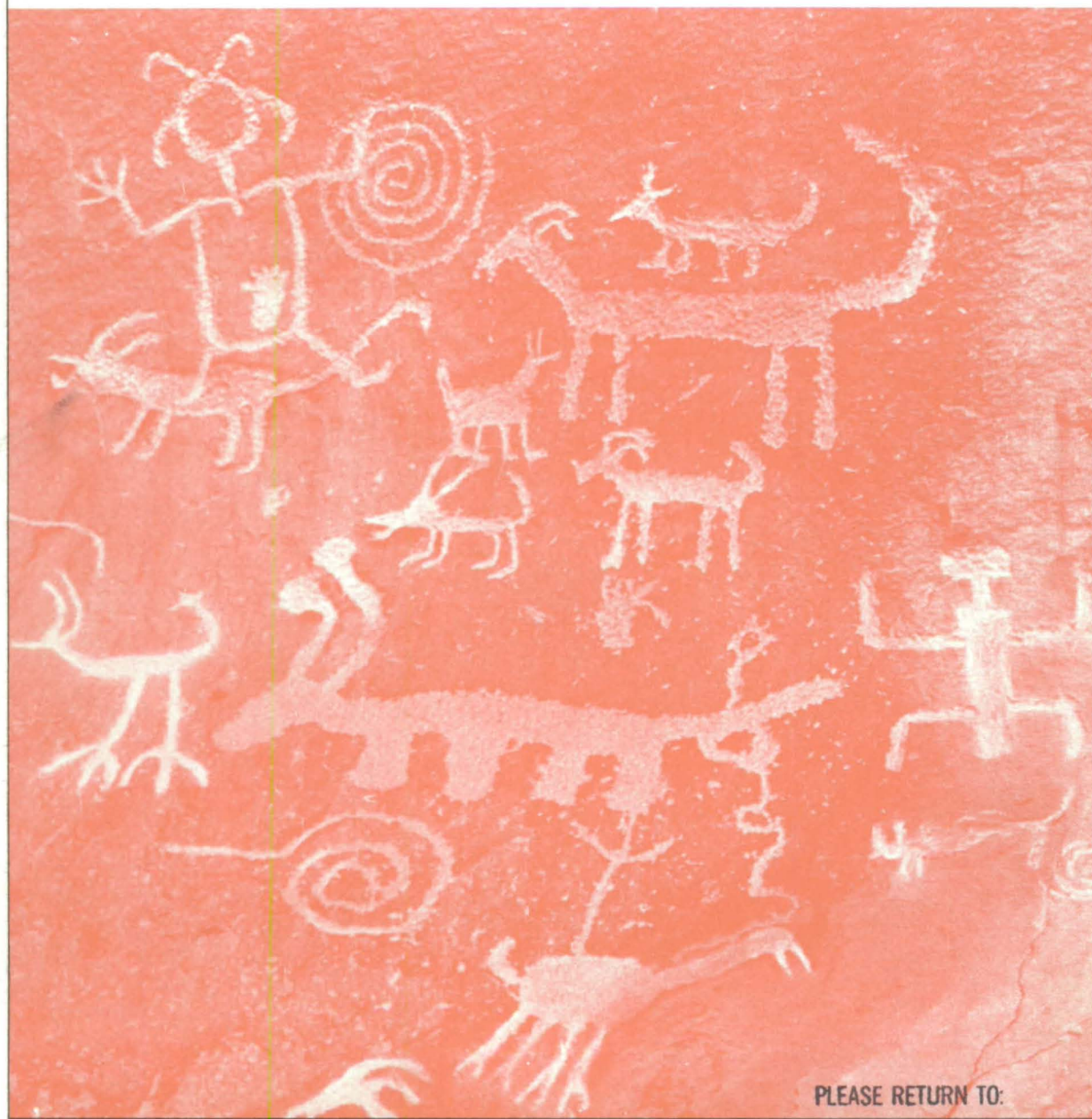


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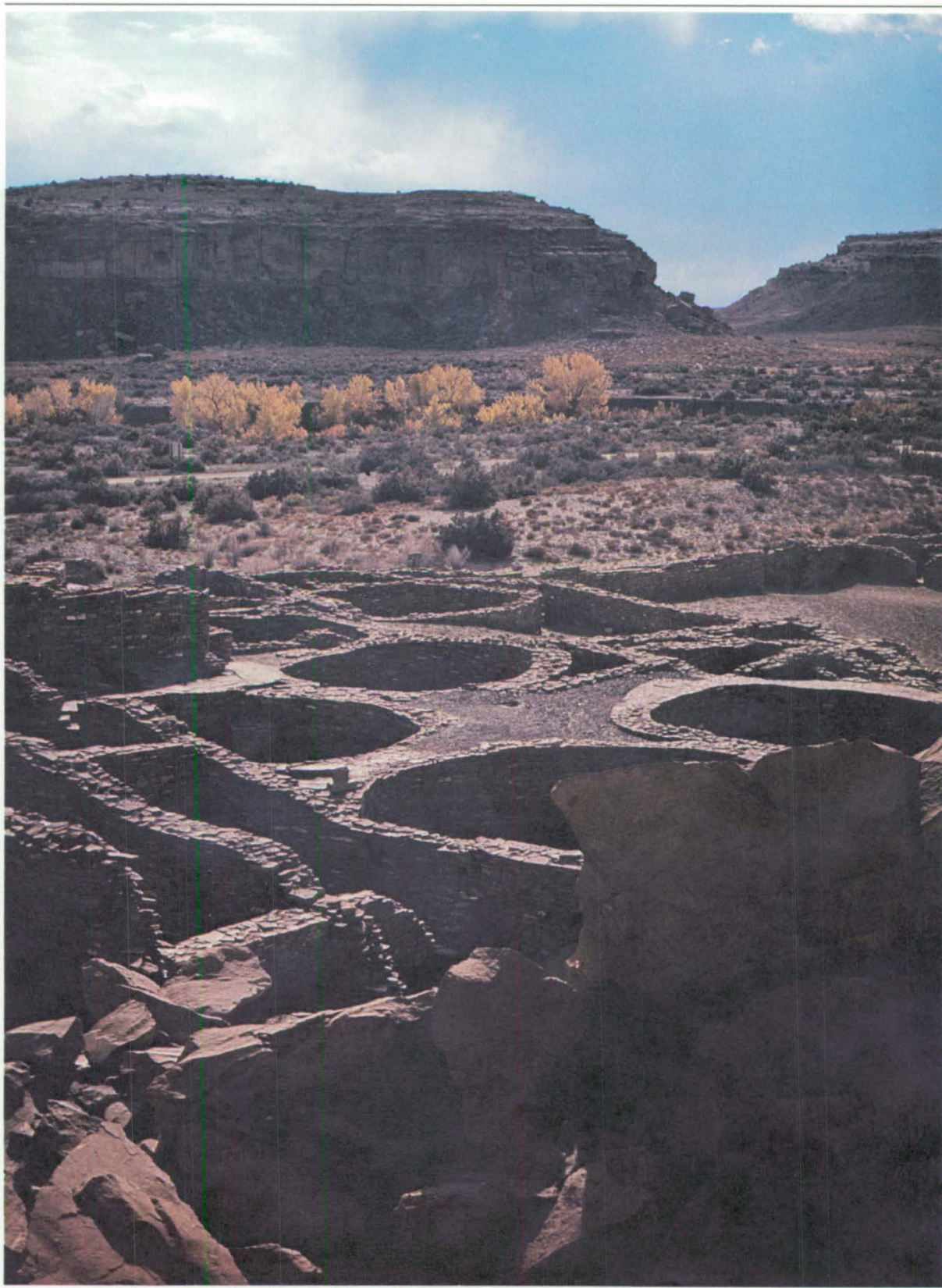
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Archeological Surveys of
Chaco Canyon



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Pueblo Bonito, looking across Chaco Wash towards South Gap.



Archeological Surveys of
Chaco Canyon
New Mexico

Alden C. Hayes
David M. Brugge
W. James Judge

Publications in Archeology 18A
Chaco Canyon Studies

National Park Service
U.S. Department of the Interior
Washington, D.C.

1981

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under United States administration.



