Study of the Pottery of Gran Quivira. Laboratory of Anthropology Notes No. 94. Museum of New Mexico, Santa Fe.

1971a Notes on the Geology and Resources of the Buffalo Springs Area, McKinley County, New Mexico. Laboratory of Anthropology Notes No. 60a. Museum of New Mexico, Santa Fe.

1971b Notes on the Geology and Resources of the Pueblo Alamo Area, San Sebastian, New Mexico. Laboratory of Anthropology Notes No. 67. Museum of New Mexico, Santa Fe.


1972b Mineral Resources of the North American Indian. Laboratory of Anthropology Notes No. 95. Museum of New Mexico, Santa Fe.


1972c Field Notes on the Naschitti Area (LA 10943). In *Archaeological Salvage Excavation of a Basket Maker III Site on U.S. Highway 666, near Naschitti, New Mexico*, by Frank J. Broilo and William C. Allan. Laboratory of Anthropology Notes No. 82. Museum of New Mexico, Santa Fe.

1972f Geology and Mineral Resources of the Apache Creek Area. In *Whiskey Creek Project: Archaeological Highway Salvage along State Highway 32 in Apache Creek Valley, Catron County, New Mexico*, by David W. Kayser, pp. 18-35. Laboratory of Anthropology Notes No. 57. Museum of New Mexico, Santa Fe.


1973c *Notes on Geology and Resources of the Tularosa Valley, Otero County, New Mexico. The Bent Highway Salvage Project* (with Regge N. Wiseman and Gail D. Tierney). Laboratory of Anthropology Notes No. 74. Museum of New Mexico, Santa Fe.

1973d *Cochiti Dam Salvage Project: Archaeological Excavations and Pottery of the Las Majadas Site, LA 591, Cochiti Dam, New Mexico* (with David H. Snow). Laboratory of Anthropology Notes No. 75. Museum of New Mexico, Santa Fe.

1974a *The Pottery and Mineral Resources of Pueblo del Encierro (LA 70)*. Laboratory of Anthropology Notes No. 98. Museum of New Mexico, Santa Fe.


16 ASNM 21: Papers in Honor of A. Helene Warren
1975a *An Archaeological Survey of the Proposed Mining Project Area, Occidental Mineral Corp., Cerrillos District, New Mexico.* Prepared for the Rocky Mountain Center on Environment, Santa Fe.


1976b The Geology and Mineral Resources of Carnuèl: A Preliminary Report Prepared for the Laboratory of Anthropology, Museum of New Mexico, Santa Fe.

1976c Technological Studies of Pottery of Chaco Canyon. Ms. on file, Branch of Cultural Research, National Park Service, Santa Fe.


1977f Geology; Geomorphology and Soil Stratigraphy; and Mineral and Land Resources. In *The Piojo Dunes Site (LA 13669): Archaeological Investigation in Southwestern Sandoval County, New Mexico*, by Stewart Peckham, pp. 2-23. Laboratory of Anthropology Notes No. 266. Museum of New Mexico, Santa Fe.


1978c Lithic Code. On file in the Library of the Laboratory of Anthropology, Museum of New Mexico, Santa Fe.


1981e  *Test Excavations at Six Sites in the Sevilleta National Wildlife Refuge, Central New Mexico, for Chevron Pipeline Company*, by Patrick Hogan and Joseph C. Winter. Office of Contract Archaeology, University of New Mexico, Albuquerque.


1985b  Notes on the Geology and Mineral Resources of the Jarilla Mountains Area, Otero County, New Mexico. Report for the Office of Contract Archaeology, University of New Mexico, Albuquerque.


Two domestic animals are noted for their stupidity, turkeys and sheep. They share more in common than needing human attention for their survival. Otherwise, they would seem to be quite different, with the turkey being a bird and native to the New World, and the domestic sheep, a mammal and native to the Old World.

**TURKEYS IN THE AMERICAN SOUTHWEST**

Turkeys were kept in two regions in pre-Contact times, in the American Southwest and in Mesoamerica, with an apparent gap between (Beals 1932:104–105, 167–169). While turkeys can potentially be kept as pets or raised for sacrifice or for their feathers, eggs, and meat, sources vary as to which purposes were foremost among different peoples in the New World.

*Turkey Breeds*

There is some disagreement as to the place or places where turkeys were domesticated, in part related to the taxonomy of the species. *Meleagris gallopavo*, as it is called by its scientific name, has been variously divided into several subspecies (Reed 1951:195–196). In the Southwest, the common turkey is known as Merriam’s wild turkey or *Meleagris gallopavo merriami*. Jean Pinkley (1965:70–72) suggested that turkeys were native to the Mesa Verde region in southwestern Colorado and that, by intruding into Anasazi settlements in prehistoric times, attracted by the food available, they had in a sense domesticated themselves, for the Indians had little choice but to attempt to control them.

Lyndon L. Hargrave (1965a, 1965b), working with the same archaeological collections as Pinkley, observed that the birds were a source of food, feathers for clothing, and bones for tools and jewelry; that turkey pens were common in the cliffhouse ruins of Mesa Verde; but that there was no evidence of turkeys prior to their domestication in the A.D. 600s. He suggested that the wild turkeys of the region sprang from feral populations left behind when the Anasazi abandoned the country about A.D. 1300.

Charmion R. McKusic (1986) summarized the data then available on Southwestern turkeys, including a detailed analysis of the temporal and spatial distribution of turkey remains, along with data on aboriginal uses of the bird and well-illustrated osteological descriptions. She recognized two domesticated varieties derived from separate subspecies. The small Indian domesticated turkey derived from a tropical stock, which she named the Tularosa Turkey and believed had been introduced into the Southwest by 300 B.C. The large Indian
domesticated turkey she thought had been brought from the eastern United States about A.D. 500. In her view, turkeys were absent in the Southwest from the end of the Pleistocene until the introduction of these domestic breeds. Like Hargrave, she saw the large domestic variety as the source of the feral populations, which developed into Merriam’s wild turkey. It also became the more common domestic breed, but the small variety was retained by some groups and survived into historic times in the Salinas pueblos. Both domestic breeds, she thought, became extinct during Spanish Colonial times, the small variety with the collapse of the Salinas occupation in the seventeenth century, and the large variety displaced sometime during the eighteenth century by the various species of livestock introduced from the Old World.

All of this appears to be a straightforward intellectual progression based on the accumulated data from an increasing number of archaeological sites. It is based, however, on an interpretation of the data in the light of genetic evolution only. A recent study by Louise Senior and Linda Pierce (1989:255–257) challenges the suggestion that the two varieties are genetically distinct breeds or subspecies, suggesting that environmental factors may well have led to the observed differences. In particular, they suggest that stress, caused by a lack of water, resulted in the distinctive traits identified with the small Indian domestic turkey. This theory, which remains to be tested, does not alter the following view of the turkey during the Contact and Colonial periods in the Southwest.

A subsequent study by Emanuel Breitburg (1993) comes full circle, in that it derives the domestic turkeys from a native, preexisting population of the Merriam turkey and postulates that domesticated turkeys diffused from the Mogollon and Anasazi peoples to southern Mexico. Breitburg places major emphasis on social and religious use of turkeys for sacrifice, feathers for prayer sticks, and grave goods, in contrast to their use for food. While he mentions use of feathers for clothing, he does not consider this a significant factor.

Uses of Turkeys

It is noteworthy that turkey domestication in the Southwest was most important among the Mogollon and Anasazi and of little consequence in the hot desert country of the Piman and other Sonoran tribes. While summers can be hot in much of the area occupied by the Mogollon and Anasazi, winters are cold, often bitterly so. In the area of Gallup and Fort Defiance, for instance, temperatures plunge well below −29 degrees C (−20 degrees F) not infrequently and have been known to go below −45.5 degrees C (−50 degrees F). Clothing is not a matter of style and modesty alone in such a climate. The era of Spanish exploration and settlement was in the middle of the Little Ice Age, when temperatures were even lower than today.

In prehistory there were three major kinds of clothing that could provide adequate protection from the cold. The earliest fabrics were made of the skins of wild animals, tanned Indian-style, with or without the hair or fur. At the time of contact, these were used both as robes and as tailored skin clothing, the latter introduced from the north, probably by Athabaskan-speaking immigrants. The most recently developed, but still of respectable antiquity, was loom-woven cloth, produced from fibers of cultivated cotton. Climatic conditions limited production of cotton to
the middle and lower reaches of Pueblo occupation along the Rio Grande, to some of the lowest elevations in Hopi country, and to the hot desert lowlands to the south and west. Elsewhere, the fiber and the finished cloth were obtained by trade. A craft of probably intermediate age was the weaving of blankets or cloaks of coarse fibers wrapped with strips of fur or feather. Rabbit fur was used, and it seems likely that periodic rabbit drives to control these avid crop raiders filled the need quite easily. The feathers used were from the turkey. At the time of contact, feather cloaks were a standard winter garment for women at some and probably all of the pueblos. Thus, turkey feathers did not serve religious functions only, but a vital requirement, an effective insulating material for winter wear.

Distribution of Turkey Use

The distribution of domestic turkeys among the pueblos, as reported by the earliest chroniclers, shows that climate was a factor both in the numbers of turkeys kept and in the uses to which they were put. We do not know enough about aboriginal social customs to fully understand how these might have differentially influenced the husbandry, trade, and use of turkeys among the various pueblos and ethnic divisions. The fit of the following data is not perfect, if based only on factors deriving from climate and trade, but it is sufficient to show that the demand for feathers for warm clothing was a significant factor.

The southernmost pueblos along the Rio Grande, where the Piro language was spoken, appear to have been the most heavily involved in raising turkeys. One source states that each "Indian," probably meaning each family head, had a corral with 100 turkeys (Hammond and Rey 1966:83). While many pueblo groups raised turkeys, information regarding their use is rather spotty. Data are not available for all groups during this early, pre-sheep period (Table 1), but such as do exist suggest a pattern. Remarks in Table 1 on the size of holdings are based on statements on overall numbers and numbers of turkeys offered to the Spanish. A no followed by a question mark indicates that no turkeys were given and that other meat, usually rabbits, was provided.

Generally, peoples living at lower elevations usually had large flocks, while those at high elevations or where water for agriculture was the least dependable usually had few or no turkeys. There is some suggestion that the few turkeys reported at Pecos had been received in trade. The major exception to this rule is among the Tompiro.

The answer to the question of which puebloan groups ate turkeys and which did not is less clear. Explicit statements that they were eaten appear only for the Piro and Southern Tiwa, but it appears likely that all those groups that regularly furnished turkeys along with other foods ate the meat themselves. Only for Zuni is there a definite statement that they did not eat turkey flesh. Still, those pueblos that had few or no turkeys appear to be those that did not normally consume the meat, but we cannot be sure whether this was the result of a prohibition or merely a lack of opportunity.

Use of feathers for blankets and cloaks is again poorly documented, being described explicitly only for the Piro, the Southern Tiwa, the Pecos, the Western Keres, and the Zuni. A general statement that all the pueblos in the Rio Grande drainage used
# Table 1. Historic Documentation of Turkey Use.

<table>
<thead>
<tr>
<th>Language</th>
<th>Dates</th>
<th>Turkeys Present</th>
<th>Eaten</th>
<th>Feather Textiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piro</td>
<td>1581</td>
<td>&quot;large numbers&quot;</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>&quot;quantities&quot;</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Southern Tiwa</td>
<td>1540–42</td>
<td>&quot;great abundance&quot;</td>
<td>probably</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>1581</td>
<td>&quot;large numbers&quot;</td>
<td>yes</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>&quot;many&quot;</td>
<td>-</td>
<td>yes</td>
</tr>
<tr>
<td>Rio Grande Keres</td>
<td>1581</td>
<td>probably</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>&quot;many&quot;</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td>Tano</td>
<td>1581</td>
<td>&quot;many&quot;</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>yes</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1591</td>
<td>&quot;in abundance&quot;</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td>Tewa</td>
<td>1591</td>
<td>yes</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td>Northern Tiwa</td>
<td>1540–42</td>
<td>no</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tompiro</td>
<td>1583</td>
<td>&quot;abundant&quot;</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td>Pecos</td>
<td>1540–42</td>
<td>few or none</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1590–91</td>
<td>no(?)</td>
<td>-</td>
<td>yes</td>
</tr>
<tr>
<td>Western Keres</td>
<td>1540–42</td>
<td>&quot;large numbers&quot;</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>&quot;many&quot; &quot;ample&quot; &quot;abundant&quot;</td>
<td>probably</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>1598</td>
<td>yes</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td>Zuni</td>
<td>1540–42</td>
<td>&quot;a few&quot;</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>no(?)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1598</td>
<td>no(?)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hopi</td>
<td>1540–41</td>
<td>yes(?)</td>
<td>probably</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>1583</td>
<td>no(?)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>


Feather textile clothing does appear for 1540–1542 (Schroeder 1968:98). If this generalization is valid, only the Hopi usage remains undocumented. While winter temperatures vary, the warmest area would be the Piro country, where use of feather clothing is documented. If the use were as general as the data suggest, the Hopi, living in an area of more severe winters, were probably making use of feather robes even if they had few turkeys.

Archaeological data for the late prehistoric and early historic years, although uneven, does support the picture provided by the documents, at least in a general way. At Pecos, there was no indication of any large number of turkeys (Kidder 1958). Other late Pueblo sites of probable Tewa...
occupation, such as Arroyo Hondo and Pindi Pueblo, show clear evidence of turkey husbandry, use as food, and, at Arroyo Hondo, for feather cloth (Lang and Harris 1984:101–109; Stubbs and Stallings 1953:47). In the Tompiro region, Gran Quivira produced evidence of turkeys, turkey pens, feather cloth, and use as food (Hayes et al. 1981:46, 164; McKusick 1981:50–52). The small Indian domestic turkey was represented by the bones of a minimum of 923 individual birds. Only one example of the large Indian domestic turkey was recovered. If the small size is the result of environmental stress, as has been suggested, it may well be that a determined effort to breed turkeys under adverse conditions is indicated—a very real possibility in view of the local environment and the seeming importance of turkeys to the Tompiro’s near relatives in the Piro pueblos along the Rio Grande. At Hawikuh in the Zuni country, excavations revealed some turkey burials, a stray turkey skull, and a fragment of what may have been a feather garment (Smith et al. 1966:92, 231, 251), which is in marked contrast to the prominence of turkeys at Gran Quivira. However, the excavations at Hawikuh were conducted at a time when far less attention was given to faunal remains, and food bones in trash deposits were not collected. At Homol’ovi in the far west, a pueblo ancestral to at least some Hopi clans, excavations revealed evidence of turkey husbandry but no indication of use for food. Turkey burials were interpreted as sacrificial offerings (Senior and Pierce 1989:251–252). Despite the speculation that Southwestern domestic turkeys became extinct no later than the eighteenth century, early Anglo-American observers in the nineteenth century reported turkeys at several pueblos, including Laguna, Zia, Santa Ana, San Felipe, Cochiti, and Jemez (Abert 1848:470; Schroeder 1968:108–110). It is not unlikely that birds descended from aboriginal stock can still be found today in some of the more conservative pueblos, although there can be no doubt that turkeys became a less significant domesticate after the arrival of the Spanish.

**POST-CONTACT DOMESTICATION**

The process of introducing Old World livestock and its impact on native cultures have been accorded little attention in studies of the Pueblo past. It is assumed that most introductions were made under the auspices of the missions. The usual view is that the Indians learned to care for and use the new animals through a sort of on-the-job training as they contributed labor tending mission herds. The missions in the seventeenth century raised sheep and cattle on a large scale, pastured both on pueblo lands and on mission estancias. The profits from these ranching operations were used to buy goods desired by the priests for their churches and conventos, as well as reserves to assist the civil government, private citizens, and Indians in time of need (Ivey 1994:77–79). The Indians also labored for the settlers and government officials, probably both under compulsion and as freely hired hands. Details that might reveal just how the Pueblo people learned the Old World methods of animal husbandry are not available. Restrictions on riding horseback and using Spanish arms limited the roles open to Pueblo Indians, but some of those who were most trusted and who worked under mission supervision appear to have been allowed exceptions (Ivey 1988:221).

It is not clear whether any Pueblo people actually came to own herds themselves. Certainly any Indians who worked regularly as herders might feel a degree of proprietary

David M. Brugge
interest in the flocks that they oversaw. Private, or at least family, ownership of flocks of turkeys existed among the Piro. We do not know how much time and energy were devoted to the care of turkey flocks, but the labor investment could not have been inconsequential for flocks with as many as 100 birds. A reallocation of time and resources from a flock of turkeys to a flock of sheep would probably have demanded some increase in effort, but the adjustment of priorities and schedules would doubtless have been more a matter of degree than of kind. Both species require a good deal of attention when kept in flocks of any size.

The rewards in terms of edible protein and insulating fiber would have been commensurate with costs. Not only is wool particularly effective for cold-weather clothing, it requires far less labor to prepare woolen textiles than feather garments. The latter are extremely labor intensive, requiring tedious hand preparation, whereas wool cloth can be woven on a loom, a semimechanical process even on the simple Pueblo looms.

It is thus a logical conclusion that turkey husbandry preadapted the Pueblos to sheep pastoralism, the kind of Old World ranching most open to them under Spanish rule. When the Pueblo Revolt drove the Spaniards from their lands in 1680, everything Spanish was initially banned by the Pueblo leaders (Kessell 1979:238). A complex interplay of economic and political forces led, in all probability, to inconsistent adjustments, however. Neither the documented history, nor Indian oral tradition, nor the archaeological conundrums of recent excavations can as yet reveal just what happened. The Navajo, who received refugees from among the Puebloan groups, are today the foremost sheep raisers among the Southwestern tribes. Not far behind, at least in the recent past, are some of the western Pueblos, especially the Laguna, who also absorbed refugee populations (Ellis 1979:438–441). The western Pueblos, which have more land and probably enjoy greater freedom from White officials, continue to practice pastoralism on a larger scale than those along the Rio Grande.

CONCLUSION

One of the most interesting problems remaining in the ethnohistory of the Southwest is the task of filling in the gaps in our knowledge of the events leading from the mission herds of the seventeenth century to the Indian herds of the nineteenth and twentieth centuries. Pieces of the puzzle are in hand in the perplexing archaeology of the upper Chama River (Carrillo 1992; Schaufsma 1992), in our increasingly detailed understanding of Spanish colonial history, and in our better knowledge of present-day Indian societies. Much remains hidden in the murky mists of past centuries, which must be revealed before we can bring the pieces from the diverse sources together to make a coherent picture.

ACKNOWLEDGMENTS

A preliminary talk on this subject aroused sufficient interest at the 1994 Archaeological Society of New Mexico meeting in Grants, New Mexico, that I have been encouraged to continue work on the subject of animal domestication in the Southwest. This version of the paper was presented at the American Society for Ethnohistory in November 1994 in Tempe, Arizona. Word-processing was done by Lauren Rimbert.

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1953 The Excavation of Pindi Pueblo, New Mexico. Monograph No. 18. School of American Research and the Laboratory of Anthropology, Santa Fe.
A photograph archive (or photoarchive) is always valuable as a reference source for visual historic information. But there is often a problem finding useful photographs. Even if the archive is indexed, searching the index and then retrieving the pictures, microfiche, or microfilm is a time-consuming exercise that is seldom very productive. As an architectural historian, the subjects that are of most interest to me, the buildings, are often in the background, not the object of the photographer. Also, the buildings are generally not of great concern to the archive cataloger who makes the index. Consequently, searching an archive for pictures of architecture is a hit or miss proposition. The Albuquerque Museum Photoarchive has a computerized system that allows the researcher to search and actually view the photographs without leaving the computer or handling the valuable images.

This paper describes and illustrates the Albuquerque Museum Photoarchive System, explaining how the descriptive and photographic data are entered and how images can be retrieved. Searches may be requested by subject, locale, and date range. A printout of the image and descriptive data may be made for future reference. A photograph can be scanned and enlarged or an area of special interest can be examined more closely. The hardware requirements are described, along with the advantages of the approach. Selections from some of the major collections in the archive are used as examples and illustrate how the system has been used for research. The Huning's Highland Addition Archive, a project spawned and nurtured by the Albuquerque Museum, is also discussed briefly.

**HISTORY OF THE ARCHIVE**

"The Photoarchives was informally established in 1976 when volunteer organizations collected approximately 400 photographs of Albuquerque as a [U.S.] Bicentennial project. The prints were donated to the Albuquerque Museum as the nucleus of an historical resource for future generations" (Johnson and Douner 1988:3). The following year the photoarchive was officially created, and a photoarchivist was hired temporarily, using a government grant. Also in that year the first photograph exhibit, "Presents from the Past: Christmas 1915," was mounted. In 1978, the archivist position was made a permanent staff position, and the photoarchive was on its way to becoming a major component of the History Division of the museum. The Brooks Collection, one of the largest, was acquired at this time and is still being processed, 15 years later. The Albuquerque Public Library transferred its photograph collection to the museum, and other generous citizens began to see the value of the archive and to donate their valued images. In 1979 the museum moved from
its original location at the old Albuquerque Airport to its brand-new facility, and the holdings grew with the *Albuquerque Progress* collection. Requests to reproduce photographs for publications came; numerous exhibits of new acquisitions were mounted; and "Early Albuquerque," the archive's first book, was published (Johnson n.d.:2). Ten years after the establishment of the archive, the first version of the computer cataloging system was put on-line. By 1995, over 10,000 photographs have been entered into the computer system, but there are many, many more still waiting.

**SYSTEM DESCRIPTION**

Although the hardware components of the archive system are technologically outdated (they are six years old), the concepts and techniques are not. The concept of storing the images on a computer and then searching and viewing the computer images rather than the delicate photographic records is the main thrust of this paper. The major components of the Albuquerque Museum Photoarchive system are a scanner to scan the images, an optical-disk recorder to record the data on, a video monitor to view the image, and a personal computer for recording descriptive information and controlling retrieval of images for viewing. In addition, a video printer and a laser printer are also attached, to print an image and its associated descriptive data. The personal computer (PC) software directing the system is The Photoarchivist, a program designed by Byran and Sharon Johnson (copyright 1990, 1991, and 1992 by Cultural Software, Rio Rancho, New Mexico).

The scanner for the system is a Sony model UY-T55 Color Video Scanner (Figure 1). Both color and black-and-white images can be scanned and recorded. Each photograph is positioned for scanning on an 8½-by-11¾-inch flat bed surface. The image is digitally recorded in 512 by 768 8-bit cells. That is about 60 pixels or dots per inch. Each pixel can have one of 256 gradations of three colors (Sony Corp. 1989:33). After the photograph is scanned, it can be trimmed or enlarged to one of 14 size levels. This trimming allows small pictures to be enlarged or zoomed to the full size of the screen for recording. When the image is positioned and trimmed as desired, it can then be recorded on the optical disk.

The optical-disk recorder used with the Albuquerque Museum system is a Panasonic model TQ-3031F Optical Disc Recorder (Figure 2). It is a write once/read many recording. That is, an image can only be written once to a given cell or frame on the disk, but it can be read or retrieved any number of times. Recording takes less than a second. The optical disk itself is 12 in. in diameter, removable, and weighs less than 2½ pounds (Figure 3). Each disk cartridge has a capacity of 54,000 video frames on each side for a total of 108,000 images per disk (Panasonic Communication and Systems Co. 1989:22). Through computer control, any one of the images can be retrieved and viewed.

The viewing device for the system is a Sony model PVM-2530 25-in. Trinitron Color Video Monitor (Figure 4). The images are displayed on the monitor when they are scanned and trimmed or when they are retrieved from the optical disk.

The PC for the system is a Hewlet Packard (HP) Vectra model RS25C, but any IBM-compatible 386 or faster PC could be used.
To complement the recording and viewing capabilities of the system, there are two printers. An HP Laser Jet III printer is used to print out descriptive data about photographs (Figure 5). Of much more value is the Seikosha model VP-3500 Video Printer (Figure 6). This device produces a 7-in. square copy of the image. Using thermal-sensitive paper and 64 shades of gray, a 1,280-by-1,280-pixel image can be produced in approximately 30 seconds (Seikosha America 1988:i). Although it is not photograph quality, the image is more than adequate as a working draft copy for research, and it is quick and inexpensive to produce.

The computer program, The Photo-archivist, allows the user to record and retrieve descriptive information about the images on the hard disk of the PC independently from the optical disk. Within this descriptive data is the location or frame number of the associated photograph. The computer program uses the frame number to direct the optical disk recorder or player to display the image on the video monitor while the PC displays the descriptive information on its own character monitor. The two screens complement each other by displaying the photograph and its description simultaneously. Total cost of the system in 1989, when it was new, was approximately $65,000. In today’s computer market, it should be considerably less expensive.
Figure 3. Optical disk.

Figure 4. Search and viewing station.
HOW THE COMPUTER SYSTEM WORKS

The two major functional areas of The Photoarchivist computer program are (1) recording the image and its associated descriptive data, and (2) searching and retrieving images.

Recording the Image

Entering the descriptive data for a photograph begins with the Catalog Number and entails specifying several attributes about the image. First is the Subject, or the key words on which a search can be requested. What are the important elements in the picture that may be of interest to future researchers? For example: Queen Anne Victorian/R Appleton Residence/Continental Oil Co./. Second is the Locale. At what location was the photograph taken? These are also key words that can be searched. Examples might be: Walter, S, 00400, Huning’s Highland Addition. If the photograph was taken in a photographer’s studio, then the location may not be as important, or it may be unknown. Third is the Image Date. When was the original photograph taken? The actual date is entered, if it is known, or it is estimated. These are the main attributes used in searching for photographs. A Description field allows more space for detailed descriptive information, but this information cannot be searched. Additional attributes complete the data for the image: Collection tells what group of photographs it is associated with. Photographer gives the photographer’s name, if known, size of original image, condition, whether a negative exists. All of these help to describe the photograph. Normally, research on the photograph is performed ahead of time, and a data sheet is completed before the data-entry process begins.

Scanning

After all the descriptive material is entered in the computer, then the image can be scanned. This process is independent of the PC and The Photoarchivist program. The photograph is placed on the bed of the scanner and is then scanned into the system. The image appears on the video display. At this point it can be trimmed so that the image fills the entire video screen. So, even if the photograph is a 2-by-3-in. snapshot, it can be enlarged to fill the 25-in. screen of the video display. When the image is trimmed to the desired size and position, it can be stored on the optical disk. The transfer takes less than a second, and the photograph is permanently stored. When the image is stored on the optical disk, the recorded frame number is displayed. The final step is to return to The Photoarchivist program and record the frame number on the catalog record so that the correct image will be displayed when the catalog record is retrieved.

Searching for Catalog Images

Searching for images can be performed through several different keys or categories: the Subject, the Locale, the Image Date, or even the Collection or Photographer. By specifying several key words for a category, (e.g., Subject), if any one of the key words is found, the picture is selected. By specifying key words in more than one category (e.g., Subject and a range of dates), then a picture must satisfy a key in each category specified. After the key words have been specified, the search is started. The data base is searched sequentially through all catalog numbers. When the key words of an
entry match the search criteria, the search stops, the image is presented on the video display, and the descriptive data are presented on the PC display. At this point the researcher can examine the image and the description to determine if the picture is interesting. If it is not, the search may be continued from the point at which it stopped. At any time the search may be interrupted and discontinued, and a new set of criteria can be entered. Since the search is relatively fast, a matter of seconds rather than several minutes per image, experimentation is possible. A researcher can attempt to determine the criteria used by the cataloger when the pictures were put into the system. The descriptive words that the cataloger used can be ascertained and used in a new search. When an interesting image is found, its Subject, Locale, or even Collection key words can be used to search further. The search and retrieval process is so rapid—close to 5,000 pictures per minute—that reiterative searching is easy and fun.

Printing

When a picture of interest to the researcher is found, it can be printed on the video printer simply by pressing the Print key on the printer. Although the printout is not of photographic quality, it is sufficiently clear for reference purposes. The catalog number can be printed on the picture, if desired. The descriptive information for the image can also be printed by pressing the Print Screen key on the computer keyboard. Again, the search can be resumed or terminated. As the search is progressing, a tally of the number of catalog entries

Figure 5. HP Laser Jet III printer.

Figure 6. Seikosha VP-3500 video printer.
searched is continuously displayed, so that progress can be observed.

When the inquiry session is finished, the researcher has a copy of the actual photographs, the catalog numbers (which can be used later to get photographic copies made), and a copy of the complete descriptive data for each photograph. All of this has been accomplished in a relatively short time, without handling the valuable photographs and without ever leaving the computer terminal. The researcher has complete information to take home, and the archive has not been disturbed.

Scan and Zoom

Another interesting use for the computer system is the scan and zoom capabilities of the Sony scanner. After a photograph has been scanned in preparation for recording, any portion can be enlarged or zoomed up to 14 times its original size. As an example, a panoramic view of Huning’s Highland Addition from the Cobb Collection (Albuquerque Museum No. 1990.013.114) shows Perkins Hall (Figure 7), which is known to have been built in 1890 (Simmons 1982:308). By zooming in on the prominent residence to the left in the photograph (Figure 8), it could be identified, from more modern photographs, as 115 S. Walter. Next door, the house at 119 S. Walter had not been built at the time of the Cobb photograph. From other sources it is known that 119 S. Walter was built by A. B. McMillen between 1893 and 1896. Therefore, the Cobb photograph can be dated between 1890 and 1896—after Perkins Hall was built but before the house at 119 S. Walter was built. Sometimes a license plate on a car can be enlarged to read the year of issue and thereby a date for the photograph.

MAJOR COLLECTIONS

The Albuquerque Museum Photoarchive contains over 10,000 scanned photographs with descriptions in the computer system. Some of the major collections are

1. The Cobb Collection (1990.013). William Henry Cobb and his wife Eddie Ross Cobb owned a photograph studio in Albuquerque from around 1888 to the 1940s (Johnson and Douner 1988:16). Several collections of glass-plate negatives are known. The University of New Mexico has one, and the Albuquerque Museum has obtained at least two different groups of negatives over the years. Many of the approximately 500 plates are street scenes of early Albuquerque.

2. The Brooks Collection (1978.151, 152). An architect remodeling a building that once housed the Brooks Photo Studio uncovered over 20,000 nitrate negatives previously walled in behind a partition. They had been abandoned when the studio was moved to a new location. The portraits and commercial photographs span the years 1928 to 1947 (Carson 1989:7).

Figure 7. Perkins Hall, UNM, and residence (Albuquerque Museum Photoarchive Cobb Collection 1990.13.114).

Figure 8. Zoomed shot of 115 S. Walter.
4. **The Milner Collection (1992.005).**
Alabama P. Milner worked in the Walton Photography studios in Albuquerque during World War I. In 1919 she bought the studio and worked in and around Albuquerque for the next 40 years. In 1958, Bob Davis bought the studio and eventually sold the collection of about 1,000 Milner negatives to the Museum.

5. **The General Collection.** Numerous small collections donated or loaned by generous present and former residents of Albuquerque provide a glimpse of the city in all different eras from the nineteenth century to the present. Most photographs are of people, but many show Albuquerque and its buildings in the background. One photograph album, the Daily Collection, which was recently brought into the archive, has a picture of "Aunt Linnie's house" (Figure 9). The picture was probably taken about 1908, when the house was brand new. An interior shot shows the canvas roof and Victorian decorating of this shotgun-style tuberculosis treatment cabin (Figure 10). The home still exists today at 409 S. Walter.

**HOW THE ARCHIVE IS USED**

A good deal of effort has been expended by staff and volunteers cataloging over 10,000 images. How has the resulting computerized archive been used?

**Exhibits and Other Projects**

Several very popular museum exhibits of historic photographs were mounted in the last year. The exhibit entitled "An Albuquerque Album: Photos of a Changing City" showed historic photographs from the archive, compared with the same locations today. The "San Felipe: El Centro de Nuestra Vida" show traced the history of this historic church on the Old Town Plaza. The television show "Colores" presented an episode in which V. B. Price discussed the importance of history to a city's identity. The visual history came from the archive. A video tape, "Early Albuquerque: The Railroad Boom Years 1880-1912" was produced by the Museum using archive photographs. Calendars for 1993 and 1994 sold at the museum and elsewhere use archive photographs for each month. The City of Albuquerque Planning Department recently published two brochures illustrated with archive photographs—"Albuquerque's Historic Landmarks" and "Albuquerque, NM, Historic Route 66, Tour Guide & Map" (Figure 11). Businesses often buy historic photograph murals and enlargements that illustrate their line of business. Research was conducted last year to determine the architecture around the Old Town Plaza in 1894, so that Artist Morris Ripple could make a painting depicting that era. A recent "Cavalcade of Enchantment" television episode presented the history of Albuquerque with archive photographs and commentary by the Photoarchivist.

**The Huning's Highland Addition Archive**

I am continuing research on the architectural history of the Huning's Highland Addition. Huning's Highland Addition Archive is attempting to gather information about the history of this historic Albuquerque neighborhood (Carson 1994). The Albuquerque Museum Photoarchive has been instrumental in forming and supporting this infant archive. Current photographs are being taken of each of the nearly 500 buildings. The Museum has provided numerous historic images and...
Figure 9. "Aunt Linnie's house" (Albuquerque Museum Photoarchive Cobb Collection 1990.13.114).

Figure 10. Interior view of Aunt Linnie's house (Albuquerque Museum Photoarchive 1993.53.10).
other information to complement the photographs of the buildings as they appear now. The annual historic house tours and "Dickens of a Dinner" progressive Christmas dinners provide an incentive to research house histories in city directories. Over 60 different homes and businesses have been open for viewing over the past 12 years. A small collection of glass negatives found in a corner of the attic of one house gives a glimpse of the neighborhood and its residents at the turn of the century. A package of love letters found in another house describes the neighborhood and Albuquerque in the 1930s. All of these artifacts, photographs, and histories are being brought together in an attempt to preserve the memory of Albuquerque’s first subdivision. The historic architecture of Huning Highlands is a valuable legacy of Albuquerque’s Victorian past.

CONCLUSION

Historic photographs are a valuable asset to any community, and a photoarchive provides the environment to preserve these irreplaceable images. But access and preservation seem to be conflicting goals. The Albuquerque Museum Photoarchive has solved this dichotomy of purposes by using a computer system to access the images and to reduce the physical handling of the historic materials to a minimum. The researcher can search at computer speeds, see the images, and make working copies without being physically close to the original photographs.

ACKNOWLEDGEMENTS

All photographs are by Ann Carson except where indicated. The author wishes
to thank Mo Palmer, Photoarchivist, and John Grassham, Curator of History, both of the Albuquerque Museum, for the wealth of information they provided on the collections, history, and procedures of the Albuquerque Museum Photoarchive.

—Albuquerque, New Mexico

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Carson, Ann L.

Carson, James

Johnson, Byron A., and Robert K. Douner

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Panasonic Communications and Systems Co.

Seikosha America

Simmons, Marc

Sony Corp.
The Three Rivers Petroglyph (LA 4923) Site in Otero County, New Mexico, contains over 21,000 rock-art designs that are mostly contemporaneous with the Jornada Mogollon (A.D. 400-1450) culture of south-central New Mexico. Six years of the Rock Art Recording Field School sponsored by the Archaeological Society of New Mexico (ASNM) have provided 100-percent documentation of the elements within the 0.56-sq-km (.22-sq-mi) site on Bureau of Land Management and State of New Mexico land.

The documentation of the Three Rivers Petroglyph site provides information to supplement both the archaeological and the rock-art contexts of this important site. Information from the site and other studies of rock-art sites in the American Southwest and Mexico suggest potential research questions for studying Jornada Mogollon rock art and culture.

This article deals with the tabulated results of the field school; more detailed discussions of the archaeological and rock-art contexts and the research questions are provided in Duran and Crotty (1994). More information on the field school can also be found in Crotty (1992).

INTRODUCTION

In 1986, Michael Mallouf, an archaeologist with the Mimbres Resource Area, Las Cruces District, Bureau of Land Management (BLM), contacted Col. James G. Bain of ASNM about the possibility of conducting a field school on lands administered by the BLM. Col. Bain was particularly interested in the Jornada Mogollon-style petroglyphs at the Jornada Rivers Petroglyph site, and he knew that the site had never been completely surveyed and recorded.

The BLM, for its part, wanted the field school to locate, record, and map the prehistoric rock art; to document existing vandalism and graffiti, as a baseline against which continuing visitor impact could be measured; and to suggest a management plan for the future protection and development of the site.

The Rock Art Recording Field School began at Three Rivers in 1987; Jay Crotty assumed responsibility for the field school after Col. Bain's death in November 1987, and continued through the summer session and a short session in the fall of 1992. The ASNM field school recorded 100 percent of the rock art on BLM land and on State of New Mexico land at the north end of the site.
In 1993 Human Systems Research, Inc. (HSR), contracted with the BLM for preparing an overview, which summarizes the six years of the Three Rivers Rock Art Recording Field School and presents a User's Guide for the documentation collected by the field school (Duran and Crotty 1994).

As part of the preparation of the overview, several rock-art specialists in the Southwest were asked to comment on an early draft of the text and to prepare a concise statement of the significance of the Three Rivers Petroglyph site. Jerry Brody, Helen Crotty, Michael Bilbo, Regan Giese, Joe Ben Sanders, Polly Schaafsma, and Kay Sutherland made contributions. Their suggestions on research topics and other subjects were excellent, and most of their comments have been incorporated into the text (Duran and Crotty 1994).

**SETTING**

The Three Rivers Petroglyph site (LA 4923) is located in Otero County, along the middle portion of the Three Rivers drainage, east of U.S. Highway 54 (Figure 1). The ridge containing the petroglyphs rises 80 m (265 ft) above the surrounding terrain. Elevation at the picnic area is 1,520 m (4,985 ft), while the highest point on the ridge is 1,600 m (5,250 ft). The petroglyphs are located on a ridge that trends northerly for about 1.6 km (1.0 mi).

The Three Rivers area is described as a warm desertic region with an average annual precipitation of 20 to 25 cm (8 to 10 in.) and average annual temperature of -15 to 16 degrees C (5 to 60 degrees F). The average frost-free season ranges from 200 to 215 days (Soil Conservation Service 1982). Snow may fall from November through March and total 7.6–12.7 cm (3–5 in.) (Houghton 1981).

Weber (1964) describes the ridge as a thin, eastward-dipping hornblende-biotite lamprophyre sill that is intrusive into the sandstones of the Mesaverde group. On the volcanic sill, the soil association is the Aztec-Rock outcrop-Lozier complex, 20 to 65 percent slopes (Derr 1981). The complex consists of deep and shallow soils and outcrops. The Aztec loam is gravelly, calcareous, and alkaline. The shallow Lozier gravelly loam is strongly calcareous and moderately alkaline.

As part of the Chihuahuan Desert, the area falls within the semidesert grassland biotic community (Brown 1982). At Three Rivers, the western exposure of the eastern edge of the Tularosa Basin allows the grassland community to continue to a higher elevation. Annual precipitation averages between 23 and 43 cm (9 and 17 in.), with the majority of the rain coming as thunderstorms between April and September.

Grama (*Bouteloua* spp.) and tobosa (*Hilaria mutica*) are the most diagnostic grasses of this community. Perennial bunch grasses have become less common with increased grazing. In areas with low precipitation, annuals are becoming more abundant. Shrubs include yucca (*Yucca elata, Y. baccata*), sotol (*Dasylirion* sp.), bear grass (*Nolina* sp.), agave (*Agave lechuguilla, A. Parryi*), littleleaf sumac (*Rhus microphylla*), and barberry (*Berberis trifoliolata*), along with creosotebush (*Larrea tridentata*), tarbush (*Flourensia cernua*), ocotillo (*Fouquieria splendens*), Mormon tea (*Ephedra trifurca*), and mesquite (*Prosopis spp.*).
Figure 1. Location of the Three Rivers Petroglyph site.
Common mammals for the Chihuahuan desert grassland are the black-tailed jackrabbit (*Lepus californicus*), kangaroo rats (*Dipodomys* spp.), badgers (*Taxidea taxus*), coyotes (*Canis latrans*), wood rats (*Neotoma albigula, N. micropus*), and mule deer (*Odocoileus hemionus crooki*). Pronghorn antelope (*Antilocarpa americana*) are common within protected U.S. Army military reservations, such as nearby White Sands Missile Range (WSMR).

**REGIONAL ARCHAEOLOGICAL AND ROCK-ART SETTINGS**

The cultural sequence and past research of the Three Rivers area provide a temporal and cultural context for the rock art at the Three Rivers Petroglyph site. The area is located within the Tularosa Basin, between the Chupadera Mesa to the northwest and the Sacramento Mountains to the east. As a result, archaeological materials in this northern portion of the Tularosa Basin reflect the interface of regional variations within the earlier Archaic culture and between the later Pueblo cultures. The culture history of south-central New Mexico is varied, because of differences in topography and environment, yet within the confines of the Tularosa Basin, the adaptation is relatively well documented. Overviews of the culture history are available (Kelley 1984; Kirkpatrick et al. 1992; Marshall 1973; Stuart and Gauthier 1981). Overviews of the rock-art chronology for the area are provided in Schaafsma (1980, 1992) and Bilbo (1984).

The Three Rivers Petroglyph site and pueblo is only listed on the New Mexico State Register of Cultural Properties. As described in the nomination, the property consists of an extensive selection of Archaic and Mogollon petroglyphs on a low hill and a pithouse and surface pueblo village (Bussey et al. 1976). No sites in the vicinity are listed on the National Register of Historic Places.

**Archaeological Research at Three Rivers**

In April 1925, C. B. Cosgrove and Harry S. Cosgrove excavated 10 rooms of an adobe pueblo, the Three Rivers Pueblo (LA 1231), located on the bench/terrace south of the Three Rivers Creek. Their handwritten notes and a typed preliminary report (Cosgrove and Cosgrove 1925), as well as a portion of the recovered artifacts, are curated at the Centennial Museum, University of Texas at El Paso. The report was subsequently published by the El Paso Archaeological Society (Cosgrove and Cosgrove 1965). This site, rerecorded by Wimberly and Rogers (1977:255), was described as nine room-block areas separated by drainages on the south side of the Three Rivers drainage. The room blocks are constructed of large river cobbles and, in some cases, adobe and probably jacal. Midden is scattered down the north-facing slope of the bench, on bench-top locations, and in the alluvial terrace facing the Three Rivers Creek.

The Cosgroves excavated in an area Wimberly and Rogers designated as Provenience 8. Of the 10 rooms excavated, two were burned. They found shallow basin hearths, subfloor storage pits, and two subfloor burials. The rooms were constructed of puddled-coursed adobe with rock elements incorporated at random. Doorways were filled with rock masonry. W. S. Stallings removed a group of tree-ring samples (Robinson et al. 1972:89) and surface ceramics and dated the site to circa A.D. 1347.
As recorded during Wimberly and Roger's later survey, the eight other proveniences on the site consist of small house blocks. Wimberly and Rogers (1977:257) note that Cosgroves' excavated provenience is located on a small flat, below a small sandstone outcrop ridge at the mouth of the lower river valley, which is the area of the latest occupation at the site. Rocks for the walls of the many rooms on the small ridge were brought from the creek bottom and were quarried from the rock immediately to the southeast of the room block.

McCluney (1961) tested four pit rooms at the Hatchet Site (LA 13495), which is located farther west along the Three Rivers drainage. He described circular, rectangular, and square rooms, probably with roof entryways. No dates or artifact descriptions have been published. Wimberly and Rogers (1977:143-145) note that Area 1 of Site LA 13495, which contained McCluney's excavations, also showed evidence that local collectors excavated additional pithouses. The site is described as a very large Mogollon village on the first alluvial terrace overlooking the Three Rivers Creek, where it enters the basin. The site extends to the north, with a lithic and ceramic concentration near the Hatchet Ranch.