Frontispiece photograph by Patrick A. Hurley

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Foreword

In 1971, the National Park Service began an intensive archeological study of Chaco Canyon National Monument, New Mexico, one of the Nation's most important cultural resources, and an area of extraordinary significance in the prehistory of the American Southwest. This survey report, written by three scientists of the National Park Service, is the first of several studies resulting from those investigations.

With the publication of this study, the first of a number of Chaco research goals has been reached: to provide a base for increasing our understanding of the ancient people who left such magnificent remains of their culture in Chaco Canyon, and to make the results known, both to the archeological profession and the general public. In addition, an express purpose of the entire project has been to provide Service management with specific guidelines as to how these valuable resources can best be preserved and protected for future generations.

Both the layman and the professional archeologist will find much of interest in this report—not the least of which should include increased appreciation for the ancient Chacoan people. We are just now beginning to realize how sophisticated they were, with their roads and irrigation canals, trade contacts with high civilizations in South America, elaborate communications towers, knowledge of astronomy, etc. Although the study of these early Indians will continue for many years, enough is now known to provide us with a tantalizing glimpse of the fascinating way in which these people lived. This report is a solid beginning in making this understanding possible.

I am pleased to introduce this first substantive archeological report on the area, and take pride in reaffirming the Service's responsibility to make available to the scientific community and the general public the results of important research on areas of the National Park Service.

RUSSELL E. DICKENSON
Director

Editor's Note:

On December 19, 1980, President Jimmy Carter signed Public Law 96-550, which changed the name of Chaco Canyon National Monument to Chaco Culture National Historical Park.

The law added 33 archeological protection sites, totaling approximately 8,771 acres, to the newly named unit of the National Park System.



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Introduction

The Chaco Center became operational in 1971 as a joint venture of the U.S. Department of the Interior, National Park Service, and the University of New Mexico. Both organizations had been involved with the Chaco for many years prior to that time. Chaco Canyon National Monument was established in 1907 to protect and preserve its numerous, outstanding archeological resources for the benefit of the public. It has been administered by the National Park Service since 1916. The University of New Mexico held title to certain inholdings in the park until 1931 when ownership was conveyed to the Department of the Interior in return for privileges allowing the University to continue to conduct scientific research in Chaco Canyon.

Organized archeological investigations in Chaco Canyon were begun several years before the Monument was created when, between 1896 and 1899, the American Museum of Natural History, supported by donations from the brothers Talbot and Frederick Hyde, conducted extensive excavations in Pueblo Bonito. George Pepper, assisted by Richard Wetherill, directed the clearing of 198 rooms recovering an extensive collection of artifacts most of which still are in the American Museum in New York. Pepper's field notes, which discuss the features excavated and list and describe the objects recovered from the diggings, were published in 1920.

Two decades later a second major archeological program was set up in Chaco. Led by Neil M. Judd of the U.S. National Museum, and supported by funds from the National Geographic Society, seven years, from 1920 to 1927, were devoted to excavating additional sections of Pueblo Bonito and a part of Pueblo del Arroyo as well as testing a number of smaller sites and

other archeological features. As could be expected, by Judd's time, advances had been made in archeological methods and theory since the first work at Pueblo Bonito and they were reflected in his investigations. He assembled an able staff that worked together to excavate with care and to undertake detailed studies of archeological remains, data gathered during digging, and environmental evidence, in order for Judd's reports not only to be descriptively sound but also to address reconstructions of culture history.

The succeeding period of archeological research featured scholars from the Museum of New Mexico, School of American Research, and the University of New Mexico. Between 1927 and 1941, these institutions, working jointly at times or independently on other occasions, excavated part of Chetro Ketl, the Casa Rinconada great kiva, a sequence of small village ruins in the vicinity of Casa Rinconada, and accomplished a number of specific studies in archeology, biology, ethnology, and geology. During this time, field training programs for university archeology students were inaugurated. By 1936, the University of New Mexico had built a permanent research station across the canyon from Pueblo Bonito, and during that summer, enrolled 47 students from 17 institutions throughout the country. This period also witnessed the return of a former member of Judd's staff, Frank H. H. Roberts, Jr., to Chaco. In 1927, he excavated Shabikeshchee Village for the Smithsonian Institution, and for years that site, aptly described in Robert's report, was considered the type site for San Juan Basin Basketmaker III.

During and following World War II, the National Park Service became increasingly more involved in archeological activities in Chaco.

Until then, Park Service personnel had been mainly concerned with custodial duties, protecting the ruins and developing facilities and interpreting the sites for park visitors. However, the urgent need to preserve the sites excavated by the succession of archeologists beginning with Pepper was recognized and a preservation program was initiated. Attention was first paid to the largest and most extensively excavated site, Pueblo Bonito. Judd attempted earlier some preservation measures there, but they had proven ineffectual. A ruins stabilization unit of local Navajo Indians was formed under the able supervision of Park Service archeologist Gordon Vivian. The larger, excavated sites, such as Pueblo Bonito, Pueblo del Arroyo, and Chetro Ketl as well as some of the smaller, cleared ruins, were stabilized. Standing walls of unexcavated sites also were strengthened and preserved. The program continues today by technicians trained by Vivian and by the park maintenance crew. To the casual observer, it appears that the massive architectural remains of Chaco are extremely durable, but the fact is that once they have fallen into ruins and re-exposed through excavation, they are extremely prone to deterioration from the elements and must be given constant care. Improved preservation methods and materials are sought continually.

Some archeological work is a necessary part of most stabilization projects, for under certain circumstances, wall foundations must be cleared and contents of rooms removed in order to accomplish the necessary preservation. This has led to the discovery of some important archeological remains such as the collection of wooden artifacts found when repairing the flood-dam-

aged rear wall of Chetro Ketl. Another form of preservation of archeological materials and data by park staff has been the salvaging of several small sites threatened with destruction by nature and a few that could not be avoided by essential park developments.

Other recent Chaco research, conducted primarily by Gwinn Vivian of the University of Arizona, has expanded our knowledge of the Navajo who live in and about the canyon, of ancient Anasazi water-control systems, and of the possibility that a stratified, class arranged society existed there in prehistoric times.

This brings our resume to the current era of Chaco Canyon studies, that of the Chaco Center. One could question whether there remains anything to learn about Chaco. Hasn't the lengthy parade through the canyon of shovel-swinging archeologists and their colleagues dug enough sites, analyzed sufficient artifacts, gathered adequate data about past climate and resources, and made appropriate comparative studies, to relate the Chaco story in finality? The answer by a group of scholars brought together in 1969 in a seminar to consider the question was to the contrary. This laid the foundation for the establishment of the Chaco Center.

John M. Corbett, formerly Chief Archeologist of the National Park Service, conceived the notion of a long-term multidisciplinary research program in Chaco Canyon years ago. He was an old Chaco hand, having worked there for Edgar L. Hewett when the Museum of New Mexico and the School of American Research were most active in the Chaco. Corbett believed there was much yet to be learned about Chaco; he was intrigued by the apparent Mesoamerican connections, and wondered how widespread might have

been Chaco culture and its influences. Finally, he convinced the National Park Service that a comprehensive examination of man and nature in Chaco Canyon, to include a re-evaluation of previous findings, could produce results significant to archeologists and to the interpretive program and management of Chaco Canyon National Monument. It was at this time that Corbett organized the above mentioned seminar of anthropologists and environmentalists, some familiar with Chaco and others who were not, who convened in Santa Fe to evaluate the status of Chaco prehistory, identify problem areas, and suggest procedures for setting up another research program for Chaco. Simultaneously, National Park Service archeologists prepared a prospectus for Chaco Canyon studies emphasizing programs that would benefit Park Service management and interpretive needs and designed an organizational structure to accomplish the task.

It was decided that the project would best be undertaken as a joint endeavor between an academic institution with previous experience in Chaco and the National Park Service. The University of New Mexico was chosen as the partner and, in 1971, the Chaco Center—originally named the New Mexico Archeological Center—came into being. The university was to build a facility on campus in Albuquerque that would provide space for administrative services, laboratory and storage, photographic dark room, archives, and offices for the staff. The National Park Service would lease this space and would supply field facilities in Chaco such as housing and field laboratory and furnish excavation equipment. Federal funds were appropriated to support the operation and a staff of archeologists and support personnel, all Park Service employees, was assembled. Certain staff members were given joint appointments in the Department of Anthropology and have served as part-time faculty. From the beginning, this small, permanent staff has been augmented by temporary employees, mainly students or recent students from the University of New Mexico and other institutions, who have assisted in field, laboratory, and analytical studies. Environmental studies have been achieved through contracts with qualified University of New Mexico scholars and specialists in other Federal agencies, academic institutions, and museums.