In 1976, archaeologists from the Cultural Resources Management Division (CRMD) at New Mexico State University developed an interpretive area for the BLM across the county road from the Three Rivers Petroglyph Recreation Area (Bussey et al. 1976). At an existing archaeological site, called the Three Rivers site (LA 4921), Richard Kelly and Judith Southward excavated a masonry surface structure; a multiroom, semisubterranean adobe structure; a group of storage pits; and a living surface.

The masonry structure was a single, rectangular semisubterranean room with four post supports and two small, additional posts. The roof had burned. The adobe structure consisted of four rooms, three of which were excavated. The walls were built of coursed adobe over a level gypsum layer. Two of the rooms were roughly square; the third was rectangular with rounded corners. All rooms contained hearths and post holes; some had ground-stone artifacts and some, burials. Four storage pits were excavated. The structures were probably roofed when they were in use, and one contained a burial.

Using Youth Conservation Corps workers, the CRMD archaeologists stabilized the masonry structure. The workers created a pithouse with a ramp entry and a brush and mud roof and conducted additional stabilization to the terrain so that it could be used by the public.

Also in 1976, HSR conducted the Three Rivers Drainage Archaeological Survey (Wimberly and Rodgers 1977). The Three Rivers survey was a sample survey of the drainage from its origins along the flanks of the Sierra Blanca (maximum elevations of 3,660 m [12,000 ft]) to the floor of the Tularosa Basin (elevation 1,220 m [4,000 ft]) near the Malpais. The drainage encompasses 710 sq km (277 sq mi). Survey consisted of 22 quadrants measuring .8 by 1.6 km (.5 by 1 mi). Transect spacing within the quadrants was 80 to 100 m between archaeologists. For this survey, isolated occurrences could include up to 100 artifacts and features. A total of 66 archaeological sites (16 of which were originally classified as isolated occurrences) and 71 isolated occurrences were found.
In 1994, Gerow (1995) surveyed 200 ha (500 acres) around the Three Rivers Petroglyph site. She recorded 14 new archaeological sites, while rerecording 7 sites and extending the boundary of Site LA 4921 to encompass 5 previously recorded sites. The remaining sites range from Late Archaic to present, with the most intensive occupation during the Early Pueblo. The ceramics are mostly Three Rivers Red-on-terracotta, Chupadero Black-on-white, and El Paso Bichrome. Very limited quantities of Mimbres White ware were recorded.

Provenience 6 of Site LA 4921, as defined during this recent survey, is a basalt knoll directly south of the BLM Picnic Area. The rock art on the knoll was recorded by Georganne Hitzfeld (1990) to earn her rock-art recorder certification through ASNM. The data from this provenience are not included in this analysis but are on file at the BLM.

Other recent archaeological research in the vicinity of Three Rivers Petroglyph site has included surveys conducted on BLM and WSMR land, as required by the Section 106 process to assess archaeological resources prior to construction. Projects on BLM land include seismic exploration and water lines (Kalina 1984; Laumbach 1990). At the west end of the Three Rivers drainage, HSR crews have surveyed a number of installations and access roads for WSMR (Browning 1990; Shields 1991, 1992).

Rock Art Research at Three Rivers

In 1953, Herbert Yeo, an avocational archaeologist from Las Cruces, made two trips to Three Rivers and photographed petroglyphs. Yeo chalked the petroglyphs that he photographed, so the elements show up well in the black-and-white photographs. He assembled 102 photographs and a drawing into a manuscript; one copy (with negatives) is on file at the Museum of New Mexico, the other is at the Branigan Library, Las Cruces. In the limited text that accompanies the photographic collection, Yeo noted a rock wall in a saddle of the Three Rivers Petroglyph site.

Over the last several years the Three Rivers Petroglyph site has been the subject of various recording sessions. The Chavez County Archaeological Society recorded a number of elements on a field trip (Ross n.d.). In 1973, Kay Sutherland (1978) led the El Paso Archaeological Society in a partial survey of the elements. Using a grid system similar to the one later employed by Jay Crotty, they documented all the elements along the first 275 m (900 ft) of the ridge. In a footnote to the report, she noted that a second survey was made on May 24, 1975, but it is unknown whether the results of that survey were ever published. Sutherland’s (1978:5) research documented 468 petroglyphs, which she classified into 45 elements representing 7 types of anthropomorphs (8.9 percent), 114 elements representing 11 types of zoomorphs (24.1 percent), and 309 elements representing 51 types of general and abstract elements (66.8 percent).

Other rock-art sites in the Three Rivers drainage were documented during HSR’s 1976 survey. Included were one site containing rock art, four isolated occurrences of rock-art panels, and three isolated occurrences containing petroglyph elements with other site materials. Site LA 13531, on an upper tributary of the Three Rivers Creek, is an Early-Late Pueblo site that was partly leveled for the historic community of Shanta. Wimberly and Rogers (1977)
provide no description of the rock art. Site LA 13533 (HSR 502 IO 1) is four prehistoric motifs and a set of historic initials on a boulder near the base of a small canyon. This site and the next five sites are in the foothills east of the Three Rivers Petroglyph site and south of the Three Rivers Creek. Site LA 13534 (HSR 502 IO 2) is three pecked designs on a boulder on the north slope of a canyon. Site LA 13535 (HSR 502 IO 3) is a series of prehistoric and historic petroglyphs pecked onto a cliff face on the upper north slope of Hamm’s Well Canyon. Site LA 13536 (HSR 502 IO 4) is a series of petroglyphs and a masonry structure on top of a butte on the south side of Hamm’s Well Canyon. The petroglyphs are geometric and zoomorphic elements and a group of historic initials. Site LA 13537 (HSR 502 IO 5) is a snake petroglyph, lithic debris, and historic initials on a ridge. Site LA 13538 (HSR 503 IO 25) is 30–40 petroglyphs and a lithic and ceramic scatter situated on an outcrop along a low ridge. Site LA 13539 (HSR 502 IO 29) is 50–100 petroglyphs, mostly simple geometric designs, along a small ridge on the north side of a major ridge along the south-central boundary of the Three Rivers Ranch, south of the Three Rivers Petroglyph site.

RECORDING AND ANALYSIS PROCEDURES

The size, terrain, number of elements, and climate made recording the Three Rivers Petroglyph site a major challenge for the ASNM Rock Art Recording Field School. It was necessary to devise a system for mapping the location of the boulders and outcrops on which the rock art is located. The recording process was more fully described in Crotty (1992) and Duran and Crotty (1994). With BLM approval, a permanent traverse was marked along the top of the main ridge and along the top of the lower slope of the central portion of the ridge’s east side. Transects, either 10 or 20 m wide, were extended at right angles on either side of the permanent traverse. These were marked with consecutively numbered iron pins. Jay Crotty’s final map of the site indicates the locations of some of the major points with drawings of the nearest rock art.

During the field school, subsites were indicated on the ground by stretching binder twine from the designated spikes at right angles to the traverse and then either east or west to another spike set along the boundary fence. After marking the boundaries of a subsite, the field-school recording crew systematically surveyed the area, setting a pin flag at each boulder that appeared to bear petroglyphs or any other human-caused marks. Whether markings are natural or human-made was a matter of consultation for the entire crew. Doubtful marks were recorded with appropriate notation, and as might be expected, the random pecking or scratches category was usually the most numerous. Each panel was then measured, described, sketched, photographed, and recorded on the photograph data sheet. Each element was segregated and entered on the element tally sheet. From 1989, a sketch drawing of the petroglyphs or graffiti was included in the photograph data sheet for each picture.

Beginning in 1988, elements were tallied by categories on a design-element sheet designed especially for the Three Rivers Petroglyph site. The totals were then entered in order of frequency under “Inventory of Elements” on the Laboratory of Anthropology Rock Art Supplement Sheet that was completed for each subsite. Other entries include the degree of repatination, superimpositioning of...
elements, natural deterioration or vandalism, and anything else the crew found noteworthy about a particular subsite.

At the end of each season, two manila folders were prepared for each subsite. Each folder contains a Museum of New Mexico Archaeological Site Survey form, a Rock Art Supplement Sheet, an element tally sheet, a map of the subsite, a map of the grid system for the site, and a photograph log. Each folder contains a set of black-on-white photographs, and one set of folders contains negatives. A complete set of the documentation was deposited at the Archaeological Records Management System, Museum of New Mexico, Santa Fe; the other is on file at the BLM Las Cruces District office.

During the years of documenting Three Rivers petroglyphs, all the elements from 256 units of various sizes were classified by element. The first year, no attempt was made to count the elements during the fieldwork; this was conducted in 1994 by HSR archaeologist Martha Yduarte. Beginning in 1988, an element classification system was developed, which included approximately 43 categories. Each succeeding year, additional categories were added. The most comprehensive form used by the Three Rivers Rock Art Recording Field School (Figure 2, revised form dated May 1991) represents 140 categories. For this final report, it was decided to use the latest form, as much as possible. Martha reanalyzed and classified almost all of the subsites recorded prior to 1991 (prior to the final version of the form). For some of the subsites from the last two years, the field tally was used, without rechecking the classification made by the field school students.

Tallies from each subsite were entered into a spreadsheet in Lotus 1-2-3 (Macintosh version) in order to compile a complete listing of the rock-art assemblage by subsite. With elements listed across the top (in the order they appear on the design-element tally sheet) and subsites on the left, the database is six pages long and eight pages wide (Duran and Crotty 1994:Appendix A).

RESULTS OF THE ROCK ART RECORDING FIELD SCHOOL

The results of 6 years of fieldwork on 254 subsites at the Three Rivers Petroglyph site yielded two copies of the data, each consisting of five file boxes of folders with documentation and photographs. One small site southwest of the picnic area at Three Rivers was recorded by Georganne Hitzfeld in 1990; this site is not included in this tally. This comprehensive, 100-percent documentation of the rock art at the Three Rivers Petroglyph site provides a significant amount of data for distributional studies of elements, for intersite comparisons, etc. However, no comprehensive element count had been prepared for the site. A major part of the effort consisted of counting the elements from the 1987 field school (for which there were no analysis sheets) and reanalyzing the elements tallied in 1988 and 1989 (which were recorded on an earlier tally sheet with fewer categories). It was decided to focus this initial effort on assembling a total element count within the categories used to record the site. The rock-art tally provides a composite view of the elements on the site, with proportions of different types of elements. Such a characterization of the elements can be used to compare parts of this site or to compare this site to other sites in the Southwest.
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<td>Animal leg: outlined infilled</td>
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Note: Count each design or element only once.

Figure 2. Three Rivers design element tally sheet.
Definition of Element Classes

Helen Crotty developed the classification system for the elements to be culturally unspecific. For example, no attempt was made to identify a specific mammal representation as a dog or a deer, which might vary from culture to culture, and thus be difficult for students to determine. The definitions are specific enough to require minimum decision-making about which category to use. For the tally, it was decided that the treatment of a mammal representation was more important than its identification, because it might indicate styles that change through time (Crotty 1995). The categories describe rather than identify the elements (for example, a square with a dot in it would be classified as a nucleated square as opposed to a possible symbol for corn or a bead blank). The approach allows the researcher to provide possible identifications for these elements and to study their occurrence, distribution, orientation, and affiliation with other elements within the database or in the individual subsite folders.

A few new subcategories were added during the reclassification, including open form and modern scratches.

The elements, as represented on the form, are grouped into 10 main categories: simple lines, intersecting lines, closed forms, tracks, figures, plant representations, artifact representations, miscellaneous, graffiti, and random marks. With each successive rendition of the tally form, these categories had been divided into more subcategories. In particular, subcategories were added for the treatment of figures (to include stick, outline, filled in, and patterned) and the various representations of circles, to include circles with rays, circles with exterior dots, circles with nuclear dots, and solid or patterned disks and dots.

The category of simple line includes subcategories for straight, wavy, angled, parallel groups of lines, curved and rectilinear meanders, circular spiral or scroll and rectangular spiral or scroll. An example of an open element in this category is the letter C. The category of intersecting lines includes subcategories for cross, X, open grid, rake (a straight line with tines), and ladder (one pole or two poles). Closed form includes the greatest variety and saw the most change in definition during the project. Basic subcategories are square or rectangular, triangle, diamond, and circle. Within these are single elements, concentric groups, nucleated groups (with a center dot), joined elements, clusters, and chains. Single, concentric, or nucleated circles also appear with exterior dots and exterior rays. Partial disks include crescents and half moon.

The tracks category includes human, bird, bear, deer, feline animal, and canine animal. The category of human/animal forms includes humans (plus mask, hand print, arm, and leg), 4-legged animal, 4-legged reptile, animal head and leg, bird, fish, insect, snake, and other or unidentified. These subcategories were subdivided by surface treatment to include stick, outline, filled, or patterned. No attempt was made to categorize types of animals beyond these basic divisions. The next major categories are plant form and artifact form. The latter included arrow points, staffs, at least one grinding surface on a rock, and possibly an actual lithic artifact. The miscellaneous category includes continuous linear design, complex geometric design, unidentified element, and other. Names and dates, modern scratches,
and other modern marks were cataloged as graffiti. The tenth category is random pecks and scratches that were identified as possibly contemporary with the rock art.

**Element Counts**

The tally, as classified during the Rock Art Recording Field School or reclassified by HSR, yielded 21,383 elements. Averaged over the 256 subites, this yields 83 elements per subsite. Subsite 174W included 579 elements, the highest number for a single subsite. The Three Rivers Petroglyph site, as recorded, covers approximately .56 sq km (.22 sq mi), averaging 3.8 elements per 100 sq m (1,076 sq ft). The elements are totaled by subsite and by element in Duran and Crotty (1994:Appendix A). Eight subites had no rock art; and 23 subites had no manila folder and are assumed to have no rock art.

The counts are presented by category in Table 1. Closed form—including rectangular, triangular, diamond shaped, and circular—is the most common at Three Rivers, representing almost one third of the elements. And over 77 percent of these are circular, including simple circles, nucleated circles, and circles with exterior rays and exterior dots.

The next most common categories are simple lines, representing 16 percent, and figures, representing almost 15 percent. Human figures, masks, and body parts comprise almost 35 percent of this latter category, while mammals represent over 21 percent. Seventy-seven fish, which are rare in the dry Chihuahuan Desert and enigmatic at Three Rivers, were also documented, accounting for only 2 percent of the figures and less than .4 percent of the whole assemblage.

Slightly more than 5 percent of the whole assemblage is considered unidentifiable. This proportion varied by unit. For the subites that were not reclassified by HSR, it was noted that some field-school students had high counts under the unidentified category, and other students were able to identify most of the elements. Another 12.5 percent of the assemblage was classified as random prehistoric pecking, scratches, or scrapes.

About 5.6 percent is modern graffiti, including names, dates, other marks (hearts), and modern scratches.

The most frequent individual elements from the classification sheet with counts over 300 are presented in Table 2. Disregarding random pecking and unidentified elements, simple circles, other circles, nucleated circles, and bird tracks are the most common.

Representing almost 15 percent of the total assemblage, the animal elements at Three Rivers are intriguing (Table 3). For many of the animal/human categories, the classification choices were stick, outline, filled, and patterned. The patterned figures are for the most part the most notable elements that are represented in photographs of Three Rivers. Filled figures are the second most common, with almost the same number of outline elements and fewer stick elements. Some elements, such as face/mask, body parts, and snake (which was written into the tally sheet) were not provided with choices for treatment; these are represented in the not specified column of Table 3. Therefore, the unspecified category is the most frequent in the assemblage.
<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple Lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Straight</td>
<td>869</td>
<td></td>
</tr>
<tr>
<td>Curved</td>
<td>1,380</td>
<td></td>
</tr>
<tr>
<td>Angled</td>
<td>831</td>
<td></td>
</tr>
<tr>
<td>Spiral/scroll</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>245</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>3,425</td>
<td>16.0</td>
</tr>
<tr>
<td>Intersecting Lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross or X</td>
<td>326</td>
<td></td>
</tr>
<tr>
<td>Multiple</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Open Grid</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Rake</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Ladder</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>358</td>
<td>3.8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>808</td>
<td></td>
</tr>
<tr>
<td>Closed Form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangle/ square</td>
<td>474</td>
<td></td>
</tr>
<tr>
<td>Triangle</td>
<td>351</td>
<td></td>
</tr>
<tr>
<td>Diamond</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Rect. other</td>
<td>671</td>
<td></td>
</tr>
<tr>
<td>Circle</td>
<td>5,464</td>
<td>33.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>7,051</td>
<td></td>
</tr>
<tr>
<td>Tracks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human</td>
<td>315</td>
<td></td>
</tr>
<tr>
<td>Bird</td>
<td>619</td>
<td></td>
</tr>
<tr>
<td>Bear</td>
<td>214</td>
<td></td>
</tr>
<tr>
<td>Deer</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Feline</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Canine</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>1,276</td>
<td>6.0</td>
</tr>
</tbody>
</table>

* Includes unclassified elements.

** Includes 448 masks.
Other Potential Analyses

Presentation of the data by unit and element provides the potential to analyze these same data in various other ways. In the past, concentrations of particular elements have been noted for different parts of the site; such areas can be identified on the site map and the composition of the subsites can be compared. Also, questions about the distribution or proportion of particular elements across the site can be answered from the unit listing. More complex analyses can be performed by Lotus 1-2-3 on distribution, or the data can be transferred to other data-base programs.

More specialized distributional analyses, such as nearest-neighbor analysis, might provide information on clustering of specific elements. To conduct nearest-neighbor analysis, it would be necessary to use the students' measurements within the subsites (distance from the traverse line) to generate a grid coordinate. Although the total assemblage is so large as to make this task seem impossible, it would be possible to choose specific elements found in the literature, such as the trapezoidal figure (Tlaloc) or a deer.

Intrasite comparisons are possible, comparing element composition and distribution at the Three Rivers Petroglyph site with results from other sites in the Southwest where complete documentation has been conducted. Definitions of style, determinations of temporality, proposed site function (beginning with determinations of sacred versus profane), etc., in the past have relied on small numbers of elements compared from site to site. Complete documentation provides additional data for these types of determinations.

ROPOSED RESEARCH QUESTIONS

Rock-art analysis and interpretation in the Jornada Mogollon area and in the American Southwest in general are conducted at various, nested levels, each relying on the results of the previous analysis. Formal analysis of rock art at the Three Rivers Petroglyph site has been

Table 2. Three Rivers Element Categories with Counts over 300.

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Pecking</td>
<td>2,676</td>
<td>12.5</td>
</tr>
<tr>
<td>Unidentified</td>
<td>1,163</td>
<td>5.4</td>
</tr>
<tr>
<td>Simple Circle</td>
<td>1,044</td>
<td>4.9</td>
</tr>
<tr>
<td>Other Circle</td>
<td>744</td>
<td>3.5</td>
</tr>
<tr>
<td>Rectangle Other</td>
<td>671</td>
<td>3.1</td>
</tr>
<tr>
<td>Single Disk/Dot</td>
<td>641</td>
<td>3.0</td>
</tr>
<tr>
<td>Bird Track</td>
<td>619</td>
<td>2.9</td>
</tr>
<tr>
<td>Single Nucleated Circle</td>
<td>600</td>
<td>2.8</td>
</tr>
<tr>
<td>Names/Date</td>
<td>554</td>
<td>2.6</td>
</tr>
<tr>
<td>Vertical Line</td>
<td>495</td>
<td>2.3</td>
</tr>
<tr>
<td>Face/Mask</td>
<td>448</td>
<td>2.1</td>
</tr>
<tr>
<td>Arc</td>
<td>442</td>
<td>2.1</td>
</tr>
<tr>
<td>Modern Scratch</td>
<td>368</td>
<td>1.7</td>
</tr>
<tr>
<td>Intersecting Other</td>
<td>355</td>
<td>1.7</td>
</tr>
<tr>
<td>Wavy</td>
<td>328</td>
<td>1.5</td>
</tr>
<tr>
<td>Curvilinear Meander</td>
<td>320</td>
<td>1.5</td>
</tr>
<tr>
<td>Human Foot</td>
<td>315</td>
<td>1.5</td>
</tr>
<tr>
<td>Single Rectangle/Square</td>
<td>311</td>
<td>1.5</td>
</tr>
<tr>
<td>Zigzag</td>
<td>304</td>
<td>1.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>12,398</td>
<td>58.0</td>
</tr>
<tr>
<td>Assemblage Size</td>
<td>21,383</td>
<td></td>
</tr>
</tbody>
</table>

Meliha S. Duran 55
Table 3. Human/Animal Totals by Style.

<table>
<thead>
<tr>
<th>Category</th>
<th>Stick</th>
<th>Outline</th>
<th>Filled</th>
<th>Patterned</th>
<th>Not Specified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>186</td>
<td>116</td>
<td>169</td>
<td>55</td>
<td>2</td>
<td>448</td>
</tr>
<tr>
<td>Face/mask</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>448</td>
</tr>
<tr>
<td>Hand print</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>102</td>
</tr>
<tr>
<td>Leg</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>Arm</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>4-leg Mammal</td>
<td>30</td>
<td>273</td>
<td>271</td>
<td>117</td>
<td>30</td>
<td>1,123</td>
</tr>
<tr>
<td>4-leg Reptile</td>
<td>42</td>
<td>50</td>
<td>94</td>
<td>26</td>
<td>1</td>
<td>213</td>
</tr>
<tr>
<td>Animal Head</td>
<td>-</td>
<td>37</td>
<td>18</td>
<td>-</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>Animal Leg</td>
<td>10</td>
<td>6</td>
<td>13</td>
<td>-</td>
<td>3</td>
<td>32</td>
</tr>
<tr>
<td>Bird</td>
<td>61</td>
<td>183</td>
<td>219</td>
<td>35</td>
<td>-</td>
<td>498</td>
</tr>
<tr>
<td>Fish</td>
<td>-</td>
<td>29</td>
<td>26</td>
<td>20</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>Insect</td>
<td>-</td>
<td>48</td>
<td>39</td>
<td>15</td>
<td>2</td>
<td>104</td>
</tr>
<tr>
<td>Snake</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>204</td>
<td>204</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>205</td>
<td>205</td>
</tr>
<tr>
<td>Total</td>
<td>329</td>
<td>742</td>
<td>849</td>
<td>268</td>
<td>1,014</td>
<td>3,202</td>
</tr>
</tbody>
</table>

Note: - indicates that no category was provided for this treatment on the tally sheet

limited, but elements from the site figure prominently in many discussions of rock art in the Jornada Mogollon area and the Greater Southwest.

Recent rock-art studies fall into four major areas of study: dating, element identification and cluster analysis, correlation to past cultures contemporaneous with the rock art, and interpretation based on current cultures. The rock art at the Three Rivers Petroglyph site is important for answering specific research questions dealing with element analysis, dating, and interpretation.

Six possible research questions for the Three Rivers Petroglyph site were suggested (Duran and Crotty 1994), with ways to approach them using data from the ASNM Rock Art Recording Field School.

1. What is the Temporal Affiliation of the Three Rivers Petroglyph site and How Does it Fit into the Rock Art Chronology of the Jornada Mogollon Area? Schaafsma (1992) and others have developed rock-art chronologies for the Jornada Mogollon area. However, element identification and dating, archaeological element matching (rock-art designs that resemble ceramic designs) and dating, and such techniques as cation-ratio dating (Francis et al. 1993) have the potential to provide additional information on the chronology of the site and its contemporaneity with nearby archaeological sites.

2. Can the Major Rock-Art Elements at Three Rivers be Identified Within a Cultural Context? Interpretation can be
as simple as identifying animals that made footprints and can progress to interpreting the importance of different animals within the culture. Some elements found at Three Rivers have been interpreted, based on their significance in other cultures (Tlaloc or rain god [Sutherland and Parker 1991]). However, much more research is needed in this area.

3. **What Do the Three Rivers Petroglyphs Indicate About the Lifeways of the Inhabitants of the Area?** The petroglyph elements and their groupings have the potential to indicate information about the daily lives, settlement, and hunting and gathering activities of the Jornada Mogollon peoples. Further, information presented in the petroglyphs has the potential to indicate religious beliefs and the source of these beliefs.

4. **What Do Site Situation in the Landscape and the Distribution of Elements Indicate about Function?** Sites at different physical locations on the landscape may have special functions. The rock art at Three Rivers may serve religious and boundary functions, among others. Identification of functions may provide information on the culture.

5. **What Can Ethnographic Analogy Contribute to Interpretation of the Rock Art at Three Rivers?** No ethnographic groups exist to provide an explanation of the rock art, as elsewhere in the American Southwest, but similarities between puebloan groups provide information to explain some of the motifs in the assemblage (Young 1988).

6. **What Does the Historic Graffiti Indicate about Attitudes Toward the Site Through Time?** Although the prehistoric rock art is the most prevalent, initials, names, and symbols scratched next to or over the prehistoric elements encode attitudes toward the native work and, by extension, the local native groups themselves. These attitudes have changed through time, which may be indicated in the dates. The distribution of the historic materials may provide information on Euro-American and Hispanic attitudes toward the location.

**RECOMMENDATIONS FOR FURTHER WORK**

Further work at the Three Rivers Petroglyph site is recommended in the following areas: (a) complete a nomination for the Three Rivers Petroglyph site to the National Register of Historic Places; (b) use the documentation provided in the ASNM Rock Art Recording Field School files and in Herbert Yeo’s ([1953]) photographs to prepare a damage assessment since 1953 and since ASNM began recording in 1987; (c) collect and process some accelerator mass spectrometry (AMS) dates and cation-ratio (CR) samples in order to date elements at Three Rivers and to calibrate the CR dates for use elsewhere in southern New Mexico.

**National Register Nomination**

The Three Rivers Petroglyph site was included in the State Register of Cultural Properties in 1969. However, at that time the nomination was not forwarded to the Keeper of the Register for the National Park Service (NPS) in Washington, D.C. Because of its age, the nomination does not conform to current register standards. However, with completion of the documentation of the site by the ASNM Rock Art Recording Field School and the
report on the work, data, maps, photographs, and research questions are available to prepare a nomination that would meet the standards of the NPS.

**Damage Assessment**

There have been periods with no or only part-time supervision of the Three Rivers Petroglyph and Pueblo Site (including LA 4921). A full-time caretaker has lived at the site since about October 1992. The periods without supervision at the Three Rivers Petroglyph site provided an opportunity for vandalism to the site. The BLM now has an important management tool, a complete inventory of the rock-art elements dating to 1987–1992, and Herbert Yeo’s series of photographs dating to about 1953. Other researchers, such as Kay Sutherland (1978) may also have good collections of photographs from partial systematic documentation of the site. The ASNM effort is a complete inventory, which documented evidence of vandalism to the prehistoric panels. These provide a baseline for future studies of damage to the rock art at Three Rivers. Yeo’s photographs illustrate 102 elements that can be located within the ASNM grid system, with a little patience, and then field checked, if necessary. This valuable resource would indicate whether the exceptional elements that Yeo photographed still remain and the degree to which they may have been affected by weathering and graffiti in the past 40 years. Furthermore, analysis of graffiti dates on the rocks at Three Rivers (as documented by the ASNM Field School) could provide a history of vandalism and an indication of whether it is increasing or decreasing.

**Dating**

Based on stylistic consideration, Helen Crotty (personal communication 1994) has suggested that the rock art at the Three Rivers Petroglyph site represents Jornada Mogollon culture and that, potentially, a figure with an hourglass body represents the only Archaic element on the site. Polly Schaafsma (personal communication 1994) sees mostly Jornada and Mimbres elements. Dating would resolve some questions on the temporality of Three Rivers rock art. Also, if the majority of the rock art at the site stylistically represents a single temporal component, dating would provide an indication of whether the materials are contemporary with the archaeological remains that surround the Three Rivers Petroglyph site. No radiocarbon dates have been obtained from these sites, and the only tree-ring dates were taken from Cosgroves’ Three Rivers Pueblo. Peter Eidenbach (personal communication 1994) believes that the tree-ring samples were taken from a beam recovered from an unknown stratigraphic context in fill at the Three Rivers Pueblo after the Cosgroves' excavation and that surface artifacts, including Mimbres Classic Black-on-white sherds, were attributed to be contemporaneous with the wood that provided the dates. Potentially substantiating this is the fact that the sample yielded the latest date for Mimbres Classic in the Southwest. Recent rock-art dating techniques may provide additional information. Although Francis and others (1993) question the applicability of the cation-ratio dating process for rock art that is less than 1,000 years old, as techniques are improved, this situation may change. Processing of a small number of AMS and CR samples would provide ages to correlate with ceramic-dated sites in the area.
ACKNOWLEDGEMENTS

The ASNM Rock Art Recording Field School was supported by archaeologists and others at the Las Cruces District office of the BLM, who gave generously of their time. Michael Mallouf, Joe Martin, and Theresa Hanley arranged for facilities and film for the 6 years of research. In addition, moneys were provided to summarize the results of the field school, making this paper possible.

I also want to thank Martha Yduarte of HSR for her help classifying and counting the 21,000 elements from the site.

—Human Systems Research, Las Cruces

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The goal of archaeology is to try to understand earlier peoples by studying the artifacts they leave behind. But on occasion the museum curators and cultural-resource managers who store and protect these artifacts have discovered a strange, gray area that appears when the artifacts begin to take on a life of their own. Sometimes a situation will appear where the people who made the artifacts and those who excavated them become equally important. Indeed, in some cases of early, poorly provenienced work, the excavator may become more important than the original individual who made the artifact. In these cases, the researcher may find he or she is really studying the earlier members of the profession by the artifacts left behind.

Early archaeological collections are often of immense value. But they should be examined with a clear understanding of the time and situation under which they were collected (Fowler 1989). Often, these collections have been sitting, untouched, for decades while methods of data recovery and research have changed. Sometimes the personality of the original collector, the time period in which he or she worked, and the history of the collection become as much a part of the provenience of the artifacts as the feature and level of the original site. In the last few years, I have had ample time to ruminate on this as I worked on survey collections for the Laboratory of Anthropology in Santa Fe (Nusbaum 1934).

In the winter of 1991, I went to work for the Laboratory of Anthropology to continue an ongoing inventory of the H. P. Mera Survey Collection. At that time, at least four other people had worked on the inventory, as time permitted. Since the Laboratory of Anthropology is a museum, time never permitted. There was always some crisis or other taking precedent over a relatively low priority project such as a 60-year-old collection of broken pottery. It would be 2 1/2 years before that inventory was completed, and it took a lot more than one person to complete it.

I had no inkling of that when I started. I just knew that I had a large and very unusual job before me, and it looked suspiciously as though I might be required to perform magic of some sort, for the H. P. Mera room was ankle deep in unmarked boxes of sherds and ground stone and dimly lit by small bare bulbs under flaring green metal shades. The whole effect was of a derelict pool hall in an abandoned basement.

But it was a basement that smelled not only of dust but also of something more subtle. It smelled of long-past days under the sun in places where the scent of juniper and cliff rose and hot red rock mixed with
the dust of sheep, horses, and times long past. It smelled of a time when Southwestern archaeology was romantic and not very organized questions posited by a group of romantic and not very coordinated people. But what a set of people! Somewhere in that basement were artifacts gathered by all the people I had heard of since I was a kid. If perhaps I could just set the place in order, I might be able to make their work more reachable to the researchers of the 1990s.

But first, I needed to know a lot more about Dr. H. P. Mera.

**H. P. MERA**

Harry P. Mera was born in Detroit, Michigan, in 1875 (Daw 1990). After high school he got a job working as a graphic artist and illustrator in New York City. Life in the big city must not have been for him. After 2 years or so he left New York for the less frenetic West and the life of a miner in Leadville, Colorado. That year as a miner convinced him of the wisdom of following in his father's footsteps by going to medical school. Upon graduation, he set up practice in Detroit and later, in 1905, he moved to Santa Fe to work at a sanitarium, it is said. From Santa Fe, Mera moved to Kansas and practiced medicine for 20 years. In 1922, Mera "retired" to Santa Fe permanently and shortly thereafter gained the job of Public Health Officer for Santa Fe County.

On previous visits to New Mexico, Mera had developed a thriving interest in the ruins and pottery of the area. As the County Health Officer, he spent as much time perusing ruins as he spent worrying about the health of the local denizens. While wandering about looking after the public health, Mera began to conduct surveys of the prehistoric sites he found as he drove around the state. Trained in science and careful in his note taking, Mera began to develop an extensive collection of sherds and records of site locations. Over the next 8 years he became a self-taught expert on the pottery of the Rio Grande area.

In 1930 Mera left the fields of medicine and public health to become the first Curator of Archaeology at the newly founded Laboratory of Anthropology (the Lab) in Santa Fe. He brought with him a lively curiosity; a keen, well-trained mind; an ability to make very careful maps and illustrations; a background in keeping studious notes; and a propensity for organization.

He also brought with him a "dowry" of sherds collected and carefully recorded from 400 sites in Santa Fe County. By the time Mera retired a second time in 1946, he had extended that survey to include well over 2,000 sites in New Mexico, Arizona, Texas, California, Utah, Colorado, and Chihuahua, Sonora, and Central Mexico, and anywhere else he could get sherds. Today, the Mera Collection has sherds from well over 5,000 sites. Mera designed the collection as a Sherd Library made up of two sections, a reference section and a site-specific section. Now, the H. P. Mera Collection is situated in the H. P. Mera Research/Study Room at the Laboratory of Anthropology. It is also known as The Hole, The Pit, and The Sub Basement, which is better than The Dungeon, where I am working right now. These collections are site specific and are housed in compartmented drawers in 27 lockers roughly organized by region.

The compartments generally have notes on the location and the type of sherds found, written by H. P. Mera or Stanley
Stubbs. The researcher is left to decide on his or her own what constitutes which type. Over the years many of the sites from which the sherds were collected have been completely destroyed in one way or another, leaving the survey collection as all that is left of the site.

As time passed, Mera spent more time in research, leaving the work of running the survey collection to his assistant, Stanley Stubbs. Southwestern archaeology profited a great deal from Mera’s early training in medicine and his time as a public health officer. He brought a discipline and organization to the field that served as a counterpoint to some of the earlier excavators, who were eager to see what was there without carefully documenting what they went through. Mera was a participant at the first Pecos Conferences and the ceramic conferences that followed. With Colton, Cosgrove, and Gladwin, he was very influential in setting the protocol that we now take for granted. For instance, they devised the use of a place designator and then a description in naming pottery types, such as Mesa Verde Black-on-white. Many of the orderly systems for describing and recording artifacts and sites were Mera’s.

After 1942, Mera began to spend more and more time on the Native American ethnographic collections, and the push to enhance the sherd collection slowed. But the collection continued to grow. Mera himself considered the sherd library as an ongoing project to be continued as long as sites continued to be found. It is still growing today (Daw 1990).

OTHER RESEARCHERS

Besides Mera’s own collection, over the years various people gathered survey collections and submitted them to the Laboratory. For a number of reasons, some of these collections of sherds had never been placed in the survey cabinets.

It became clear at once that the main problem with my job, adding these sherds to the existing collections, would be a lack of information. Over 30, 40, or in one case 60 years, files and maps had vanished, data had been lost, and the collectors had died or forgotten where they had collected the sherds. All I had to go on was fading memories and old publications. This is the sort of thing frustrations are made of; it was also something which promised a lot of interesting if difficult research.

_Bertha Dutton and the Girl Scouts_

My first experience with these difficulties was Bertha Dutton’s Girl Scout Surveys. For a number of years, "Bert" would take groups of Girl Scouts on 1,500-mile forays, visiting sites all over the Southwest (Borher 1979). Realizing the tremendous impact these trips made on the girls, Bert did the trips TWICE a summer. The result of these raids resided in Bertha’s garage until the Lab wheedled them out of her clutches in 1988. In 1991 I found them crouching in a corner of the Mera Room in a miasma of dust, motor oil, and cat spray, hiding in a true mountain of shoe boxes (size 5½ C, Daniel Green Conmies and Hush Puppies Duchess designs). Each site had to be inventoried, put in an archival container, assigned a catalog number, and placed in a suitably accessible place.

Finding where Bertha picked this stuff up often involved chasing her across the map through articles she had written for *El Palacio* or from notes in professional journals. Bertha’s own reply to inquires was
"Good God! that was 50 years ago! How should I know where I was!"

In the boxes notes consisted of cryptic designations such as
Tent Rocks on the Frito
Half mile north of Mother's Pueblo
Provenience lost due to cats
Up the old road from Zuni
Where we had lunch

Strangely enough, over the course of several years, most of these sites have been located. All that is except the one whose location the cats destroyed.

**Stuart Baldwin**

After wrestling Bertha's sherds into something resembling order, the next group seemed to be pretty easy. They were pretty much in order. And, surprise, there were site reports and notes as well. This was Stuart Baldwin's collection of the Central New Mexico Survey from around Abo and Carrizozo. However, the sherd collection and notes had been in a hotel attic in Mountainair since the early 1980s. Though very dusty and full of bat guano, this collection reflected the type of careful recording researchers working today hope to find in old collections. It took a lot of rebagging and matching of records and sites, as the collection was very large, but the sherds were processed with very little difficulty (Accession Records, Lab of Anthropology).

**Reginald Fisher**

I wish I could have said the same about the next batch. In an assortment of very nondescript boxes, I found a collection of very oddly designated sherds with no clear references or notes at all. There was only a Q number and notes about Santa Fe and Albuquerque quadrants. After several months of poking here and there, I realized that these probably were the very early and long-lost surveys of Reginald Fisher. Fisher, a newly graduated researcher from the University of New Mexico, conducted a very serious survey in the late 1920s. But everyone I talked to was sure that these collections had been destroyed or lost years ago. And everyone was pretty sure that any notes that went with them had vanished in the 1940s. Several months later, while looking for something completely different, I found Fisher's notes in another part of the Laboratory building where someone had stashed them long ago.

An instructor under Edgar Hewett, Fisher wanted to do a really professional survey of sites in the Southwest. After all, he was an archaeologist and not a public health doctor. Mera had been taking in sherds and giving the sites consecutive numbers, no matter where they were. Fisher was determined to be more methodical. He divided the Southwest into designated regions or quadrants. These quadrants were divided into standard squares. Fisher began an ordered square-by-square survey of sites in New Mexico, starting with the squares near Albuquerque and proceeding outward, one square at a time, including the Rio Abajo area (Marshall and Walt 1984). Alas, while Fisher did OK for 2 or 3 years, he then reached the Chaco Canyon area. (At that time Hewett was beginning long-term excavations in the Chaco area.) Site reports came thundering in by the basket full. Chaco and the Four Corners area seemed to be vast and endless morasses of sites. There were far too many to be handled systematically in 1933 (Fisher 1931). Even now with computers and aerial surveys we are just beginning to get a handle on the areas. Fisher suddenly lost all interest in
systematic surveys and decided that if he wanted to preserve his sanity it would be wiser to direct a fine-arts museum. At least fine arts contained a handleable amount of data. His notes landed in a closet where, 60 years later, they surfaced in a storeroom at the Lab. How they got there is anyone's guess.

I am still trying to identify Fisher's sites when I can. Perhaps I will someday find a key to his codes and be able to reconcile his work with the current state numbering system.

**Wesley Bradfield**

The next group of boxes I hauled out of storage came from Wesley Bradfield, another of Hewett’s assistants. Bradfield was one of those early geniuses you read about in monographs who suddenly vanishes, seldom to be mentioned again. He was one of the very first researchers in the Mimbres area and, while we had some sherds of the Cosgroves’, another pair of early Mimbres researchers, Bradfield was a special case.

Bradfield was one of the very first to look at pottery technology. Back in the 1920s he made a type collection from his sites using type names and type descriptions, based on the technology and materials used to make the pottery. Remember, this was before all the conferences were set up to establish a structured system for naming pottery types. For me to break his code took some stepping back and reconsidering. Most archaeologists have looked at the Mogollon culture since A. V. Kidder wrote about it. Bradfield started his work before Kidder and was principally interested in the techniques and materials that went into the pottery. Kidder concentrated more on surface treatment and design, while Bradfield held surface treatment as secondary to construction technique. To see where he was coming from required letting go of the designations we have become so familiar with and looking at the pottery from a totally different perspective. Not a bad thing to do, sometimes. Interestingly enough, many of the noted were written on the back of concert cards. It seems that, in the late 1920s, the New Mexico Archaeological Society used to sponsor Sunday afternoon concerts. Bradfield, who had a very fine singing voice, seems to have kept the extra programs for scratch paper (Figure 1; Hewett 1928; Johnson 1930).

From 1928 on, there was also some correspondence between Bradfield and Anna O. Shepard. Bradfield sent sherds to Shepard, who was in California, for clay and temper analysis. Who knows what would have happened in the field of Mogollon pottery had Bradfield not died the next year at the age of 53. Instead, Kidder worked for a short time in the Mogollon area and declared it to be "peripheral." Very little work was done in the area after that until the 1970s. By that time, the major sites in the area had been so pot-hunted that we will probably never get a full picture of what was going on.

**Anna O. Shepard**

Anna O. Shepard was around the Lab until 1937 or so, then she moved to Boulder to continue her research with grants from the Carnegie Foundation. (By the way, the Lab has her clay and temper samples as well as Helene Warren’s in lockers in the Mera Room.) Anna became an institution in Boulder where her work got a lot more respect (Chauvanet 1983; Thompson 1991). Sadly enough, it was not until the 1970s that researchers began to realize how...
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Anger Dance
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Reel
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concert.

Figure 1. Wesley Bradfield's notes on back of New Mexico Archaeological Society concert
program (on file, Laboratory of Anthropology, Museum of New Mexico, Santa Fe).
important Shepard’s contributions really were to the study of pottery. The bits of correspondence and reports I have found reveal a woman far sharper than many of the more-noted researchers around her (Cordell 1991).

**Helen Blumenschein**

After dealing with Bradfield’s brief flash of brilliance, I found myself rummaging around in the darkest storage areas. And very dark they were, too. The first boxes I found were Helen Blumenschein’s survey from the Taos area.

While there were notes, the references were all related to landmarks only Helen knew. I was able to place a few sites on the maps, and then I drew a blank. It took me 2 more years to find the maps that might tell me where the rest of the sites were. Helen’s sherds are at the Laboratory of Anthropology; her maps are at the Kit Carson Foundation; and it seems her notes are at Ft. Burgwin Research Center. Alas, this is not an unusual situation. Helen, it is said, put a different site number wherever she felt like it. But her surveys are some of the few in the Taos area, so if we can just correlate her codes with something on the ground, the collections could be quite valuable.

**Edward T. Hall**

After I got Helen Blumenschein’s sherds in order (which I could do even if I could not find the sites on a map), I found that the next group was the very well ordered survey work of Edward T. Hall (plus some of his excavation material). Hall had worked in the Governador region from 1938 to 1941. The first place it seemed wise to look was in H. P. Mera’s log, to see if any of these sites had been recorded. I found at once that, in the middle to late 1930s, Hall had done a large number of surveys for the Lab, mostly on the Hopi and Navajo Reservations. These of course were already in the survey collection. I also noticed an interesting notational difference. Until Hall began research for his doctorate, the sites were referenced N. Hall (that is, Ned Hall). When Hall began his doctoral, studies Mera began to note the sites as located by E. T. Hall. In Mera’s eyes, when he started working for his Ph.D., he became a grown-up. Hall did his research in 1939 and 1940, resulting in the publication *Early Stockaded Settlements in the Governador, New Mexico* (Hall 1944). Then, of course, World War II suddenly became a far more important issue for the whole world and no one worried about archaeology for several years. By the time Dr. Hall returned to civilian life, he was ready to continue his career elsewhere. I found his sherds still in the old papers describing the battle of Midway and other actions in the South Pacific.