The first order of business for the Chaco

Center was to inventory the cultural resources of Chaco Canyon National Monument which, despite all the previous activities, had never been completed. The first survey, designed and directed by W. James Judge, utilized sampling techniques and was confined to selected areas. However, to provide more comprehensive information and to furnish the manager of the park with a complete inventory of the cultural resources for which he is responsible, a "blanket" survey of all 32 square miles of the monument and its several detached areas was accomplished by Alden C. Hayes. The results of these surveys are discussed in this volume. Hayes describes the Anasazi sites recorded by the traditional overall reconnaissance, Judge writes of the sampling survey, and comparisons between the two approaches are made. David Brugge, an expert on the Navajo, has taken the data gathered by Hayes on Navajo sites and discusses this recent phase of Chaco occupation.

In an effort to assess prior research on Chaco prehistory, the Center, early in its existence, set up an archive of documents pertaining to Chaco which is curated by Thomas Mathews. Starting with a large, valuable collection of unpublished papers, student reports, field records, and copies of obscure references assembled by Gordon Vivian, the archival holdings have been increased by additional items of similar nature plus a quantity of notes and reports produced by staff members and collaborators. Some of the reports have been published in our Chaco Center Papers, an in-house publication program. More will be made available in that format. Other reports and analytical notes will be incorporated into more comprehensive volumes in this series. The archives also contain field notes made by some previous investigators and photographs and descriptions of artifacts recovered by those individuals which presently are housed in museums across the country. Examination and documentation of these collections has been the responsibility of Natalie Pattison.

Remote sensing has proven to be a most valuable tool to Chaco research. Encouraged originally by John Corbett to explore the possibilities of employing various types of aerial photography in our research, Thomas R. Lyons has become our specialist on remote sensing. Working with imagery obtained from a gamut of sources ranging from tethered balloons to orbiting satellites,

we have put it to use in mapping and recording architectural remains and natural features, defining an elaborate network of prehistoric roadways, supplementing our knowledge of ancient water-control systems, and in many other studies of importance to scientists and to the management of the area.

Of course, in this age of computer science, the Chaco Center has designed various computer programs and uses the University of New Mexico Computing Center to record and analyze great quantities of data on artifact attributes, distributions, and frequencies, to standardize and store voluminous field records, to catalog specimens and archival data, and to compile a comprehensive bibliography on Chaco. Forms have been developed which allow data, both from the field and the laboratory, to be recorded in a manner compatible with input into computers.

With the survey of Chaco underway, an activity deemed absolutely essential to most later investigations, the Chaco Center staff put its mind to planning those future programs. Guided by the experience and knowledge of several individuals who had worked in and around Chaco, Alden Hayes, Tom Mathews, and Robert H. Lister, and considering the guidelines in the prospectus on Chaco Canyon studies and the transcription of the Santa Fe seminar, a research program was formulated. It had to be designed in consideration of anticipated funding, personnel and time frame, and had to serve Park Service needs. It was to be oriented toward contributing to knowledge of cultural processes and of the environment. Specific questions were posed relative to the impact of the development of agriculture upon the sequence of resultant changes in the cultural systems to include demographic organization, religion, and the arts, the relationship between this system and others apart from it, and the effects of this introduction upon the ecosystem. Did the Chaco pattern of town life achieve urbanization? To what extent were population pressures, religion, water-control systems, depletion of resources, etc. important, influencing this development and possibly contributing to the downfall of Chaco culture?

The sequence and chronology of cultures in the Chaco, from preceramic times through the Anasazi occupation to the modern Navajo, needed refinement and elaboration. Additional details were required concerning the availability and

utilization of natural resources. What external cultural contacts may be discerned as influencing cultural evolution in the Chaco, and vice versa? Specific studies in biology, geology, ethnology, physical anthropology, climatology, pedology, palynology, mineralogy, etc., which would contribute to the goals of the Chaco Center were identified.

The above and many other questions, problems, and objectives were considered originally, and additional ones have arisen during the course of the project which changes directions, much like a forest fire, as new factors, findings, and directives are introduced.

What has the Chaco Center accomplished toward fulfilling its objectives? Emphasis, to date, has been upon the gathering and analysis of materials and data in order to test hypotheses, examine problems, fill gaps in the cultural sequence, and assemble the necessary facts and figures to expand our understanding of culture patterns and environment in Chaco Canyon.

Investigations in the field have included three archeological surveys, two of which are addressed in this report. The third consisted of identifying a series of outliers, Chaco sites outside the main stem of the canyon which contributed to the formation of a greater Chaco system.

Excavations, ranging from total clearing of villages to limited testing of ruins or features to answer specific questions, have been carried on in a representative series of sites selected from the survey records. Three Archaic sites have been extensively tested, two situated in the open and the third beneath a dry rock shelter which yielded a valuable collection of wooden artifacts and unprocessed vegetal remains. The entire Chaco Anasazi sequence has been reexamined. Three Basketmaker III units were excavated and Shabikeshchee Village, dug originally by Roberts, was probed for samples of burned clay from which dates have been obtained allowing for a more accurate temporal placement of the site.

Six sites containing Pueblo I manifestations have been cleared. Three are predominately of that culture stage, while the other three are interdigitated with Pueblo II culture. A four-season excavation program, coupled with intensive environmental studies, has been completed in a small side canyon known as Marcia's Rincon. A community of village remains ranging in age from Basketmaker III to Pueblo III was exca-

vated for the purpose of comprehending the development of culture in a localized ecological niche. Plans call for several of these units to be stabilized as exhibits-in-place for park visitors. To represent the climax period of Chaco culture, Pueblo III, we chose to execute a comprehensive testing program at Pueblo Alto, one of the major Chaco communities. That investigation has progressed through two field seasons, one season remains to be completed.

The Navajo are the latest Native Americans to move into Chaco Canyon and many of their abandoned homes and affiliated features are scattered throughout the monument. One such community, dating from the 18th century, has been excavated. Ethnohistoric research, pertaining to various aspects of Chaco Navajo culture, also has been conducted.

Concurrent with the archeological programs, investigations in biology and geology have been carried on during each of the field seasons. Soil and vegetation maps and inventories of Chaco flora and fauna have been prepared, the geologic history of the canyon—from bedrock to recent alluviation and arroyo cutting—has been studied, and searches for and analyses of lithic deposits which provided materials for a variety of artifacts are in progress. Palynological studies are providing details about the indigenous vegetation and the introduced agricultural plants. Weather, climate, and runoff records have been compiled for Chaco Canyon and the Chaco drainage. Growth patterns of coniferous trees existing in and near the Chaco basin have been charted and evaluated to reconstruct past climatic conditions.

Other projects, frequently requiring multidisciplinary endeavors, have dealt with a wide range of phenomena. Ground plans of all major Chaco ruins have been compiled through the use of archeological data, aerial photography, and photogrammetry. Over 200 miles of Anasazi roadways and associated features have been identified and mapped by employing remote sen-

sing techniques and follow-up ground checks. A group of "stone circles" situated on cliffs above habitation sites were tested by archeologists and, after their contents and characteristics were pondered by ethnologists, it was postulated that they may have played a part in religious activities. Evidence has been gathered and tested which supports the notion that the Chacoans had a visual communications system linking together their settlements and perhaps extending as well to neighboring population centers.

Twenty-five reports on specific aspects of Chaco archeology, geology, remote sensing, and ethnohistory have been published in various journals, monographs, and in the papers of the Chaco Center. Detailed site reports, artifact analyses, and studies of paleoecology are yet to come, as are summations of the evolution of the Chaco system.

It has been the responsibility of the project director to strive to keep the program on even keel and to plan and coordinate a multitude of diverse activities, all hopefully contributing ultimately to the goals of the Chaco Center. My task would have been more difficult had it not been for the performance of several highly skilled National Park Service archeologists, Al Hayes, Jim Judge, Tom Windes, Tom Mathews, Dave Brugge, and Tom Lyons, and a dedicated group of competent part-time assistants, all of whom contrived ways of putting plans and programs into action. Administrative support has been provided by Laurie Rimbert, Dorothy Cassidy, Rosemary Ames, Del Peterson, and Ray Kloth. Our illustrator, Jerry Livingston, has produced quantities of high quality art work to document reports.