Mera had recorded the Governador sites that he and Ed Hall had surveyed in 1938 (Mera 1931–1947), but only a few were credited to Hall after that. As the Lab had quite a lot of artifacts from Hall’s sites, it was assumed that the more of these sites we could pinpoint, the better it would be for the collections. I called Dr. Hall, and because he lives not too far from the Lab, he was very happy to come over and look at what notes I had. As it turned out, Dr. Hall had nearly forgotten he ever did the survey. He thought that all his work had been thrown out in the 1960s. The Archaeological Records Management System of the New Mexico Historic Preservation Division has Hall’s site maps, but the survey maps went to Columbia University with him.
With World War II, those maps became lost in the myths of academic storage. I contacted Columbia University, where communications broke down. The Department of Anthropology said that the maps, if they still existed, were probably in the archives in the library. The library said "no, those things are kept by the Department. They have probably put them in the attic and are using them for insulation." (This is no joke.) The anthropology person I next reached said "Who? Us? Where? We've never heard of Hall or the Gobern... whatever." Shortly after delivering this paper¹, I found that these maps were probably in the hands of someone in Albuquerque. I owe a very deep "Thank You" to Frank Eddy. In October someone wandered into where I was working and said "Dody, you'd better look at this." While cleaning a top shelf and rearranging things, the person had found a box. By Golly! it contained a bunch of Edward Hall’s notes on his 1941 survey and excavations! I may get the whole thing together yet.

Van Valkenburg

However, let us return to our narrative. Having done the best I could with Hall's very extensive surveys in the Gobernador, I set them aside to cook and began work on several very impressive boxes labeled VAN VAUKENBURG.

I had a hunch that these were sites found in New Mexico during the Navajo Land Claim Surveys. As it turned out, I was right, except that the sites were also from Arizona, Colorado, and Utah. The Land Claim Surveys papers are in Window Rock, but we had enough information in the Museum of New Mexico's own archives to try to work out a key to the codes. Also we had copies of Van Valkenburg's site maps. Unfortunately, the site maps are not very fine tuned.

Over the next few months I became very well acquainted, if in absentia, with a number of people who had worked in this very large survey area. In the course of the work other sites had been found that were not important to the legal case, and these collections had somehow found their way into the Laboratory’s storage facilities. They sat causing me a great deal more trouble than I had first believed. They were so organized with such an elaborate code. But did all the sites fit?!

Finally, I found someone who had worked on the project who was still living and could remember what had gone on. "Oh Yes!" he exclaimed, "The code wasn’t working the way we thought it should. So we changed it! Oh! I guess we all knew we changed it, so we didn’t write it down anywhere. After all, WE all knew." This is how some of these myths about wild men in the field get started.

Herbert Yeo

And while we are on the subject of colorful personalities, let us not forget Herbert Yeo. So many of Yeo’s collections were already in the Mera Survey drawers that I could hardly believe it when we found more boxes of sherds that had never been touched. Before I arrived, Meliha Duran and Betty Ayer, working on a grant from the Historic Preservation Division, inventoried the records and photographs of the indefatigable Herbert Yeo (Duran and Ayer 1994). Yeo was another of those schizophrenic New Mexico civil servants who really wanted to be an archaeologist. An engineer (privately and for the state and federal governments), Yeo worked in New
Mexico all his life. I still wonder when he had time to do any engineering! It seems that his every waking hour was spent wandering around the Southwest, meticulously recording sites and picking up surface collections, which he dutifully sent to Mera, who graciously took them, also meticulously recorded them, and put them into the sherd collection. Except, of course, for the ones that got dumped in boxes to be recorded later, where they still sit today, waiting for me.

Bill Sundt

In 1992 the Laboratory of Anthropology was given William Sundt’s collection of survey sherds. Bill Sundt had always wanted to be an archaeologist but, trained as an engineer, he was an avocational rather than as a professional archaeologist. As an engineer, he had been trained in very conscientious recording, and as an amateur of the highest order he had the training and time to be sure his recording and research were done properly (Sundt 1990).

There are times when someone who is not a working professional but who loves a subject can produce incredible work. For Bill Sundt, archaeology was a labor of love, and his sherd collection was a reflection of that love. All the information was not only written but in computer files. All the sherds were carefully sorted into individual cubicals. Sundt’s collection looked like a mini-Mera collection done by a very dedicated man with modern equipment and time to do the job as he felt it should be done (Sundt 1987).

Alas, need I say that Bill Sundt’s collection was so well done that I never got to do more than pet it before someone else took it to be recorded and entered into the collections, while I set myself to face THE MYSTERY LOCKER.

The Mystery Locker

By the summer of 1993, with the help of volunteers and a group of part-time laborers, inventory of the original 51 lockers was finished and added to the computer records. We had a record of artifacts from 5,288 sites. While this was going on, I began tackling a locker no one had wanted to even look into. I knew the job was made for me, because it consisted of drawers and drawers of shoe boxes.

Accustomed as I was to shoe boxes, Bertha Dutton’s in particular, and realizing that flamboyance was an integral part of the early Southwestern archaeologists’ tool kit, I set to work with a sense of glee to find what the mystery locker held. I must admit I took Bertha’s name in vain several times while trying to make heads or tails of her notations (such as they were). The notes were few and cryptic and there was almost nothing I could cross-reference with the State of New Mexico system. The site designations seemed to be in the OLD Museum of New Mexico code; however, I have never found a complete listing of this code. To make matters worse, I found that the code, as it was written on the sherds and notes, was not consistent. The designator for state sites in the New Mexico code is B. But here P or J were also used. In the case of several boxes, the P designation had been later altered to produce a B. I got a real jolt when I found a sherd with the notation "K C 1920." In 1920, the Laboratory of Anthropology had not been started, and Bertha Dutton was still in Nebraska (Stocking 1982). So who had put this collection together?
I began taking out the collection box by box and putting all of the sherds on the layout tables in order to study them closely. Almost all of these sherds were from the Jemez area or from the Pajarito Plateau. One group with a very early numbering system was from Tecolote Ruin near Las Vegas, New Mexico. I knew Marge Lambert had worked on Tecolote in 1932. But who had worked on the Pajarito Plateau that early? Edgar Hewett? If so, then the K. C. would have to be Kenneth Chapman, who worked as Hewett’s assistant before their parting of ways over the founding of the Laboratory. And in the Jemez that early? The dates and names began to fall into place. Could these be sherds from the early Museum of New Mexico field schools? Sure enough, I began to find initials and other indications that suggested that is what they were.

If so, then what was the possibility that these were some of Edgar Hewett’s type specimens and sherds selected from the first field schools in New Mexico? There were a few notes and comments, but enough to suggest that the odd site designators were from the period when the Museum of New Mexico’s codes were just being set up and were not firmly fixed (Chauvanet 1983; Mathien 1990). Could it be that the changes were due to the researchers setting up their codes after the fact and then going back to reidentify sherds gathered earlier?

If these were Hewett’s sherd collections, the notations and initials make a lot of sense. Marge Lambert had dug Tecolote as a student of Hewett’s, and the field schools were all done by Hewett protégés. AND ALL OF THOSE SHERDS WERE IN SHOE BOXES! Whoa, Bertha! Is this where you learned to store sherds that way? It was Edgar Hewett I had to thank for all those nightmares about shoe boxes I have had over the last few years!

But then there was one last bag of artifacts that did not fit even with Hewett’s collections—at least not at first. These sherds were with a separate bag in a large group of other sherds that seem to have been excavated very early at Puye. As early as 1907? I could not be sure, but maybe. These sherds were tentatively labeled "San Francisco River, near Glenwood?" Someone—Stuart Peckham, I believe—had written underneath in big letters "NOT LIKELY."

On inspection, they seemed to be Mesa Verde sherds. This was further corroborated when I found a note on yellow paper saying "M.V. kiva ’B’" So what were Mesa Verde sherds doing in Edgar Hewett’s Pajarito Plateau collection from 1907?

As I sat there, staring at them, I could not help remembering the wonderful story Sylvanus Morley tells:

Tenderer tenderfeet never followed Horace Greeley’s advice. We met Dr. Hewett after a sixty-mile wagon ride from Mancos, Colorado, at "Moki Jim" Holly’s ranch in McElmo Canyon close to the Utah line....The next morning Dr. Hewett—and what a foot-traveller he was in those days—tramped us miles down the blazing hot canyon. We panted after him up the mesa at the McElmo’s Junction with the Yellow Jacket. From its towering prow we could see Mesa Verde and Ute Peak in Colorado; the Abajos and distant Henry Mountains in Utah; the tall, red buttes of Monument Valley and the blue line of the Lukachukais in Arizona. None of
us had ever viewed so much of the world all at one time, or so wild and barren and broken country as lay about us.

Dr. Hewett waved an arm. "I want you boys," he said, "to make an archaeological survey of this region. I'll be back in six weeks. You'd better get some horses." We thought, looking it over, that maybe we had. [Kidder 1950:95–96]

Were these sherds the ones picked up by Morley and Kidder on that eventful trip to the Mesa Verde area in 1907? I can think of no way to find out. Perhaps it is unimportant. What seemed most important to me, sitting in that basement room, was that I was surrounded by a big chunk of the history of Southwestern archaeology. The artifacts in that room had truly acquired a life of their own. Not only are they reflections of their makers, the Southwest Indians, but also of their excavators. In some cases, they are infused with more importance by who picked them up than by who used them.

**FINAL THOUGHTS**

Sometimes it seems that the personalities of those early researchers had as much to do with how these artifacts were collected, organized, and studied as the provenance in the original site records. This is as legitimate a part of their value as any other.

By the time I had reached the Yeo collections, I had become as interested in the people who had made these surveys as I was in the artifacts, themselves: Bradfield, who had such promise and died just as he hit his stride. Van Valkenberg, who changed his codes in mid stream and forgot to mention this in his notes. Ed Hall's lost maps. Bertha's Girl Scouts and their 1000-mile perambulations. Helen Blumenschein, rich and famous, an artist and art patron, with her well-intended surveys, enthusiastically begun but scattered. Stu Baldwin, who got irritated one day and left his artifacts and notes to molder in an attic. Reginald Fisher, who began with such assurance and bravado only to find himself over his head in sites too numerous to count. And then there was Mera himself. An illustrator and medical doctor who, in his methodical fashion, helped craft many of the conventions for nomenclature and seriation that researchers use today. And the stories and ideas that resulted when all of these people and many more interacted with each other through the history of New Mexico archaeology. Each had his or her personal agenda. Each of these extreme individualists in some way had an impact on the approaches and interpretations that make up the way we view the prehistory of the Southwest.

We have many Mesa Verde sherds. How many do we have that might have launched two distinguished careers in Archaeology? We have a pretty good selection of Mimbres sherds, but how many in an envelope sent by Wesley Bradfield to Anna Shepard? Most of these people have passed and are as lost to us as the Anasazi and the Mogollon. We cannot bring them back for further inquiries. The people who collected those sherds were an independent, flamboyant group of individuals with separate and often conflicting agendas. It would be wise to remember this when studying their collections.

I end this paper on a note of caution. Remember that, when studying early excavation material, you are dealing not only

Dody M. Fugate
with site provenance but the information that was being filtered through the screen of some very powerful personalities who had their own ideas of what truth was at that time. And they placed their persona on the collections as well. On the other hand, while cursing the lack of information on the area you are looking for and snarling about the lack of organization, remember that what you do know comes from what they were trying to find out then. Cut these people some slack, will you; if they had not done what they did back then, you probably would not have a job today.

—Museum of New Mexico, Santa Fe

ENDNOTE

1. This paper was first presented at the Pecos Conference, 1994.

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Although many archaeologists are aware that the prehistoric inhabitants of the southwestern U.S. mined numerous turquoise sources to obtain raw material (e.g., Weigand and Harbottle 1993; Weigand et al. 1977; Windes 1992), few are knowledgeable about the evidence of use for some of the less-publicized mining districts. One of the areas is the Orogrande Mining District of southern New Mexico, where Helene Warren examined the geology and mineral resources available to prehistoric inhabitants during a 1985 survey in the Tularosa Basin (Warren 1988). Shortly thereafter, Geyer (1986) discussed evidence for prehistoric mining and trading of turquoise from the Jarilla Mountains. In the meantime, Warren and I returned to the area for a three-day reconnaissance (Figure 1). The goal of this report is to consolidate information on the Orogrande District and to report the results of that reconnaissance.

Located in the western half of Otero County, the Jarilla Mountains are described by Hidden (1893, 1893-1894) and Kelley (1949) as being a low range that extends for about 16 km (10 mi) in length and 5-8 km (3-5 mi) in width. The geology of the area has been described, documenting the presence of several minerals (Graton 1910; Schmidt and Craddock 1964). In addition to turquoise, deposits of copper, gold, iron, and garnet have been mined (Graton 1910; Heylmun 1985; Kelley 1949; Schmidt and Craddock 1964).

Turquoise is found in two basins in the southern part of the Jarilla Mountains (Sterrett 1914:699-702; Figure 2). The first basin is located about 4 km (2 mi) northwest of Orogrande in the smaller of two nearby basins; the second is located about 6.4 km (4 mi) northwest of Orogrande and about 2.4-3.2 km (1.5-2 mi) north of Brice, a town that grew as mining increased. In both basins, the deposits of turquoise are found mainly around the edges, near the foot of the steeper slopes. This report is concerned mainly with the southernmost of these two basins where there is evidence of prehistoric mining, but other mining data will be reviewed to place the prehistoric mining within a broader perspective.

**PREHISTORIC TURQUOISE MINES**

Today, evidence for prehistoric mining in the Jarilla Mountains is limited. A century ago prehistoric turquoise mining was evident in at least 10 locations; all were shallow mines that stopped whenever hard rock was encountered (Hidden 1893). In these areas, the turquoise occurred in nearly vertical thin seams, cracks, and crevices. Few other details about the mines themselves were provided at the time.
Figure 1. A. Helene Warren standing in Area C of the Jarilla Mountains, Orogrande Mining District, 1985.

Based on inferences from archaeological data collected in the area, there is some indication of who used the mines. Schmidt and Craddock (1964:5) indicate that a prehistoric village dating circa A.D. 1200 is located to the south, at the north end of Rattlesnake Hill. More recent surveys document a cluster of sites at Rattlesnake Hill, which date to the El Paso phase (A.D. 1200-1400; Way 1979). Although there is evidence of sites within the larger Tularosa Basin that range in time from the Paleoindian through the El Paso phase of the Jornada Mogollon, Carmichael (1983:163-164) proposes that the greatest use of the Jarilla Mountains as a mining area may have occurred during the Doña Ana phase, which he dates circa A.D. 1150-1250. Carmichael’s examination of the southern Tularosa Basin suggests that cluster patterning in this area was all but gone by the El Paso phase, possibly because of a shift in settlements toward the middle of the basin during the later period. Because of decreased rainfall during the El Paso phase, Carmichael suggests that the Jarilla Mountains were not occupied primarily for agricultural purposes, but for mining of local resources, such as turquoise, malachite, azurite, hematite, and kaolin.

When Carmichael (1983:164) wrote his dissertation, data were not available to tie the local archaeological sites to the mining district, but he considered the possibility worth investigating. Geyer (1986) echoes his sentiments; she lists a number of proposed trade routes and possible cache areas that need to be checked. She indicates that, in 1984, Michael Foster and Rhona Bradley...
Figure 2. Map locating the Orogrande Mining District.
were using X-ray fluorescence to study turquoise from La Cabrana (a site near El Paso). Only more detailed analyses of turquoise artifacts and source samples, however, can confirm trade relations among various groups within the larger area. Weigand and Harbottle (1993) are working on this problem using neutron activation; several samples from Orogrande are included in their studies. One concern with trace-element studies is sampling; because of the variability in trace-element contents of turquoise, veins worked prehistorically may not be identical to what remains of them today, especially in an area where considerable historic mining has altered the landscape. For this reason, a review of historic use of the area is included here. Also, different techniques may be needed to correct this problem; a new approach using lead-isotope decay rates (Young et al. 1994) may solve this problem.

**HISTORIC MINING**

Lasky and Wootton (1933) indicate that prospecting in the Jarilla Mountains occurred in 1879, but extensive operations did not begin until the late 1890s. Jones (1904) attributes the first historic prospecting to S. M. Perkins in 1879. Further, he attributes the prominance of this district to discoveries by Amos J. De Mueles, who mined considerable amounts of turquoise during the late 1890s. One turquoise mine shaft was already 21 m (70 ft) deep when Hidden (1893) visited the area in 1892.

By 1892 a permanent mining camp (the Shoo-ar-mé Mine) had been established (Hidden 1893:401); this is probably the result of the 1880s work referenced by Graton (1910). A 21-m (70-ft) deep shaft had been sunk, and turquoise was present throughout. Over 50 kg of marketable turquoise was shipped during the first six months of operations, and only one of ten prehistoric mines was developed during this period. Turquoise was found in semiglobular or reniform masses and nodules. The predominant color of the turquoise from this area was blue, but shades of green were found; the deep blue colors faded when exposed to air. "Where the rock is purest there the turquoise is found of best color, normal hardness and greatest durability" (Hidden 1893:402).

Other minerals were found in great quantities. Some ore was probably shipped by wagon to El Paso from small copper and gold mines, but no major development occurred until the railroad reached the area in 1898. A branch into the mining town of Brice was constructed a few years later. Several authors have summarized the history of mining in the Jarilla Mountains (e.g., Graton 1910:184–187; Heylmun 1985: Kelley 1949; Lasky and Wootton 1933; Pogue 1974:58; Schmidt and Craddock 1964; Sterrett 1914; Warren 1988). Schmidt and Craddock (1964:43–47) provide locations for some of the prominent copper, gold, iron, lead, and silver mines; maps in Kelley (1949:Figures 37 and 38) indicate the locations of the iron mines.

Sterrett (1914:699–702) reports on several turquoise mines. In the northern and larger basin surveyed during this project, two mining claims for turquoise were worked. These are the De Meules groups, which consisted of two sets of claims, both near the western part of the basin. The first, located on the north side of a draw, consists of a cut that is 12–15 m (40–50 ft) across and 6 m (20 ft) deep. Although it had been filled by the time of Sterrett's visit, some small branching tunnels run northeast into
irregular rooms and small stopes. About 160 m (175 yds) to the south of these and across the draw are about a dozen irregular cuts, pits, and shallow shafts. One is up to 12 m (40 ft) deep. In both areas of the De Meules claim, the turquoise appears in joints, small fissures, and fracture zones in the form of veinlets, with a tendency toward nodular development in some instances. Colors range from pale to dark blue, blue-green, and green, and the quality of the stones is good (Sterrett 1914:700-701). De Meules obtained considerable amounts of good turquoise between 1896-1898; after his murder, the claims were leased to Cy Ryan and Tom Kelly, who also obtained a large amount of good turquoise.

Approximately .5 km southeast of the De Meules claim is the Laura claim, made by F. B. Stuart, where two sets of workings are evident. It produced good-quality turquoise. One set of workings is on the gently sloping ground at the foot of a hill, with another one about 180 m (200 yds) northwest in the hillside (three shallow shafts 4.6-6.1 m [15-20 ft] deep). Veinlets and nodular masses are dense, hard, and of a fairly pure blue (Sterrett 1914:701). To the north are some pits and a tunnel that show pale-blue and bluish-green turquoise in the dumps. Here turquoise occurs in seams, veinlets, and nodules.

About 1.0 km (.6 mi) southeast of the De Meules mine (on the south side of the same basin) are the workings of Allen Culver, who also mined copper. A 30-m (100-ft) deep shaft, a 18-m (60-ft) tunnel, and several open cuts are present; scattered small pieces of turquoise occur in the tailings. Specimens of light blue and greenish blue indicate that the turquoise forms in seams and veinlets with some nodular development (Sterrett 1914:701-702).

The claims in the southern basin, west of Brice, are known as the Tiffany (Alabama claims) and the Luna, Moreno, and Ascarate claims. The Alabama claims consist of two sets of workings on the southeast side of the basin. The one located on the steep hillside south of the draw consists of five small, open cuts and pits, plus a shaft sunk 30 m (100 ft) deep. Sterrett (1914:702) reports that prehistoric workings were mostly obliterated by modern excavations; numerous veinlets of turquoise had been followed in open cuts. In the second area, about 230 m (250 yds) south-southwest of a low-walled hollow, are three groups of workings about 91 m (100 yds) apart. An open cut 18 km (60 ft) long to the northwest was about 6 m (20 ft) deep; fine dark-blue turquoise was obtained from several crosscutting trenches and pits. Two other small cuts and a shaft were found about 90 m (100 yds) to the southeast on the hillside; only inferior turquoise was documented by Sterrett (1914:702). About 90 m (100 yds) northwest of the main cut were two other shafts in which turquoise was plentiful. Nodules and veinlets were present; a soft pale-blue semiturquoise was present in the dumps.

The Luna, Moreno, and Ascarate claims are about 137 m (150 yds) north of the Alabama claims and across the draw, where pits and open cuts in the hillside cover an area of about 23 by 38 m (75 by 125 ft) in a northwesterly direction (Sterrett 1914:702-703).

Schmidt and Craddock (1964:1, 43) document other recovered minerals, including copper, gold, lead, and silver mined around 1900 and iron mining about 1913. Two towns, Brice and Ohaysi, each with a
population of several hundred miners, grew up. A railroad spur connected the Brice mining area with the main line located to the east around 1900. Southwest Smelting and Refining Company established a copper smelter at Orogrande in 1907, but the reduction facility was dismantled in 1909. Consolidated Kansas City Smelting and Refining Company of El Paso processed most of the copper production. Other nonferrous mines include the Nannie Baird, Lucky, Garnet, Three Bears, and the I mines. The most productive mining period for base metals, gold, and silver was between 1912–1918 (Kelley 1949:181).

Iron is the major mineral extracted in later years. Ohaysi was established by the Oro Iron Company in 1913, and the railroad spur was extended from Brice to the Cinco de Mayo mine. By 1921, major mining operations ceased. "Except for brief periods of placer operation, mining activity ceased about 1930" (Schmidt and Craddock 1964:1). These brief activities included Anaconda Copper Company's extraction of copper in the mid-1940s (at Three Bears) and Colorado Dry Screen Mining Company's (Little Joe and Cottontop claims) extraction of gold.

Heylmun (1985) indicates that there were no major mining operations from 1921 until recently, but most of the old mines are still patented. Rock hounds still visit the area in search of turquoise, garnet, and fine orthoclase crystals, as well as ore minerals. Currently the State of New Mexico Abandoned Mine Land Bureau is examining the area and preparing a plan for backfilling some of the deeper pits and shafts, where appropriate (Homer Milford, personal communication 1994).

THE 1985 RECONNAISSANCE

The reconnaissance in October 1985 was preliminary; our goal was to explore the mining area and collect turquoise samples for future studies. Our survey was limited to the area described as the southern location for turquoise mines—the basin west of Brice. Several historic mines were located in this area (R.E.C., Adah Lee, Alabama, Copper King No. 2, Monogram, Mid Day, and Macon [Kelley 1949:Figure 37]). Several turquoise mining areas were located. The following describes our observations during the three-day visit.

Two hills were investigated; these have several pits, cuts, pieces of turquoise, and some evidence of prehistoric mining, labeled Areas A–F and H. Area G is located north of these hills.

Area A: On the northern slopes of the tallest hill at about 1,417 m (4,650 ft) is evidence of modern mining. Turquoise is seen in the tailings, and four small samples were collected.

Area B: Located directly south (uphill) of Area A at about 1,463 m (4,800 ft) is a recent claim stake. No turquoise was seen.

Area C: Located due north near the bottom of the hill are several large pits that are probably recent. Brown glass is scattered on the ground. There are four larger and three to four smaller pits toward the bottom of the hill near the wash. Two smaller pits on the upslope or southern part of this group are possibly prehistoric. The first is about 31 m (102 ft) long by 9–11 m (30–35 ft) wide (east-west) and is V-shaped. The second is about 61 m (200 ft) long in a north-south direction. One battered piece of monzonite located nearby may have served
as a mining tool. Other tools noted to the southeast included an oval-shaped piece of granular monzonite with two crude grooves (crevices) probably used for mounting the piece to a shaft in order to use it as a hammer. Both ends were battered (Figure 3). Another battered piece was seen. Over 30 samples of turquoise were collected.

**Area D:** Just east of Area A and about halfway downslope to the saddle between this hill and a lower one to the northeast is an old road cut that comes uphill from the wash on the north. Just above the road (about 1,378 m [4,520 ft] elevation) are one large pit, one small pit, and several tested areas. Historic artifacts in this area include Anheuser-Busch beer cans, a tin can, and broken glass. Six samples of turquoise were collected.

**Area E:** Located east of Area A and just east of the road that crosses the saddle between the two hills is a deep modern pit. There are a number of smaller pits to the east and north, plus a shallow trench going north-south on the hillside about 8 m (25 ft) below the large pit and above the lowest part of the shoulder of the saddle. Tailings go downslope (northward) toward a large pit on the ridge just above the valley bottom.

Prehistoric artifacts were more numerous here than in other areas (Figure 4). A number of flakes and tools in the tailings indicate early use of this area. Over 30 turquoise samples were collected.

**Area F:** Just below this saddle on the northern side of these two hills are the remains of an old house (a fireplace and footings for the west wall); broken glass and tin cans to the west across a small arroyo probably represent the dump. Just northwest of the arroyo and house is a T-shaped pit extending about 30 m (100 ft) north-south. There are numerous tin cans on the north side.

About 15 m (50 ft) upslope and to the east is a much smaller pit (about 2.4 by 3.0 m [8 by 10 ft]). A few stone tools were present (Figure 5). No turquoise was seen or collected.

**Area H:** This modern mine, located on the northwest side of the smaller hill at (about 1,417 m [4,650 ft] elevation). It extends over 100 m up the slope of the hill. A deep pit at the northern end still has wooden beams in the shaft. Below this is a large pile of tailings. A small amount of turquoise was present. In a smaller pit located to the south there was no evidence of turquoise.

West of these two pits were two other small pits that were probably mined during the historic period. No turquoise was collected.

**Area G:** The only other area examined during the reconnaissance was not on the hills. Area G is located north of the easternmost of these two hills near the cemetery. A miner’s cairn and historic artifacts were present. Over 40 small samples of turquoise were collected.

In summary, three prehistoric mining areas could be identified (Areas C, E, and F) in a reconnaissance of eight mining areas. Only a few tools remained, but their presence insures that our samples were approximately from the locations mined prior to Euro-American incursions. Whether the turquoise samples collected are representative of the turquoise mined prehistorically remains to be demonstrated.
Figure 3. Monzonite hammer found in Area C, Jarilla Mountains.

Figure 4. Possible prehistoric tools found in Area E, Jarilla Mountains.
ANALYSIS OF SPECIMENS

To date, the analysis of specimens is limited to a description of the samples (Table 1). Each was measured, and color was coded using a Munsell color chart. The matrix, thickness of vein material, etc., were described. Overall, the specimens match the descriptions found in Sterrett (1914:701-702)—a light-blue and greenish-blue colored turquoise occurring in seams and veinlets with some nodular development.

Sigleo (1970:33–34) included the Orogrande District in her study of turquoise composition. She used arc-emission spectrometry to record 11 elements. Unlike other materials collected for her study (25 total), specimens from Orogrande contained no lead (Pb), zinc (Zn), or manganese (Mn); there were only undetermined amounts of barium (Ba), cobalt (Co), and iron (Fe) and a trace of vanadium (V) (Sigleo 1970:Table 5). Weigand (Weigand and Harbottle 1993:162; Weigand et al. 1977) also collected specimens from Orogrande for neutron-activation analysis. To date, no detailed reports of their results that include the characteristics of the Orogrande District have been published.

In 1993 our samples were sent to Suzanne Young of the Archaeometric Laboratory of the Peabody Museum of Harvard University, to be included in a lead-isotope decay study undertaken to characterize the differences among turquoise mining districts. Although the Orogrande samples were not part of the initial run, results of a pilot project (Young et al. 1994) indicate that there are differences in the amount of lead in turquoise samples from
<table>
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<tr>
<th>Area</th>
<th>Material</th>
<th>Spec. No.</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Thick (cm)</th>
<th>Color</th>
<th>Comments (measurements in cm)</th>
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<td>1</td>
<td>1.57</td>
<td>.88</td>
<td>.44</td>
<td>5 BG 8/4</td>
<td>Golden brown matrix</td>
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<td>1.32</td>
<td>.72</td>
<td>.35</td>
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<td>.53</td>
<td>.62</td>
<td>5 BG 7/8</td>
<td>Golden brown matrix, whiter on other side</td>
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<td>4</td>
<td>1.03</td>
<td>.59</td>
<td>.36</td>
<td>5 BG 7/8</td>
<td>Piece not as veinlike; more reniform looking</td>
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<td>4.10</td>
<td>3.15</td>
<td>.91</td>
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<td>Mostly matrix with fine vein of turquoise ca. .20 thick</td>
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<tr>
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<td>2.85</td>
<td>2.00</td>
<td>1.05</td>
<td>5 BG 8/4</td>
<td>Mostly matrix with fine vein of turquoise, ca. .12 thick</td>
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<td>2.11</td>
<td>1.68</td>
<td>1.11</td>
<td>2.5 BG 8/4</td>
<td>Mostly matrix. Color lighter near one end where material more intermixed with matrix.</td>
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<td>White matrix. Vein is ca. .49 thick</td>
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<td>Color varies from light to dark. Lightest was recorded; all are greens</td>
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<td>.79</td>
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<td>Thin vein (.16) in matrix</td>
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<td>Mostly vein</td>
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<td>Several small pieces similar in color</td>
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<td>Varies from 7.5 to 10 BG</td>
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<td>3.75</td>
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<td>10 BG 7/8</td>
<td>Color deepens in spots; mostly matrix</td>
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<td>.78</td>
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mines in the southwestern U.S. and one source from Chihuahua, Mexico. In addition, there are differences in lead isotopes ($^{206}$Pb/$^{207}$Pb) from the Cerrillos Mining District and five other mining districts in the American Southwest. The samples from the Orogrande Mining District will be evaluated during future research using this new technique. If distinctions among mining districts in the Southwest can be made, then it will be appropriate to compare artifacts from the El Paso phase Jornada Mogollon sites against the baseline data on source material to determine whether or not Carmichael’s (1983) and Geyer’s (1986) hypotheses about the prehistoric use of this mining district are correct.

—National Park Service, Albuquerque

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Geyer, Barbara

Graton, L. C.

Heylmun, Edgar B.

Hidden, W. E.


1894

Jones, Fayette A.

Kelley, V. C.

Lasky, Samuel G., and Thomas Peltier Wootton


Young, Suzanne M. M., David A. Phillips, Jr., and Frances Joan Mathien
A preliminary pattern-recognition study to identify contextual use of pictographs and petroglyphs from the Bandelier National Monument Inventory Survey provides heuristic information about cavate motif organization. A maximum-likelihood factor analysis delineates three patterns, while a chi-square test confirms a fourth, which was suggested by the factor analysis. This preliminary study is a first step toward constructing mid-range theory to explain the appearance of pictographs and petroglyphs in archaeological contexts. These preliminary patterns, defined beyond the intuitive level, present a methodology for studying rock-art distribution through time and across a small section of the Pajarito Plateau region of New Mexico.

INTRODUCTION

As scholarly interest in rock art increases along with sophisticated technology to analyze data, regional studies of pictographs and petroglyphs are able to move away from subjective assumptions concerning stylistic classifications and meanings to problems of dating (Bard et al. 1978; Clottes et al. 1992; Dorn and Whitley 1983; Francis et al. 1993) or to problems of causality using various computerized analyses (Magne and Classen 1991). Within the last 20 years, cation-ratio dating of rock art begins to provide outside documentation of rock-art classifications in the Cosco Range in California (Dorn and Whitley 1983) and in Wyoming (Francis et al. 1993), as well as other parts of the world (Dorn 1992; Watchman 1992). Laser technology (Watchman and Lessard 1992) may provide a direct dating technique in the near future. Magne and Classen (1991) use a principle-component analysis to study relationships of similar morphologies contained in anthropomorphic figures in petroglyphs within a region of Alberta, Canada. Their analysis showed that intuitive assumptions about relationships between form and cultural affinity may not be substantiated statistically.

Ever since Leroi-Gourhan (1969) statistically demonstrated clear separation of subjects by location in Paleolithic caves of France and Spain, questions about relationships between perceived patterns and how they articulate with cultural systems have intrigued scholars. In North American archaeology, Steward (1929) suggested intentional distribution of certain petroglyph motifs in the Great Basin, based on site function and structure. Heizer and Baumhoff (1962), Thomas (1975), and Nissen (1982) continued to investigate functional relationships between hunting sites and petroglyph motifs. Ethnographic information taken from many parts of the world (e.g., Binford 1991; Forde 1949; Lewis-Williams 1986; Mallory 1972; Menninger 1958) demonstrates use of graphic images for all types of mnemonic
purposes, from herders keeping track of goats in a flock while tending several flocks in the Swiss alps to shamans recording out-of-body experiences in South Africa, as well as many other types of experience.

It is in the same spirit of exploration of the relationships between archaeological sites and pictographs and petroglyphs that this study is directed. The goal of this paper is to present a viable method using one archaeological feature to test the variability of motif distribution for connecting human use of graphic images in a social context with archaeological data. The connection demonstrates the existence of a graphic communication system used by the Anasazi of the Pajarito Plateau. This exploratory effort specifically tests relationships between one site-type and the petroglyphs and pictographs found there to learn whether relationships are statistically supportable and, therefore, predictable. If choice and intentionality are culturally bounded, then pictographs and petroglyphs left by prehistoric people may show patterns of use distributed across space. Earlier studies of rock art associated with archaeological sites in Hovenweep National Monument (Olsen 1985) and an ethnographic study of motif repertoires at Hopi and Zuni as they relate to patterns of use and mnemonic function indicate that such patterns exist (Olsen 1989). Trask and Bawden (1993:2) find concentrations of petroglyphs and pictographs clustered at certain geographical locations in the Jemez Mountains in ancestral Tano lands. In Bandelier National Monument, redundant appearance of motifs with several types of archaeological sites further suggest intentional patterning. Rohn and others (1989:40) find clear differentiation of motif clusters in sections of the Long House site in Frijoles Canyon. Rather than plotting the distribution of certain motifs on a topographic map, this study uses one site type, a cultural feature of the Pajarito Plateau classified as a cavate (Haury 1988:43; Hewett 1909:438), which will be held constant in order to observe statistically how the motifs found in association with the architectural component vary.

**PROJECT PARAMETERS**

Bandelier National Monument occupies a southeastern portion of the Pajarito Plateau in New Mexico. It is bounded on the north by State Highway 4 to Los Alamos and the Valle Grande in the Jemez Mountains. On the east it is bounded by the Rio Grande River; on the west by the National Forest of the Jemez Mountains; and on the south by the Cañada de Cochiti land grant (Figure 1). East-west trending volcanic tuff mesas are separated by deeply cut drainages that contain water in the higher elevations, but only in Frijoles and Capulin Canyons do streams flow year round into the Rio Grande. The Anasazi, ancestors of the present Pueblo Indians of New Mexico, constructed pueblos on the mesa tops between A.D. 1150–1325 (Carlson and Kohler 1990:10; Orcutt 1991:321), carved rooms into the volcanic tuff along the tops of talus slopes between A.D. 1325–1450 (Steen 1977:14; Van Zandt 1993:22), and built pueblo communities against the cliffs and in canyon bottoms between A.D. 1375–1550 (Carlson and Kohler 1990:24–25; Hewett 1938:85).

The database for the Bandelier Rock Art Documentation study comes from two sources. First, the National Park Service (NPS) archaeological inventory survey of monument lands from 1987–1991 (Powers and Kohler 1993) identified and recorded all archaeological sites with a stratified random
Figure 1. Bandelier National Monument in the Pajarito Plateau, New Mexico.
sampling strategy covering 43 percent of the monument acreage. Second, other volunteers and I returned to the sites later and recorded all of the images pecked, incised, or painted there, including modern graffiti. The benefit of this strategy is that the presence of petroglyphs and pictographs did not influence the identification or classification of the site types, nor did the site classification influence the decision to record the rock art. In this manner, the pictographs and petroglyphs in the Bandelier survey project were systematically recorded, resulting in a database that contains a random sampling of rock art from 43 percent of the Monument lands and qualifies the collection for statistical analysis. This nonbias frees the research design from questions of correctness or completeness in favor of questions about motif variability and opens up the investigation to studies of relationships within cavate contexts.

The NPS survey identified a total of 1,959 sites (Powers and Kohler 1993:8); 103 of those sites or just over 5 percent contained any type of rock art. Thirty-three of the rock-art sites, or less than 2 percent, are located in the Tsankawi section north of the main monument area; 19 sites or 1 percent containing pictographs and petroglyphs were counted in Frijoles Canyon, where the main visitor center is located. The remaining 51 sites and isolated occurrences or 2.6 percent are distributed in Bandelier back country, south of Frijoles Canyon.

THE STUDY

Tewa-speaking members of San Ildefonso, Santa Clara, and Tesuque Pueblos, Keres-speaking members of Cochiti and Santo Domingo Pueblos, and Towa-speaking members of Jemez Pueblo view the area of the Pajarito Plateau as ancestral land; Hewett (1938:48, 99), reported that specific oral tradition in each Pueblo tied families to prehistoric ruins in or near the area that Bandelier National Monument now embraces.

Additionally, according to Adolph Bandelier in 1880, Cochiti men herded horses and other livestock and hunted deer and wild turkey in the canyons of what is now Monument land (Lange and Riley 1966:221). The ruins of T'shirige, Tsankawi, Otowi, and Puye Pueblo north of Frijoles Canyon, as well as many smaller ones, are tied by oral tradition to San Ildefonso and Santa Clara Pueblos (Hewett 1938:46–49). Abundant evidence indicates that the landscape has been continually used since these occupation sites were abandoned in favor of the present locations affiliated with these groups.

This study recognizes that, by collecting all examples of pictographs and petroglyphs within the survey sampling area, the completed database of 842 or more motif observations in the field represents a cumulative total of prehistoric and historic Tewa, Keres, and Towa motifs. Further, many of the motifs and panels of motifs are difficult to distinguish by chronological periods except relatively by patina on the same panel. Historic images are counted as those that contain obvious references to Western European culture, such as horses, men on horses, men in jodhpurs, Roman crosses, and the Roman alphabet. Since 1916, when the land was set aside as a National Monument, outsiders have visited and added occasional inscriptions and graffiti. Now at best, the images overlap historically and ethnically. If this study is to be functional, a statistical method is needed that will sort out differences between
random additions and patterned choices made by original primary occupants of the settlement sites.

Although pictographs and petroglyphs appear in association with eight types of archaeological sites designated by the NPS survey, this preliminary study focuses on the architectural cavate feature for practical and statistical reasons. Images that appear inside cavates preclude earlier production, since the room has to be carved out of the tuff before the petroglyphs can be cut or painted onto the interior walls. Chronologies for most of the cavates is now better established (Van Zandt 1993:10). By combining these two concepts, there are logical steps that can be taken to place more of the rock-art motifs within certain general time frames. Statistically, the cavate context provides a single-factor focus for the interpretation of the factor analysis that was chosen for this study. Petroglyphs that are cut into the tuff directly outside the cavate opening (within 3 m) cannot preclude earlier fabrication than the cavate, but close association with the opening does increase the probability that their origin relates to the use of the cavate.

All cavate interior walls were originally dressed with clay plaster extending from the floor to about 2.5 m in height. Above the plaster, the upper wall and ceiling were smoke blackened. Images that appear to be part of the original context are painted with black or red paint in the plastered wall section. Chapman (1938:141) and Bandelier (Lange and Riley 1966:228) observe that the images cut through either the plaster or the smoke blackening are probably post-occupation creations. Outside the cavates, viga holes above and below the opening attest to a probable floor or roof addition, sometimes for three stories. The petroglyphs that were cut into the tuff between and above the final row of viga holes further indicate fabrication during occupancy, since the wooden beams that fit into the holes were the only support for the image makers. Now the beams, floors, and walls are gone, making it difficult or impossible to add images to the cliff face. With these criteria, four types of motifs painted into the wall plaster can be counted as most probably prehistoric images: triangles, stepped motifs, plain bands with a squared macaw-like shape (motifs observed on potentially concurrent pottery wares (Glaze II/B, III/C, and IV/D [Kidder 1936:84, 129, 185]; also compare Snow [1982:253–254] with Van Zandt [1993:22]), and positive white left-hand prints. Likewise, pecked/incised motifs occurring under smoke blackening, such as the horned-serpent and spotted-animal profiles, can be added to the potentially prehistoric category. Outside of cavates, motifs occurring above viga holes—such as heads, snakes, birds, ungulates, and nested-circle motifs—can be considered probable prehistoric petroglyphs.

The lesson to be learned from Adolph Bandelier, Kenneth Chapman, and the current archaeological-inventory survey is that all assumptions about styles and style chronologies for the images must be set aside in favor of unbiased sorting and testing.

THE PROBLEM

The hypothesis to be tested states that if the presence of petroglyphs and pictographs are intentional and the placement is the result of the limiting semantic context of the archaeological feature in which they are found, then pecked and painted images will
be nonrandom. A homogeneous distribution would be random.

Cavate components range from a single room (e.g., the site in Sanchez Canyon), to a set of constructed rooms in talus pueblos (e.g., Group F, Group G, Group J, Group K, Group L, Group M, Bat Breeze House, and Talus House in Frijoles Canyon), to kiva-cavates in two communal pueblos (e.g., Long House in Frijoles Canyon and LA 50976 on the southeast side of Tsankawi Mesa). All cavate sites in the 43-percent sample survey containing petroglyphs and pictographs were used, yielding a sample of 31 sites. Each cavate or tiered cavate section with images incised or painted inside and out (within 3 m of the opening) were counted and are treated as one observable unit to allow all observations equal chance for representation in the statistical analysis. The NPS classification of cavate and the criteria for the designation cavate is based on the observation of human construction of a complete room or partial modifications of naturally occurring rock shelter. Additional features of a cavate include a fire pit, a smoke hole, carved niches of varying sizes, storage cists, viga/loom holes, and bedrock cavities in some floors. Large rock shelters such as the Painted Cave (LA 13662) in Capulin Canyon or a natural amphitheater (LA 70834) above Medio Canyon were deemed inappropriate to the cavate category, since the modifications there are primarily graphic additions rather than modifications made for permanent occupation.

The first condition for the images, then, is that they accompany occupation features. Occupation classifications are further divided into housing and kiva-cavates, suggesting continuous versus seasonal cycles of living. Van Zandt (1993:8) finds certain cavates reused for secondary occupation, transient occupation, or ephemeral occupation. Those images that are cut through the plaster and smoke-blackening probably result from one of the later types of occupation.

Observations of motifs and panels of all motifs together, including fragmented ones, were recorded with scale drawings and black-and-white and color photography. Some infrared pictures were taken, as well. A second condition for the images is that, in primary occupation locations, the images ought to be covered by smoke-blackened layers or ought to be above viga holes that are now out of reach from further additions.

Classification of the motifs in this study adopts a range of similarity as the criteria for sorting images into groups. Rather than using style classifications, which essentialize one shape to stand for many, or adopting an ideal shape, a composite of all like shapes (Hempel 1965:160). The best representation of the empirical data is the extreme classification, where two opposites contain a continuum of changes from one to the other (Hempel 1965:157).

Bandelier Monument's images were first sorted by identical morphology in a visual, side-by-side comparison. With this comparison, 170 initial groups of elements included several one-of-a-kind images, and were collapsed into an Other category. For the remaining motifs, redundant appearance of motifs allowed general grouping into 11 categories: single and multiple-nested circles and spirals (CC); snakes on vertical to horizontal presentation (S); left hands and right hands (HA); heads and heads attached to shoulders (HS); birds exhibiting different shaped tail feathers and beak configurations (B); anthropomorphic whole figures showing
all gestures by arms and legs (A); plant-like shapes (PL) having one vertical stem with attachments along it; footprints of birds, humans, and animals (PR); ungulates designated by various sets of horn/antler configuration (U); other animal shapes with short ears and tails of varying length (OZ); and straight-line abstract/geometric (often pottery-like) motifs (GEO) (Figure 2). Where shapes might be considered ambiguous, ethnographic sources from Eastern and Western Pueblos were consulted for guidance.