Finally, recognition need be paid to those scholars who, through cooperative agreements, contracts, and voluntary efforts have contributed immeasurably to our understanding of Chaco Canyon and its people. They will be given due credit in succeeding reports in which their contributions are incorporated.

ROBERT H. LISTER

Santa Fe, NM
March, 1978

Part One

A Survey of Chaco Canyon Archeology

Introduction

No place north of Mexico contains so spectacular an array of prehistoric ruins concentrated in so small an area as a 10-mile stretch of Chaco Canyon, in northwestern New Mexico (Fig. 1). Curiosity about the origins and eventual fate of the builders of the large stone pueblos found there, and the myriad smaller ones, prompted the first white men to record their impressions—and to speculate. Over a century of investigation, at times intensive, has supplied much descriptive and comparative information. Speculation is better informed now than in 1849, when Lt. James H. Simpson wondered about the possibility of a connection between Chaco Canyon and Casas Grandes in Chihuahua, and whether both places might not owe something to the Toltecs or Aztecs of Mexico. But, speculation hasn't ceased, nor has curiosity been satisfied.

The most recent attack on the problems of Chaco Canyon archeology was jointly launched in 1971 by the National Park Service and the University of New Mexico, following the establishment of the Chaco Center in 1971. The Center seeks, through various multidisciplinary avenues of research, to learn the history of man's occupation of Chaco Canyon, the extent to which his life was determined or limited by his physical environment, and what effect his activities had upon his surroundings.

A thorough archeological survey is a first requirement.

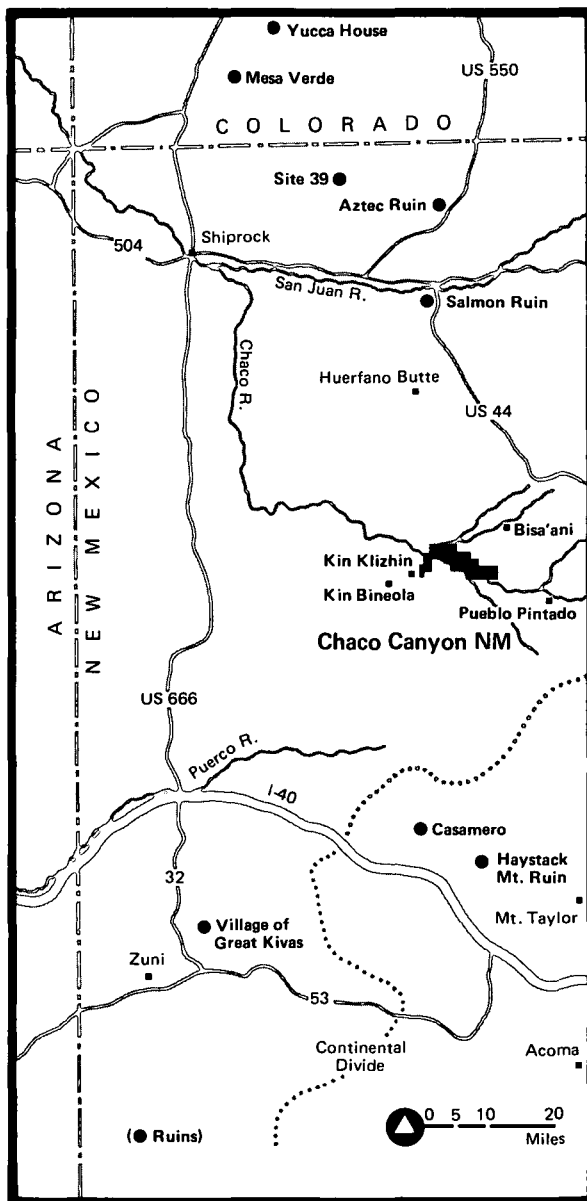


Figure 1. Map of northwestern New Mexico.

Background

Purpose

Archeological surveys can assume as many different characters as the purposes that stimulate them. Ours was intended to be as comprehensive as possible, and to fulfill three functions.