Original meanings are gone forever; some Pueblo people acknowledge that even they do not know what meaning was originally intended. Further, images take on different meanings cross-culturally within Pueblo cultures, so that even if one Pueblo group knew meanings for certain motifs, those meanings cannot be carried across linguistic and ethnic boundaries to be used in another Pueblo setting (Olsen 1989:421). For this study, the meanings of the motifs were not sought; rather this study tests the presence of semanticity by examining correlation variations in the motif repertories bounded by the pragmatic limits of meaning associated with cavates during the primary occupation period. Although secondary, since temporary and ephemeral occupations of cavates identified by the NPS survey could be the product of descendants of the primary occupants, these pictographic and petroglyphic elements ought to contribute random "noise," because the same systematic use of locations would no longer pertain.

The total motif frequency distribution by percent of the morphological groupings for the 12 categories of motifs is illustrated in Figure 3 for the 31 sites. The numbers are presented in Table 1. The differences, by percent, of category distribution and of interior and exterior cavate contexts are shown in Figures 4 and 5. Given location, category, and complexity of the sites, it is intuitively apparent that motif categories vary by their placement.

Since the potential exists for motifs to intermix as a result of separate occupation phases in the same context, a multivariate data analysis method is appropriate to aid in delineating patterns not easily observed. Several types of multivariate statistics are available for complex data sets (Hodson 1969; Hodson et al. 1966; Kim and Mueller 1978; Neff 1992). In the Bandelier Monument data, 12 groups of variables are observed in 88 cavate rooms. Since factor analysis determines variance and covariance along linear paths stemming from one underlying factor source or constant, the cavate context is considered in this study as the constant or source of variability, allowing the unique and common variation to be separated and scrutinized. In the factor analysis statistic, standardized regression coefficients produce factor loadings in a ranked order, showing ranked strengths of a commonly shared underlying factor. This is referred to as the communality of the variables, since none of the variables has complete correlation, but each variable always contains some portion that remains unique. At the outset of this study, relationships of the motifs to each other and to the archaeological feature were not clearly defined. By mathematically comparing the strengths of the correlations of the 12 variables simultaneously, the factor analysis compresses the data set dimensions, allowing potentially inherent relationships to emerge. If the underlying causal factor is a given, such as a cavate, then correlation paths showing different clusters of categories indicate potential separation based on changes in the context.
Figure 2. Motif categories.
SAS/STAT version 6.03 factor-analysis programs used for this study are further divided into principle-component analysis, principle-factor analysis, and maximum-likelihood factor analysis. The SAS maximum likelihood (ML) analysis was selected for this study for several reasons. ML does not require a multivariate normal distribution (SAS/STAT 1990:778–779); for this preliminary study, motif category frequencies for cavate contexts do not have completely normal distributions, although they do in the whole data set. Second, as an exploratory technique, ML tests each step to ensure that all of the statistical requirements are met. Third, ML "finds the most likely population values that would have produced the given correlation matrix under the hypothesis that one common factor model fits the data perfectly in the population and the joint distribution is multivariate normal" (Kim and Mueller 1978:53).

The first step in the program plots a partial correlation matrix, then ranks amounts of communality in a set of preliminary eigenvalues, which separate amounts of uniqueness from communality variance in the correlation matrix. The eigenvalues showing amounts of shared variance are illustrated in descending order in Figure 6. The 12 rows of values refer to the amount of communality found by comparing variances in the correlation matrix. The first row (1) contains the greatest amount of common variance, the second row (2) shows additional communality that is different from the first, the third (3) another small amount of common variance, and so forth. The first row is thought to explain the greatest amount of variation.

Next the ML tests for adequacy of category samples and for N number of factors. Since one of the purposes of the
Figure 4. Interior/exterior motif frequency distribution by category.
Figure 5. Interior/exterior motif category distribution by cavates.
factor analysis is to find the smallest number of underlying factors that are responsible for the commonly shared variance, the SAS ML program was run with N as 2, 3, and 4. An in-program chi-square test of adequacy of the factors to represent all variance determined that three factors was the smallest number that could be used and still retain the maximum amount of explanatory power.

Positive nonzero loadings indicate the thread of communality shared by each variable in the factor vector (Tables 2–3). The negative loadings indicate negative correlation, with the high positive numbers indicating, for example, that where ungulates (the highest value in Factor 1) occur, geometrics and concentric circles/spirals probably will not be found. Factor 2 shows greater variance than the first but is defined in terms of Factor 1. Factor 3 contains even wider amounts of bipolarity and is defined in terms of the other two factors. One might think of Factors 2 and 3 as dependent subsets of Factor 1, where Factors 2 and 3 are defining some particular aspects of Factor 1.

The second step in the ML program rotates the axis of a Cartesian graph to gain the "compressed pattern" of the variables. Since the proposition for this exploratory test expects correlation, the oblique rotation by Promax is used to produce the final correlations seen in the next three illustrations. In Figure 7, Factor 1 plotted against Factor 2, shows distinct separation of two categories I (Ungulates) on the vertical axis and E (Birds) on the horizontal axis,
Table 1. Distribution and Frequency of Motif Categories by Site.

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with less distinct groupings of Other Zoomorphs, Hands, Snakes, and Anthropomorphic features stretched between horizontal and vertical axes in the upper right quadrant. Factor 1 plotted against Factor 3 in Figure 8 shows an even more defined separation, situated on the two axes, but variables B (Snakes), J (Other Zoomorphs), and C (Hands) are clustered around the vertical axis, while F (Anthropomorphic) is closer to the horizontal axis. Factor 2 compared with Factor 3 finds E (Birds), D (Heads & Heads and Shoulders) and L (Other) loosely grouped around the
Figure 7. Factor 1 graphed with Factor 2.

Figure 8. Factor 1 graphed with Factor 3.
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<tr>
<td>Birds</td>
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<td>Snakes</td>
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<tr>
<td>Gran/Storage</td>
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<tr>
<td>Concentric Circles</td>
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<tr>
<td>Anthropomorphs</td>
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<td>Other Zoomorphs</td>
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<tr>
<td>Head/Shoulders</td>
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Table 3. Factor Structure (Correlations).

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<th>Category</th>
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<th>Factor 3</th>
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<tr>
<td>Ungulates</td>
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<td>Other Zoomorphs</td>
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<td>.18429</td>
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<td>Hands</td>
<td>.45949</td>
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<td>Snake</td>
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<td>.28218</td>
<td>.08561</td>
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<td>Birds</td>
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<td>.83392</td>
<td>-.02149</td>
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<td>Anthropomorph</td>
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<td>.09026</td>
<td>.26535</td>
<td>.09212</td>
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<tr>
<td>Concentrics/Sirals</td>
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<td>.10240</td>
<td>-.02520</td>
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<td>Geometries</td>
<td>-.02583</td>
<td>-.07572</td>
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<tr>
<td>Plant-like</td>
<td>.17359</td>
<td>.09846</td>
<td>.99632</td>
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</table>

Variance explained by each factor ignoring other factors

<table>
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<th></th>
<th>Factor 1</th>
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<th>Factor 3</th>
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<tr>
<td>Weighted</td>
<td>1.383953</td>
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</tr>
<tr>
<td>Unweighted</td>
<td>1.837112</td>
<td>1.704401</td>
<td>1.242502</td>
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</table>

vertical axis and G (Plant-like shapes) lies directly on the horizontal axis. Interestingly, large cavates in Frijoles Canyon and Tsankawi Mesa. Where Ungulates appear, Snakes, Hand prints and Other animals can also be expected to appear. Birds outside cavates appear only a fraction more often in Frijoles Canyon than on Tsankawi Mesa and A (Concentric circles and spirals), K (Geometries), and C (Hands) remain close to 0 in all three rotations, signifying no correlation. What does all this mean for Bandelier Monument petroglyphs and pictographs relative to the cavate context and what does all this mean for the study of rock art in general?

**INTERPRETATIONS**

The multivariate maximum likelihood analysis provides a means for observing differences and strengths of communality in terms of frequency distribution, where a change in X produces a change in Y. Within a general cavate context, there are subsets of cavate function: occupation for daily use (e.g., food processing and consumption, sleeping, and storage), and kiva-cavate use by (probably) initiated adults for ceremonial purposes seasonally and/or cyclically. Where motifs in both sets are potentially products of a primary occupation phase, ungulates and birds appear outside cavates in opposition to uncorrelated geometric shapes painted into kiva-cavate plasters. If both sets of images are roughly contemporaneous,
then the two cavate contexts may be hypothesized as separate causal agents and semantic boundaries delineating two different uses of cavates.

In Figure 9 the Ungulate variable on the vertical axis opposes the Bird variable on the horizontal axis, indicating another potential separation. Ungulates do not frequently occur with cavates, but when they do occur, they are consistently seen directly above and outside the opening of are frequently accompanied by Bird foot prints, other Zo\-morphic shapes, and Anthropomorphic figures. Both Ungulates and Birds consistently appear above viga holes of cavates in Frijoles Canyon where, in most cases, deteriorated walls and removed beams make it unlikely that these motifs were added after occupation. Hence these two motifs qualify for a potential prehistoric fabrication and semantic use. Although Birds and Ungulates are observed on the same panels, the ML differentiation of the two motifs suggests that each is correlated differently, inferring different semantic functions, possibly slightly different ethnic uses, for example. The third factor G, Plant-like shapes, is the most ambiguous and may require further classification refinement in order to become less ambiguous. However, plant shapes are found nearly exclusively in the Tsankawi area and are always seen on the interior of cavate contexts.

Several points about the subsets of the general cavate context are apparent. First, contextually, Factors 1 and 2 represent motif categories consistently found on the exterior of cavate openings and are thus available for viewing by the general community, while the Plant-like shapes, on the interior of cavates large enough to be
classified as kiva-cavates, infer restricted viewing by initiated members of a sodality (Table 1). Secondly, chronologically, the images that are most certainly prehistoric, belonging to the final occupation phase (at least), are not well represented in this test—they hovered around 0, indicating lack of correlation. The distance between the correlated motifs and uncorrelated motifs may indicate social distance produced by motifs used publicly as opposed to those used in private social circumstances. Differences between the painted interior motifs and exterior motifs may be differences separating daily use and lineage occupying cavates from sodality use, where initiation is required for entrance.

The distribution of all motif categories by canyon and mesa are shown in Figure 10, which indicates that the majority of ungulates above cavates are found on Tsankawi Mesa, but birds are ubiquitous. However, separation of birds by subcategories of shape may reveal more differences in the future. Plants, on the other hand, are found nearly exclusively on Tsankawi Mesa and on the interiors of kiva-cavates there.

Conversely, many heads or heads and shoulders bearing headdresses, full anthropomorphic figures, animals with tails, and some snakes are often pecked through plaster or cut through smoke-blackening, indicating that they are products of a later time period. Variables F (Anthropomorphic figures), L (Other, which includes graffiti and one-of-a-kind elements), and D (Heads and heads on shoulders) may be separated from the others by a time factor. The third point here is that the emphasis indicated by the factor correlations on spatial separation of motifs (inside-outside, Tsankawi Mesa and Frijoles Canyon) suggested a chi-square test of homogeneity to learn whether the differences between interior and exterior motif placement might occur more often than random chance would allow. The testable hypothesis (H₀) states that interior/exterior motif populations will be distributed homogeneously or randomly; this is what the statistics need to prove.

Category frequencies for all cavate interior and exterior locations were summed and entered into the SAS chi-square procedure. With 11 degrees of freedom and alpha value set at the .05 (or 95 percent) confidence level, the chi-square statistic is 98.829. Since the critical value for 11 degrees of freedom at .05 confidence level is 19.675, the hypothesis is rejected. However, although a clear separation of interior-exterior motif categories is confirmed, individual categories responded to the chi-square test heterogeneously. The rejection is driven by the several other categories: Concentric circles/spirals, Snakes, Birds, Anthropomorphic figures, Geometric motifs, and Other. Individually these categories rejected the null hypothesis strongly, while the other categories could not reject it. What does all this mean for the archaeological information derived from these tests?

CONCLUSIONS

By selecting one site context and observing the patterns of variance within it, the exploratory maximum-likelihood factor analysis designated, beyond the intuitive level, that there are potentially strong, consistent correlations for a small number of variable categories of rock art within cavate sites. Four separate variations of motif groupings are indicated by functional differences in possible social contexts. First, kiva-cavate contexts are differentiated by
maximum-likelihood factor analysis to have *Ungulates* and *Bird* categories from those containing painted geometric motifs. Second, social division by ethnicity is suggested by separating *Ungulates* and *Plant-like shapes* (Tewa-speaking locations) from *Birds* (Keres-speaking locations) in Frijoles Canyon and farther south. Third, interior or private space is separated from exterior (publicly available) space. Fourth, some chronological separation of motif categories is possible in the cavate context using Chapman’s (1938) and Bandelier’s (Lange and Riley 1966) observations. Taking all those conditions together, a repertory of probable prehistoric motifs can be logically constructed for cavate contexts. *Ungulates*, *Other animals*, *Birds*, *Hands*, *Snakes*, *Plant-like shapes*, *Geometric motifs*, and *Human heads and heads on shoulders* are the most likely a repertory grouping for prehistoric/final occupancy periods. Full *Anthropomorphic* figures may belong to a later, post-occupancy period, and the *Other* category represents the one-of-a-kind assortment of motifs expressing the random visits by descendants and outsiders. Motif categories appear to convey more complex relationships than imagined (Table 1).

A tentative explanation of the appearance of the petroglyphs and pictographs in cavate contexts may be approached in the following manner. Ethnographic information is available in Bahti (1968), Binford (1991), Bunzel (1929), Colton (1949), Colton and Colton (1931), Cushing (1920), Fewkes (1892, 1897, 1906), Forde (1949), Hill (1982), Lange (1959), Levi-Strauss (1955, 1963), Lewis-Williams (1983, 1986), Mallory (1972), Menninger (1958), Munn (1973), Ortiz (1969), Parsons (1939), Smith (1991), Stephan (1936), Stevenson (1905), Titiev (1937, 1944) and Vinnicombe (1986). This information collectively demonstrates that humans use certain images consistently to define social boundaries and subsistence information, to code religious symbolism, and to communicate political status and clan history. In the American Southwest, these ethnographies document the boundary conditions whereby motifs are distributed across space by social contexts on trails, at shrines, and in kivas to acknowledge participation in ritual activities (e.g., clan symbols) or to designate changes of farm field boundaries. Other motifs belong to shrines and sacred springs where they are visited by priests of a society or by individuals in regular seasonal cycles. Abstracted (or shorthand) graphic symbols are used by people universally as mnemonic cues to summon up information banded in the cultural memory of one social group (also Bahti 1968; Ellis 1975; Mallory 1972).

Baddeley’s (1982:20) clinical studies into the operations of the human mind emphasize the importance of visual and audio cues to assist the long-term memory, particularly in societies where important cultural information is not written. Images, sounds, and action are used by humans to recall information relevant to a context at later points in time, cyclically, sporadically, or as forms of notation for recording counts. Binford (1991) finds these combinations of recall important for teaching/learning—important cues to assist one generation in passing on important survival-cultural information to the next generation.

If boundary conditions of ethnographic circumstances demonstrate that pictograph and petroglyph repertories are limited by pragmatic and semantic conditions and are explained by laws of mnemonic operation, then the ungulates, birds, and plant-like forms delineated by the results of the ML
test are affected by differences of cavate function and/or location.

However, predictions that ungulates will be located exclusively above cavate openings where a potential lineage resided does not take into consideration the whole picture. For example, looking at larger samples of Bandelier data, ungulates are observed in other contexts near cavates in plaza-like areas. On a larger scale, expectations and predictions will have to be modified to include other site types where context semantics and pragmatics create other boundary conditions. This study has shown some contextual differences in ranges of motifs that suggest two types of kiva-cavates, some separation by linguistic difference, some separation by temporal difference, and clear separation spatially of interior from exterior.

Petroglyphs and pictographs found in Bandelier National Monument contain some consistent motif category variation. Although there is not enough information available yet to definitively support the presence of an incipient nonalphabetic graphic communication system at Bandelier National Monument, initial differentiations through multivariate analysis direct research toward a potentially complex motif organization based on site function during the primary occupation period of the Bandelier area. This study is preliminary to investigating the four delineated separations, as well as others, while studying the whole data base in all seven site contexts. These results and future ones benefit Pueblo communities interested in learning about their past and the archaeological community interested in refining methodological techniques that investigate relationships between the graphic images pecked and painted on stone features and prehistoric social organization.

ACKNOWLEDGMENTS

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Watchman, Alan, and Denis Lessard
Prehistoric mining activities are known from many locations in the Southwestern United States. Helene Warren was especially interested in that activity, as it was practiced by the Anasazi. Many times in her career she made it her job to investigate prehistoric mining activities. At the Yellow Jacket site, mining for clay can be documented by identifying excavations in the clay/shale-bearing formation below the site; X-ray diffraction can then be used to match raw clays to clays excavated within the room blocks of that site. Results show that clay used in the manufacture of ceramics was mined locally by the Anasazi inhabitants of the site.

**THE YELLOW JACKET SITE**

Yellow Jacket (5MT3) is an Anasazi Pueblo site located in southwestern Colorado, about 29 km (18 mi) northwest of Cortez, Colorado. The earliest absolute date from Site 5MT3 is A.D. 519 (Cater 1989:41), and the latest date was A.D. 1275 (Cater 1989:50). The site was abandoned during the Pueblo I time period, from about A.D. 700 to 875 (Cater 1989:42). Occupation was during the Basketmaker III time period (ca. A.D. 519 to 700), Pueblo II times (ca. A.D. 875 to 1100), and Pueblo III times (ca. A.D. 1100 to 1275), with final abandonment at the end of the thirteenth century.

The site itself is just off U.S. Highway 666 at the township of Yellow Jacket (see Figure 1, which shows the location of the site in relation to the Southwest, and Figure 2, a topographic map of the Yellow Jacket District). The place received its name from a historic stage stop that was located at the Yellow Jacket Spring, named for the abundance of bees (also known as yellow jackets) found there (Lange et al. 1986:1).

The first mention of Yellow Jacket was in a geologic report prepared for the U.S. Government by John S. Newberry (1876:88):

> Sage is predominant vegetation, and no water is found in the interval (the trip from the Mancos River east to Yellow Jacket) yet we passed several ruined buildings, and broken pottery is scattered everywhere.

The fact that sherds were reported to have been everywhere suggests a substantial ceramic industry in the past.

The Yellow Jacket area was also occupied by the Ute Indians, as evidenced by the pictographs that are found in the canyon rock shelter (designated Site 5MT7) just to the east of Site 5MT5. The area was also inhabited by the Navajo, according to Newberry (1876:89). The spring at Yellow Jacket served as a stage stop until late into the nineteenth century (Lange et al.
Finally European settlers moved into the valley, and the intensive agriculture found there today began.

Research at Yellow Jacket began in 1954, when a ceramic vessel was brought to Dr. Joe Ben Wheat by a friend of the farmer who owned the land at that time (Lange et al. 1986:20). This proved to be an Anasazi bowl from the Stevenson Site (5MT1), named after the farmer, Hod Stevenson, who owned the property. The University of Colorado Museum conducted their field school at the site for over 20 years, only ending in 1991. Many archaeologists were trained in field techniques at this Anasazi village, and much research continues on the materials excavated from there.

Reports of these excavations have been published by several authors. Joe Ben Wheat (1955, 1980, 1983) has contributed several papers on the site. These papers have been supplemented by other publications, including a book entitled Yellow Jacket: A Four Corners Anasazi Ceremonial Center (Lange et al. 1986). The volume is intended for the general audience but contains valuable information on the Yellow Jacket site.

Priscilla Ellwood (1978) produced a study of the ceramic wares from the excavation of Site 5MT1 and Site 5MT3 House 3. This essential volume is very useful for organizing ceramic materials from Yellow Jacket. It was the first comprehensive ceramic study to be completed on the Yellow Jacket site.
Figure 2. Topographic map of Yellow Jacket Canyon showing locations sampled for raw clays. Each numbered location is the site of a suspected clay mine.
John Cater (1989) was the next to look at the ceramic assemblage from the site. He used the types as dating devices and did not do a detailed study of materials or designs. For the first time, he presented information on the suspected clay mines found in the canyon below Sites 5MT3 and 5MT5 (Cater 1989:15).

Coburn (1985) made the first attempt at locating the sources of raw materials from Yellow Jacket Canyon and matching them with the ceramics. That brief study used fired samples from suspected clay mines within Yellow Jacket Canyon. The fired clay samples were matched with refired Pueblo II sherds excavated from Site 5MT3. It was assumed that a match in color would indicate if the clay was the right source or not.

Coburn's (1985) study could not have succeeded, since all of the variables involved in the final color of pottery were not considered in the experiment. The color of fired clays depends not only on the raw clay, but its iron content (and any impurities within the clay), the chemical composition of aplastic inclusions, and the firing atmosphere and temperature. Inclusions include sandstone, which contains variable amounts of iron, as well as other elements, including manganese, which is a major constituent of black and brown Pueblo II sherds (Kay 1994). All of these variables work together to produce the final color of the finished ceramics (Shepard 1980:17).

GEOLOGY OF THE AREA

Clay sources are difficult to locate at best, but the geology of a site can provide some clues to their identification. A blanket statement such as "sources not definitely known, possibly from the Mancos shale" (Breternitz et al. 1974:21) is not acceptable. It is also misleading, because the Mancos shale does not occur throughout the northern San Juan region. At Mesa Verde, researchers such as Norman Oppelt (1991:14) and Mary Griffts (1990:13) have recognized this.

In most of the Montezuma Valley, Mancos shale does not exist. Of the major sites in this prehistoric population center (Oppelt 1991:14), Yucca House is the only one that sits directly on the Mancos shale. In fact Yucca House and Mud Springs are the only Anasazi sites in the valley that have direct access to Mancos shale.

Other Anasazi sites in the valley are situated either on the Morrison, Burro Canyon, or Dakota formations, making the above statement by Breternitz et al. (1974) a problem. If the Mancos shale does not occur at these sites, where did the clay used for ceramics come from? Clay is available within all of these lithologic units, as well as Mancos shale. Each of these has its own distinct characteristics, and it may be possible to distinguish each by their different types and proportions of clay minerals.

The area surrounding the site is agricultural land today and is covered with irrigated fields of alfalfa, wheat, and pinto beans. Soils of the Montezuma Valley are a fine loess that has been deposited here by the wind during the last one million years (Griffts 1990:13). This loess soil covers a thick sandstone member called the Dakota formation at the head of Yellow Jacket Canyon. Dakota sandstone is a conglomerate of many layers containing several different types of sandstone, shale, and other materials, such as coal (Owen 1963:120–123).
A geologic cross section of the valley from Yellow Jacket west to Alkali Ridge (or Mesa) is shown in Figure 3.

The base of the Dakota sandstone is estimated at being about 2,012 m (6,600 ft) above sea level at this location (Thaden and Zech 1984), so the entire Dakota formation is exposed within Yellow Jacket Canyon at an elevation 2,080 m (6,825 ft). The Dakota sandstone unit is middle and upper Cretaceous in age, composed of sedimentary rocks that were deposited about 100 million years ago (Grifits 1990:41). These are the result of fluvial, swamp, and lacustrine materials left by the Cretaceous Sea that covered part of this area during that period (Owen 1963:147). The many different layers of the Dakota sandstone are illustrated on Figure 4.

In most of Yellow Jacket canyon the Dakota formation is completely exposed, along with the upper 11–15 m (35–50 ft) of the Burro Canyon formation. With the exception of the Yellow Jacket sites, located where the canyon begins, the Burro Canyon formation is not exposed at all. Burro Canyon sandstone sits on top of the Brushy Basin member of the Morrison formation from the Jurassic age. Burro Canyon is characterized by a macroconglomerate with interbedded shales, clays, and sandstones (Owen 1963:127).

The only other geologic features of note are extrusive igneous rocks that were deposited in the Cenozoic. These consist of volcanic domes of the Abajo Mountains to the west in Utah and the Sleeping Ute Mountain to the South. The dome within Sleeping Ute Mountain, known as McElmo Dome, is shown on the cross section in Figure 5. Three other volcanic dikes are located to the southeast in Mancos Canyon, just outside Mesa Verde National Park. These are composed of andesites that are highly micaceous, while Ute Mountain is primarily dioritic in composition (Mary Grifits, personal communication January 1992).

Yellow Jacket Canyon is an erosional feature that was created by runoff from the large catchment area to the northeast. Another major agent of erosion is the spring at the head of the canyon, which served the early stage stop and the earlier Anasazi inhabitants. This spring provides a source of fresh water to the canyon for most of the year. Both the Dakota and Burro Canyon formations form substantial aquifers within Montezuma Valley. These Mesozoic aquifers are exposed along the canyon, and contact springs result there. The potentiometric surface for the Dakota aquifer has been estimated in this area to be 2,075 m (6,800 ft) above sea level (Freethay et al. 1988). Yellow Jacket site 5MT3 is at a bench mark at 2,080 m (6,825 ft) above sea level (USGS 1965). Contact springs are found in the canyon and are characterized by increased vegetation around them.

CLAY SOURCING

The geology of the Yellow Jacket district is of prime concern to those doing research there. The geology and hydrogeology concerns the sources of raw materials for manufacturing artifacts and architectural features. These include pottery, lithics, pendants, and walls. The materials that are locally available should represent those readily available to the people living at these important sites in prehistory. The geology of Montezuma Valley is not homogeneous. I have just outlined the general geology of one small section of a very large region, demonstrating that all the

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Figure 3. Stratigraphy of Montezuma Valley West to Alkali Ridge.
Loess Soil

Dakota Sandstone

Upper Sandstone
Circa 49 feet, contains fine grained sandstone and quartzite

Middle Shale
circa 90 feet, consists of carbonaceous siltstone and sandstones

Lower Sandstone
circa 115 feet, with conglomerate sandstones, quartzite, and red and green shales

Burro Canyon Formation

circa 78.5 feet sandstone interbeded by green/gray shale

Morrison Formation

Figure 4. General stratigraphy at Yellow Jacket Sites 5MT3 and 5MT5.
Figure 5. Geologic stratigraphy from southeast to northwest across Montezuma Valley.
essential materials required to manufacture pottery are present and available.

The ruins of Hovenweep National Monument on the Utah-Colorado state line (i.e., Square Tower Group, Holly Group, Hackberry Group, and Cutthroat Castle) are located directly upon the Burro Canyon formation. The only clays available to potters working at these sites would have come from this lithologic unit. Also, the aquifer is substantially different at these sites. Water comes from local hydrogeologic systems that consist of Burro Canyon conglomerates, as the younger Dakota formation deposits have long since eroded away.

Examination of samples by X-ray diffraction was done to identify exact clay minerals present in samples collected from the Dakota formation, the Burro Canyon formation, Mancos shale, and a gray clay excavated at Site 5MT3. The method provides identification of these minerals by their crystalline structure.

The process of X-ray diffraction uses an X-ray beam directed at a sample of the mineral to be examined. As the X-rays pass through a crystal, they diffract at different angles for different minerals. By measuring the angle of X-ray diffraction through the sample, a mineral can be identified (Carroll 1970:1). Since clay minerals are so small, 1/256 mm or less in diameter (Challinor 1986:46), X-ray diffraction provides a better way to identify the mineral than visual identification.

Identifying clay minerals within fired ceramics can be a problem. The crystalline structure of clay is destroyed at high temperatures; at about 500 to 600 degrees Centigrade the crystalline structure of clay minerals is destroyed (Rice 1987:385). If the ceramics being examined had been fired at temperatures above this, the clays will not be identifiable in the sherds.

The first samples examined were raw clays that I collected during the 1991 field season. Information on suspected clay mines was taken from Cater (1989) and from the field crew headed by Jeanette Mobley-Tanaka and Joe Ben Wheat, both from the University of Colorado Museum. Samples from Yellow Jacket Canyon were taken from several locations identified as prehistoric clay mines and from in-situ clay beds within the Dakota formation. The exact locations of the samples are shown on Figure 2. Also analyzed were samples from clay beds and shale layers collected during the 1992 field season as part of a regional geologic and hydrogeologic survey that I conducted. Those samples include Dakota-formation clays from Alkali Mesa, Mancos shale from the base of Mesa Verde near Mancos, Colorado, and the Morrison formation in McElmo Canyon. Other samples examined were from Units 18 and 19, House 2, excavated at Yellow Jacket Site 5MT3. Those samples were excavated by the University of Colorado field school in 1978. Another sample was from a clay mine identified in 1978 by the field school (Location 3 on Figure 2). Clay minerals found in all samples tested are shown in the Table 1.

Sample 1 was taken from an in-situ clay layer that is just below a coal seam in the middle member of the Dakota formation. The sample should represent the most uncontaminated clay available. The other samples are weathered from the same layer but were found below the formation. This clay layer runs the entire length of Yellow Jacket Canyon. It is associated with coal and
Table 1. Clay Minerals Found in Samples from Montezuma Valley, Colorado.

<table>
<thead>
<tr>
<th>Lithologic Unit</th>
<th>Location Sampled</th>
<th>Iron Content by Weight (%)</th>
<th>Illite (%)</th>
<th>Montmorillonite (%)</th>
<th>Kaolinite (%)</th>
<th>Chlorite (%)</th>
<th>Muscovite (%)</th>
<th>Calcite (%)</th>
<th>Quartz (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mancos shale</td>
<td>Above Mancos, on the slope of Mesa Verde</td>
<td>2.01</td>
<td>&gt; 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&gt; 50</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Dakota formation</td>
<td>5MT3</td>
<td>1.84</td>
<td>&gt; 40</td>
<td></td>
<td>&gt; 40</td>
<td></td>
<td></td>
<td>&gt; 10</td>
<td>&gt; 10</td>
</tr>
<tr>
<td></td>
<td>EU-18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dakota formation</td>
<td>Yellow Jacket Canyon in situ</td>
<td>2.54</td>
<td>&gt; 40</td>
<td></td>
<td>&gt; 40</td>
<td></td>
<td></td>
<td>&gt; 10</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Dakota formation</td>
<td>Yellow Jacket Canyon prehistoric clay mine</td>
<td>2.24</td>
<td>&gt; 40</td>
<td></td>
<td>&gt; 40</td>
<td></td>
<td></td>
<td>&gt; 10</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Dakota formation</td>
<td>Alkali Mesa in situ shale layer</td>
<td>2.34</td>
<td>&gt; 15</td>
<td>&gt; 35</td>
<td>&gt; 25</td>
<td>&gt; 10</td>
<td></td>
<td>&gt; 5</td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Burro Canyon</td>
<td>Hovenweep, Holly Group in situ shale</td>
<td>1.47</td>
<td>&gt; 25</td>
<td></td>
<td>&gt; 25</td>
<td>&gt; 25</td>
<td></td>
<td>&gt; 10</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>formation</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morrison formation</td>
<td>Brushy basin member, McElmo Canyon, mouth of Sand Canyon</td>
<td>2.11</td>
<td>&gt; 25</td>
<td>&gt; 25</td>
<td>&gt; 40</td>
<td></td>
<td></td>
<td></td>
<td>&gt; 10</td>
</tr>
<tr>
<td>Morrison formation</td>
<td>Brushy Basin member, McElmo Canyon, 8 km east of Ismay</td>
<td>1.94</td>
<td>&gt; 20</td>
<td>&gt; 20</td>
<td>&gt; 45</td>
<td></td>
<td></td>
<td>&gt; 5</td>
<td>&gt; 10</td>
</tr>
</tbody>
</table>
would be called by traditional potters a "fire clay." Fire clays are those that are high in hydrous aluminum silicates and have little iron content (Challinor 1986:72). They usually have a good organic material content that is derived from the coal layer. Clay of that type would be one that knowledgeable potters would have sought out because of its quality, both in its plasticity and its fired color.

Suspected clay mines were identified by several attributes. Excavations were identified within the clay/shale layer of the Dakota formation, and any artifacts were noted. Those could be easily distinguished from the historic coal-mining features that were accompanied by early twentieth-century artifacts and a motor-vehicle road.

The X-ray diffraction patterns of seven samples superimposed are shown in Figure 6; the major clay mineral groups are identified as well. The clays are predominantly kaolinite with montmorillonite. Kaolinite is a type of clay used to manufacture fine porcelain—the name comes from a hill in China where the material was used to make high-quality Chinese ceramics (Challinor 1986:104). The clay material montmorillonite, also known as bentonite (Carroll 1969:25), is high in hydrous aluminum silicates. Both of these produce a plastic clay that fires to a nice white color, making it a good clay for making gray and white wares.

The types and proportions of the minerals are identical from all samples examined from the Yellow Jacket district. In-situ clay, as well as excavated clays, are identical to those from clay mines within the canyon. Five samples are superimposed over each other for comparison in Figure 7. All samples appear to have originated from the same geologic source.

The next analysis was done on fired ceramic sherds from the site. Thirty-six sherds were examined by X-ray diffraction. They were chosen by ware and type, representing all time periods and types. Results of the examination showed that the only mineral present was quartz. The diffraction pattern is shown in Figure 8. Identification of only quartz crystals in the samples shows that the ceramics were fired above 600 degrees Centigrade. The clay mineral structure had been destroyed, and the identification of clay minerals in sherds was impossible.

DISCUSSION

Analysis has shown that the potters of Yellow Jacket had a supply of good-quality clay locally available. The source of the clay could be many locations within the canyon. Clay samples from excavation units on the site show that they are the same clays found in the canyon, clearly indicating that the potters of Yellow Jacket were mining clay for use in their ceramics. The analysis also demonstrates that ceramics from Site 5MT3 were fired well above 600 degrees centigrade.

Clay mines were identified by Cater (1989) at Locations 3, 6, and 7 on Figure 2. Those locations as well as others were sampled for clays. The X-ray diffraction analysis showed that they all have the same mineral content. The layer of clay within Yellow Jacket Canyon is very homogeneous, of good quality for ceramic manufacture.

The consistency of Yellow Jacket Canyon clays contrasts with the clays from other geologic formations. A sample of Burro Canyon formation clay from near the Holly Douglas R. Parker 131
Figure 6. X-ray diffraction of raw clays showing the clay minerals present. To the left are kaolinite, and to the right is montmorilinite.
Figure 7. Comparisons of raw clays from excavation units (18 and 19), Canyon Clay Mines (S-4 and S-19), and in situ clay member of the Dakota formation (S-1).

Figure 8. X-ray diffraction of a typical ceramic sherd from Yellow Jacket 5MT3. Diffraction indicates only quartz.
A group of Hovenweep National Monument was also a similar gray-colored clay. The clay has less kaolinite and illite than the Dakota clays that were analyzed. The clay, while capable of producing gray and white wares, is not as plastic and would be subject to much greater shrinkage during the drying process. Also different is the presence of muscovite in the clay. Muscovite is a type of mica that can occur naturally in clays, giving them a shiny color when fired.

Morrison-formation clays were found to contain similar amounts of kaolinite, and montmorillonite as well. That clay mineral is found in quantity in Alkali Mesa clay beds as well; it contains noticeable amounts of chlorite, another clay mineral. All of the raw clay sources are distinct from each other, making them distinguishable by X-ray diffraction.

Clay samples from the suspected clay mines all contain the same types and proportions of clay minerals. Additionally raw clay samples excavated from room blocks at site 5MT3 have an identical mineralogy. It can be concluded that the clay excavated from the site originated from the clay-bearing formations within Yellow Jacket Canyon.

I have shown that the clays in Montezuma Valley are not homogeneous. Sources of raw materials for ceramic production would have come from many different formations in the valley. At Yellow Jacket, Dakota formation clays would have been easily obtainable for that purpose, and the analysis of clay excavated from the room blocks shows that they did. Hovenweep occupants would have used Burro Canyon clays. People living at Yucca House would have used Mancos shale materials, and clays from Mancos shale and the Menefee formation were available to Mesa Verde potters.

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—Department of Anthropology, University of Colorado, Boulder

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It started out just about the same as any other summer day in Chaco Canyon back in the middle 1950s. Put up the flag. Keep one ear peeled for visitors, including airplanes flying overhead, which we had to report by phone to Albuquerque as part of the paranoid civil-defense program of the period. Do the governmental paperwork in the two-room visitor center until someone showed up wanting the 25¢ guided tour of Pueblo Bonito. The little museum was in front of the visitor’s center, a portable wooden affair, with the office in the rear half.

No more construction projects were going on in the canyon that summer. The multiplate culvert in Mockingbird Wash, which was required when a summer flood washed out the road, had just been finished by a Navajo crew and the road put back in use. No archaeological work was going on since the University of New Mexico had closed its field school in 1947. Nor was there any stabilization activity taking place on any of the canyon’s magnificent ruins. Things were pretty quiet that summer day.

To relieve some of the boredom, a party was planned for the monument staff that long summer evening. The women, both of them, were busy at the residential area, cooking and making plans for the get-together.

A little after lunch one of the Navajo neighbors, Art Werito, who worked for us or the stabilization crew off and on and had been on the Mockingbird Wash culvert crew, showed up at the office. He informed me that another member of the crew had just died in his hogan that morning. The dead man had gone out after breakfast to catch his favorite pinto pony. After catching the pony he came back to the hogan, where he lived with his mother, lay down, had an apparent heart attack, and died.

Werito asked if he could have enough plywood to build a coffin and would I help bury the man? Knowing the beliefs the Navajo have about death and thinking about the fortunate fact that the man had not died in the culvert on the job, I gave an affirmative answer to both questions. If the man had died in the culvert, it would have been very difficult to get the job finished with the Navajo crew, and there were no other workers in the area. It would have been highly possible that no Navajo would even want to cross over the culvert on the road. In addition there would have been reams of governmental paperwork to fill out concerning the death on the job.

To assist in the burial would relieve some of the family from undergoing a 4-day, somewhat expensive curing ceremony to get rid of any fear of being haunted by the spirit of the dead man. Standard Navajo
practice was to get a non-Navajo to do the burial. For some reason, they did not feel that Navajo spirits would bother whites. Perhaps they just did not care, so long as the body was buried by sundown on the day of death.

Werito and I got the coffin nailed together and a hole drilled in one end to let the man's spirit out, according to Navajo belief. By the time we finished, it had assumed the size and aspects of a shipping carton for a small-sized refrigerator. We loaded it on my old government pickup and drove to the hogan, which was located on the north side of Escavada Wash. The trip was somewhat longer than necessary, as we had to go up the wash some distance to a "good" crossing of the heavily sanded Escavada—a caution I was to ruefully remember later.

At the old-style cribbed wooden hogan were gathered the man's mother and several other relatives. Also present was the Anglo-American trader from the nearby trading post where the man did most of his business. The corpse lay on the floor of the hogan, fully clothed and untouched since he had died early that morning.

One of the relatives, Big Charlie, was working for us at the time; he asked the trader and me to wash the body in preparation for burial. The trader was willing but, frankly, I was a little squeamish and refused. Although as an archaeologist I had dug up the skeletal remains of ancient burials, a fresh corpse was not to my liking. Big Charlie, with the help of the trader, grimly undertook the task. The rest of us stood around and watched.

As the corpse was rolled over his stomach contents were regurgitated. One of the women gasped and said "poison." I quickly allayed her fears and hoped there would be no stories of witchcraft concerning the man's death. Witchcraft belief was strong among the Chaco Navajo. What was not part of their own culture came from the neighboring Spanish-American, who had a rich belief in the subject themselves and shared much of it through occasional intermarriage with the Chaco Navajo. When stories of Navajo being witches are spread, the subjects can have miserable and dangerous lives. Eventually most of the accused left the territory for friendlier places.

The body washing was a somewhat hasty affair, after which a new set of blue jeans and a shirt were placed on the body. The body was then put in the coffin in an extended position, and several pairs of new blue jeans and other clothing were placed beside it. I had thought the coffin a little large when Werito and I had built it, but the reason for a large coffin became evident when a practically new saddle was brought out. Someone slashed it with a knife to make it unusable, as if the burial with the corpse would not have accomplished the same thing. It was the last thing to be placed in the coffin, and the lid was unceremoniously nailed down.

By now the whole affair must have weighed close to 400 pounds. We struggled to lift the coffin, trying to keep it upright. Then we remembered that, to get it through the hogan door, we would have to turn it on its side. The immediate solution was to tear out part of the door frame, as we followed the man's mother out to the burial site.

The burial place, which the mother had picked out, was downhill from the hogan on
a flat near an arroyo. The soil at the site was pure adobe. Working in the grave hole three or four at a time, we strained to break up the adobe of almost concrete consistency. As the sun sank lower in the west, our efforts finally came to a halt as we decided the depth of the hole was such as to give the man a decent though somewhat shallow burial. Besides, we were all totally played out.

After the coffin was covered and the dirt over and around it tamped down, Big Charlie brought up the favorite pinto pony of the deceased—the one he had caught that morning just before the heart attack. Inquiries were made about a gun. None was to be had. Big Charlie went to the Hogan and brought back a double-bit, long-handled axe with which he proceeded to give the pony a horrendous blow to the head. The pony’s knees buckled but he remained standing, blood streaming down his face. The handle of the axe broke from the power of the blow, but Big Charlie picked up the short-handled axe and kept hitting the poor pony until it finally collapsed on the grave, and we all gave a sigh of relief. (The next morning, I was told later, the pony was off grazing, having partially recovered from its strange ordeal. This time a gun was available, and the pony was led back to the grave and given a less-gruesome coup de grace.)

After the horse went down during the funeral, the burial party broke up. Big Charlie told me he would not be back to work for 4 days so he could undergo the curing ceremony associated with burying the dead man. I said I understood. The sun was close to setting in its usual place. The trader convinced me that the crossing of the Escavada, which made a shorter route home, was passable for me and my old government pickup. I followed him and, looking in the rear view mirror, I saw a plume of smoke. The hogan with its cribbed wooden roof had been set ablaze to be forever known as a che’iindi hogan—one inhabited by the ghost of a dead Navajo. I wondered where the old mother would live.

I watched carefully where the trader and his souped-up black sedan with balloon tires crossed the Escavada. The balloon tires should have triggered something in the back of my usually cautious mind. It did not, for it was late and I was tired, with thoughts of the party to come. I just wanted to go home. The trader made it across. I gunned the old pickup and tore across the wide, sandy streambed. I made it a little more than halfway across when I came to a sickening, sinking halt. I was stuck—grandly and gloriously stuck up to the axles. I got out, surveyed my predicament, and said some Anglo-Saxon words under my breath. I had visions of a wall of water coming down the Escavada from a storm far upstream to finish the job and bury the old pickup. More paperwork!

Meanwhile back at the party, two women and four little children had been there all afternoon. The maintenance man, his wife, and a couple visiting them were nowhere to be seen. Neither were the superintendent nor the Chaco Trading Post trader and his family. Getting worried as the sun sank behind the cliff at Peñasco Blanco at the end of the canyon, the two women loaded the kids in a car and drove the 5 miles to the visitor’s center at Pueblo Bonito. They were greeted by the open door to the museum and the flag floating lazily in the summer breeze. Thinking that possibly the end of the world might have come and they had not been notified, they went back to the housing area to wait, totally puzzled.
As I cursed my stuck pickup, wondering how I would ever extract it or how far I might have to walk to get help, I glanced across the remaining stretch of Escavada sand to see a young Navajo who worked for us and his three children coming toward me, carrying planks, shovels, and a handy-man jack. The Navajo had a knowing half smile on his face as if to say, "Crazy Belagana." Setting to work, they jacked up the truck, dug out the front and back wheels, and placed planks under them. I gave the truck all it had and progressed a short distance ahead. It took more replays to get across the rest of the way, but finally the truck was on solid ground. I gave them some money and gratefully headed for the party.

Within a few minutes of my arrival everyone else showed up, to the great relief of the two homebodies. The maintenance man and his group had been down in Chaco Arroyo checking the well in the bottom of the wash. The superintendent and the Chaco trader had gone to town, and it took longer than expected.

The next day I got the usual tourist question, "What do you do out here for entertainment?" I could only smile and think of the events of the previous day.

—Moab, Utah
Despite the importance of prehistoric ceramic production to archaeological investigations in the Anasazi culture area, there have been relatively few positively identified pottery-firing features or kilns reported outside the northern San Juan region. This paucity is especially acute in the northern Rio Grande region. Our ability to find pottery-firing features appears to have been strongly hampered by the use of ethnographic and modern models of Native American pottery-firing methods, as well as by too little archaeological attention to small, nonarchitectural artifact scatters. Recent excavation of two features and associated ceramics near Santa Fe, New Mexico, has yielded what we believe to be the first Santa Fe Black-on-white pottery-firing features recognized in the northern Rio Grande Valley (Lakatos 1994; Post 1994; Post and Lakatos 1994).

POTTERY MANUFACTURE AND FIRING EVIDENCE IN THE PREHISTORIC SOUTHWEST

Pottery-firing features are conspicuously unreported from the archaeological record in the North American Southwest, outside the northern San Juan region (Purcell 1993; Sullivan 1988). Pottery-production stages are usually inferred from the presence of raw materials and tools such as processed clay, temper, unfired vessels, puki (bowl molds), and sherd scrapers. These things are often recovered during excavation but are rarely found associated with pottery-firing locations (Sullivan 1988). An early exception to this rule is the excavation at the Hohokam village of Snaketown (Haury 1976), where manufacturing tools and pottery-firing features occurred together (Sullivan 1988).

THE ETHNOGRAPHIC POTTERY-FIRING MODEL

A major factor contributing to the difficulty in recognizing these features is the reliance on the commonly referenced ethnographic pottery-firing methods (Purcell 1993). Ethnographic descriptions of Southwest Native American pottery firing have been provided by Guthe (1925), Colton (1939), and Shepard (1965), among others. Similar methods are still preferred among the Hopi and contemporary Rio Grande pueblo potters (Batkin 1987; Trimble 1987). This generalized firing strategy involves lighting a prefire to dry out the ground, then placing inverted pots on a bed of sherds, rocks, sheet metal, or a metal grate to separate the vessels from the ground. Sometimes, sheet metal or cover sherds are placed around the vessels to keep the fuel from smudging them. The most common fuel is manure, which is stacked around the vessels and ignited (Batkin 1987). This method would have left minimal evidence in the archaeological record and may have been appropriate for low-fired utility wares.
The ethnographic model of surface firing within or near the village limits has had a strong effect on archaeological expectations for finding pottery-firing features. Cultural and natural processes may have further decreased the archaeological visibility of firing features (Purcell 1993; Schiffer 1987). Some cultural processes that might have affected feature preservation include facility reuse, changing activity-area locations, and pueblo expansion. Natural processes of erosion and deflation could have quickly erased shallow firing features. Because of the recognition biases and the effects of cultural and natural processes, we needed to look beyond the village limits for the pottery-firing features.

NORTHERN SAN JUAN ANASAZI TRENCH KILNS

Excavation of shallow trenches associated with pottery in the northern San Juan region has challenged the utility of the ethnographic pottery-firing model. These shallow, slab-lined trenches have been interpreted as pottery-firing features; collectively, they are termed trench kilns (Blinman 1992; Bradley 1982; Fuller 1984; Jennings 1978; Purcell 1993).

A total of 18 trench kilns have been excavated (not including kilns recently excavated at Mesa Verde National Park). They are all located north of the San Juan River in Utah, Colorado, and New Mexico (Purcell 1993). Most of these features were not found near habitation sites or associated with tools or raw materials identified with pottery manufacture (Purcell 1993). The discovery of these features indicates that construction and decoration of pots and their firing may have occurred at different locations.

The firing features of the northern San Juan Anasazi tradition, in general, are subrectangular trenches 1.5 to 8 m long by 1 m wide and 10 to 30 cm deep, with flat bottoms and sloping sides (Blinman 1992; Purcell 1993). The trenches are usually excavated to bedrock, are often perpendicular to slopes, and are lined with upright sandstone slabs (Purcell 1993). Interior oxidation is usually present, extending onto the sides and bottom of the features and forming a "rind." Fire-cracked rock, ash, and black "greasy" (Helm 1973:213) fill are also distinguishing characteristics. Charcoal and 3 to 5 cm of black earth are found under as well as over an irregular layer of rocks in the lower trench fill. These rocks are believed to provide vessel support during firing, and ceramics are usually found above this kiln furniture. Sherds and vessels from the kilns often display evidence of thermal exposure, such as spalling, oxidation, bloating, or vitrification. Most of the excavated features were used to fire carbon-painted black-on-white pottery during the eleventh and twelfth century (Purcell 1993). Recently excavated kilns from Mesa Verde National Park dated to the tenth century A.D. and yielded mineral-painted white-ware vessels (Brisbin 1993). Bowls are the most common vessel type recovered, followed by jars, dippers, and pinch pots (Purcell 1993). Bradley (1982) and Fuller (1984) give detailed descriptions of these features and Purcell (1993) synthesizes the kiln data from excavations predating 1993.

THE STRATIGRAPHIC SEQUENCE AND FIRING REPLICATION

Using stratigraphic information from kiln excavations at Mesa Verde (Brisbin 1993), Clint Swink (1993) has developed a firing sequence for the trench kilns, which serves as a model for firing carbon-painted pottery
in the northern San Juan region. The firing sequence is divided into four stages: **primary fire**, **setting**, **secondary firing**, and **smothering** (Swink 1993) (Figure 1).

The **primary fire**, set in the bottom of the trench, dries out the lining and prepares a thick bed of coals 8 to 15 cm deep. This fire also dries out the kiln furniture (the tabular sandstone slabs) and warms the vessels that are set around the perimeter (Swink 1993). Juniper was the most common fuel recovered from the primary firing layer in the Mesa Verde trench kilns (Brisbin 1993).

The **setting** is created by placing a uniform layer of preheated kiln furniture over the bed of coals created by the primary fire. The stones are spaced to allow heat to circulate while still providing support for the vessels. Vessels are placed on the kiln furniture in a single layer, and vessels of similar size are grouped together with the bowls inverted (Swink 1993). Cover sherds are placed around and over the vessels to shield them from the fuel and extreme temperature fluctuations.

The **secondary firing** provides the majority of the heat needed to fire the pottery. Fuel is cribbed over the setting, with longer pieces spanning the feature and providing support for the crib. The crib is then ignited at the top. A draft is created with this fire, accelerating combustion of the primary fuel layer. Management of the secondary fire is critical to the success of the firing. The type of fuel for this stage does not seem to be as important to the success of the firing as in the primary stage (Swink 1993).

The **setting** is smothered with a thick layer of soil free of any combustible material. The kiln cools slowly and is ready to open in 18 to 24 hours (Swink 1993). When the vessels are removed, the ash and charcoal deposit is mixed and scattered. The vessels are covered with ash and need to be brushed, so that the result of the firing can be seen.

This replicated firing sequence can account for all of the characteristics of the northern San Juan Anasazi trench kilns. The distinctive oxidation rind, the dense black fill, abundant rock embedded in dark charcoal-stained fill, and the relatively clean upper layer provide a robust stratigraphic sequence. Associated spalled, bloated, or heat-altered sherds associated with these features are also strong evidence of pottery firing. We believe that the stratigraphic sequence and the condition of the associated pottery can be used to identify carbon-paint pottery-firing features outside the northern San Juan region.

**SANTA FE BLACK-ON-WHITE POTTERY-FIRING FEATURES**

The Las Campanas Archaeological Project is a multistaged investigation of a 1,945-ha residential/resort development. The project area is located 8 km west of Santa Fe, New Mexico, at Las Campanas de Santa Fe. The project is the largest to date that has been conducted in compliance with the Santa Fe Archaeological Ordinance. Archaeological inventory of the project area identified 218 small prehistoric artifact scatters (Lang and Scheick 1989, 1991; Post 1992; Scheick 1991, 1992; Scheick and Viklund 1991, 1992). The survey identified 32 components with pottery types that date to the late Coalition or early Classic periods of the Rio Grande sequence, A.D. 1275 to 1425 (Habicht-Mauche 1993; Wendorf and Reed 1955). This is the period of greatest
Representative stratigraphy:

- Earth with some charcoal and rare oxidized stones; no wash-in structure to the deposit
- Dark earth with abundant charcoal and few oxidized stones; vessel fragments may be present
- Dense black earth and charcoal with abundant stones within or at the top of the layer
- Oxidized sandstone slabs lining the trench margin and sometimes the trench base

Figure 1. Generalized profile of the Northern San Juan trench kiln stratigraphic sequence (from Blinman et al. 1994).

prehistoric population along the Santa Fe River (Lang and Scheick 1989; Post and Snow 1992). The Las Campanas project area is located 5 to 7 km north of the Santa Fe River villages, Pindi Pueblo and the Agua Fria Schoolhouse site. The sites extend our knowledge of land-use patterns beyond the immediate vicinity of the Santa Fe River. One project result has been the identification and excavation of two small sites (LA 86159 and LA 84793) that yielded Santa Fe Black-on-white bowl fragments in association with heavily burned pit features.

**Initial Identification**

Sites LA 86159 and LA 84793 initially were described as Santa Fe Black-on-white pottery concentrations of fewer than 20 m in diameter. Test excavation of Site LA 86159 revealed a grayish soil stain associated with 160 thumbnail-sized sherd spalls and bowl body fragments. Test excavation of Site LA 84793 revealed a shallow thermal feature. A partial excavation exposed a profile with three burned cobbles suspended in black, charcoal-stained soil. Sherds were recovered from within the feature fill above the cobbles. Sherd spalls and bowl rim and body sherds also were scattered around the feature. These features were interpreted as possible pottery kilns, based on the many spalled sherds recovered from both sites and the stratigraphic profile of the thermal feature on Site LA 84793.

**Pit and Trench Kiln Description and Comparisons**

These Santa Fe Black-on-white pottery-firing features are described and compared with the northern San Juan trench kilns. The two kiln types will be referred to as pit kilns and trench kilns. The trench-kiln data
are derived from Blinman (1992), Purcell (1993), and Swink (1993).

Sites LA 84793 and LA 86159 were located 6.1 and 7.0 km, respectively, from the nearest recorded village sites of LA 1 (Pindi Pueblo) and LA 2 (the Agua Fria Schoolhouse site), which are located to the south along the Santa Fe River. Trench kilns typically have been found from 1.0 to 5.6 km from the nearest recorded habitation site. Topographically, Sites LA 84793 and LA 86159 are on low, gently angled, south or southeast oriented slopes in slightly eroded and deflated settings. This location contrasts markedly with the excavated trench kilns, which commonly occur perpendicular to steep slopes and within or near a drainage (Purcell 1993). Recent data from Mesa Verde (Brisbin 1993) and from pottery-firing replications (Blinman et al. 1994; Swink 1993) suggest that steep slopes may not contribute significantly to a successful firing. Pit-kiln locations also lend support to the latter interpretation.

The pit kilns on Sites LA 86159 and LA 84793 were shallow, oval basins. The LA 86159 pit kiln was 1.7 m long by 1.1 m wide by 12 to 26 cm deep (Figure 2). The LA 84793 pit kiln was 1.6 m long by 1.1 m wide and 9 to 18 cm deep (Figure 3). Trench kilns are so named for their tendency to be 2 to 7 times longer than they are wide (Purcell 1993). Size differentiation in the trench kilns may reflect the scale of production. The smaller pit kilns would have lacked the productive capacity of the trench kilns, reflecting household-level production.

Pit kilns were excavated into native, calcium-carbonate impregnated, sandy loam. The walls were moderately to steeply sloped. The floors were uneven but level, and the interiors were unlined. Pit-kiln rims were oxidized and hardened by exposure to high heat. Trench kilns were also shallow (average depth of 40 cm) with moderately steep walls. Often the walls and sometimes the floor were lined with tabular sandstone slabs. For both kiln types, shallow depth relative to length and width and a moderately steep wall angle may have been used to control the firing atmosphere and to contain the fuel and setting. Slab lining in the trench kilns probably indicates longevity and reuse needs of large-scale production rather than serving any thermal purpose.

Both kiln types exhibit a well-baked and oxidized rind. In the pit kilns, this rind consists of light pinkish orange or dark gray stained calcareous sandy loam. On top of the baked rind was a 3- to 12-cm-thick layer of greasy, homogenous, dark, charcoal-stained primary fill with charcoal flecks, burned calcareous inclusions, and spalls of fire-cracked rock. This lower layer is analogous to the primary firing layer of charcoal and ash in the trench-kiln firing sequence (Blinman et al. 1994; Swink 1993).

Each pit kiln contained 20 to 40 burned quartzite cobbles that were embedded in the top of the stained soil layer (Figure 4). Most cobbles were lying flat, and few cobbles were in contact with the feature floor or walls. The cobbles appear to have functioned as a platform for the vessels. Tabular sandstone slabs were used in the trench kilns (Purcell 1993), and they are part of the setting in the trench kiln firing sequence (Swink 1993). Differences in raw material for the kiln furniture reflect geological setting and not functionality. Tabular sandstone is abundant in the northern San Juan, but it is absent from the immediate vicinity of the pit kilns. Quartzite, metamorphic, and igneous
Light gray sandy loam with charcoal flecks, FCR, and artifacts (Smothering layer).

Dark gray charcoal stained sandy loam with charcoal flecks, fire cracked cobbles, and artifacts (Secondary firing).

Very dark gray charcoal stained sandy loam with numerous charcoal flecks (Primary firing).

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Figure 2. Plan view and profile of the LA 86159 pit kiln.
Figure 3. Plan view and profile of the LA 84793 pit kiln.
cobble is abundant in the alluvial deposits of the Santa Fe formation.

Located above the cobbles in the pit kilns was a mixed deposit of charcoal-stained, sandy loam with unburned pebbles and Santa Fe Black-on-white pottery. This layer is located above the cobbles. This mixed deposit appears to be analogous to the secondary firing layer (Swink 1993), which collapses on and around the vessels. Above the mixed deposit is clean, sandy soil that may be a remnant of the smothering layer (Swink, personal communication 1994).

The pit-kiln ceramic assemblages were exclusively bowls represented by sherds, spalls, and partly reconstructible vessels. Most sherds in the Site LA 86159 pit kiln were lying bowl face up. A minimum of seven vessels were identified from the 597 sherds recovered from the feature and associated discard area. Most sherds within the Site LA 84793 pit kiln were lying bowl face down. One vessel was identified from 255 sherds recovered from in and around the feature. The trench-kiln assemblages are also dominated by bowls, but the larger sample exhibits greater vessel form diversity.

The analysis of pottery recovered from the pit kilns revealed breakage patterns that may be important criteria for identifying kilns. Sherd spalls and spalled sherds comprise 17 to 81 percent of total sherds assigned to each vessel. In the analysis, a sherd with one intact surface was defined as a spall. A sherd with two intact surfaces that exhibited negative spall scars was identified.
as a spalled sherd. One distinctive breakage pattern was bilaterally opposed spalling. Bilaterally opposed spalling is recognized by negative spall scars on each surface that originate at opposite sherd edges. In other words, an interior surface spall scar is opposite to an intact exterior surface and vice versa. Spalling may result from rapid heat rise or from vaporization of moisture in a vessel wall. Replications using local raw materials and the trench-kiln firing method have produced failures with breakage patterns that are remarkably similar to the archaeological pattern. Besides the presence of spalls, trench-kiln pottery assemblages exhibit sherds that are oxidized, bloated, and vitrified (Purcell 1993).

A discard area was located southwest of the Site LA 86159 pit kiln. It had an irregular shape, covered 10 sq m, and consisted of a 5- to 7-cm-thick charcoal-stained sandy loam that contained sherds and spalls. The mix of sherds and stained soil may reflect discard from cleaning before reuse of the feature. The spalled sherds remain from partial firing failures. Discard areas were reported for three trench kilns, two of which had associated burned sherds (Purcell 1993).

CONCLUSIONS

Clearly, there are numerous similarities between the Santa Fe pit kilns and the northern San Juan Anasazi trench kilns. Morphologically, they are shallow relative to length and width, and they have moderately steep angled sides. The stratigraphic sequence is very similar; only the smothering layer has been difficult to delineate for the pit-kiln profiles. Bowls were the most abundant vessel form remaining at the kilns. Both kiln types were used to produce carbon-painted black-on-white pottery. Spalls, sherds, and partial or whole reconstructible vessels were associated with the kilns and discard areas. Stratigraphy, and by inference, firing sequence, kiln-wall angle, and shallow depth may be linked to the successful production of carbon-painted black-on-white pottery, regardless of topographic setting or available geologic materials.

Differences between pit and trench kilns occur in the topographic setting, size, and geologic material used in their construction. These differences are few and may be inconsequential to the firing sequence necessary to produce carbon-painted black-on-white pottery. A more serious challenge to the interpretation of the pit and trench kilns is their distance from the places where vessel construction probably occurred. For the Santa Fe pit kilns, we continue to struggle with the problem of raw-material source. To date, the distance between potential sources of clay suitable for the production of Santa Fe Black-on-white pottery and the villages challenges the ethnographic models suggested in the literature (Arnold 1985).

The identification of pit kilns is significant in many ways to archaeological investigations in the northern Rio Grande region. They provide criteria for recognizing pottery-firing features during inventory and excavation. As previously recognized in the northern San Juan region, we have also learned to look beyond the village back door for evidence of pottery firing. Just as the trench-kiln firing sequence challenges the entrenched models of prehistoric pottery production in the Anasazi culture area, the Santa Fe pit-kiln studies will lead to a broader understanding of the mechanisms of pottery production in the northern Rio Grande.

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—Office of Archaeological Studies, Santa Fe

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The Las Madres Pueblo is located in the Gallisteo Basin, South of Santa Fe. The site was excavated in 1963 by Bertha P. Dutton (1964). The chronology of Las Madres Pueblo was developed in 1969 in the context of a graduate paper (Schaafsma 1969). It is based upon a stratigraphic excavation done for Dr. Dutton in July 1965, and an attribute analysis of the ceramics I conducted for her in 1965 and 1966 (Schaafsma 1969). Dr. Dutton had always wanted to prepare a final report on Las Madres that would include this detailed ceramic work, but that was not possible. Accordingly, this account of the chronology of the site is provided here, since it includes basic data that may prove useful to current research. There has been no attempt to modify the basic discussion, and it is presented essentially as written in 1969. The revisions are editorial in nature.

INTRODUCTION AND METHODOLOGY

Archaeologists have long been concerned with the dimension of time in their work, and a realistic arrangement of the materials recovered in their excavations and surveys has occupied a great deal of their energies. In the Southwest, pioneer methods of time control were first utilized. The validity of applying stratigraphy to archaeological deposits was first worked out by N. C. Nelson (1916); ironically, he dug in Las Madres in 1916 and did some of his more important stratigraphic tests at Galisteo Pueblo, across the arroyo. Seriation is another method that was first tested in the Southwest, when A. L. Kroeber (1916) made his study of Zuni potsherds. These methods have been given much greater depth as the years have gone by, but they still retain their validity.

The principal of seriation has promised to offer the best means for correlating large collections that have only occasional absolute (dendrochronology, \(^{14}\text{C}\)) dates. A great deal of work has centered around the problem of obtaining good chronological order by seriation methods (Hole and Shaw 1967). The basic idea in this method is that "like goes with like," regardless of whether one is seriating features in a site or sites in a region.

The first paper that presented a statistical method for obtaining a good serial order of archaeological materials was that of Robinson (1951). He presented a matrix method for ordering archaeological materials and devised an "index of similarity" that shows the degree to which two samples are alike or dissimilar. His method is sound, but it is difficult to apply when there are more than a few items in the matrix. A computer program to operationalize the Robinson method was later presented by Ascher and Ascher (1963); unfortunately, this program...
gave poor results when run by Hole and Shaw (1967:69), and they recommended that it not be used. While this statistical method is theoretically valid, it was, when this paper was written, incapable of ordering ceramic data from a site as large as Las Madres.

A new method for obtaining a chronological order was devised and tested by Hole and Shaw that shows promise of giving the order needed. They call this method the "permutation search" technique.

Meighan (1959) devised a simple method for obtaining an approximate serial order that utilizes the percentage shift among the three major types in an assemblage. I applied this technique to the Las Madres features and used it to check the composite method that was eventually devised. It is a valid method, but too vague to be a primary control method.

The method of stratigraphy is well-known, and we were able to obtain one good stratigraphic block at Las Madres. I excavated this block in July, 1965, following natural levels in a deep trash deposit (Figure 1). It provided us with excellent time control over much of the life of the pueblo. The information latent in this layered stratigraphic block provided the backbone for the chronological arrangement discussed below.

There were a number of dendro-chronological specimens obtained in the excavations, which provide gross limits to the site’s occupancy but are of little value in arranging the features temporally. A few reliable dates are about A.D. 1340 (1342, 1341), with the majority from the decade of 1350 to 1360. The latest date is 1361. Presuming that these dates in the 1350s are construction dates, they are quite in agreement with the dating derived from ceramic cross-dating.

After reviewing all the basic seriation methods available in 1969, it became clear there was little value in trying to arrange all the features in a serial order from earliest to latest. Another approach was followed, which assumes that the features from a particular period can be grouped together on the basis that they share a similar suite of pottery. It assumes that, at any one period, the pottery in use at the site overall should be basically homogeneous; a new pottery innovation or change would mark another period that would also be reflected throughout the site. Features that share a similar suite of pottery thus should date from the same time period. Rather than obtaining a serial order based upon the assumption that there is an "oldest" feature that leads to a "youngest" feature, six periods were defined that are roughly equivalent to phases that would be used in ordering sites in a site survey. These periods are quite securely placed in sequential order. Approximate years were assigned to the periods based on patterns within the region.

A composite approach was employed to obtain these six periods into which the features were arranged. All relevant information available was dovetailed to arrange the features into periods. There were a number of different clues that wove together to associate the features of each period. The basic method is summarized below.

The pottery conditions revealed by the levels in the stratigraphic block were the primary control for defining the periods. Five distinct layers with different suites of pottery were found in the stratigraphic test.
Figure 1. Stratigraphy of test block (from field notes dated July 25, 1965).
These five trash levels equate with five temporal periods, and the pottery suite present in each of them provided us with a model of the pottery conditions existing at any particular time (Table 1). A sixth period was added later that corresponded to a layer that had been removed prior to July 1965. The pottery differences in the trash levels were found to coincide with ceramic events that occurred throughout the region; the pottery microcosm from the trash deposit mirrors quite faithfully the macrocosm of the regional pottery history.

The next step was to group together the features from the overall site that had a pottery profile that most closely approximated the conditions in the model provided by the stratigraphic test level. A number of features were rejected as being too small or were aberrant in other ways. The reliable features were arranged into six groups on the basis of their resembling the model from the test and the ceramic conditions extrapolated from the regional archaeology. This procedure is similar to determining the ceramic conditions during a particular phase and then assigning sites to the phase according to their resemblance to the model. The arrangement into periods was, therefore, descriptive and initially carries only the implication that features grouped together share a common pottery suite that in turn resembles a level of the stratigraphic block. A more hypothetical assumption is then made that since these features are alike in pottery, they were deposited during a single time period in which that particular suite of pottery conditions existed at the site and in the region. The relative temporal positions of these groups is grounded in their arrangement in the stratigraphic block. This period method gives more realistic summary statistics than does a seriation method that attempts to provide a linear sequence of features. However, it will probably prove to be the case that one method is best on some materials, while the other method is best on others.

DEFINING THE PERIODS

The following summary describes the ceramic events that went into determining the various periods.

Period I

Previous work in the Rio Grande valley has demonstrated that Glaze Red appeared well before both Glaze Yellow and Biscuit A. Furthermore, archaeologists seem to agree that the earliest form of Glaze Red was entirely tempered with crushed sherds (Stubbins and Stallings 1953:56). It would appear then that there must have been a time when there was no Biscuit A or Glaze Yellow present, and that all Glaze Red sherds were tempered with crushed sherds. Such a suite of pottery was happily found on the bottom levels of the stratigraphic test. Level 5 has no Glaze Yellow or Biscuit A, and the Glaze Red sherds are 100 percent sherd tempered (Figure 1). This level then demonstrates that the Las Madres site was in existence during the period hypothesized, based on the regional archaeology, and it allows us to group all features that have this pottery condition into one period. Another characteristic of this early time, before glazes became significant, was a high percentage of Galisteo Black-on-white. Level 5 of the stratigraphic test has 68 percent Galisteo, and all of the features grouped into Period I have a total of 73 percent Galisteo Black-on-white. The 893 sherds from features that belong to Period I have the following pottery profile: Galisteo Black-on-white, 73 percent; Glaze Red, 11 percent; Poge Black-on-white, 6 percent;
<table>
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<th>Level</th>
<th>Period Model and Generalization</th>
<th>Ceramic Typis (percents)</th>
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<tr>
<td></td>
<td>General</td>
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Kendi Black-on-white, .2 percent; Wiyo Black-on-white, 6 percent; and Pindi Black-on-white, 4 percent (Table 1).

**Period II**

The next period takes as its model Level 4 of the test. This level was deposited in a time when the Galisteo Basin was becoming a center of Glaze Red production and "adesite" temper was beginning to be used—likewise the amount of Glaze Red was increasing greatly. However, this was still before the appearance of either Biscuit A or Glaze Yellow. Several varieties of Glaze Red temper had appeared by this time, but the percentage of Sherd-tempered Red was still high, or about 75 percent. Using Level 4 as a template, it was possible to infer that there would be a group of features characterized by the lack of Biscuit A and Glaze Yellow, a decreasing percentage of Galisteo, and a high but not exclusive amount of sherd temper in the Glaze Red. Twelve features met these requirements and are grouped in Period II. The 1,010 sherds are divided into Galisteo, 47 percent; Glaze Red, 37 percent; Poge Black-on-white, 8 percent; Wiyo Black-on-white, 4 percent; Wiyo-Santa Fe Black-on-white, .7 percent; and Pindi Black-on-white, 1 percent. A trickle of other sherds are present that are probably drift in this case.

**Period III**

The next period is characterized by the presence of Biscuit A but no Glaze Yellow. Level 3 of the stratigraphic test is the model for Period III with 50 percent Galisteo, 31 percent Glaze Red, 3 percent Poge Black-on-white, 2 percent Kendi Black-on-white, 7 percent Wiyo Black-on-white, and 1 percent Biscuit A (Table 1). This stratigraphic evidence and Mera’s (1934) survey of the Biscuit area indicate there was a period when Biscuit A was being made, but Glaze Yellow had not yet appeared. Mera found at least nine sites in the Biscuit area that had Biscuit and Glaze Red but no Glaze Yellow. Among these are Tsiping (LA 301), Wiyo (LA 158), Kundiyo (LA 31), and Shupina (LA 795) (Mera 1934). Twenty-one features from Las Madres grouped on this primary criterion were found to also be located about the right place, on the basis of other projected pottery trends. For example, since overall there is a gradual decrease in the amount of Galisteo Black-on-white and a concomitant rise in Glaze Red, one would expect this period to have slightly less Galisteo and more Glaze Red than Period II. It appears that during this period these two types were about equally balanced, with 42 percent Galisteo and 34 percent Glaze Red—or not much difference from the situation in Period II, except for the expected slight drop in Galisteo Black-on-white. There were 1,714 sherds from this period. Galisteo and Glaze Red had the percentages noted above. Poge makes up 8 percent. Kendi seems to have fully arrived by this time, there being 21 sherds (1.2 percent) from this period, compared with 4 in the previous two periods. Wiyo is at a high point for this site with 7 percent, its highest showing. Biscuit A makes up 4 percent of the total, and there are 33 transitional Wiyo-Biscuit A sherds that make up 2 percent. Pindi is still present with 2 percent. Sherd-tempered Glaze Red has dropped to about 50 percent relative to the other temper types.

**Period IV**

Once Glaze Yellow appeared, there must have been a period during which it was produced in relatively small amounts. Level 2 of the stratigraphic test would appear to
be from this period. This level contains about 4 percent Glaze Yellow, deposited on top of Level 3, which has no Glaze Yellow. I made a somewhat arbitrary division and used 7 percent Glaze Yellow as the upper criterion for deciding which features should be in this early Glaze Yellow period. Thus in Period IV are all features that have Glaze Yellow, but in percentages of less than 7 percent. In the stratigraphic test, Biscuit A is well represented with 4 percent; Galisteo has dropped to 34 percent; and Glaze Red has risen to 45 percent. Sherd-tempered Glaze Red has dropped to 20 percent of the total Glaze Red. This is the most extensive period already at the site, with 40 features being included; quite clearly, the dominant occupation of Las Madres occurred in the first decade or so after the appearance of Glaze Yellow. There are 4,549 sherds assignable to this period. In this total sample there are 36 percent Galisteo, 42 percent Glaze Red, 4.3 percent Glaze Yellow, 6 percent Poge Black-on-white, 1 percent (48 sherds) Kendi Black-on-white, 6 percent Wiyo Black-on-white, 2.6 percent Biscuit A, 1 percent Wiyo-Biscuit A, and 1 percent Pindi Black-on-white.

Period V

The final two periods from the site are a little less secure, since there were no discrete ceramic events, such as the appearance of Biscuit A, to mark their limits. The model for Period V was Level 1 of the stratigraphic test. The 167 sherds from this level are divided into 35 percent Galisteo Black-on-white, 32 percent Glaze Red, 7 percent Glaze Yellow, 2 percent Poge Black-on-white, 8 percent Wiyo Black-on-white, 7 percent Biscuit A, 1 percent Wiyo/Biscuit A, and 2 percent Pindi Black-on-white (Table 1). The level contains 7 percent Glaze Yellow, which helps justify the generalization for the period that it includes features with a range of 7 to 15 percent Glaze Yellow. An arbitrary upper limit for the period of 15 percent Glaze Yellow was used, since there seems to be a real division about this point on the basis of the cheek made with Meighan's (1959) three-pole graph method; there is a clustering below this point and a wide scatter above it that belongs to Period VI. The 2,699 sherds included in Period V are divided into the following types: Galisteo, 31 percent; Glaze Red, 45 percent; Glaze Yellow, 11 percent; Poge, 4 percent; Kendi, .5 percent; Wiyo, 5 percent; Biscuit A, 3 percent; and Pindi, .9 percent. Overall, sherd-tempered Glaze Red had dropped to 21 percent and "andesite" temper had risen to 62 percent.

Period VI

Period VI has no level in the stratigraphic test to demonstrate its existence, but it is clearly inferable from the pottery distributions within the site; in other words, there was a period when the site was still being used but no trash was represented from the test area. Interestingly, I found after the analysis had been finished that there was originally an upper layer of about .3 m (1 ft) that had been removed in the early days of the excavation that very likely dated from this sixth period. The main clue to the existence of this sixth period was that, whereas there was only 7 percent Glaze Yellow in the uppermost layer of the test, there were many legitimate features that had 20 percent or more Glaze Yellow. There must therefore have been a period when Glaze Yellow had risen to be a very significant type at the site. Similarly, many features had very small amounts of Galisteo Black-on-white, suggesting that they had been deposited near the time when this...
type was being phased out. It was also noticed that features that were very high in Glaze Yellow and very low in Galisteo were also low in percentages of sherd-tempered Glaze Red (12 percent) and high in "andesite" tempered Glaze Red (76 percent). Features that shared these traits were then grouped into Period VI with a major diagnostic being the presence of 15 percent or more Glaze Yellow.

This period was the second heaviest period of occupation at the site with 3,191 sherds from 42 features belonging to it. Once the features were grouped and summarized, it was found that the types were divided in the following manner: Galisteo Black-on-white, 19 percent; Glaze Red, 48 percent; Glaze Yellow, 20 percent; Poge Black-on-white, 4 percent; Kendi Black-on-white, 5 percent; Wiyo Black-on-white, 4 percent; Biscuit A, 2 percent; and Pindi Black-on-white, 1 percent. It might be noticed that Galisteo, Poge, and Wiyo were declining during this final period of the site's history.

DATING THE PERIODS

Approximate dates were assigned to these six periods at San Marcos on the basis of ceramic cross-dating from other sites in the area. A number of sites from approximately the same period have been well-dated and offer reasonable means for dating the first appearance of several key types at Las Madres. Of primary value in this context is the tree-ring study made by Smiley and others (1953). The earliest features at the site equate with the latest levels of the Pindi site, which has been firmly dated as ending about A.D. 1348–1350 (Stubbs and Stallings 1953:155). Mera (1940:3) was of the opinion that by A.D. 1340 the early type of sherd-tempered Glaze Red was established in the Rio Grande Valley. He further offered evidence that the later type of Glaze Red (crushed-rock temper) had become popular by A.D. 1350. Since Period I features are either entirely or largely sherd-tempered, it seems reasonable to see these early features as existing by A.D. 1340—but probably no earlier. The upper limit of A.D. 1350 is suggested by the presence of crushed-rock temper in the Glaze Red sherds of the next level, Level 4. Period I thus has been given the dates of A.D. 1340–1350.

Period II is very likely from the decade of 1350–1360. The lower date is derived through the reasoning given above. The upper date depends upon the first appearance of Biscuit A in the region. This period is characterized by the presence of small amounts of "andesite"-tempered Glaze Red and no Biscuit A. Stubbs and Stallings (1953:154) use the same pottery chart, as do Smiley et al. (1953). This chart suggests that Biscuit A appeared about A.D. 1370. However, if this is true, the emergence of Glaze Yellow would have to be substantially past A.D. 1370 (1380?) to accommodate the sites (and Level 2) that have Biscuit A and no Glaze Yellow. It seems unlikely that Biscuit A appeared that late. Cundiyo site (LA 31), in the heart of the presumed origin area of Biscuit A, has a late date of A.D. 1343 (Smiley et al. 1953:39). It has Biscuit A, but is thought to have been abandoned at the beginning of the Biscuit tradition (Mera 1934:18). At least two sherds "resembling Biscuit A" (Stubbs and Stallings 1953:17) were present in the late deposits at the Pindi site. Stubbs and Stallings (1953:15, 56) thought the few sherds of Biscuit A at Pindi "were undoubtedly carried across the river from the School House Site." If indeed Biscuit A did not yet exist by the A.D. 1350.
abandonment of Pindi, this would give good evidence that the type did not come into being until after 1350. On the other hand, Agua Fria (LA 2, the School House Site) has Biscuit A in a context that indicates it was present by A.D. 1360 (Smiley et al. 1953:39). These and other sites discussed in Mera (1934) and Smiley and others (1953) incline me to believe that the transition to Biscuit A had taken place by 1360, or roughly 10 years before Stubbs and Stallings (1953) suggest. Period II then is terminated by the first appearance of Biscuit A and therefore would have ended by 1360. Period II thus dates between 1350 and 1360.

Since Period III is defined by the presence of Biscuit A, and this type is believed to have appeared about 1360, the beginning of the period is about 1360. Since the transition to Period IV took place when Glaze Yellow appeared (as discussed above), the upper time limit of Period III depends upon the date of the first Glaze Yellow. As with the early date of Biscuit A, the appearance of Glaze Yellow is only sketchily discussed in the literature. The total lack of Glaze Yellow at Pindi would definitely keep the appearance of this type at post-1350. In a similar manner, the sites that have Biscuit A but lack Glaze Yellow (Mera 1934) would indicate that it appeared late. If Biscuit A appeared by 1360, Glaze Yellow would have to have developed after 1360. Only a few dated villages actually offer clues to the dating of this type. Hupobi site (LA 380) has a late date of A.D. 1367 (Smiley et al. 1953:39) and apparently lacks Glaze Yellow (Mera 1934). Arrowhead Ruin (LA 251) is closer to the glaze production area and had dates between 1365 and 1392 (Smiley et al. 1953:39). This site has Glaze Yellow, but there is no suggestion as to when it appeared between 1365 and 1392. Mera (1940:3) only says that Glaze Yellow was present by 1392. In view of the fact that Glaze Yellow is present at Las Madres site in the next level above the first appearance of Biscuit A and that regionally Glaze Yellow seems to have appeared shortly after Biscuit A, I believe that this type began to be made shortly after 1360 or probably about 1370. Provisionally, this is the date I have used in this report, and I doubt if future work will change it more than 5 years either way; any change will probably be toward A.D. 1375. Period III would therefore date 1360 to 1370.

Period IV begins with the first appearance of Glaze Yellow, and as this is believed to have taken place about 1370, the period would have to have begun about 1370. This date is the last definite ceramic event that can be confidently correlated with regional ceramic patterns. The last three periods are thus dated backwards from the possible upper limit. There are two major types lacking at Las Madres that provide an upper limit to the dating of the site. These types are Glaze II (Largo Glaze Polychrome) and Biscuit B (Bandelier Black-on-gray). Stubbs and Stallings (1953) indicate on their chart that Biscuit B appeared by A.D. 1400. Mera (1934:17) says it appeared "some time before 1450." Biscuit B was not present at the Arrowhead Ruin (LA 251) in 1392 (Smiley et al. 1953:28). An interpolation between these dates would place the appearance of Biscuit B about 1425. If Stubbs and Stallings are correct (as they often are), the date would be closer to 1400. Glaze II is also somewhat hazy in the literature, but its presence at Site LA 183, which is just south of Las Madres, in the period A.D. 1413–1450 would be a strong suggestion that this type was present by 1425, if not earlier. These two types indicate that Las Madres was abandoned by 1425, if not earlier, since they are lacking
here and 1425 is the date of their probable first appearance. I am of the opinion that Las Madres was abandoned no later than 1415.

Somewhat arbitrarily I assigned each of the three periods following 1370 to a decade each. Obviously this could change between the limits of A.D. 1370 and 1415, but these approximate dates give a flexible framework in which to work. I thus believe that Period IV terminated about 1380, this being the time that Glaze Yellow began to appear in quantity. Period V would thus be after 1380, and it could have lasted to about 1390. Period VI lasted from about 1390 to the end of the site—sometime between 1400 and 1415.

—Museum of New Mexico, Santa Fe

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Stubbs, S. A., and W. S. Stalling
Metal arrow points of the historic period in the Southwest heretofore have received only scant documentation. This is particularly true for New Mexico. Accordingly, I will describe the physical attributes and distribution of 11 metal points in a surface collection from the Río Abajo section of the Río Grande Valley in and near Socorro, New Mexico. The term "Río Abajo" is used, in the sense of Marshall and Walt (1984:1), for the "...Pueblo and Hispanic province of the Piro, believed to have extended from the Paraje de Fra Cristobal on the south to Abeytas or Sabinal on the north."

**DISTRIBUTION AND DESCRIPTION**

The points exhibit considerable variation in configuration (Figure 1) and probably could be classified into several distinct types, if a sufficiently large collection were available. In view of the small number of points and their limited distribution, this will not be attempted here.

All are iron, with the exception of K in Figure 1, which is copper. Both A and K are the only examples of their particular style, whereas the other styles are each represented by two or more specimens.

Points B, C, D, and E are of particular interest, as they occurred in a cluster only a little more than 5 m across and are believed to have come from the quiver of a single individual. The circumstances of their loss challenge the imagination! Points B and C have narrow triangular blades, abrupt shoulders, and short rectangular stems with serrations produced by hacking with a knife. Both have been cut from thin sheet metal 1.5 mm thick. Shoulders retain chisel marks, and blade edges have been beveled and sharpened by filing. The tip of Point B was rusted through and broken off; it was probably trampled by stock. Part of the tip was recovered. Otherwise, there was no evidence of impact or other damage to any of the points.

Points D and E contrast to Points B and C in their narrow, willow-leaf blades with rounded shoulders and contracting stems. The stem on Point D was serrated with a file, whereas on Point E it was hacked with a knife. Chisel marks from initial shaping were largely obliterated, and edges were beveled by filing. Both were cut from thin sheet iron 1.5 mm and 1.7 mm thick (Points D and C, respectively).

This cluster was the northernmost occurrence of the metal points discussed in this paper, at approximately 25 km north of Socorro and well away from the river on the broad west slope of the valley.
Southward, at Socorro, three points occurred within a line approximately 40 m long (Points F, G, and H of Figure 1). Two of these (Points F and H) were only 7 m apart. Despite their proximity, I am reluctant to consider their apparent association as the result of a single event, although such a possibility cannot be ruled out. These points were recovered on the west edge of the valley at the eastern foot of the Socorro Mountains, within the Town of Socorro Grant.

Two distinct styles are represented. Point F appears to be a variant of Points D and E; the stem is shorter and rounded, with a
single file serration on one side. The blade is thicker (2.2 mm) and bears a central longitudinal ridge on each face, which is beveled toward the lateral edges. There is some suggestion that this may have resulted from hammer forging on an anvil, although it also could have been produced by filing, although the striae are now obscured by corrosion.

Points G and H differ markedly from Point F in having prominent barbs, rectangular stems, and little evidence of modification after having been crudely cut with a chisel. Point H shows slight impact damage to the tip. Both were fabricated from sheet iron that is 1.8 mm thick.

A single, isolated point (Point J in Figure 1) was recovered from the floor of a small mining prospect drift in the eastern foothills of the Socorro Mountains, a short distance west of the Town of Socorro Grant. Although it too is prominently barbed, it has a long, narrow stem; a short blade with markedly beveled edges; and more careful finishing by filing. Barbs have been carefully cut with a triangular file. Only the basal end of the stem retains the original chisel cut. Point J also was fabricated from sheet iron 1.8 mm thick.

Another isolated point was recovered from the east bank of the Rio Grande (Point I in Figure 1), also within the Town of Socorro Grant. Typologically it resembles Point H. It too is prominently barbed, has a long rectangular stem, and was crudely cut by chisel from thin sheet metal, with little subsequent modification. The thickness probably was originally less than the measured 1.4 mm because of its battered and corroded condition.

Point K is unique in this collection; it is sheet copper and has a broader leaf-shaped configuration, with a short rectangular stem. Both faces bear hammer marks from flattening. Chisel marks that may have resulted from initial shaping have been obliterated by filing of the blade and stem edges. The tip reveals slight twisting damage. The thickness is 1.7 mm. It may have been cut from a copper kettle, as these were in widespread use during the period in which this point was likely to have been manufactured (see discussion below). This point was recovered east of the Rio Grande and east of the Town of Socorro Grant.

The southernmost point (Point A in Figure 1) came from the eastern foot of the Magdalena Mountains on the western margin of the Rio Grande Valley, approximately 26 km southwest of Socorro. It differs from all of the others in its leaf shape, with ill-defined shoulders that taper gradually into the contracting stem. It retains traces of chisel marks and has knife-hacked serrations, file-beveled edges, and a nail hole. Thickness is only 1.2 mm. The nail hole is from a small, square, cut nail, which may indicate fabrication from an iron strap of the type used to bind wooden boxes of supplies shipped to the western military posts, as noted below.

**SOURCES OF METAL**

The native inhabitants of New Mexico and the Southwest north of Mexico had no metallurgical tradition prior to the first Spanish entrada, that of Coronado in 1540. The only metal available to them prior to that date consisted primarily of native copper, such as that obtainable from deposits at Santa Rita; occasional finds of iron-nickel meteorites; and copper bells traded from Mexico. Metal goods had only
limited availability prior to the Pueblo Revolt in 1680. With abandonment of New Mexico by Hispanic and Piro residents during the revolt, the sacking of villages and missions that followed probably provided sources of metal goods left behind in the hasty retreat of the occupants. A metal arrow point was recovered at a Navajo refugee site in the Largo-Gobernador district of northwestern New Mexico; the site provided tree-ring dates of 1679 and 1713, thus bracketing the interval of the revolt and the subsequent reconquest in 1692 (Powers and Johnson 1987:196). The point, unfortunately, was neither described nor illustrated.

It was the arrival of the U.S. Army under General Stephen Watts Kearny in 1846 that ushered in a period with increased availability of metal goods. The military was well supplied with metal-strapped boxes of supplies, barrel hoops, "tin" cans, cooking gear, and metal stock for the blacksmiths that could easily be fabricated into functional projectile points. Sword blades were readily converted for use in lances, as noted below.

**CULTURAL AFFILIATION**

Most metal projectile points are recovered as isolated surface finds lacking in recognizable cultural association and datable context. Contemporary literature commonly only briefly mentions the use of bows and arrows without adequate description or illustration of the points that would permit comparison with these finds. A brief review of the limited literature at hand has provided only a few references.

The Rio Abajo lies within the northern fringes of the Apachería, land of the Apaches (Thrapp 1967:ix–xii), and near the southeastern edge of Navajo territory (Brugge 1983:Figure 1C) by 1800. Both Athapaskan groups traded and raided into Socorro and the nearby villages and farms. Both of these groups are suspect as bearers of the points shown in Figure 1. However, another less notorious cultural group may have used metal points. These were the local Hispanic New Mexicans, who for lack of firearms armed themselves with bow, arrow, and lance. This also was true of the organized militia. A review of the militia of the mayorality of Belen on November 4, 1819, states that most members of the 3rd Co. of the 2nd Squadron were armed with gun and lance and 15 cartridges; 7 were armed with bow and 25 arrows, of which 6 also had a lance (Torres 1968:159–160). It may be assumed that the arrows were tipped with metal points.

Captain James H. Tevis and Mose Carson (a brother of Kit), while on a hunting and trapping expedition in 1857 on the San Francisco River in eastern Arizona, were threatened by a band of Indians. Carson shot one of these and removed an arrow from the victim's quiver, which he later declared bore the hallmark of Mangas Colorado's band, a copper arrow point (Tevis 1954:38, 42).

McNitt (1964:100, Footnote 107) noted that Navajo bows were short, backed with sinew, and powerful; arrows were steel tipped. This statement may have been derived from Hill (1936). McNitt (1964:201–202) further reports an observation by Henry Linn Dodge in 1855 that the Navajo had "...eighteen native blacksmiths who work with hand bellows and the primitive tools used by the Mexicans with which they make all of the bridle bits, rings, buckles &c." From this it appears highly probable that they also were capable of forging arrow
points from miscellaneous metal fragments, rather than being limited to thin sheet metal that could be shaped with a chisel.

Cremony (1954:188–189) commented as follows: "Let it be well understood that the Apache of today is armed with the best kind of rifle, with Colt's six-shooters...with ammunition to suit." And farther along: "In their hunting excursions they never fire a gun or pistol if it can possibly be avoided, but depend entirely upon their skill in approaching the game near enough to use the bow and arrow" (1954:194).

Betzinez (1959:5), an Apache born in 1850, made the following observation: "Many times as a boy have I watched men making spears and bows and arrows. The lances were generally tipped with the blades of sabers taken from the cavalry, while arrowheads were likewise filed from bits of steel or iron. In my time stone arrowheads had not been made for generations."

**COMPARISONS**

Only a few adequately documented illustrations were found of the various styles of Southwestern metal points that are comparable with those shown in Figure 1. Several of these examples will be cited in the notes that follow.

Perino (1968:10–11, Plate 5G) illustrates a point that is very similar in form to Point A in Figure 1. Designated as a Benton point, type B, from the Norteño focus that extended from Oklahoma, through Texas, into New Mexico, these points occur outside the geographic and cultural range of those from the Rio Abajo and elsewhere in western New Mexico.

Kidder (1934:Figure 250) illustrates two iron points (C and D), one of which has some similarity to the abruptly Shouldered Point B in Figure 1, and a prominently barbed point with a narrower blade than those from the Rio Abajo. Cultural affiliations are unknown, but both Apache and Comanche bands traded and raided at Pecos, and the Pecos themselves may well have used such points.

Basso (1971) shows a hafted arrow point of the Western Apache that exhibits the abrupt shoulder of Point B in Figure 1.

Roessel (1983:509, Figure 4) also shows an arrow with a hafted metal point, similar to Point B in Figure 1, that is attributed to the Navajo.

It may be expected that a thorough search of the literature will provide additional examples for comparison with the collection considered herein. Museum collections could prove even more revealing, regarding style variations, methods of manufacture, and possible cultural affiliations and dating. Private collections also merit study to aid in extending the currently limited distributional data. If it serves no other purpose, perhaps this paper will at least stimulate further research into the who, how, where, and when questions that still surround the use of metal projectile points in the Southwest.

**ADDENDUM**

After completing the manuscript for this paper, I received extracts from a report by Thompson (1979) that provide comparative illustrations of a number of metal arrow points from the Sacramento Mountains in southeastern New Mexico and from the vicinity of El Paso, Texas. I am indebted to...
David T. Kirkpatrick for bringing this material to my attention.

The points illustrated by Thompson (1979:Figures 1 and 2) have a particular significance in having come from two limited geographic areas; they are believed to be attributable to the Mescalero Apache, with the exception of Points K, L, and M of Figure 2 (Thompson 1979:149). Point A of Thompson's Figure 1 bears some similarity to Point A of Figure 1 of this paper in its simple leaf shape, rounded shoulders, and tapering serrated stem. Most of the remaining points in Thompson's Figure 1 generally resemble Point C on my Figure 1 in their triangular blades, abrupt angular shoulders, and short rectangular stems, some of which are serrated.

Thompson's (1979) Figure 2 includes points of both forms noted above. The prominently barbed points and willow-leaf forms of the Rio Abajo area, however, are not represented in the collections from the Sacramento Mountains and El Paso area, probably as a consequence of the cultural homogeneity of the latter two collections.

—Socorro, New Mexico

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Pueblo San Marcos (LA 98) is one of eight large pueblos located in the Galisteo Basin of New Mexico that were first recorded when Spanish explorers passed through the region (Nelson 1914; Schroeder 1979). Its adobe room blocks and enclosed plazas date from A.D. 1340–1700 (Warren 1981; See also Creamer 1992, 1994, 1995; Nelson 1913, 1914, 1915, 1916, 1919; Reed 1954). Its occupation spans a time of development and change in trade among the northern Rio Grande pueblos and between the pueblos and the information. Ethnohistoric and archaeological information allude to Pueblo San Marcos as a center for pottery production, with specific trade links to the southern plains (Habicht-Mauche 1987; Warren 1981). San Marcos’ proximity to the Cerrillos Hills, where the raw materials of galena (lead ore for glaze paint) and turquoise were available, also hints that it may have been a center for trade and specialization (Cordell 1991; Rice 1991; Shepard 1942, 1965; Warren 1979, 1981).

Surprisingly, only limited information is available about Pueblo San Marcos, although three episodes of excavation, some ceramic analyses, and numerous surface surveys have taken place there (see Creamer 1992, 1994; Habicht-Mauche 1987; Lightfoot 1990; Nelson n.d.; Reed 1954; Warren 1981; Welker 1994). The most current excavation suggests that San Marcos had over 2,000 rooms in 40 roomblocks (Creamer 1994).

However, as early as Nelson’s (n.d.) work, more than one phase of occupation was hypothesized. Creamer (1992:10) suggests "at least three phases [with] far fewer than half the roomblocks...being utilized during the final period of occupation."

Helene Warren’s petrographic analysis of the pottery of San Marcos is to date some of the most intensive work done on the pueblo. Warren (1979, 1981) focused attention on San Marcos as a center for ceramic production of glaze-on-yellow. She argues for specialization, based on the high concentration of glaze-on-yellow pottery found near the pueblo. The density of this "signature" pottery decreases with increased distance from the site (Warren 1979:Figures 10.10–10.12).

THE SURVEY

Pueblo San Marcos’ role within the greater northern Rio Grande and Galisteo Basin network is little understood. In order to put together a more comprehensive picture, I conducted a survey of surface ceramics at the site in the summer of 1993 (see Welker 1994). It was not possible to conduct a wholly conclusive analysis, because the entire pueblo could not be surveyed. Permission was granted to carry out research only on the 8 ha (20 acres) of San Marcos owned by The Archaeological Conservancy (Welker 1994). In addition, the
density of vegetation at the site was a limitation. Most of the upper and lower thirds were surveyed, the vegetation being thickest and the visibility the worst in the middle of the property (Figure 1). The areas closest to the 1981 excavations with the best visibility were given precedence in the lower third of the property.

The well-established Rio Grande Glaze pottery sequence was used to develop a relative ceramic dating for the site (Mera 1933; Nelson 1916). A noncollection survey was required, thus no detailed petrographic or chemical analyses could be made. A chronology of occupation phases was developed through the horizontal stratigraphy, and a sample of ceramics was examined for evidence of trade.

**SURVEY RESULTS**

Rim sherds were classified according to Mera’s (1933) Rio Grande glaze types. Rims thought to be transitional (i.e., one rim appears to be intermediate between two glaze types) were labeled as such. Frequency distributions of glaze rim types were calculated for the upper and lower areas of the pueblo. Bar-graph distributions of rim sherds across the pueblo appear in Figure 2, which shows that the lower end of the pueblo is clearly dominated by Glaze A and Glaze B, while the upper pueblo is dominated by Glaze C, Glaze C/D, and Glaze D. According to the surface assemblage, the use and occupation of the lower and upper pueblo are not wholly contemporaneous.

The distribution found at the bottom of the pueblo is 82 percent Glaze A and Glaze B rim sherds, dating the major occupation from approximately A.D. 1315–1450 (Figure 1). For the upper pueblo, 83 percent of the rim sherds are Glaze C and Glaze D, for an approximate occupation from A.D. 1425–1515. It is clear that the two areas do not greatly overlap in time. A more conservative estimate of the pueblo’s relative dates is obtained by factoring in all sherds according to changes in surface decoration.

The surface colors of Rio Grande glaze sequence types are outlined in Table 1. A decrease in glaze-on-red and/or glaze-on-yellow wares and a rise in glaze-polychrome should occur in the areas of the pueblo occupied after the end of the Glaze A and Glaze B series (see Table 1). The major ceramic types in San Marcos’ surface assemblage are presented in Table 2.

Few glaze-on-red sherds were found on the upper and lower pueblo. Glaze-on-red wares can indicate not only an early Glaze A occupation (A.D. 1315–1425) but also a later Glaze F occupation (A.D. 1600–1700) (Habicht-Mauche 1993). However, the small amount of glaze-on-red wares decreases the chance that either the upper or lower pueblo was occupied when glaze-on-red wares were dominant (Table 1).

Glaze-on-yellow was prominent early in the glaze sequence. Cordell (1984:340) states that "after about 1450, sites in the Galisteo Basin became production locations for glazes with cream-yellow-colored interior slips." More glaze-on-yellow is present on the earlier lower pueblo than on the upper pueblo, although the total square-meter area surveyed on the lower pueblo (14,400 m²) is little more than half the area surveyed on the upper pueblo (24,000 m²). In addition, more glaze-polychrome is found on the upper pueblo than on the lower pueblo, which correlates with less glaze-on-yellow as later glaze types take over. The glaze rim types document the progressive growth of
Figure 1. Area surveyed during 1993 at Pueblo San Marcos.
Figure 2. Bar graphs representing the frequency of glaze rim types on the lower and upper pueblo.
Table 1. General Appearance of Rio Grande Glaze Sequence Types.

<table>
<thead>
<tr>
<th>Ceramic series</th>
<th>Type name</th>
<th>Surface Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glaze A</td>
<td>Agua Fria Glaze-on-red</td>
<td>Glaze-on-red</td>
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<tr>
<td></td>
<td>Sanchez Glaze-on-red</td>
<td>Glaze-on-red</td>
</tr>
<tr>
<td></td>
<td>Cieneguilla Glaze-on-yellow</td>
<td>Glaze-on-yellow</td>
</tr>
<tr>
<td></td>
<td>Los Padillas Polychrome</td>
<td>Glaze-polychrome</td>
</tr>
<tr>
<td></td>
<td>San Clemente Glaze-polychrome</td>
<td>Glaze-polychrome</td>
</tr>
<tr>
<td>Glaze B</td>
<td>Largo Glaze-on-red</td>
<td>Glaze-on-red</td>
</tr>
<tr>
<td></td>
<td>Largo Glaze-on-yellow</td>
<td>Glaze-on-yellow</td>
</tr>
<tr>
<td></td>
<td>Largo Glaze-polychrome</td>
<td>Glaze-polychrome</td>
</tr>
<tr>
<td>Glaze C</td>
<td>Espinoso Glaze-polychrome</td>
<td>Glaze-polychrome</td>
</tr>
<tr>
<td></td>
<td>Pottery Mound Glaze-polychrome</td>
<td>Glaze-polychrome</td>
</tr>
<tr>
<td>Glaze D</td>
<td>San Lazaro Glaze-polychrome</td>
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<td>Glaze E</td>
<td>Puaray Glaze-polychrome</td>
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<tr>
<td></td>
<td>Pecos Glaze-polychrome</td>
<td>Glaze-polychrome</td>
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<tr>
<td>Glaze F</td>
<td>Kotyiti Glaze-on-red</td>
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<tr>
<td></td>
<td>Kotyiti Glaze-on-yellow</td>
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<tr>
<td></td>
<td>Kotyiti Glaze-polychrome</td>
<td>Glaze-polychrome</td>
</tr>
</tbody>
</table>

Note: Sources: Habicht-Mauche 1993; Warren 1979.

Table 2. Major Ceramic Types in Pueblo San Marcos Surface Assemblage.

<table>
<thead>
<tr>
<th>Type</th>
<th>Lower Pueblo (%)</th>
<th>Upper Pueblo (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glaze-on-yellow</td>
<td>34</td>
<td>20</td>
</tr>
<tr>
<td>Glaze-polychrome</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Polished-red</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Polished-yellow</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Utility ware</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

the pueblo, with the lower pueblo being occupied earlier and the upper pueblo being used later. However, the analysis of all the sherds and their wares blurs this distinct picture. Glaze-on-yellow makes a strong appearance on the lower pueblo and are dominates, along with polished-yellow wares. However, glaze-polychrome and polished-red dominate the upper pueblo. Overall ware analysis indicates a greater overlap in occupation than do the rim types, although the temporal division of the pueblo is supported. The lower pueblo assemblage strongly argues that it was used
during the Glaze A and Glaze B periods (A.D. 1315–1450), but there may have been occupation during the production of Glaze C (A.D. 1425–1500). The upper pueblo’s glaze-on-yellow pottery cannot be ignored; therefore this part of the site was probably in use from Glaze B to at least the beginning of Glaze D (A.D. 1400–1515). Occupation of the upper pueblo could extend into historic times, but the evidence is not great enough to state that with certainty.

The rim sherds on the lower pueblo confirm its earlier occupation, indicating concentration upon use of glaze-on-yellow. The upper pueblo shows the end of the concentration upon one glaze ware type; more types appear and are counted in similar percentages, and the rims exhibit the shapes developed later in the Rio Grande glaze sequence. The rim sherds give a narrowly focused chronology, while the glaze ware types allow the chronology to be expanded. The general appearance of all the pottery offers a more reliable chronology.

**Temper and Vessel-Shape Analyses**

With the pueblo’s chronology established, we may look at two attributes of pottery that can be affected by trade and exchange. Temper can indicate local or nonlocal manufacture of ceramics. Vessel shape offers an interesting correlation with trade after A.D. 1350.

Pottery found on a site was not necessarily produced at the site. Temper and paste provide clues to suggest whether ceramic items are locally manufactured or imported. Ethnographic and archaeological evidence indicate that raw materials for ceramics are not likely to have been carried great distances (Habicht-Mauche 1993:59). Distinctive geologic materials can be traced to their source of origin, thereby suggesting the place of manufacture for the pottery.

Temper and paste of all recorded sherds were examined with a 10x hand lens under natural light. Andesite, as named by Anna Shepard (1942), is for San Marcos and the Galisteo Basin. The signature temper material Andesite is referred to in the literature as augite-latite/monzonite, augite-latite tuff, and San Marcos latite (Habicht-Mauche 1993; Olinger 1992; Schaafsma 1979; Warren 1981). I will use the term "augite-latite." Red-firing clay is also a noted local characteristic producing a paste color that can range anywhere from red to gray to a mix of both, depending on firing conditions.

Sherds were typed when possible with a general vessel shape (i.e., jar, bowl, ladle). Changes in vessel shape may be related to the increasing importance of trade. Habicht-Mauche (1993:47) notes "that the introduction of the olla form corresponds temporally with evidence for increasing contact and trade between the various pueblos of the northern Rio Grande" and that the spread of the jar form after A.D. 1350 is related to increased trading and a new need for transport and storage containers. Vessel shapes found on the surface of Pueblo San Marcos should show evidence that the olla functioned as a popular container for the transport and exchange of other commodities and possibly as a trade item itself, although other uses such as carrying water to fields cannot be dismissed (Habicht-Mauche 1990).

On the lower pueblo, 76 percent of the jar vessels were made with augite-latite temper and a red-firing clay. On the upper pueblo, augite-latite temper and gray paste
dominate the jars. Atypical tempers in jars are more frequent on the upper pueblo than on the lower pueblo. There is a slight decrease in the augite-latite and red-firing clay combination and a 9 percent increase in augite-latite temper and yellow paste sherds on the upper pueblo.

The pottery at San Marcos is dominated by augite-latite temper with a gray or red paste. Augite latite with yellow paste increases in frequency on the upper pueblo. The temper of these yellow-paste sherds could be a closely related latite that was not distinguishable under 10x magnification in the field. For instance, a hornblende-latite temper and yellow or buff paste combination has been considered indicative of the Tonque variety of Glaze I Yellow or Cieneguilla Glaze-on-yellow; the sherds could be imported from there (Schaafsma 1979; Shepard 1942; Warren 1981). Augite-latite temper and yellow paste occur in the upper pueblo pottery 17 percent of the time, compared with 8 percent on the lower pueblo. The increase in potentially imported pottery could represent the decline of San Marcos’ role as a trading partner. This indicates a change in the ceramic assemblage whether or not it is due to a change in local manufacturing or an increase in the acquisition of imported pottery.

Vessel shapes were determined on the basis of curvature and the location of paint or slip decoration. On the upper pueblo, 796 sherds were assigned to a vessel form. Fifty percent of the sherds analyzed on the upper pueblo were identified as bowls, 32 percent were of unknown shape, and 18 percent were identified as jars. The lower pueblo specimens numbered 478. Forty-seven percent of the sherds on the lower pueblo were from bowls, 28 percent were of unknown shape, and 25 percent were classed as jars.

K-sample chi-square tests were performed to determine if the vessel shape assemblage was any different between the upper and lower pueblo. There is a significant difference between the presence of jars on the upper and lower pueblo ($\chi^2 = 35.3331$, $p < .001$, $df = 5$). Bowls also exhibit a significant difference between the lower and upper pueblos ($\chi^2 = 125.0663$, $**p < .001$, $df = 8$). The vessel shapes do not fit into the same frequency distribution.

The relative dating of the site places the earlier occupation at the lower pueblo. The occupation of the upper pueblo is contemporaneous after approximately A.D. 1400 but continues beyond the expected occupation of the lower pueblo. As discussed above, an increase in jar-shaped vessels (particularly the olla form) occurred after A.D. 1350 (Habicht-Mauche 1993). The greater percentage of jar shapes encountered on the lower pueblo falls within the time frame of increased trade and the corresponding need for ceramic storage and transportation vessels. The lower percentage of jar shapes on the later-dated upper pueblo can be correlated temporally to the decline in trade for Pueblo San Marcos and the entire Galisteo Basin in the late 1400s (Warren 1979). It is also possible that the decrease in the jar shape reflects a change in behavior or use patterns. For instance, perhaps earlier agricultural intensification entailed bringing many jars to the fields to water crops. Likewise, jars could also have been discarded in areas not encountered in a surface survey.

Evidence for change in San Marcos’ pottery is found when comparing the
frequencies of augite-latite temper with gray, red, or mixed pastes (Table 3). The number of bowls and jars with this temper and paste combination differ significantly between the lower and upper pueblo (*p < .001). The bowls and jars on the lower and upper pueblo with the augite-latite temper and yellow paste also differ significantly (bowls at **p < .001 and jars at .001 < p < .01).

The change in the proportions of wares with the local temper and paste combinations may demonstrate the apex of Pueblo San Marcos’ role as a major ceramic or trading center. The incidence of bowls and jars with the locally available augite-latite temper and gray, red, or mixed paste combination is not the same between the earlier, lower pueblo and the later, upper pueblo. Correspondingly, the rise of the potentially foreign augite-latite temper and yellow paste combination on the upper pueblo significantly impacts the jar form. It is likely that, by the time the upper pueblo was occupied, the role that Pueblo San Marcos played in trade, ceramic production, and redistribution was diminishing.

DISCUSSION

Clearly, the ceramic assemblage was not static at San Marcos. The types of glaze wares produced, used, and discarded changed through time, but San Marcos always emphasized yellow-slipped wares. The vessel shapes changed, as evidenced by the rise of new temper and paste combinations in jar forms and the corresponding trend toward locally made bowl forms on the later, upper pueblo.

Pueblo San Marcos lies east of the Cerrillos Hills where lead ore and turquoise were mined. Outcrops of intermediate volcanic rocks are close at hand (Habicht-Mauche 1993; Shepard 1942; Warren 1981). Helene Warren (1979:190) commented that, during the glaze-on-yellow period from A.D. 1325-1450, "the main ceramic industry was at San Marcos Pueblo (LA 98), which was strategically located near extensive clay deposits and within two miles [3 km] of the Cerrillos lead mines. The distinctive tempering material, augite latite from the Espinaso Volcanics, was quarried nearby." My research performed in 1993 was intended as the initial step toward specifically outlining and confirming the role Pueblo San Marcos played in the wider exchange network.

For at least the first 50 years of the fifteenth century, Pueblo San Marcos produced mainly glaze-on-yellow ceramics that emphasized the jar form. In addition, Warren (1981:2) notes that "the production of glaze-on-yellow and glaze-polychrome in the Galisteo Basin has long been recognized. Glossy cream-colored slips on red-firing clays are distinctive. Such wares had been well developed by A.D. 1400 and San Marcos appears to have been the major production and distribution center for this pottery." As it stands, the preponderance of yellow-slipped wares probably indicates the apex of Pueblo San Marcos role in large trading networks. The local manufacture of glaze-on-yellow seems to be corroborated by temper and paste analysis showing that nearby geologic materials were used in the ceramics. Anna Shepard (1942:158) said "the most significant difference between the two stylistic groups is in relative temper uniformity: unlike the Early Group [Glaze A Red], the Intermediate Group [Glaze A Yellow, Glaze B, Glaze C] is comparatively homogenous; it furnishes a clear-cut example of correlation of style and temper." The Intermediate sherds on the surface at
Table 3. Common Temper and Paste Combinations by Vessel Shape, at San Marcos.

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Lower Pueblo</th>
<th>Upper Pueblo</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Count</td>
<td>Combination</td>
</tr>
<tr>
<td>Bowls</td>
<td>149</td>
<td>Augite-latite temper and gray, red, or mixed paste</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>Crushed rock temper and gray paste</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Augite-latite temper and yellow paste</td>
</tr>
<tr>
<td>Bowls</td>
<td>89</td>
<td>Augite-latite temper and gray, red, or mixed paste</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Augite-latite temper and yellow paste</td>
</tr>
</tbody>
</table>

San Marcos comply with this observation. To summarize, San Marcos’ early ceramics phase emphasized yellow slips, jar forms, and locally available materials. Later ceramics show a decreasing emphasis on yellow slips and an increase in potentially imported pottery.

There are some problems with continuing to tout San Marcos as a ceramic production center, although it is clear the pueblo exhibits the influences of trade. The clay sources near San Marcos are located within 5 km (3 mi) of the pueblo, although not at any great distance. Reconnaissance during the summer of 1994 in the general area, aided by Helene Warren’s 1967 petrographic collection, yielded extensive red and gray clay sources near San Marcos and Pueblo IV-period petroglyphs of kachina masks. Outcrops of augite-hornblende latite are abundant near the clay sources. However, thin sections made from outcrops near San Lazaro, another Galisteo Basin pueblo, were magnetite-augite latite and augite-latite magnetite porphyry. This raises the question whether augite-latite temper really indicates an exclusive signature for San Marcos pottery. This signature temper may be more global than local in occurrence. Augite and latite inclusions are a definite characteristic of Galisteo Basin ceramics, but we may not be able to localize those outcrops within that greater geographic province. Geologic maps show other sources of augite latite near San Lazaro and Pueblo Blanco. A known prehistoric clay mine occurs on San Lazaro, and evidence of ceramic production was recently located (John Ware, personal communication 1994). Latite is common in
intrusive igneous rocks throughout the Galisteo Basin.

The lack of ceramic-firing or production areas within the pueblo is also alarming, since San Marcos' stature as a major ceramic producer remains unchallenged (Warren 1979, 1981). No statistics on the volume of prehistoric ceramics have been produced that would help to prove surplus or increased production, presumably because comparative databases for two or more sites are hard to come by. As I am often reminded, volume ceramic production is a messy operation and kiln areas away from habitation areas, such as the Woods Mesa example (Sullivan 1988), seem to evidence that people moved ceramic production away from their homes as necessary or desirable. (see Sullivan 1988). Indeed, the Museum of New Mexico, Laboratory of Anthropology's Archaeological Research Collection has an enigmatic bag labeled "San Marcos workshop" with directions to a location near the clay resources. I hope that further investigation can relocate or locate workshop or production areas near San Marcos. This is a large reconnaissance task to accomplish with the ever-increasing urban residential development around the site.

The surface assemblage of San Marcos hints at the information contained within the greater Galisteo Basin region. Chronologies need to be further refined, and evidence of trade influences beyond pottery should be explored. Many new questions arise at the end of each field season, making interpretations of the Galisteo Basin pueblos even more complex.

ACKNOWLEDGMENTS

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PREHISTORY OF THE GALLINAS MOUNTAINS, SOCORRO COUNTY

John P. Wilson

In the summer of 1991 I surveyed 109 km (68 mi) of old roads prior to their closure, in the Gallinas Mountains and on adjacent slopes northwest of Magdalena, New Mexico (Figure 1; Wilson 1991). These lands are all within Cibola National Forest. In this paper, I present the results of the archaeological survey and their implications for the prehistory of the Gallinas Mountains.

ENVIRONMENTAL SETTING

The Gallinas Mountains form part of the Mogollon-Datil volcanic field, which here overlies the Mogollon slope, a gently dipping sequence of mid-Tertiary volcanogenic strata along the southeastern margin of the Colorado Plateau in western Socorro County. This field is an outlier of a much broader volcanic province that formed before the fault-block physiography of the Basin and Range province had fully developed (Chamberlain and Cather 1994:5-6; Elston 1989:43-44).

Rhyolite tuff of the Hells Mesa member occurs in the northeastern part of the survey area, while latite of the Spears member is present to the west and south. Both members were originally included in the Datil formation, but this terminology is being revised in light of the complex lateral gradations now recognized. The Spears member typically weathers into rounded hills and ridges, whereas the rhyolite of the Hells Mesa tuff forms steep vertical cliffs. Lava flows cap some of the higher elevations. East of the tuffaceous strata is an exposure of the underlying Baca (now Hart Mine) formation, a series of mudstones, sandstones, and conglomerates. Lower-lying areas are covered with Quaternary alluvium and bolson deposits (Cather et al. 1994:259-266; Chamberlin and Cather 1994:5-6; Dane and Bachman 1965; Givens 1957; Tonking 1957; Weber and Willard 1963:38).

Topographically the project area is dominated by broad, rolling slopes and low rounded hills and ridge lines, separated by eastward-draining arroyos (Figure 1). North of Council Rock Arroyo, the terrain becomes a series of mountainous ridges and canyons with occasional flats and parks. The latter include large areas with sand fields. Many of the arroyos have firm, flat beds and serve as roads. Elevations range from 2,195-2,376 m (7,200-7,800 ft) in the mountains, with the higher peaks rising to above 2,560 m (8,400 ft).

Around 1954 the Gallinas Mountains were virtually clear-cut of timber because of disease then affecting the ponderosa pines. The young or small trees that were not cut survived and grew, but are not reproducing, so that ponderosa growth throughout the mountains is scattered. Piñon-juniper woodland is the dominant cover, with tree...
Figure 1. The 1991 Project Area.
spacing at lower elevations more open, and alligator junipers appearing on the higher slopes and ridges. The understory is nearly free of brush. Surface water is scarce, with no permanent streams and few springs.

**KNOWN RESOURCES**

Danson (1957:75–79) summarized most of what is known about the prehistory of this region, but the area of his own fieldwork lay principally to the north and west. In addition, cultural-resources management surveys generated 31 brief reports on telephone-cable corridors throughout the Magdalena Ranger District. The best-known site is the very large, multistoried pueblo ruin at Gallinas Springs, LA 1178, where three field schools and a stabilization effort produced a series of manuscript reports (Bertram 1987; Davis and Winkler 1960; Green 1974; Knight 1981). Berman (1979: 64–65, 70–71) reviewed the nature and status of this site.

**THE GALLINAS MOUNTAINS**

The roads that I examined in 1991 tended to follow ridges and valleys and provided a means for sampling several types of terrain. Prehistoric sites were unexpectedly numerous and occur almost everywhere up to elevations of 2,410 m (7,900 ft). Thirty sites were recorded and assigned the numbers LA 85488–85494, LA 85528–85539, and LA 85837–85847, inclusive. Probably as many more were seen outside of the survey corridors. These new findings provide a basis for outlining the prehistoric occupation of the Gallinas Mountains.

These sites represented four discrete intervals, separated by periods during which we have no evidence for people living in these mountains. Because of these discontinuities, the Gallinas Mountains lack a developmental sequence, in the sense of a continuing occupation with one prehistoric phase leading into another. This did not seem to be a result of a small sample size, and the movement in and out may be a normal pattern where areas were not favorable for permanent settlement.

**Late Archaic Period**

Only a single lithic scatter, LA 85534, was recorded. Occasional isolated artifact finds and the way that such scatters are commonly found in groups suggest that additional sites are present. Site LA 85534 lay on a long ridge line at the point where a gentle, southeasterly slope flared into a flat below. Although no features were present, the site area had good integrity. Much of the lithic debitage was concentrated within 150 m² in an overall area 11 times that size. Fifty-eight pieces of debitage (all that were observed) and three projectile point fragments were tabulated.

One point base was a small San Pedro point, a style typical for the San Pedro stage of the Cochise culture from southern Arizona. The material however was the chert with scattered red and yellow mossy inclusions in a white chaledonic matrix (No. 10921) from the Coronado Quarry near St. Johns, Arizona. A second point, of rhyolite, appeared to be a large San Pedro style, and a third one with half of the base missing was an Armijo point possibly of San Andres chert (No. 1016?) identified within the Oshara sequence of north-central New Mexico.

The projectile-point chronologies that underlie both the Oshara and Cochise sequences are not well documented (Camilli
et al. 1988:6–1; Chapman et al. 1985:111, 130; Hogan 1985:91, 93). These studies and others have considered Archaic-period point styles from this part of New Mexico and adjacent Arizona at length (Bruder 1993; Dick 1965; Hurt and McKnight 1949; Westfall 1981). Hogan’s conclusion was that San Juan Basin materials were predominantly Oshara styles, while those from the San Augustin Plains (a few kilometers west of LA 85534) primarily indicated Cochise groups. The Fence Lake area north of Quemado, New Mexico, contained a mixture of materials from the two sequences (Hogan 1985:94–97). However, an older study of points from surface sites on the San Augustin Plains appeared to show mostly Oshara forms, however (Hurt and McKnight 1949).

The situation actually is more complex because the Pelona and Augustin points identified from the San Augustin Plains belong to no named tradition, while a series of small, generally convex-base unnotched and unstemmed projectile points from preceramic sites south of Quemado were most similar to certain points at preceramic sites near Santa Ana, New Mexico (Agogino and Hester 1953:137, fourth row; Wilson 1989). These presently have no name.

As for Site LA 85534, it appears to be Late Archaic and of uncertain affiliation. The concentration of debris suggests that this site represents a single family and a single dwelling, perhaps with multiple visits. Eleven types of lithic materials were identified, four of which were nonlocal in origin and occur in amounts greater than 10 percent. Combined with the small size of the debitage (80 percent between 1.0–2.0 cm long), these suggest that LA 85534 was a short-term work station where flake detachment was incidental to the principal activity, which was perhaps piñon collecting.

**San Marcial Phase**

Near the conclusion of the survey, two days were spent in mapping and puzzling over a very large (circa 31,000 m²) and nearly featureless site spread over a low, flattened ridge line. Finally, I realized that Site LA 85844 was a large San Marcial phase site, the only one found during this survey. Nineteen years earlier I had recorded a similar San Marcial site at LA 4032 in far western New Mexico and had misinterpreted the findings at the time.

**Other San Marcial Sites.** In 1935 H. P. Mera defined San Marcial Black-on-white from Site LA 1141 in the lower Rio Grande valley just north of the town of San Marcial. He added later that 11 sites in the valley, between the mouth of the Rio Salado on the north and Nogal Creek on the south, exhibited San Marcial Black-on-white with associated brown-ware ceramics (Mera 1935:25–27, Plate XIV, 1943:9–10). Marshall and Walt (1984:36–45, 313) revisited the area and found a few San Marcial Black-on-white and Cibola Gray ware sherds at LA 1127, together with brown-ware sherds similar to those at eight additional sites they assigned to the San Marcial phase. Mera’s original descriptions were quite good, but he made one serious error in considering San Marcial Black-on-white to be "a regional derivative of White Mound Black-on-white" (Mera 1943:9).

In 1953, a site with San Marcial decorated pottery was finally excavated near Santa Ana pueblo in the middle Rio Grande valley. On the surface and in two shallow, circular pithouses, the archaeologists found the San Marcial pottery in association with
Woodruff Brown and a variety of other utility wares. The utility wares were similar to Lino Gray with well-smoothed to polished surfaces and surface colors ranging from white to light gray, tan, brown, reddish brown, and brick red, including fugitive red (Allen and McNutt 1955). While the colors exhibited this gradation, the *affinis* Lino sherds remained identical in other respects. The investigators explained the site as representing a mixture of traditions, predominantly Anasazi.

Pottery from the excavation of Site I of the Artificial Leg sites near Corrales, New Mexico, included San Marcial Black-on-white and a combination of plain gray and brown wares. The archaeologist dated this San Marcial phase component to between A.D. 550–700 by combining data primarily from ceramic analysis and a single archaeomagnetic date (Cordell 1979:42; Frisbie 1975, 1982; Galinat et al. 1970). Other locations in the middle Rio Grande valley that probably date to this same phase include Pithouse 3 at the Denison Site (Vivian and Clendenen 1965) and Pithouse I of two pithouses near Zia Pueblo reported by Vytlacil and Brody (1958).

Sites with ceramic complexes very similar to these are more widespread than any of these authors realized. Another excavated site, LA 2506 southeast of Tohatchi, New Mexico, had two shallow pit structures associated with Woodruff Brown and Polished Lino Gray pottery (Wendorf et al. 1956:51, 56). About 1.6 km (1.0 mi) away at LA 2507, Pithouse A yielded polished-surface gray-ware pottery identified as Twin Trees Plain and Twin Trees Black-on-white, to the exclusion of rough-surfaced sherds found elsewhere on the site. This structure had tree-ring bark dates of A.D. 605 and 606, with nonbark dates of A.D. 610vv and 611+vv, as well. Pithouse 5 at this same site featured tree-ring cutting dates of A.D. 622, along with Lino Gray and small amounts of both polished-surface gray-ware and brown-ware pottery. The decorated sherds there obviously caused much confusion, but they were eventually classed as La Plata Black-on-white (Bannister, Robinson, and Warren 1970:31; Johnson 1962; Wendorf et al. 1956:56–65).

Just west of the state line at Lupton, Arizona, the slightly earlier Pithouse 2 at AZ K:12:16 had predominantly Lino Gray pottery associated with tree-ring dates of A.D. 532vv and 552v. Brown-ware types found in small amounts in Pithouse 2 were dominant in two nearby pithouses assigned to the same Lupton phase (Bannister et al. 1966:15; Wasley 1960). This early community appears to be another San Marcial phase settlement, but better descriptions of the ceramics are needed. Perhaps the well-preserved remains at a nearby site with a tree-ring date of A.D. 915cB, identified only as Lupton-Misc. I, belongs to this horizon as well (Bannister et al. 1966:31).

**Interpreting the San Marcial.** By the 1970s, Mera’s original discussion had largely been lost. Some years earlier Helene Warren had been introduced to San Marcial Black-on-white, and in 1972 she began petrographic examination of sherds from the type site, LA 1151, and from other Basketmaker III sites in the upper middle Rio Grande valley and the San Juan Basin (Warren 1985). Others were raising questions as well (Laumbach 1974). Although Warren published relatively little on her findings, her work was extensive. Much of this section derives from conversations with her, and from an earlier synthesis of her ideas (Wilson 1976:39–44).
San Marcial sites have seldom been recognized for several reasons:

1. San Marcial Black-on-white is unfamiliar and has been confused with Black-on-white styles such as White Mound and Kiawatha Black-on-whites. The latter appear to be more recent by 150 to 250 years.

2. San Marcial sites have been subsumed under the heading of Basketmaker III, a class that includes La Plata Black-on-white, Lino Black-on-white, Chapin Black-on-white, and other styles. This limits any discussion about cultural affiliations to the proportions of brown and gray wares (Mogollon or Anasazi?).

3. Large individual San Marcial sites and clusters of small ones are often widely separated. Even extensive surveys may locate none at all or only one or two. For example, a transmission line survey east of Tohatchi, New Mexico, encountered a cluster of smaller sites at LA 11222, LA 11223, LA 11357, and LA 22358; all have typical San Marcial phase ceramics and are no doubt part of the same colony or community as Sites LA 2506 and LA 2507. About 16 km (10 mi) to the east near Coyote Canyon, excavations at Site LA 2547 produced large amounts of a plain ware that is red to brown in color and usually polished, apparently from an early component there (Hammack 1964). Yet just to the north in the Chuska Valley, more than 1,700 sites in an area of some 1,856 km² (725 mi²) included only a single eroded sherd scatter at Site LA 7326 west of Newcomb, New Mexico, with ceramics similar to those from the cluster near Tohatchi (Peckham and Wilson n.d.). The Bisti-Star Lake project examined 62 parcels, each approximately 2.56 km² (1 mi²) to the north and east of Chaco Canyon and identified no San Marcial sites (Huse et al. 1978). The Alamito Coal Lease (26 sections) and Star Lake (22 sections) surveys, both to the east of Chaco Canyon, reported none of these sites (Wait 1976; Wilson 1979). The San Augustin Coal Area survey north of Quemado yielded an extensive refuse scatter at Site 429, Cheap Johns Village, which by the description appears to be a large San Marcial-phase community similar to Sites LA 4032 and LA 85844 (Camilli et al. 1988:5-18 to 5-20, 5-28 to 5-30, 5-51). Site 335, scarcely 6.4 km (4 mi) north of Quemado, may be another such site (Bullard 1962:7; Camilli et al. 1988:2-3 to 2-4; Wendorf et al. 1956:64).

Warren (1979:190-191, 214-216) has defined San Marcial Black-on-white as "Polished surfaces; course grained [sandstone] temper; red, black mineral paint designs; fine lines, ticking, flags, Z's, dots, framed elements....best dates A.D. 500-675." In Ceramic Group I created but not used for the Alamito Coal Lease survey, associated types were San Marcial Black-on-white, Lino Polished, Lino Polished (fugitive red), Lino Smudged, Lino Red, Woodruff Brown, Woodruff Smudged, Woodruff Red, Lino Gray, and Lino Gray (fugitive red). Elsewhere she included additional type names, some of which are probably synonymous, among the ceramics of her San Marcial phase (Warren 1985:2). In San Marcial Black-on-white sherds from the lower Rio Grande valley, the tempering material was a hornblende latite, probably from the Datil formation volcanics of central and west-central New Mexico (Oakes 1986:84; Warren 1980:154, 1985:1). Good illustrations of the decorative style may be seen in Mera (1935:Plate XIV), Wimberly
The mineral-paint San Marcial designs range in color from black through reddish brown to red, with reddish tones being more common than black. The exterior or decorated surfaces are well-smoothed and usually polished. Small bowls and seed jars, the latter with pierced lug handles, are common forms. The designs have little in common with White Mound Black-on-white (Ferg, in Hammack et al. 1983; Frisbie 1984), while La Plata Black-on-white, another type that is primarily later in time, has similar designs but unpolished surfaces (Warren 1979:191). Allen and McNutt (1955) noted aptly that "some sherds suggest crude and heavy version of Kiatuthlanna B/w." In my own experience, distinguishing San Marcial from Kiatuthlanna Black-on-white is the greatest identification problem.

The question of when and where the San Marcial phase arose can be answered tentatively. The tree-ring dates cluster between A.D. 520 and the A.D. 620s. Pottery-bearing sites with earlier radiocarbon or tree-ring dates have been found in the Hay Hollow Valley of east-central Arizona, in northern Arizona, and in Utah (Berry 1982:39–44, 54–56, 63–65, 68; Gladwin 1957:41–43, 50–52), but these are apparently unrelated. The excellent data assembled by Berry (1982) show that by A.D. 520, an Obelisk Gray/Lino Gray tradition existed in the northern Southwest, without decorated pottery, and that at least in northern Arizona this may have continued through most or all of the sixth century A.D. (see also Peckham [1954] and Bannister et al. [1966:34]). There are no grounds for suggesting that the San Marcial phase originated to the north, west, or east of its presently known distribution.

The forms, the polished surface, and the stylistic similarities between San Marcial Black-on-white and Mogollon Red-on-brown vessels; the wide color variation in Lino-like utility ceramics; and the widespread distribution of San Marcial sites combine to indicate that this phase began when people from the Mogollon area moved into the country north of present U.S. Highway 60, as far north as Chaco Canyon, soon after A.D. 500. They retained their brown-ware pottery traditions but with highly variable results during the first century or so, in part because they initially lacked familiarity with the pottery clays in the new country. This situation is probably analogous to the supposedly degenerate glaze-paint ware at Pecos pueblo, which was actually a reflection of the trials and errors at the beginning of glaze-paint pottery production there (Warren 1980:154). By about A.D. 620 the experimentation was over and the gray-ware tradition we associate with the prehistoric Anasazi won out. From the evidence of the Cerro Colorado site, the La Plata phase probably began around A.D. 630, perhaps in west-central New Mexico rather than in the far northern Southwest (Bannister, Hannah, and Robinson 1970:18–21; Bullard 1962).

From the data he assembled, Berry (1982:89–90) believed that the temporal patterning for the first half of the Anasazi sequence contained two hiatuses, with the more recent one between about A.D. 370–600, and that this undermined the concept of a continuous development. His research was limited to the Colorado Plateau, and he was not aware of the San Marcial concept, nor did he control all of the available literature. My own interpretation is that the San Marcial phase is probably neither Mogollon nor Anasazi but something transitional; in Berry's terms,
however, it fills the latter part of his more recent hiatus.

During the century or so about A.D. 520–620, San Marcial sites consisted of rounded and often shallow pithouses with or without rock-cobble outlines surface rooms that presumably had jachal superstructures. The largest site areas are almost featureless on their surfaces but may have a Great Kiva. Settlements are found on reasonably level terrain, often in nonagricultural areas, and there is little evidence of a pattern other than the substantial distances between the large sites and the clusters of smaller ones, as if these had been colonizing ventures. In addition to the very large site areas at Sites LA 4032, LA 85844, and the Cheap Johns Village, Warren (1985:2) identified Site 29SJ 423 at the west end of Chaco Canyon as a San Marcial phase site and stated (personal communication circa 1976) that Site 29SJ 1659 (Shabik'eshchee Village) had a San Marcial component. Roberts (1929:75–77, 146) had previously determined, from stratigraphic evidence, that Shabik'eshchee Village had two occupations. The two latter sites have tree-ring dated structures. A sixth century occupation is now postulated for Shabik'eshchee. A preliminary report placed initial construction of the Great Kiva at 29SJ 423 between A.D. 520 and 540, with a rebuilding between A.D. 540 and 550, and a third episode of construction after A.D. 557 (McKenna and Truell 1986:39–42, 54–58). The large sites apparently had no smaller satellite communities, while a group of small sites does not necessarily imply the presence of a very large one nearby.

It seems clear that antecedents for the decorated pottery lie within the Mogollon area, but it is not the case that San Marcial Black-on-white has no descendants (Marshall and Walt 1984:38). At the Cerro Colorado site north of Quemado, the earliest pithouse dated from around A.D. 626, while others assigned to the Basketmaker III period had been built at intervals during the seventh century. Pottery included several varieties of Lino Gray; lesser amounts of Mogollon Brown wares of the Woodruff, Alma, and Forestdale series; and La Plata Black-on-white as the only decorated type. Many sherds of the latter were well smoothed (Bannister, Hannah, and Robinson 1970:18–21; Berry 1982:71–76; Bullard 1962:10–11, 62). At this site and presumably elsewhere it appears that the San Marcial Black-on-white of the early seventh century was one of the pottery types that underlay the development of La Plata Black-on-white.

This reconstruction favoring a southern origin for certain Anasazi ceramic production and decorative techniques aligns with Wasley's (1960) interpretations based upon his work at Lupton, rather than with inferences that early Basketmakers pushed south and west out of highland zones on the northern periphery of the San Juan Basin (in Vivian 1990:119, 131–133, 456). Warren's petrographic analysis of sherds from Sites 29SJ 423 and Shabik'eshchee lends support, in that most of the decorated vessels and nearly all of the utility ware used during the sixth century came from the Chaco Slope, the Red Mesa and Puerco River (west) valleys, and the northern Chuska Valley. Vessels evidently made in Chaco Canyon exhibited the transition from polished brown ware to unpolished gray- and white-ware types (Vivian 1990:17–18, 129).

In eastern Arizona another development took place. Kiatuthlanna Black-on-white is defined by its design style and is dated between A.D. 800 and 870 or 900 (Bullard 1962:65; Cibola White Ware Conference
The outstanding characteristic of pottery from the Kiatuthlanna type site, situated about halfway between St. Johns, Arizona, and Interstate 40, is that it is extremely well made and uniformly polished over the vessel surface (Roberts 1931). This alone separates it from most other black-on-white types, including an unknown proportion of what has been identified elsewhere as Kiatuthlanna Black-on-white. It is understood that this same part of Arizona has other communities with ceramics like those at the type site, but the extent of this distribution is not known. From the standpoints of design and finish, it appears that Kiatuthlanna Black-on-white developed from San Marcial phase ceramics, but what transpired during the approximately 175 years separating the two types is unknown.

Still another development is the pottery of Alkali Ridge in southeastern Utah. The discoverer said that "the red-on-orange ware [i.e., Abajo Red-on-orange] does not fit anywhere" (Brew 1946:248), but the probable explanation is that this is an eighth-century A.D. type developed by a San Marcial group that settled far to the north. The pink to gray color is also typical of the Lino-variety sherds on San Marcial sites near Tohatchi, New Mexico. The decorated surface "having been polished, is smooth and lustrous," and the forms include shallow bowls and small globular jars (Brew 1946:251–255, Figures 99–102).

Brew himself explored various hypotheses to explain the presence of Abajo Red-on-orange without reaching a conclusion, but he did note the interesting association between long rows of slab-walled storage chambers, about 130 in all, and Abajo Red-on-orange pottery at Alkali Ridge Site 13 (Brew 1946:Figure 27, 153, 190, 292–294). Much farther south, on the narrow crest of a prominent ridge line near the junction of Naschitti and Coyote Washes in northwestern New Mexico, is a row of 150 or more contiguous slab-lined units without pithouses but with San Marcial and La Plata Black-on-white pottery trailing down the slopes (Wilson 1977). Nothing else like this is known from the area; the architectural similarity with Alkali Ridge lends credence to the suggested development of Abajo Red-on-orange from San Marcial Black-on-white, with unknown intermediate types. Warren (1980:155) suggested additional successors to the San Marcial ware.

**San Marcial Summary.** To return now to the 1991 survey, LA 85844 appears to be a relatively late example of a large San Marcial phase site, the pottery here being less well made than at other recorded sites. This community probably marks the first occupation by pottery-making people in this part of the Gallinas Mountains. No other settlements of comparable age were found, although Danson’s (1957:75–79) Sites 115 and 130—the former farther to the northwest in the mountains and the latter overlooking the Rio Salado—might have components this early. Whether LA 85844 represents a relatively short-lived community or a repeated series of visits is not known, nor is the activity that drew the people to settle here. The Artificial Leg Site I, the San Marcial site west of Corrales, also produced carbonized cob fragments of the modern Pima-Papago race of flour corn (Galinat et al. 1970). Nothing subsequent to LA 85844 for at least 400 years has been recorded from this part of the Gallinas Mountains.

**The Socorro Phase**

In the Gallinas Mountain survey, 26 of 30 sites were assigned to the Socorro phase by virtue of their associated pottery. There
Figure 2. Socorro Phase Site Plans in the Gallinas Mountains.
were several small pithouse communities and single pithouses, but most of the units were surface structures of jícar or masonry, with up to a dozen rooms (Figure 2). At all but four of these sites, ceramics were relatively sparse, numbering in the 10s and 100s. The predominant decorated style was well-executed, black-on-gray/black-on-white sherds of Socorro Black-on-white. Occasional examples of Reserve and Tularosa Black-on-white and early White Mountain Red wares were present, but the proportions of trade or intrusive pottery were very small. Four small masonry pueblos with two to a dozen rooms each had 1000s of potsherds, but at two of these no red wares were seen. Danson (1957:77) recorded pueblos with up to 25 rooms each, all but one of which had a possible kiva depression as well.

At all of the newly recorded sites, the associated utility pottery was primarily plain brown ware with polished and unpolished, smudged and unsmudged surfaces. The occasional neck-textured brown wares gave a suggestion of chronology or time depth to the overall occupation, but there was no real way to order these. Some time after A.D. 1100, Pilares Banded and Pilares Fine Banded appeared; these were present on most of the Socorro sites. Many of the plain-utility sherds may be from the bodies of Pilares jars. The minority types were indented-corrugated and ribbed neck-textured styles suggestive of Tularosa Corrugated. At the latest occupations, such as LA 85839 and LA 85846, only plain brown ware sherds, Pitoche Ribbed and Rubbed-Ribbed, and Los Lunas Smudged accompanied Socorro Black-on-white (Mera 1935:27–29). None of the Mesa Verde-like Magdalena Black-on-white pottery was seen on Socorro-phase sites.

Socorro-phase pithouses and pueblos are apparently found through much of the country between El Malpais lava flows and the Rio Grande valley, and from the Rio San José south through the Datil and Gallinas Mountains (Mera 1935:27), but there are outliers well beyond. The small database prior to my project was two surveys (Danson 1957:75–79; Wimberly and Eidenbach 1980) and four excavated pueblos (Wendorf et al. 1956:233–255, 292–323), plus two small pueblos on the Cañada Alemita north of Pueblo Pintado in northwestern New Mexico (Simmons 1982:1:270–272, 1982:3:783–805). Apparently no pithouses have been excavated. All of the pottery types are poorly dated or undated; the estimated age for Socorro Black-on-white is A.D. 1050–1275, and for Los Lunas Smudged, A.D. 1100–1370 (Warren 1979:193, 196; 1980:155).

Sites LA 2639 and 2640 near McCartys, New Mexico, both had a heavy predominance of Socorro Black-on-white as a painted ware along with Pilares Banded and Fine-Banded in lesser proportions than gray-ware corrugated, making these two sites the most nearly comparable to those in the Gallinas Mountains. Although no independently derived dates (tree-ring, radiocarbon) are available, the excavators believed that both were occupied during the A.D. 1050–1125 period (Wendorf et al. 1956:307, 323). At Site LA 2567 along the Rio Puerco (East), to the west of Los Lunas, New Mexico, Socorro Black-on-white was associated with plain brown ware and Pitoche Smudged-Ribbed. Nearby is Site LA 2569, with plain brown ware and Los Lunas Smudged. The reports said that LA 2567 appeared to have been visited repeatedly from early Pueblo II to late Pueblo III times, while LA 2569 was a late Pueblo II-

Sites LA 17360 and 18080 near Cañada Alemita Wash both had Socorro-series pottery second in quantity after Cibola White ware types, and Los Lunas Smudged was present as well at the former site. The assemblages at both locations presented problems in dating, and the conclusions by members of the project team were not entirely consistent. The most specific conclusion was that LA 17360 represented a single-component site dating between A.D. 1125 and 1190 (Simmons 1982:1:284) and that LA 18080 was occupied between the mid-1100s and A.D. 1240 (Simmons 1982:1:289).

From all of this and particularly the absence of thirteenth-century red wares at the sites in the Gallinas Mountains, I would conclude that all of the Socorro-phase sites there probably date to the twelfth century A.D. There seems to be no reason to expect that the individual pithouses and small pithouse communities differed in age from the small masonry pueblos, though the variable proportions of utility wares suggest that not all of the sites were contemporary.

What was clear was that the Gallinas Mountains had their only substantial prehistoric occupation during the Socorro phase. Sites were numerous, at all elevations to above 2,377 m (7,800 ft). There appeared to be three types of settlements: (a) sites with pithouses (Figure 2, upper); (b) surface rooms that may be accompanied by a single rounded kiva depression, on the lower slopes away from the mountains (Figure 2, middle); and (c) sites closer to and within the mountains that featured small pueblos with full-height masonry walls in one or more rooms and plazas instead of kivas (Figure 2, lower). None of the pueblos were adobe. Figure 2 shows typical plans, and although the Socorro phase belongs within the Mogollon tradition, the architecture at these sites appeared to be quite rigid or formal in its layout, with wall lines still well-defined and exhibiting an unfamiliar range of room sizes, occasionally with striking plans (see also Wendorf et al. 1956:Figure 170). In all cases the broadcast refuse implied short occupations, although some site areas were inhabited more than once.

The reason why Socorro-phase peoples lived in the mountains on occasion became evident as the survey progressed. The topography of the Gallinas Mountains, with the underlying Spears member, tends to be rounded with gravel-sized loose rocks on the surface at the steeper grades rather than rock outcroppings. Large areas of sand fields are present in the higher valleys and mountain parks, along the slopes of ridges, and on the lower slopes of the mountain peaks. A ridge that lies crosswise to the direction of the prevailing winds will have a gravelly surface on the windward side and perhaps along the crest, with sand fields to the leeward side.

Sites were more numerous within the mountains, associated with the sand fields, than at lower elevations. The significance is probably that the people practiced a variation of the well-known Hopi system of sand-dune agriculture with the farmers essentially dry-farming the sand fields (Hack 1942). Since these sand deposits may be fairly extensive—not in the form of dunes but shallow sheets—an unusual coincidence of moisture and length of growing season may have been needed to use these areas to grow crops. These circumstances—a winter of heavy snowfall followed by adequate and timely summer rains—may have come about
only infrequently. When the prehistoric weather-watchers did decide that they had a reasonable prospect for success, they initiated a land rush to plant in the Gallinas Mountains for at least one season. This would explain why the Socorro phase occupation(s) resulted in so many sites, all used only briefly. The circumstances that prompted people to take their chances may have happened only two or three times during the span of this phase. How well their crops succeeded under these marginal conditions is not known.

The Socorro-phase occupation in the Gallinas Mountains probably terminated by A.D. 1200 or soon after. The strongest evidence is the absence of later pottery types, with scarcely a half-dozen sherds of White Mountain Red ware types (through Wingate Black-on-red) and even fewer fragments of Tularosa Black-on-white. The Socorro phase may well have persisted later at places outside of this range. There was nothing to show continuity with any later (or earlier) occupation, and it appears that the mountains afterward were unoccupied for 50 to 100 years.

**The Gallinas Springs Ruins**

The latest known prehistoric settlements cluster around Gallinas Springs in the Gallinas Canyon, on both sides of the arroyo. These ruins lie well within the mountains and almost in the center of the 1991 project area. They were not visited, principally because the only access road along the arroyo bed was wet much of the time. The Gallinas Springs Ruins, LA 1178 and LA 1180, are reported to be a late thirteenth/early fourteenth century masonry pueblo with four large room blocks and three smaller ones that contain an estimated 300 to 500 rooms and 3 major midden deposits (Berman 1979:64–65; Bertram 1987; Danson 1957:77–78; Green 1974). There is a permanent spring within the site.

In addition to the main ruin, which was Danson’s Site 118, there is a large circular ruin upstream (Site AR-03-03-03-329), another large ruin downstream (AR-03-03-03-02), plus known or suspected low-lying room blocks just east and west of LA 1178 (Bertram 1987:12). These have very limited surface artifact assemblages, reportedly because of alluvial deposition, and their ages or affiliations are unknown. In addition, there is Danson’s (1957:77) Site 117, a walled pueblo of about 50 rooms. With the rooms on two sides and walls on the other two sides of the compound, it was apparently planned for defense. Site LA 1178 is the only site that has been excavated, and the findings are unlike what has been found elsewhere in the Gallinas Mountains.

Site LA 1178 has been somewhat controversial. Field schools did limited excavations in 1960, 1974, and 1977, and excavations were conducted as part of a stabilization program in 1987. Pottery was abundant, and the utility wares included plain and indented-corrugated Mogollon brown wares tempered with locally available gray rhyolitic rock. The great majority of the decorated white-ware vessels contained the same temper but featured forms, finish treatment, and designs that closely resembled McElmo and Mesa Verde Black-on-white. By 1981, this white ware had been named Magdalena Black-on-white (Knight 1981; Warren 1974).

Two schools of thought developed: one explained the pueblo and the pottery as the result of a Mesa Verde migration into this area (Davis and Winkler 1960; Lekson...
The argument against an actual movement of people preceding the local manufacture of Mesa Verde-like white ware was that "it seems more likely that the Magdalena White wares represent a local tradition developed over some length of time" (Knight and Gomolak 1987). But, as has been seen, there is no such local ceramic tradition in the Gallinas Mountains. After the Socorro-phase occupation, which had both white ware and utility ceramics very different from those at Gallinas Springs, there was no occupation in the mountains until the arrival some time in the late thirteenth century of the persons who lived at LA 1178 and perhaps in the nearby pueblos. Unfortunately, there are no tree-ring dates for any of these properties. Around the Gallinas Springs area, the other sites belong to the Socorro phase. Although this point has not been raised, any sort of agriculture along Gallinas Canyon would be virtually impossible.

The probable explanation of why LA 1178 and perhaps the other large pueblos were there is quite different. Berman (1979:65) offered a clue with her observation that at Site 117 she observed a variety of masonry styles in one pueblo. This admits the possibility of more than one group. In their 1987 investigations, the Chambers Group did not analyze the artifact collections, but they did cite the experience of three other archaeologists who noted that, during the A.D. 1150–1350 period when the Southwest underwent massive dislocations and movements of populations, totally dissimilar assemblages of ceramics, which had their stylistic sources hundreds of kilometers apart, were commonly found in adjacent and contemporary rooms of pueblos of this period (Bertram 1987:66). It was the opinion of the Chambers Group staff "that similar observations may apply at Gallinas Springs."

Bertram went on to cite the work of Knight and Gomolak (1987) on Gallinas Springs pottery as an invaluable framework for assessing the ceramic complex, particularly with respect to dating, but conversely, the data from the 1987 project in many cases may have sampled time periods, vessel assemblages, and deposit types poorly represented in the prior database. Specifically, no two trenches appeared to produce the same ceramic materials, and cursory field observations seemed to indicate that adjacent excavations contained an El Paso/Jornada Mogollon-like assemblage on the one hand and a Cibola Mogosazi-like assemblage on the other. These variations were reflected in both the culinary and decorated wares, and even the presumably indigenous Magdalena Black-on-white was by no means uniformly represented. The conclusion that most vessels at LA 1178 were locally made might obscure differences within the pueblo that had ethnic or affiliative implications (Bertram 1987:66).

These observations, combined with the lack of agricultural prospects, raise the questions of who lived in the pueblos around Gallinas Springs and what activities did they engage in? I am indebted to recent communications with Mr. David M. Brugge of Albuquerque, New Mexico, and to Berman’s (1979:68) summary of the faunal analysis from the 1974 excavations at LA 1178 for some leads. Not only did mammals account for 96.8 percent of the total usable meat, but mule deer, pronghorn antelope, bison, and mountain sheep were the most important animals (emphasis added). At
Gallinas Springs more species were represented in the faunal than in the floral assemblage.

The San Augustin Plains are only a few kilometers from Gallinas Springs; along the southeastern side of these plains is the important Bat Cave site. The dating of the early varieties of corn found there has been the focus of endless debate since the cave was excavated almost 50 years ago. However, totally lost in all of this was the fact that 1,400 of the 1,600 identifiable animal bones, some 87.5 percent, were bison remains. With admirable understatement, the report noted that the many leg and foot bones led to the supposition "that the animals may have been killed in close proximity to the cave" (Dick 1965:90–91). In addition there were many fragments of bison hide. Approximately 90 percent of the bison remains came from midden levels I and II, which were the ceramic-bearing strata at Bat Cave, dating from some time after A.D. 1 into the 1100s.

Such a quantity of bison bone indicates something more than an occasional herd of bison wandering within hunting range and a few animals being killed (Dick 1965:92). Linskey (1975:262–263) seems to be the only one who has grasped the obvious, that "Bat Cave probably was a bison hunting and butchering camp." Historically there are no known references to bison on the San Augustín Plains, but the quantities of bone and hide fragments at Bat Cave leave little doubt but that this was the case. Linskey's (1975:261) undocumented claim that "in winter, antelope and bison traveled in large herds on the San Augustine[sic] Plains" is probably quite true, from some unknown period of time until at least A.D. 1300. When and under what circumstances bison left this area or were killed off must be examined at another time.

Although the proportion of bison bones from the 1974 excavations at Site LA 1178 were not cited, they were obviously a substantial part of the total. Their presence here, along with other bits of evidence offered by Bertram (1987:66) and summarized above, suggest that Site LA 1178 was itself a glorified bison-hunting and butchering camp, with persons from various cultural groups coming there with their families to live for awhile, while the men hunted bison. Floral resources in these mountains were scarce. The attraction of this location was the water, Gallinas Springs, since surface water was scarce in the Gallinas range. There is no known precedent for this proposal in southwestern ethnology or history, but the combination of potable water, the lack of agricultural possibilities, the quantities of bison bone, and suggestions of disparate groups living side by side at LA 1178 make more reasonable the conclusion that this was really a huge bison-hunting and processing camp in late prehistoric times. Hurt and McKnight (1949:176, 189, 191, 193) mentioned Pueblo campsites on the San Augustín Plains, without suggesting their dates or possible functions. Perhaps these were temporary campsites of the bison and antelope hunters who were based at Gallinas Springs. The pueblo(s) then might have been a prehistoric neutral ground similar to the early historic trade fairs in New Mexico (Hickerson 1994:99; Kessell 1979:134–137, 266, 364–369, 406, 408).

Whenever the persons at Gallinas Springs left and wherever they went, we do not know, but with their departure we have no evidence for people returning to the Gallinas Mountains country to live until the
late nineteenth century. The numerous ruins testify to the attractiveness that these mountains once held for their prehistoric residents. Curiously enough, each group that lived there probably focused upon a different resource, and none were able to make their occupation a permanent one.

ACKNOWLEDGEMENTS

I very much appreciate David Brugge’s original suggestion with respect to bison, and the conversations with Stewart Peckham about the San Marcial phase and San Marcial Black-on-white. Mr. Peckham also restudied the pottery collection from Site LA 3098 near Tohatchi, New Mexico, and furnished copies of the LA 2547 pottery analysis and excavation notes. Ms. Lou Haecker of the Office of Cultural Affairs made available certain site survey data and the LA numbers for sites mentioned in this article. —Las Cruces, New Mexico

ENDNOTE

1. Lithic material classified under A. Helene Warren’s lithic classification system.

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In a volume dedicated to Helene Warren, it seems appropriate that her most complete statement on lithic-material types for western New Mexico, together with her lithic-material identifications for a series of sites there, should be included. This work (conducted in 1972 and included as the lithic-analysis section in this article) was the only final analysis of collections from the survey of a Tucson Gas & Electric Company (now TEP) transmission line corridor down the western side of New Mexico (Figures 1 and 2).

In the years since 1972, I have found her descriptions to be extremely useful for identifying lithic materials from that part of New Mexico and east-central Arizona. Indeed, in 1978 the source of her Type 1092 was found to be Site AZ Q:7:30, the Coronado Quarry, located about 4.0 km (2.5 mi) southeast of the SRP Coronado Generating Station near St. Johns, Arizona. For this material type and several others, her original definitions have been updated to reflect our current understanding of their source and distribution. This 1972 study actually provides a more complete guide than her workshop handbook (Warren 1979) and similar lists, because her descriptions here are more complete. This system still requires a great deal of practice to use it effectively.

NOTES ON ARCHAEOLOGICAL SITES IN CIBOLA AND CATRON COUNTIES, NEW MEXICO

John P. Wilson and A. Helene Warren

OVERVIEW OF PROJECT AREA

Since 1972, there have been surveys and excavations west of the corridor in Arizona (Doyel and Debowski 1980; Schreiber and Sullivan 1984; Westfall 1981; Wilson 1976, 1978, 1983), surveys to the east in New Mexico (Camilli et al. 1988; Hogan 1985; Kayser and Carroll 1988), and a survey with excavations along a transmission line that parallels the TEP corridor for about 14.4 km (9 mi), north and south of Highway US 60. Site LA 70096, excavated during this more recent project, is apparently the same as LA 4037 (Bruder 1993). The TEP sites were located only on that company’s plan and profile sheets and not on USGS 7.5-minute topographic quadrangles, which in 1972 were just being published for far-western New Mexico. The TEP data have been used very little, although an overview published in 1979 did include it (Berman 1979).

Nearly all of these publications have included a summary of the prehistory of this region, without being aware of the remarkable variety among the TEP sites and the unusual nature of several of them. My paper therefore has a second purpose—to review what the 1972 survey found. A brief, tabular description of the sites, drawn from the clearance report (Wilson 1972), appears in Table 1. Because the sites have not been revisited since about
Figure 1. Northern portion of TEP project area.
Figure 2. Southern portion of TEP project site.
1984 and the collections have not been restudied, the terminology may sometimes be dated.

**ARCHAEOLOGICAL RESULTS**

The TEP corridor extends from the San Juan Generating Station near Farmington, New Mexico, to the Vail Substation outside of Tucson, Arizona, a distance of slightly more than 640 km (400 mi). The right-of-way width is 100 m (330 ft), sufficient for two 345KV transmission lines. Clearance surveys were done at various times in 1972 and early 1973 by three institutions. Museum of New Mexico archaeologists examined the corridor segments between the San Juan Station and the north boundary of the Zuni Indian Reservation, and from the south boundary of the Zuni Reservation to the northern border of Apache National Forest. The Museum of Northern Arizona was responsible for the route across the Zuni Reservation and the Apache and Gila National Forests. The Arizona State Museum examined the line from the point where it exited the Apache National Forest near Clifton, Arizona, on into Vail. All of these surveys resulted in clearance reports that were primarily short descriptions of the sites encountered, because the practice of issuing clearances with only a letter had ended around 1971.

Between July 23 and August 22, 1972, assisted by George Jackson, I surveyed 90.4 km (56.5 mi) of this corridor from the southwestern corner of the Zuni Indian Reservation south to Apache National Forest (Figures 1 and 2). Although this was a pedestrian survey, by present standards it was not intensive—the distance between the two surveyors averaged 50 m.

We recorded 55 new sites, 2 in Arizona and the rest in New Mexico, and assigned the Laboratory of Anthropology numbers 3984 through 4038 to these. Many sites had multiple components and more than a single locality; the latter were distinguished by letters A, B, C, etc. Lithic artifacts and pottery were surface-collected at all except sites LA 4009, LA 4015B, and LA 4022, the two former being petroglyph locations. Minimal collections (all uncontrolled) of 100 sherds or 100 lithic artifacts were sought at the pueblan sites and the lithic scatters, with separate collections from each locality, but the collection minimums were rarely met. Lithic samples were gathered at some of the pueblos as well. The pottery was washed and examined carefully in the field to allow estimates of the number of components at the sites and their ages (Table 1). The lithic materials were studied later in Santa Fe. Site LA 4031 had a historic component, and LA 3993A had a probable protohistoric feature, while the others ranged in age from a late Paleoindian Cody knife and Archaic-period lithic scatters to late Pueblo III occupations. All of these sites were successfully avoided; none was excavated.

Of the 55 sites, 25 lay entirely or partially within the 100-m corridor, while 30 were outside of it by 1.0–6.4 km (1–4 mi). So long as the archaeologists kept pace with the line surveyors, they were at liberty to record sites elsewhere, in order to obtain an archaeological cross-section through a part of New Mexico that, until then, had been a blank. Apart from Helene Warren’s lithic analysis and a short final report on the Museum of Northern Arizona’s investigations (Fuller 1980), studies of the sites never progressed beyond the clearance reports. Regge N. Wiseman of the Museum of New Mexico recorded many additional
<table>
<thead>
<tr>
<th>Probable Age</th>
<th>Site Type</th>
<th>Site Nos.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NONARCHITECTURAL SITES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>Circular stone foundation</td>
<td>4022</td>
</tr>
<tr>
<td></td>
<td>Petroglyphs</td>
<td>4009, 4014A, 4015</td>
</tr>
<tr>
<td></td>
<td>Hearth</td>
<td>4035*</td>
</tr>
<tr>
<td>Cody</td>
<td>Isolated find</td>
<td>4003</td>
</tr>
<tr>
<td>Archaic</td>
<td>Camptiste</td>
<td>3991A, 3994, 3998C, 4001B, 4002, 4005, 4010, 4021, 4034, 4036, 4037, 4038</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3987*, 3988*, 3995, 3997, 4004, 4011, 4017</td>
</tr>
<tr>
<td>A.D. 600-750</td>
<td>Sherd scatter</td>
<td>3996</td>
</tr>
<tr>
<td>A.D. 750-825</td>
<td>Sherd scatter</td>
<td>3990</td>
</tr>
<tr>
<td>A.D. 800s</td>
<td>Waffle garden</td>
<td>3999*, 4014B*</td>
</tr>
<tr>
<td>A.D. 900s</td>
<td>Sherd scatter</td>
<td>4035*</td>
</tr>
<tr>
<td>A.D. 900-1050</td>
<td>Sherd scatter</td>
<td>3998A&amp;B</td>
</tr>
<tr>
<td>A.D. 1000s</td>
<td>Sherd scatter</td>
<td>3987*, 3991B, 3999*, 4014B*, 4015*</td>
</tr>
<tr>
<td>A.D. 1100s</td>
<td>Isolated find</td>
<td>4006</td>
</tr>
<tr>
<td></td>
<td>Sherd scatter</td>
<td>3987*</td>
</tr>
<tr>
<td>A.D. 1100-1250</td>
<td>Sherd scatter</td>
<td>4007, 4014B</td>
</tr>
<tr>
<td>A.D. 1250-1325</td>
<td>Sherd scatter</td>
<td>4001A</td>
</tr>
<tr>
<td>ARCHITECTURAL SITES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.D. 520-620</td>
<td>Large pithouse community (many units)</td>
<td>4032</td>
</tr>
<tr>
<td>A.D. 800s</td>
<td>Small Pithouse community (1-2 units)</td>
<td>4031*</td>
</tr>
<tr>
<td>A.D. 900-1050</td>
<td>Medium pueblo (11-40 rooms); Great Kiva</td>
<td>3993D</td>
</tr>
<tr>
<td>A.D. 1100s</td>
<td>Pueblo farm house (1-2 rooms)</td>
<td>3992, 4008, 4016</td>
</tr>
<tr>
<td></td>
<td>Small pueblo (3-10 rooms)</td>
<td>4012, 4013, 4014A*, 4018, 4019, 4020, 4024, 4025, 4027*, 4028*, 4029*, 4031*, 4033</td>
</tr>
<tr>
<td></td>
<td>Medium Pueblo (1-40 rooms)</td>
<td>4023*</td>
</tr>
<tr>
<td></td>
<td>Single large pueblo or cluster of individual pueblos (40+ rooms)</td>
<td>3993A&amp;B*, 4030*</td>
</tr>
<tr>
<td>A.D. 1050-1150</td>
<td>Small Pueblo (3-10 rooms)</td>
<td>3985</td>
</tr>
<tr>
<td>A.D. 1100s</td>
<td>Medium pueblo (11-40 rooms)</td>
<td>3984</td>
</tr>
<tr>
<td></td>
<td>Small pueblo (3-10 rooms)</td>
<td>3988*, 3989, 4031*</td>
</tr>
<tr>
<td></td>
<td>Medium pueblo (11-40 rooms)</td>
<td>4023*</td>
</tr>
<tr>
<td></td>
<td>Single large pueblo or cluster (40+ rooms)</td>
<td>3986</td>
</tr>
<tr>
<td>A.D. 1100-1250</td>
<td>Small pueblo (3-10 rooms)</td>
<td>4014A*, 4027*, 4029*</td>
</tr>
<tr>
<td></td>
<td>Single large pueblo or cluster (40+ rooms)</td>
<td>4026, 4030*</td>
</tr>
<tr>
<td></td>
<td>Great Kiva</td>
<td>4026</td>
</tr>
<tr>
<td>A.D. 1175-1275</td>
<td>Single large pueblo or cluster (40+ rooms)</td>
<td>3993A&amp;B*, 3993C</td>
</tr>
<tr>
<td>A.D. 1250-1325</td>
<td>Pueblo farm (1-2 rooms)</td>
<td>4000</td>
</tr>
<tr>
<td>Apache</td>
<td>Round stone dwelling</td>
<td>3993A*</td>
</tr>
<tr>
<td>Early 20th Century</td>
<td>Masonry room, modern construction</td>
<td>4031*</td>
</tr>
</tbody>
</table>

A, B indicates localities, * indicates multiple-component sites
sites while monitoring construction of the first TEP transmission line.

**Paleoindian Period**

As for the survey findings, the earliest was a complete Cody knife recorded as Site LA 4003. The material, a red jasper, is easily recognizable, but unfortunately is not temporally diagnostic or from a known source. Sites and artifacts of the late Paleoindian Cody complex are known from this part of New Mexico and Arizona (Berman 1979:14-15; Hogan 1985:39; Schreiber and Sullivan 1984; 28-29, 49).

**Archaic Period**

The 12 lithic scatters, identified as Archaic-period campsites, were probably all short-term residential and hunting camps. The near-absence of projectile points (see Table 2), a situation by no means unique to this survey (Bruder 1993:5-30; Camilli et al. 1988:4-10, 7-28; Hogan 1985:162), prevented any chronological subdivision of these sites. All were eroded to some degree and featured greater or lesser amounts of lithic debris but rarely any formal ground- or chipped-stone tools. Fire-cracked rocks were found occasionally, and by reference to excavations near St. Johns, Arizona, these may represent deflated roasting pits rather than hearths or fire pits (Westfall 1981). The dark circular stains at Site LA 3998C appeared to be eroding hearth areas rather than subsurface pits; however, these were the only distinct features at any of the Archaic sites.

**Formative Period**

Temporally, next was Site LA 4032, whose nature was completely misunderstood in 1972 when it was identified as a Kiatuthlanna-phase occupation. Subsequent work with the pottery from this and similar sites elsewhere by Helene Warren confirmed that Site LA 4032 was instead a nearly pure San Marcial phase component, probably dating from circa A.D. 520-620. Site LA 4032 was one of the extremely large (circa 170 by 200 m) and nearly featureless San Marcial sites now gradually being recognized. Other examples are Cheap Johns Village (Site 429), "an extensive refuse scatter associated with possible surface and/or subsurface structures" southwest of the Zuni Salt Lake (Camilli et al. 1988:5-18 to 5-28); Site LA 85844, just east of the Gallinas Mountains (Wilson 1991); and Site 29SJ423, at the west end of Chaco Canyon (Hayes et al. 1981:24; McKenna and Truell 1986:39-41; Warren 1985). Recognition of San Marcial phase components has been greatly hindered by the wide intervals between the larger sites or clusters of smaller ones throughout western New Mexico and east-central Arizona and the tendency to confuse San Marcial Black-on-white with later pottery, particularly White Mound and Kiatuthlanna Black-on-white (see Ferg’s discussion in Hammack et al. 1983; Frisbie 1984). These types are approximately two and three centuries more recent in time. The problem of recognition is discussed at greater length in my other paper in this volume.

No early brown-ware sites were found; the next-oldest communities were a series of herd areas that dated from the seventh and eighth centuries A.D. The pottery had derived from diffuse refuse deposits or eroded dwelling areas and was not associated with recognizable hearths, pithouses, surface rooms, or other features. The pottery types were La Plata and White Mound Black-on-white and Lino Gray. These small, relatively short-term sites
Table 2. Artifacts and Material Types from TEP Sites.

<table>
<thead>
<tr>
<th>LA and Specimen No.</th>
<th>Artifact Type</th>
<th>Lithic Material Type</th>
<th>Lithic Code No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3986-0-3</td>
<td>Saw</td>
<td>Silicified wood, white &amp; yellow</td>
<td>1140</td>
</tr>
<tr>
<td>3987-0-2</td>
<td>Projectile point</td>
<td>Apache Creek chalcedony</td>
<td>1251</td>
</tr>
<tr>
<td>3990-0-2</td>
<td>Scraper</td>
<td>Chert, red, &amp; yellow inclusions</td>
<td>1232</td>
</tr>
<tr>
<td>3993-0-2</td>
<td>Projectile point</td>
<td>San Andres chert, cream</td>
<td>1016</td>
</tr>
<tr>
<td>3993-0-7</td>
<td>Saw?</td>
<td>San Andres chert, cream</td>
<td>1016</td>
</tr>
<tr>
<td>3996-0-2</td>
<td>Grooved maul</td>
<td>Vesicular basalt</td>
<td>3050</td>
</tr>
<tr>
<td>3998-0-3</td>
<td>Maul fragments</td>
<td>Feldspar vitrophyre, gray</td>
<td>3740</td>
</tr>
<tr>
<td>3998-0-4</td>
<td>Projectile point</td>
<td>Silicified wood, red</td>
<td>1120</td>
</tr>
<tr>
<td>3998-0-5</td>
<td>Awl?</td>
<td>Chert, light gray</td>
<td>1600</td>
</tr>
<tr>
<td>3998-0-6</td>
<td>3 Point fragments</td>
<td>Apache Creek chert, black</td>
<td>1251</td>
</tr>
<tr>
<td></td>
<td>1 Point fragments</td>
<td>Chert, mottled tan</td>
<td>1661</td>
</tr>
<tr>
<td>4003-0-1</td>
<td>Cody knife</td>
<td>Chert, red</td>
<td>1060</td>
</tr>
<tr>
<td>4005-0-2</td>
<td>Tool (point?)</td>
<td>Chalcedony, clear</td>
<td>1052</td>
</tr>
<tr>
<td>4010-0-2</td>
<td>Knife fragment</td>
<td>Silicified wood, gray</td>
<td>1112</td>
</tr>
<tr>
<td>4010-0-3</td>
<td>Biface fragment</td>
<td>Apache Creek chert, black</td>
<td>1251</td>
</tr>
<tr>
<td>4010-0-4</td>
<td>Tool fragment</td>
<td>Apache Creek chert, black</td>
<td>1251</td>
</tr>
<tr>
<td></td>
<td>Flake, worked</td>
<td>Silicified wood, light brown</td>
<td>1112</td>
</tr>
<tr>
<td>4014-0-3</td>
<td>Arrow point</td>
<td>Apache Creek chalcedony</td>
<td>1251</td>
</tr>
<tr>
<td>4018-0-3</td>
<td>Flake, worked</td>
<td>Chert; red &amp; yellow moss jasper</td>
<td>1233</td>
</tr>
<tr>
<td>4021-0-2</td>
<td>Drill fragment</td>
<td>Chert; white, pink; San Andres</td>
<td>1016</td>
</tr>
<tr>
<td>4034-0-2</td>
<td>2 Flakes</td>
<td>Apache Creek chert, white</td>
<td>1251</td>
</tr>
<tr>
<td></td>
<td>1 Flake</td>
<td>Apache Creek chert, clear</td>
<td>1251</td>
</tr>
<tr>
<td>4036-0-2</td>
<td>Point fragment</td>
<td>Chalcedony, red moss agate</td>
<td>1092</td>
</tr>
<tr>
<td>4037-0-2</td>
<td>2 Point fragments</td>
<td>Obsidian, Red Hill</td>
<td>3550</td>
</tr>
</tbody>
</table>

represented no more than a single dwelling and perhaps only a seasonal camping location (Table 1).

Waffle gardens (miniature gardens formed of stone gridworks and used for raising vegetables, herbs, and condiments) are usually associated with Zuni Pueblo and northern New Mexico. Site LA 3990 was an obvious prehistoric waffle garden, well-preserved with 14 or more units, at the north base of a mesa. Two Line Gray and one Kiatuthlanna Black-on-white pot sherds suggested a Pueblo I age; Regge Wiseman subsequently recorded extensive waffle gardens, many from this same period, at Sites LA 11388, LA 11393, LA 11396, and other sites on lower mesa remnants and at places on a lower mesa top (site forms on file, Archeological Records Management System, Museum of New Mexico). These gardens are unreported elsewhere in this part of New Mexico or Arizona.

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There were few signs of tenth-century occupations: sherds of Red Mesa Black-on-white at a hearth with two small sherd areas (LA 4035), sherd areas at Sites LA 3998A and 3998B, and Site LA 3993D. The masonry pueblo and possibly the great kiva at Site LA 3993D may have their origins in that century. This great kiva measured about 10 m in diameter.

Where the TEP line and the state boundary cross the Zuni River, there appears to have been a cultural frontier in the eleventh century; the sites to the north were small pueblos, apparently of adobe construction, associated with a sherd-tempered gray corrugated ware and what might now be called a Puerco variety of Black-on-white decorated ceramics (Fuller 1980). From the southwestern corner of the Zuni Reservation south to Site LA 4031, the southernmost pueblo recorded during this survey, the eleventh- and early twelfth-century sites were sherd areas, farmhouses, and masonry pueblos; many of the latter had a later component that obscured the original construction. Decorated white wares were mineral-painted Cibola White ware styles that exhibited late Red Mesa, Puerco, and the intermediate Reserve-Tularosa styles remarked on by analysts as far back as Danson (1957:70), whose own survey did not include this area. The finer chronological distinctions in Table 1 were based upon the presence or absence of red-ware types.

One unique and undated prehistoric site was a circular stone foundation about 5 m in diameter with an opening to the south, built at the base of a talus slope along the north edge of a broad valley. This caused considerable puzzlement and was originally recorded as a Navajo hogan. More recently Kelley (1988:2–9) noted that it lay almost exactly on a straight line from the Zuni Salt Lake to the confluence of the Zuni and Little Colorado Rivers, the trail to "Zuni Heaven." The most likely interpretation is that the site, LA 4022, is the remains of a small windbreak/shrine along this trail (Kelly 1988:2–9). During construction of the TEP line, Wiseman recorded possible shrines at Sites LA 11394, LA 11398A, and LA 11399B above Jaralosa Draw.

Sites of the twelfth and thirteenth centuries included several large masonry pueblos, all with Tularosa Black-on-white as the associated decorated pottery, plus various western black-on-red and polychrome varieties. A complex of large sites at LA 4023, LA 4024, and LA 4026 (and other pueblos unrecorded for lack of time) formed a virtually undisturbed community in a valley at the Goesling Ranch. The unusual state of preservation was due to the success of the Goesling family at preventing vandalism. A great kiva at the largest (200 or more rooms) pueblo measured 20.5 to 22.5 m in diameter and had a ramp entry on the southeastern side. Notable here and also at Site LA 4023 along Carrizo Wash was an association with brown-ware utility pottery, marking a late northward shift into areas where a century earlier people had made gray utility wares. Danson (1957:71) recorded the same phenomenon in the Mariana Mesa region to the east. At Sites LA 3986 and LA 3993A-C, however, the utility vessels were a gray-brown indented corrugated ware, apparently sherd-tempered, similar to what has been reported from the San Augustín Coal Area north of Quemado, New Mexico (Camilli et al. 1988) and the areas northeast of Springerville and St. Johns, Arizona (Doyel and Debowski 1980; Westfall 1981).
**Apache Indians**

A quite different type of site was a 2-m-diameter room with low stone walls and an opening to the east, built within a prehistoric pueblo room at Site LA 3993A. A TEP inspector subsequently told me of several more such structures on the canyon rim north of Jaralosa Draw, west of the transmission-line corridor. These were probably protohistoric Apache dwellings, comparable to the stone ring structures superimposed upon pueblo ruins in the Point of Pines area in Arizona (Asch 1960; Gerald 1958). As recently as the late nineteenth century, the White Mountain Apaches apparently still used such shelters (Bandelier 1892:399-400; Spier 1919:380-381).

**LITHIC MATERIALS FROM ARCHAEOLOGICAL SITES**

The TG&E [TEP] corridor in Cibola and Catron Counties crosses the Mogollon Slope at the southern end of the Colorado Plateau. The escarpment that separates the plateau from the Basin and Range Province to the south is somewhat obscured by accumulations of volcanic rocks. Although topographic relief may be several hundreds of meters, the terrain is one of broad rolling plains and sandstone or lava-capped mesas. The Zuni uplift to the north has exposed sedimentary rocks that range in age from Permian to Pleistocene. In the southern part of the corridor, Quaternary basalt flows and volcanic rocks and sediments of the Datil formation predominate.

A window of the San Andres formation (Permian) crops out a few kilometers south of Ojo Caliente, at the southern edge of the Zuni Indian Reservation. This may be the source of the flakes and artifacts called San Andres chert (Code 1016; Table 3) that were collected from sites along the corridor from this point south. The Chinle formation (Triassic) is widely exposed from Zuni to Atarque. The pebble cherts and quartzites (Codes 1661, 4000, etc.) may have derived from the Chinle formation or possibly from the Baca formation (Tertiary). Silicified wood has been found in both of these formations. The andesite or anesitic basalt flows of the Datil formation (Tertiary), which overlie the sedimentary rocks in the vicinity of Red Hill, undoubtedly produced the Apache Creek chalcedony and chert (Code 1251).

Sources for most of the lithic materials found by the archaeological survey can be found along the TG&E corridor. The exceptions may be a few flakes of light-colored silicified wood, probably from the Chinle formation in northeastern Arizona; an obsidian flake from Polvadero Peak in the Jemez Mountains; and artifacts of a red and yellow mossy chert or jasper from an unidentified source [Coronado Quarry].

Temporal and cultural preferences as well as geologic source distributions are reflected in the lithic collections from 24 of the 55 sites recorded along the Tucson Electric transmission line right-of-way. The most notable differences in material preferences were between the 12 Archaic and the 11 Pueblo sites (Tables 4 and 5). Chert from the San Andres formation constituted nearly 30 percent of the lithics from Archaic sites but only 3 percent of the stone material from Pueblo sites. Although chalcedony and chert from the Datil formation andesites occurred at 19 of the 24 sites, a black chert was favored by the Archaic peoples, while the Pueblos showed a definite preference for a clear, banded chalcedony from the same source. Both
Table 3. Descriptions of Lithic Material Types from TEP Sites.

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1016</td>
<td>&quot;San Andres chert.&quot; The physical characteristics of this chert vary greatly but most diagnostic is a glossy luster. In some areas color banding resembling fingerprints is characteristic. Outcrops of the San Andres formation are known in the Zuni Mountains at Oso Ridge and south of Blue Water; in the Sacramento Mountains; near Romeroville, New Mexico; and in northern Chihuahua, Mexico. An outcrop south of Ojo Caliente probably produced the material found on the TEP sites. No banding was noted, but the material has a high gloss and ranges from white to pink and light gray or light red. Microfossils are common and take the form of milky inclusions. The material shows no evidence of transportation by water and was probably gathered at or near the source. San Andres chert seems to have been favored during the Archaic period and it constitutes about 27 percent of all lithic materials collected from the TEP Archaic campsites. Only 3 percent of the stone material from Puebloan sites was classified as San Andres chert. San Jose sites near Grants also produced artifacts of this material (Bryan and Toulouse 1943).</td>
</tr>
<tr>
<td>1044</td>
<td>Chert, greenish-gray. Source unknown.</td>
</tr>
<tr>
<td>1045</td>
<td>Chalcedony, light green. Source unknown.</td>
</tr>
<tr>
<td>1050-53</td>
<td>Chert, white. Ranges to clear chalcedony (1052). May have black dendritic inclusions (1051, 1053). Probably from several sources.</td>
</tr>
<tr>
<td>1060</td>
<td>Chert, red. Miscellaneous red jasper from various sources.</td>
</tr>
<tr>
<td>1070</td>
<td>Chert, yellow-brown. Miscellaneous yellow-brown jasper from various sources.</td>
</tr>
<tr>
<td>1072</td>
<td>Chert, yellow-brown with black dendritic inclusions. The formation from which this chert comes has not been determined, but it has in the past been called Chinle chert. Sources south and north of the Zuni Mountains seem probable; however, it has been reported from the Spears member of the Datil formation south of Socorro. More recently, extensive quarries of this lithic material, in different color variations, have been reported on the slope of Lookout Mountain in the Zuni Mountains. This spotted chert is very distinctive. Probably intrusive to TEP Site LA 3993C as only a single flake was found on the entire survey.</td>
</tr>
</tbody>
</table>
### Table 3. Descriptions of Lithic Material Types from TEP Sites (cont.).

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1092</td>
<td>Chert with scattered red and yellow mossy inclusions in a white chalcedonic matrix; coloring highly variable and ranges to dark blue with an icy-blue chalcedonic matrix. Luster generally dull. Usually easy to recognize. Geologic source is Owl Rock member of the Chinle formation. Principal known exposure is the Coronado Quarry, Site AZ:Q:7:30, 3.2 km (2 mi) SSE of the SRP Coronado Generating Station, with other minor exposures along Marion Haws Draw and the nearby Carrizo Wash valley (Westfall 1981:48–51). Also occurs as cobbles in Quaternary deposits. Only five flakes were found at TEP sites, all on Archaic-period camps, but this is one of the most common lithic materials in the St. Johns/Springerville area. Also found at archaeological sites in the Zuni area, in the western part of the Gallinas Mountains, and as far southeast as the Pine Lawn Valley.</td>
</tr>
<tr>
<td>1112</td>
<td>Silicified wood, dark colors (brown, gray, red), waxy luster, and conchoidal fracture. Although colors vary in the flakes from the TEP sites, wood with cream and medium-brown banding is most common. All gradations to the silicified wood types listed below are present. Outcrops of the Chinle formation (Triassic) and Baca(?) formation (Tertiary conglomerate, which contains reworked Chinle wood) are the probable sources.</td>
</tr>
<tr>
<td>1113</td>
<td>Silicified wood, usually light brown but occasionally red; translucent and chalcedonic; waxy to dull luster. Source as above.</td>
</tr>
<tr>
<td>1120</td>
<td>Silicified wood, red colors, waxy luster. Various sources.</td>
</tr>
<tr>
<td>1140</td>
<td>Silicified wood, white colors, chalcedonic. Source as No. 1112.</td>
</tr>
<tr>
<td>1142</td>
<td>Silicified wood, light colors, chalcedonic, variegated. Source as No. 1112.</td>
</tr>
<tr>
<td>1160</td>
<td>Silicified wood, varicolored in pink, white, yellow, orange, or lavender; chalcedonic. From the Chinle formation in northeastern Arizona. Petrified Forest and Beautiful Valley are major source areas. No source of this particularly beautiful and popular material is known in New Mexico.</td>
</tr>
<tr>
<td>1221</td>
<td>Chalcedony, clear and colorless with abundant yellow mossy inclusions. Source unknown.</td>
</tr>
<tr>
<td>1230</td>
<td>Chalcedony, clear with sparse red inclusions. Source unknown.</td>
</tr>
<tr>
<td>1231</td>
<td>Chalcedony, clear with abundant red inclusions. Source unknown.</td>
</tr>
<tr>
<td>Code No.</td>
<td>Description</td>
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</tr>
<tr>
<td>1232</td>
<td>Chalcedony, clear with scattered red and yellow inclusions. Source unknown.</td>
</tr>
<tr>
<td>1233</td>
<td>Chalcedony, clear with abundant red and yellow inclusions. Source unknown.</td>
</tr>
<tr>
<td>1251</td>
<td>Chalcedony; clear, colorless, yellow, light green; banded in white and black. Ranges to a glossy black chert. Most artifacts of this material are a very glossy clear chalcedony. Quartz crystal druzes (crust lining a cavity) are found in some specimens. This material occurs in andesite flows that cap many of the mesas from Mogollon to north or Red Hill, and as a reworked component in the Quaternary sediments that cover many of the mesa-like highlands in west-central New Mexico and east-central Arizona west to the Little Colorado River. The black chert does not appear to be as abundant as the white chalcedony, and its high incidence on TEP sites of the Archaic period may be an indication of preference by the occupants. This was a favorite material for making lithic artifacts in west-central New Mexico, and it is common at some sites in the St. Johns area as well. Numerous quarries and associated chipping areas and shrines have been found along Apache Creek, hence the name Apache Creek chalcedony (Warren 1971).</td>
</tr>
<tr>
<td>1310</td>
<td>Chalcedony, very light yellow. Source unknown.</td>
</tr>
<tr>
<td>1400</td>
<td>Chert, miscellaneous, no specific description or source.</td>
</tr>
<tr>
<td>1600</td>
<td>Chert, light gray, waxy to dull luster. Some of these flakes may be San Andres chert but the identification is uncertain. Source otherwise unknown.</td>
</tr>
<tr>
<td>1620</td>
<td>Chert, light cream or yellow. Source unknown.</td>
</tr>
<tr>
<td>1660</td>
<td>Chert, light tan or buff. Source unknown.</td>
</tr>
<tr>
<td>1661</td>
<td>Chert, various colors including tan, gray, cream, white, and red. Fine-textured. In the northern part of the TEP corridor area, mottled, fossiliferous cherts are common, and flaked artifacts made from this type are common around the Zuni area. Occurs as pebbles and cobbles from conglomerate; many of the pebbles have color bending corresponding to the pebble outline. Source of these pebbles and cobbles may be the Shinarump Conglomerate member of the Chinle formation, the Baca formation (Tertiary) or the Gila Conglomerate (Tertiary-Quaternary). Quartzite and quartzitic mudstones and siltstone pebbles may also derive from any of these conglomerates.</td>
</tr>
</tbody>
</table>
Table 3. Descriptions of Lithic Material Types from TEP Sites (cont.).

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>2200</td>
<td>Quartzitic sandstone. Miscellaneous, source unknown.</td>
</tr>
<tr>
<td>2201</td>
<td>Quartzitic sandstone, from the Dakota formation? This formation crops out in the survey area.</td>
</tr>
<tr>
<td>2204</td>
<td>Quartzitic sandstone and siltstone, ranges to red chert. Similar material reported from the Spears member of the Datil formation (Tertiary) in central New Mexico. Definite source not known.</td>
</tr>
<tr>
<td>2251</td>
<td>Mudstone, indurated, and siltstone. Pink and light red. Probably from the Datil formation volcanic sediments. The material is well-cemented and can be made into flaked artifacts. Common in the Apache Creek to Quemado area; found in the volcanic sediments below the andesite flows that contain Apache Creek chalcedony (No. 1251).</td>
</tr>
<tr>
<td>2600</td>
<td>Mudstone, siltstone. Dark gray and grayish-green, well-indurated. Pebbles and cobbles, probably from conglomerates of the area (see No. 1661).</td>
</tr>
<tr>
<td>2860</td>
<td>Fossil shell. Probably from Mancos shale (Cretaceous), a formation that crops out in the survey area.</td>
</tr>
<tr>
<td><strong>SEDIMENTARY ROCKS (CODE 2000–2999)</strong></td>
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<tr>
<td>3050</td>
<td>Basalt. Very fine grained, dark gray. Can be flaked into crude artifacts. Probably from Quaternary basalt flows near Red Hill.</td>
</tr>
<tr>
<td>3530</td>
<td>Obsidian. Medium dark gray, turbid or smoky, waxy luster. The source of this obsidian is in the vicinity of Polvadero Peak, in the northern end of the Jemez Mountains. This source was known by both Paleo- and Archaic-period Indians, and material from it was widely traded.</td>
</tr>
<tr>
<td>3550</td>
<td>Obsidian. Clear, nearly colorless to gray and silvery gray. Waxy luster. Nodules of this obsidian are found as lag gravels over a wide area about 8 km (5 mi) south of Red Hill. The peculiar luster is difficult to describe. The obsidian has been found as far north as Zuni and east to Grants on archaeological sites.</td>
</tr>
</tbody>
</table>

John P. Wilson and A. Helene Warren 223
Table 3. Descriptions of Lithic Material Types from TEP Sites (cont.).

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>3740</td>
<td>Vitrophyre or glassy welded tuff. Dark colored. Probably from the Datil volcanics. Can be flaked.</td>
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</table>

**METAMORPHIC ROCKS (CODE 4000–4999)**

<table>
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<td>4000</td>
<td>Quartzite, undifferentiated. Various colors. Usually pebbles and probably from the same source as No. 1661.</td>
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**MINERALS (CODE 5000–5552)**

<table>
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<tr>
<td>5010</td>
<td>Quartz, white, coarsely crystalline. Source unknown.</td>
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</table>

Varieties of minerals and cherts are referred to here as Apache Creek chert or chalcedony. Apache Creek chalcedony composed about 24 percent of the Archaic lithic artifacts but only 12 percent of the Pueblo site materials, although the source was presumably at a considerable distance from both types of sites and known to their inhabitants.

Silicified wood was most abundant at sites in the central part of the corridor length, probably indicating geologic sources in that area. The preference for silicified wood by Pueblo Indians was about twice that of Archaic peoples. The incidence of flakes and artifacts made from cherts derived from conglomerates was three times as great at the Pueblo sites. The inference can be made, from these distributional patterns, that the Pueblo Indians obtained most of their source materials close at hand while the Archaic peoples were more mobile and carried their stone materials greater distances.

Among the Archaic sites there appeared to be preferences for lithic materials that were not based upon geologic and geographic factors. Only 5 of the 12 Archaic sites produced flakes and formal tools of San Andres chert and at least 3 of these 5 were located at some distance south of the probable geologic source at the northern end of the corridor segment. The reverse is true in regard to Apache Creek chert, as sites 32 to 48 km (20 to 30 mi) north of the source area contain appreciable percentages of this material. At 6 of the 12 Archaic sites, Apache Creek chert and silicified wood were the predominant lithic materials, while San Andres chert was absent, even though its source area was at no great distance.

Certain lithic types appeared only at Archaic camps. These included a red and yellow moss jasper (Code 1092), red-colored silicified wood (Code 1120), obsidian from the northern part of the Jemez Mountains (Code 3530), and obsidian from the Red Hill area (Code 3550). A fine-grained basalt (Code 3050) came from one Archaic site.

Colorful chalcedonic wood from Arizona (code no. 1160) was found only on Pueblo
Table 4. Lithic Artifact Materials from Archaic Sites, Listed North to South.

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Table 5. Lithic Artifact Materials from Pueblo Sites, Listed North to South.

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The various types of lithic materials are listed below and described briefly in Table 3. Code numbers are Museum of New Mexico lithic material designations. The distributions of lithic artifact materials and formal tools by site are given in Tables 2, 4, and 5.

**SUMMARY**

In this review and in the reports of surveys and excavations both east and west of the corridor area, projectile point styles have principally been used for distinguishing among preceramic occupations, and pottery analyses, for establishing chronological placement and cultural relationships of the ceramic-period sites. Much effort in the past has been expended on the investigation of lithic technologies, as well; the principal result of this has been the demonstration of a bifacial reduction strategy/soft-hammer percussion and biface reduction at Archaic sites, and hard-hammer core reduction techniques at Puebloan sites (Hogan 1985; Westfall 1981). This provides a rather flat picture for the Archaic sites, the more so when formal tools are sparse or absent. Only Larralde (in Camilli et al. 1988:6-5 to 6-6) and Elyea (in Hogan 1985:55-56) made limited use of Warren’s lithic materials classification. The conclusions that they drew—that most materials were of local origin, nonlocal materials were rare, and all were available in conglomerates or terrace gravels nearby—do not always apply.

More accurate sourcing information is always desirable, but even without it, much can be said about trade or other forms of interaction. In my own experience there are often substantial differences in the lithic material assemblages from one Archaic site to the next, even when sites almost adjoin one another, a clear indication that there is more to selectivity than picking up the nearest suitable rock. With careful attention to identifications, lithic-material types can provide distributional information similar to what we expect from identification of pottery types. The keys are having at hand enough information and paying careful attention to identifications, similar perhaps to the work in recent years with sources of obsidian. In her lithic analysis, Warren offered leads and preliminary judgments that have been useful guides and that provide a basis for an expanded understanding of western New Mexico/east-central Arizona prehistory.

—Las Cruces, New Mexico

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**COPROLITE ANALYSIS FOR GIARDIA LAMBLIA AT SALMON RUINS**

Stuart D. Wilson, M.D., Maria M. Jordan, M.T., and Maria A. Jordan

*Giardia lamblia* is a freshwater protozoan whose habitat is temperate climates worldwide. It is widely distributed and very prevalent as a human intestinal parasite. In 1978, U.S. State Health laboratories reported that *Giardia* was the most frequently reported pathogenic parasite identified in human fecal specimens (Smith and Gutierrez 1991). In the State of New Mexico, the Department of Health reported 241, 300, and 284 cases in 1991, 1992, and 1993, respectively (Gallaher and Vold 1993, 1994). While the majority of cases were reported from Bernalillo County, San Juan County in New Mexico has averaged 9 cases per year from 1984 through 1992 (Maggi Gallaher, personal communication 1992 and 1993). Although not proven, it is reasonable to assume that, in the absence of modern sanitary conditions, infestation by this organism may not have been uncommon in prehistoric Anasazi peoples in this same area of northern New Mexico. However reasonable this assumption may be, the hypothesis is complicated by a paucity of archaeoparasitological documentation that this organism or any protozoan parasite did in fact exist in prehistoric populations.

In his comprehensive review article, Reinhard (1990) specifically noted that "the preservation of protozoa has not yet been demonstrated in any North American study" of prehistoric parasitism. Shortly thereafter, Faulkner (1991) identified *Giardia intestinalis* (lamblia) in one of eight human coprolites recovered from Big Bone Cave excavations in Tennessee. He was able to achieve this unique finding through the use of an immunofluorescent assay, which employed a monoclonal antibody (detection reagent) specific for the antigenic cyst wall of *Giardia*. By way of explanation, such assays employ a marker (a specific, "purified" antibody) that attaches itself to the parasite's outer surface (antigen). This attachment is confirmed by a secondary marker, which is joined to the antibody. This second marker is visually recognized under the microscope, because it fluoresces when exposed to a light source with a specific wavelength. As such, the fluorescence is an indirect indicator that the specific antibody has combined with the specific antigen, thus identifying the parasitic cyst wall. This current technology was not routinely employed in earlier studies because of its unavailability as a commercial kit until recently.

During the 1970 excavation of Salmon Ruins, located 22.4 km (14 mi) east of Farmington, New Mexico, 112 coprolites with different proveniences recovered from several latrine areas were studied (Reinhard 1988; Reinhard et al. 1987). In Reinhard’s study, only 12 of these specimens (11 percent) demonstrated parasites, and these
were all reported as *Enterobius vermicularis* (pinworm). No protozoan parasites were identified. Based on the hypothesis that *Giardia lamblia* organisms might reasonably have existed in this population, restudy of a sample of the Salmon Ruin coprolite material utilizing a specific monoclonal antibody label by the immunofluorescent technique was undertaken.

**MATERIALS AND METHODS**

An initial survey of coprolite material was conducted on samples acquired from multiple levels of a single fully excavated room. This room (No. 62) was used as a latrine during a period estimated to span A.D. 1200 and 1275. Thirty-three coprolites were included in this preliminary study. Reinhard had previously analyzed these samples, utilizing traditional methods. It was felt that focused evaluation of this limited sample would assess the likelihood of *Giardia* infestation at this Anasazi site located along the upper San Juan River.

For the purpose of protozoal (*Giardia*) study, 5.0-gm samples were separated from each coprolite. Rehydration employed a 0.5-percent trisodium phosphate solution, with immersion of each sample in the solution for a minimum of 48 hours. After 24 hours, Pen-Fix was added to each rehydrating coprolite to retard microbial growth. The mixed specimens were screened with distilled water through 300- and 180-μ mesh brass geological sieves. Screened fluid was centrifuged for 2 minutes at 2,000 rpm in 50-ml capped plastic conical test tubes. After decanting the supernatant, each specimen was preserved in 20 ml of 10 percent sodium acetate buffered neutral formalin (a solution of formaldehyde with methanol). Sedimentation for 4 hours was accomplished after addition of 5-ml ethyl acetate. After sedimentation, the plug at the top of the conical tube was loosened with an applicator stick, and the supernate was decanted. The sediment was resuspended by gently tapping the bottom of the tube.

The MerIFluor kit with controls was provided in commercial form by Meridian Diagnostics of Cincinnati, Ohio. This kit employs a FITC-labeled monoclonal antibody (detection reagent) specific for the cyst wall of formalin-fixed *Giardia*. Following the manufacturer's recommended procedure (MerIFluor 1991), a drop of each resuspended specimen was applied to the treated slide well and spread over the surface, being careful not to scratch the slide surface. Both positive and negative control specimens were applied in the same manner. After air drying for 30 minutes, the detection reagent and eriochrome black counterstain were added to each well. Following light-protected incubation in a humidified chamber for 30 minutes, slides were rinsed with buffer solution and drained of excess fluid. After adding a cover slip with formalinized buffered glycerol as the mounting medium, slides were scanned at 100–200x magnification, utilizing fluorescent microscopy with a mercury lamp. One or more cysts with apple-green fluorescence and characteristic morphology would represent a positive test.

This immunofluorescent method has shown to be highly specific for *Giardia* cysts. According to the manufacturer, the sensitivity and specificity for *Giardia* in stools are both 100 percent. Based on clinical trials preparatory to the release of the kit for commercial purposes, a wide variety of protozoa, helminths, bacteria, yeast, and fungi did not cross-react with the antibody nor demonstrate nonspecific fluorescence. However, it should be noted
that the Meridian Diagnostics kit for *Giardia* also contains a second monoclonal antibody for *Cryptosporidium* species. This organism is an opportunistic protozoan parasite to be found in the bowel of humans whose immune system is damaged defending against infection. Such immunologically compromised people are either born with the deficiency or develop it as part of a disease process. While its presence was sought as part of this study, it is unlikely that examples would be identified in the presumed immunocompetent (normal immune response) prehistoric Native American.

**RESULTS**

Thirty-three coprolites were evaluated. No *Giardia lamblia* organisms were conclusively identified in any of the typical coprolite material. Controls for *Giardia lamblia* did give appropriate positive fluorescence with the procedure. While these coprolites were recovered from multiple levels in the one room, the small number that was analyzed represents less than a statistically significant sample population of coprolites deposited over time at this site.

**DISCUSSION**

Infection with *Giardia lamblia* is enteric, principally involving the small intestine. The organism has been documented in both sporadic endemic and epidemic infestations. While person-to-person and rarely food transmission have been demonstrated, the most common source of infestation is secondary to contamination of local water supplies. Transmission by water contamination has been implicated as the principal source of most large outbreaks in modern times (Smith and Gutierrez 1991). Incidence of infection is more prevalent in areas where contaminated local water supplies are not provided with adequate public health measures (Owen 1993). Obviously, prehistoric habitation sites did not utilize such measures, creating and perpetuating opportunities for endemic infestation of the population.

It is reported that only about 50 percent of exposed individuals become infected. Factors favoring infection include youth, malnutrition, bacterial overgrowth in the upper small bowel, and impaired immunological defenses. These factors may operate in a synergistic manner to enhance the parasite’s pathogenicity or ability to cause infection. While infestation with the organism is asymptomatic in most patients, those with symptoms exhibit varying degrees of fatigue, nausea, vomiting, anorexia, postprandial distress, abdominal cramps, diarrhea, and weight loss. Some individuals, especially children, may progress to develop a malabsorption syndrome with significant complications: steatorrhea (excess of fat in stools); reduction of serum carotene, vitamin B12, and folate; and impairment of D-xylose excretion (Monroe 1995). Growth retardation may be seen in children. Chronic fallout from these disease effects can be debilitating and may result in significant modification of an individual’s ability to cope with environmental challenges.

The implications of symptomatic infections on prehistoric peoples are significant. In societies where a high degree of physical competence was necessary for survival, the competitive edge would go to the healthy individual. When marginal circumstances existed in the environment and malnutrition prevailed, effects of even limited disease on a culture could have been
very significant. Protozoan infections are known to have had adverse effects in modern populations. The individual’s motivation to cope and compete could reasonably be expected to suffer as the incidence of disease complications increased. Moreover, it has been well documented that helminthic (intestinal worm) infestations were more prevalent in sedentary groups than in more transient and mobile prehistoric hunter-gatherers of the Southwest (Reinhard et al. 1987). Similar findings have been documented in twentieth-century primitive societies (Chernela and Thatcher 1989). It may be reasonable to assume that this same phenomenon could have operated in regard to protozoan infections, creating an imbalance between adversaries. Thus, the defense capabilities and subsistence strategies of more sedentary peoples with predominantly agricultural traditions may have been compromised relative to those of the more mobile, marauding aggressors with dominant hunter-gatherer traditions.

While the preliminary results of this initial sample did not demonstrate Giardia organisms, the test sample of the total coprolite population that could be presumed to have been deposited at this site over the time of occupation was small. The test sample was also limited to only one of the identified latrine rooms at the site. It would be appropriate to study additional samples from other rooms to conclusively disprove the hypothesis in a statistically meaningful way. Regardless of the ultimate results, it is apparent that a new technical standard in archaeological studies has been established. Whether Giardia lamblia is or is not ultimately demonstrated in the Salmon Ruins coprolites, it is no longer appropriate to limit future studies of coprolite and contaminated soil material to traditional, less-sensitive methods for protozoan parasite identification. There are currently commercially available kits that permit application of monoclonal antibody technology by immunofluorescent techniques for the identification of three protozoan enteric parasites, including Entamoeba histolytica (amebiasis). In areas where modern endemic infections occur or where environmentally appropriate conditions existed in prehistoric times, it would be appropriate to subject all materials to immunofluorescent techniques to identify not only Giardia lamblia, but Entamoeba histolytica as well.

ACKNOWLEDGEMENTS

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REASSESSMENT OF THE DATING OF THE POJOAQUE GRANT SITE (LA 835), A KEY SITE OF THE RIO GRANDE DEVELOPMENTAL PERIOD

Regge N. Wiseman

The prehistoric chronology of the Rio Grande Anasazi is based partly on tree-ring dates, partly on ceramic cross-dating, and partly on the postulate that the Rio Grande region was culturally marginal to the Chaco and Mesa Verde Anasazi. Fundamental to this last notion is the idea that major changes in the Rio Grande derived from, and therefore postdate, similar developments in the Four Corners Anasazi. Reassessment of 222 tree-ring dates from the Pojoaque Grant site (LA 835) north of Santa Fe, New Mexico, indicates that this site, and therefore certain key manifestations in the Rio Grande area, date earlier than previously thought. Thus, the development of Rio Grande prehistory and its relationship to the Four Corners Anasazi must be reconsidered.

INTRODUCTION

Rio Grande prehistory is perceived by some to have been culturally marginal to the Four Corners Anasazi (Chaco and Mesa Verde) (Cordell 1979:64–105; Wendorf and Reed 1955:133–134). In this view, the diffusion of traits and ideas, such as certain types of architecture and pottery, is the primary stimulus for cultural development and change in the Rio Grande. Because of the time required for the diffusion of ideas, some scholars have assumed that changes in Rio Grande archaeological traits are later than, or lag behind, the same changes in the Four Corners region. Site LA 835, with tree-ring cutting dates that postdate A.D. 1000, provided much of the evidence for the assumption of marginality.

Not all archaeologists have accepted the cultural-lag thesis. In one of the more recent discussions of Rio Grande prehistory, Dickson (1979) avoids the question altogether by not mentioning cultural lag or LA 835!

So, what is the problem? Warren and Mathien (1985:97) illustrate the situation when they suggest that Kiatuthlanna, Red Mesa, Escavada, and Gallup Black-on-white potteries, which "have been believed to be of different consecutive time periods ranging from A.D. 720 to 1200" in the Four Corners region, date from A.D. 1000 to 1150 in the Rio Grande. Clearly, we need to look at the dates and assumptions pertaining to Site LA 835.

Site LA 835, the Pojoaque Grant site, was partly excavated in 1953 by Stanley Stubbs of the Laboratory of Anthropology. Considered the dean of Rio Grande archaeology, Stubbs died before he could write the final report on the excavation. But it is clear from his preliminary statements that the site is important to his and therefore our understanding of Rio Grande prehistory (1954:45; see also Stubbs and Stallings 1953:155). Stubbs believed LA 835
to be a site-unit intrusion from the Four Corners region and therefore pivotal in the transmission of cultural traits from that region to the Rio Grande.

THE RIO GRANDE DEVELOPMENTAL PERIOD

The Developmental period (A.D. 600-1200) is a key period in Rio Grande prehistory, but it is also the least known. First defined by Fred Wendorf and Erik Reed (1955), the period corresponds to Basketmaker III, Pueblo I, Pueblo II, and early Pueblo III of the Pecos Classification. The beginning of the Developmental period is marked by the appearance of pottery at A.D. 600. The end date, A.D. 1200, is marked by the shift from mineral paint to carbon paint on black-on-white pottery.

The first modern conceptualization of Rio Grande prehistory produced by Wendorf and Reed (1955) was based on mostly unpublished information that was quite new at the time. Very little was known about sites that date early in the period. Since then, we have learned much more about early Developmental period sites but have gained virtually no new information about the late Developmental period. Excavation data from the late Developmental sites discussed by Wendorf and Reed remain unpublished, depriving today's scholars of information crucial to understanding the prehistory of the region.

The description of the Developmental period that follows is based mainly on Dickson (1979). The dates reflect recent thinking about pottery types from the Four Corners region and do not address the concept of culture lag or its presumed effect on the dates of cultural developments in the Rio Grande. A reassessment of the dates for Site LA 835 brings that site into line with the dating in this construct. For more details, consult Wendorf and Reed (1955), Wetherington (1968), McNutt (1969), and Dickson (1979).

The Developmental period can be divided into three subperiods. The Early Developmental (circa A.D. 600-900) is denoted by pithouse architecture and Lino Gray and San Marcial Black-on-white pottery.

In the Middle Developmental period (circa 900-1000), pithouses continued in use, but surface structures (pueblos) of jacal or thin adobe walls were also built for living and storage. Kana-a Gray and Red Mesa Black-on-white are the diagnostic pottery types. More sites are known for this subperiod than the preceding one, and they are found over a much larger area.

Pueblos of the Late Developmental period (circa 1000-1200) were larger (had more rooms on the average) and had one or more pit structures in front of them. It is not certain whether the pit structures were habitations or kivas. Sites range in size from a single pueblo and pit structure to groups of a dozen or more such units. Late Developmental pottery includes Kwahe’e Black-on-white and indented-corrugated ware.

THE POJOAQUE GRANT SITE, LA 835

The Pojoaque Grant Site (LA 835) is a cluster of about 15 small pueblos, associated pit structures, and a great kiva. Stubbs (1954) excavated Pueblos A and B (Figure 1), tested several others, and uncovered portions of the great kiva. Pueblos A and B are 35 m from one another and are...
Figure 1. Site LA 835: map of Pueblos A and B, as excavated by Stubbs.
separated by a small drainage. Average depth of the pueblo floors was 30 cm below the modern surface, and the deepest was about 50 cm deep. The pit structures, which Stubbs believed to be kivas, and the great kiva were the deepest structures at the site. The pottery assemblage is dominated by locally made utility ware. The painted types, dominated by Red Mesa and Kwahe’e Black-on-white, are only a minor component of the pottery.

Over 200 pieces of datable wood were recovered from the site, most coming from the fill of pit structures. Presumably the dated specimens reflect a variety of activities at each pueblo, including construction, heating, and cooking.

Stubbs (1954:45) initially estimated the major occupation "was during the 1000s, and possibly as late as 1150 A.D." Elsewhere, he guesses that the occupation occurred between A.D. 950 and 1100 (Stubbs and Stallings 1953:155).

The Tree-Rings

Since Stubbs (1954) made his preliminary dating estimates, 222 pieces of wood have been dated, though most lack the outside rings and are annotated vv and ++vv (Robinson et al. 1972:49-52). For vv dates, "there is no way of estimating how far the last ring is from the true outside." The ++ symbol means that "a ring count is necessary due to the fact that beyond a certain point the specimen could not be dated" (Robinson et al. 1972:5).

Only six cutting dates—1003rB, 1003rB, 1047+rB, 1064rB, 1128rB, 1129r—and two near-cutting dates of 995v and 1133v were obtained. Robinson and others (1972:52) conclude, "The dates appear to represent occupation from the early 11th century until the early 12th century. Lack of adequate descriptions and an almost total absence of cutting dates does not permit detailed chronological interpretation." All but three of the dates are on piñon; the three exceptions are Douglas fir.

In a more recent evaluation, Ahlstrom (1985:537-542) suggests that Kiva 1 of Structure (Pueblo) A may have been built in the late A.D. 900s, and that Kiva 2 of Structure (Pueblo) B was built in the second half of the 1120s. Clearly, the dating situation at Site LA 835 is poor, but late tenth-, eleventh-, and twelfth-century dates are still in line with the notion that Rio Grande culture lagged behind development elsewhere.

While gathering information of the Pojoaque Grant Site, I learned that 216 dated tree-ring samples, including the 995v and 1133v near-cutting dates, had not been considered when Stubbs originally dated the site. I therefore grouped the dates into 25-year increments and plotted them on graph paper (Figure 2).

One principle guides my interpretations offered here. It should be possible to use large numbers of noncutting dates from controlled proveniences to date sites through the notion of strength in numbers, especially if the dates are mutually reinforcing. In the context of Site LA 835, it is unreasonable to assume that 214 pieces of wood each lost 50 to 300 rings between the time that site was occupied and the time the wood was excavated by archaeologists. Grouped appropriately, the dates from these pieces of wood should permit general dating, even though they are not cutting dates.
Figure 2. Histograms of tree-ring dates grouped in 25-year increments.
Two proveniences—involving four lots of tree-ring specimens and a total of 193 noncutting dates and 4 cutting dates—yielded the large numbers of dates necessary for this "safety in numbers" assumption. Two of the lots, labeled "Structure B, Pit 2" and "Structure B, Kiva 2," probably represent the same provenience, that is, Pit Structure 2 of Pueblo B. (Ahlstrom [1985: 542] concurs with this). According to the excavation maps and meager documentation, the lots labeled "Pit Trench 2A, Test 1" and "Pit Trench, Test 2" represent Pit Structure 2A of Pueblo A. Within each provenience, the dates span three centuries, with good representation for at least two centuries. Although they are not from the four tree-ring lots being considered here, the cutting dates of 1047+rB and 1064rB and the near-cutting date of 995v are included in this discussion because they are from these structures.

The results are noteworthy. The two distributions for Pueblo B are virtually identical, strengthening the hypothesis that both tree-ring lots are from Pit/Kiva 2B. An important feature of the distributions is that they are skewed slightly to the right. The robustness of the distributions—plus four cutting dates of 1003, 1003, 1128, and 1129—indicate construction and occupation in the A.D. 1000s and the first quarter of the 1100s. The steepness of the right tails of both distributions reinforces an interpretation that the 1128 and 1129 cutting dates are at or very near the final construction date in this structure.

The Pueblo A distribution, on the other hand, is very different, with two or possibly three modes. Significantly, the strongest mode, the one that I believe marks the initial construction and occupation of Pueblo A, centers in the last quarter of the A.D. 700s. This mode is right-skewed and its right tail is steep, suggesting that the true initial construction date is no later than the early to middle 800s. Minor modes in the second half of the 800s and the middle 900s indicate construction periods or increased activity (i.e., more people, more cooking, more heating) in the early 900s and about A.D. 1000. Pueblo A evidently was abandoned some time in the A.D. 1000s.

Richard Ahlstrom, in reviewing an earlier version of this paper, pointed out that an 1128vv date is recorded for the lower fill of Pitstructure 2 of Pueblo A. This date is clearly at odds with the interpretation offered here, that Pueblo A was abandoned in the A.D. 1000s. In the Tree-Ring Laboratory sheets on specimen lots that he provides, this date is also anomalous with the other specimens in the two lots representing the upper and lower fill of the structure. The upper fill lot (RG-1033) has 9 dated specimens ranging from 747vv to 949vv. The lower fill lot (RG-1028), excluding the date in question, has 7 other specimens ranging from 703vv to 982vv. None of the noncutting dates in the other lots from this structure are later than the 982vv date. The 1128vv date, then, is a minimum of 146 years younger than all other noncutting dates from the structure.

How might we account for this discrepancy? In the absence of excavation notes and fill interpretations, we can only speculate. The 1128vv specimen could represent a late reuse of the structure, but this interpretation does not seem likely, because only one questionable date is present. The two cutting dates of 1047 and 1064 and the near-cutting date of 995v are from a floor feature of the structure and therefore are stratigraphically lower than the 1128vv date. Other possible explanations...
include bioturbation and error during excavation or laboratory handling. Whatever the explanation, an isolated tree-ring date cannot be taken any more seriously than an anomalously late potsherd.

**The Ceramic Data**

Even though the tree-ring distributions are generally consistent, ceramic data provide an independent cross check (Figure 3). Pottery dates used in this study are presented in Table 1.

I recently reanalyzed the better-preserved black-on-white sherds from Site LA 835. Several known types were recognized, including White Mound and/or Kiatuthlanna, Red Mesa, Escavada, Gallup, and Kwahe’e (Figure 3). A single sherd of Chaco Black-on-white was also noted.

Some of the black-on-white sherds are small, rendering assignment to specific types ill-advised. Thus, the earliest sherds from Site LA 835 are assigned to the dual black-on-white categories of White Mound/Kiatuthlanna and Kiatuthlanna/early Red Mesa. The more numerous and larger Red Mesa sherds embody a variety of design styles, permitting delineation of early sherds from middle to late ones. Forty-one black-on-white sherds do not readily fit the descriptions of established pottery types and are not considered further here.

The utility pottery was briefly examined but not reanalyzed. The majority of utility sherds at both pueblos are plain-surfaced. They may represent Lino Gray-like vessels, the lower portions of banded vessels, the lower portions of indented vessels, or some combination of all three. Pueblo A produced 61 percent plain sherds, and Pueblo B produced 54 percent. Since I cannot confidently assign these sherds to specific time periods, they are omitted from further discussion. Two minor utility types—Taos Incised (1 percent at Pueblo B; absent at Pueblo A) and "scratched" (3 percent at Pueblo A; 6 percent at Pueblo B)—are also omitted.

The balance of the utility pottery has temporal value. While Stubbs (n.d.) did not use formal type names, he did use the terms "wide band coil," "narrow band coil," and "indented coil" in a bar chart he evidently had prepared for publication. A brief examination of the actual collections confirmed that his style groups can be readily correlated with several familiar types in the San Juan Basin of northwestern New Mexico. The "wide band coil" equates with Kana-a Neckbanded; the "narrow band coil," with Tohatchi Banded; and the "indented coil," with Exuberant Corrugated and Chaco Corrugated. Brief examination of the pastes of many utility sherds from Site LA 835, however, indicate that they were made in the Rio Grande. The surface treatments of the Rio Grande analog sherds so closely duplicate the San Juan Basin types that I use the dates for the San Juan Basin types here.

The diagnostic pottery data of Pueblos A and B are summarized in Figure 3. Three points can be made from these data. First, excavations at both pueblos produced small quantities of the Basketmaker III, Pueblo I, and early Pueblo II types of White Mound Black-on-white and/or Kiatuthlanna Black-on-white and early Red Mesa Black-on-white, but on a percentage basis, Pueblo A produced roughly twice as many of these types combined (28 percent to 16 percent). Small and/or short occupations during one or both of these periods are indicated at both locations, but no associated features can be
Table 1. Dates of pottery types from LA 835.

<table>
<thead>
<tr>
<th>Pottery Type</th>
<th>Best Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Painted</td>
<td></td>
</tr>
<tr>
<td>White Mound Black-on-white</td>
<td>750-800</td>
</tr>
<tr>
<td>Kiatuthlanna Black-on-white</td>
<td>825/850-910</td>
</tr>
<tr>
<td>Red Mesa Black-on-white</td>
<td>850/900-1050</td>
</tr>
<tr>
<td>Late Red Mesa Black-on-white</td>
<td>1050-1125</td>
</tr>
<tr>
<td>Kwahe’e Black-on-white</td>
<td>1115-1200+</td>
</tr>
<tr>
<td>Santa Fe Black-on-white</td>
<td>1200-1350</td>
</tr>
<tr>
<td>Utility</td>
<td></td>
</tr>
<tr>
<td>Kana-a Neckbanded</td>
<td>760-900</td>
</tr>
<tr>
<td>Tohatchi Banded</td>
<td>900-1050?</td>
</tr>
<tr>
<td>Exuberant Corrugated</td>
<td>890-1075</td>
</tr>
<tr>
<td>Chaco Corrugated</td>
<td>1050-1110</td>
</tr>
</tbody>
</table>

* After Breternitz 1966.

specifically identified for them. On the basis of the pottery, these occupations could have started as early as the middle A.D. 700s and lasted well into the A.D. 800s.

Second, excavations at both pueblos produced Red Mesa Black-on-white with middle and late design styles. These styles constitute 71 percent of the identifiable painted sherds from Pueblo A but only 27 percent of those from Pueblo B. Similarly, Pueblo A produced 32 percent of the wide-banded utility pottery, the earlier type, as opposed to Pueblo B, which produced only 8 percent. Accordingly, the main Pueblo A occupation clearly took place when middle to late Red Mesa Black-on-white and wide-banded utility pottery styles were popular. The estimated pottery dates for the main occupation of Pueblo A are from some time in the A.D. 900s to well into the A.D. 1000s.

Third, excavations at both pueblos also produced the later-dating types, Kwahe’e Black-on-white and indented corrugated, but the emphases are just the opposite of those noted for the earlier types. Pueblo B produced 48 percent Kwahe’e and 27 percent indented corrugated, compared to 2 percent and 3 percent, respectively, at Pueblo A. Thus, the main Pueblo B occupation took place when Kwahe’e and indented corrugated were popular. This pottery assemblage in the Rio Grande dates to the A.D. 1100s. On the basis of the pottery, then, main occupation of Pueblo B probably started in the early to middle A.D. 1000s and lasted well into the 1100s.

**DISCUSSION**

The pottery and tree-ring data are complementary but have slightly different emphases, as might be expected when dealing with construction data (tree-ring dates, in part) and occupation data (the pottery and an undetermined number of tree-ring dates on fuel wood). The assumption here is that, although pottery fragments and some fuel wood would accumulate during the construction episode(s) at the site, larger quantities of both types of debris would accumulate...
Figure 3. Pottery recovered from Pueblos A and B.
during the period of occupation following the construction event.

Considering the salient features of the tree-ring dates and the pottery data, several points are evident. First, the pottery assemblages from Pueblos A and B have early components, suggesting use of both areas as early as the A.D. 800s. The Pueblo A tree-ring group, with a modal curve peaking about A.D. 800, indicates initial construction or occupation starting in the early to middle A.D. 800s. Although a few tree-ring dates in the Pueblo B group also suggest construction or other occupation as early as the late A.D. 800s, the data are weak, suggesting a much smaller or less intense use than Pueblo A. Given the proximity of the two pueblos, these pieces of early-dating charcoal could also be intrusive from Pueblo A to Pueblo B.

Second, the pottery indicates that the occupations of both pueblos continued into the A.D. 900s, though again, the Pueblo A occupation was larger or more intensive. The Pueblo A tree-ring data indicate a continuation of construction or other occupation into the 900s and 1000s, but on a diminishing basis. Conversely, the evidence for construction at Pueblo B during the 900s and especially the 1000s increases strongly, both in terms of noncutting and cutting dates.

Third, the tree-ring and pottery data indicate that the primary occupations of Pueblos A and B were different. The occupation of Pueblo A peaked in the late 900s and 1000s, ending by A.D. 1100. The occupation of Pueblo B peaked in the late 1000s and 1100s and ended by A.D. 1200.

The tree-ring dates from Pueblo A indicate cessation of most building and other activities in the late A.D. 900s or early 1000s. However, two isolated cutting dates of 1047 and 1064 and a near-cutting date of 995 indicate minor levels of construction or maintenance activity, perhaps in the form of one or more reoccupations. This suggestion is buttressed by a circular surface room superimposed over the west end of the Pueblo A room block.

The Pueblo B tree-ring data, on the other hand, give strong, clear evidence of construction and other activities throughout the A.D. 1000s and well into the 1100s. The precipitous fall-off of the tree-ring group by A.D. 1150 indicates Pueblo B was abandoned by the end of the century. The absence of Santa Fe Black-on-white, dating A.D. 1175 or 1200 to 1300 or later, confirms this interpretation.

**SUMMARY AND CONCLUSIONS**

Over the past several decades, archaeologists have dated Site LA 835, a key middle to late Developmental period site in the Rio Grande, solely on the basis of six tree-ring cutting-dates. These placed the occupation after A.D. 1000. For dating purposes, 216 noncutting dates were essentially ignored.

This study, which uses a simple graphing technique to investigate the distribution of 193 of the 216 noncutting dates, shows that occupation of Pueblos A and B began in the early to middle A.D. 800s and continued into the A.D. 1000s and 1100s, respectively.

The Pueblo A tree-ring distribution, constructed of noncutting dates from the fill of a pit structure, has three modes. It demonstrates that Pueblo A may have been built, at least in part, as early as the middle A.D. 800s and that the occupation continued...
into the 1000s. The associated pottery supports the indications for an early occupation but shows that the heaviest occupation took place in the A.D. 900s and 1000s. Tree-rings and limited architectural superpositioning suggest minor construction, or perhaps one or more reoccupations, in the middle to late 1000s. For all practical purposes, the Pueblo A area was abandoned by A.D. 1100.

Pueblo B is represented by two lots of tree-ring samples from the trash fill of an associated pit structure. The tree-ring distributions of both lots are virtually identical and indicate that the pueblo was built and occupied during the eleventh and early twelfth centuries. However, the pottery assemblage suggests that the initial occupation of the Pueblo B area took place at an earlier date, perhaps as early as the A.D. 800s but certainly during the 900s. Abandonment of Pueblo B took place during the latter half of the 1100s.

This study suggests several implications.

1. Large numbers of noncutting dates can be an important source of temporal data about sites.

2. LA 835 had a long history of occupation starting in the A.D. 800s. The individual small pueblos were not all built or occupied at the same time, suggesting sequential or overlapping occupations rather than a single large occupation of the site as a whole.

3. The tree-ring data from Site LA 835 indicate that the dates established in the Four Corners region for Kiatuhianna Black-on-white, Red Mesa Black-on-white, Escavada Black-on-white, and Gallup Black-on-white are valid for the Rio Grande area as well. The notion of temporal lag for these types in the Rio Grande is invalidated.

4. This assessment of the dating of Site LA 835 indicates that many (most?) cultural events in the Rio Grande were essentially contemporary with developments in the Four Corners area. Thus, they could not have been solely the result of "diffusion" from that region. The best example is the shift from pithouses to pueblos as primary habitations. Clearly, our conception of prehistoric cultural developments in the Rio Grande must be revised.

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