A basic purpose was to provide a tool for the management of the area. The National Park Service is charged with the protection of the archeological sites within the boundaries of the Monument—a difficult task without precise information about numbers, locations, and types of sites. There has long been general knowledge of major concentrations, but because of limited funds and manpower, and more pressing commitments, no complete inventory was available until the end of the summer of 1972.

A second, more conventional, purpose was to gather information leading to conclusions about the distribution of populations and cultures through both space and time; and to make some inferences, when possible, about why people located where they did, when they did, and what in their culture they might have owed to whom. This goal of survey is obviously better achieved when there is a sound base of knowledge of the area to work from. Although a first, cursory reconnaissance may teach the investigator to differentiate between habitations and canals, not until some stratigraphic excavations have been made can he place a site in a relative period of time. Fortunately, our initial data base was considerable. In the past 75 years, five major excavations and several minor ones have provided information that enhances site recognition. With the experience of earlier archeologists at hand, the surveyors knew, with reasonable certainty, what kind of site they were looking at, and could usually place it in the right century. But not much light was shed on the “why” questions. We are not prepared, on the basis of survey, to write a history of Chaco Canyon.

A third purpose of the Chaco survey was to pose questions. A summation of current knowledge of Chaco survey data added to the results of earlier research will reveal the obvious gaps in that knowledge, and give us the reference point from which to plot the direction of further investigations. The survey record is also an inventory of resources available for filling in the

gaps. In realizing this third purpose, the survey was successful. There is still no shortage of ignorance.

Setting

The Chaco Plateau of the Navajo Section of the Colorado Plateau (Fennemans, 1931) is a rolling plain characterized by occasional cuestas where outcropping Cretaceous sandstones form low mesas (Fig. 2). Relief is rather gentle except for the sharply incised stretch of Chaco Canyon. The plain is mantled with Quaternary silty alluvium, although there are exposed sections of steeply eroded shales and clays which form spectacular badlands. Sand dunes laid down by the prevailing southwesterly winds are common.

The plateau is bisected by Chaco Wash, which heads at the Continental Divide at an altitude of about 7,000 feet, and runs west for 65 miles, then bends to run north for 45 miles to join the San Juan River near Shiprock at an altitude of 5,000 feet. About 10 miles from its head, the wash forms a 20-mile canyon which has cut 400 to 500 feet into the plateau. For most of its length, the wash is broad and shallow, but through the canyon it has cut a steep-banked arroyo up to 30 feet deep. Today, the Chaco is an ephemeral stream that normally runs only a few weeks of the year—as a gentle stream following spring snow-melt, and more violently as a result of summer's monsoonal storms. No live water exists except for an unpotable saline pool just above the confluence of Escavada Wash at the canyon's mouth. Here, the channel has cut to bedrock, bringing water to the surface. It is known that throughout most of the period of prehistoric occupation, the present channel did not exist, and that the streambed was near the valley floor. It was a period of aggradation rather than erosion, and although flow was probably not constant (Bryan, 1954), the presence of quantities of *Scirpus* rushes and *Phragmites* cane from the excavations indicates that moisture was quite near the surface. Shallow wells for domestic water were probably practicable. This situation no longer exists, as arroyo cutting has lowered the water table (Bryan, 1954; Hunt, 1967).

The canyon bottom, from a quarter to a half mile wide, is relatively flat, with a gentle gradient of about 20 feet to a mile. The canyon does not achieve its depth as a sheer fall, but rather

descends over a terrace, or bench. Of the two principal cliffs formed, the inner wall, somewhat over 100 feet in places, is generally the higher and more precipitous. Climbing from the top of the lower cliffedge, one crosses a gently sloping bench, often broken by shallow ledges 5 to 10 feet high, to reach an upper cliff at the edge of the plain. To the north of the canyon, the plateau dips slightly to the north, and is unbroken at the canyon rim except by short tributary canyons.

Near the lower end of the canyon, the south side is breached at two places. South Gap, with a minimum opening of 1,000 feet, separates West and South Mesas. Fajada Gap, almost 2 miles wide, separates South Mesa from Chacra Mesa—the latter extending beyond the head of the drainage. Fajada Wash drains the entire south side of Chacra Mesa west of the Continental Divide. The wash enters the canyon through Fajada Gap, which is named for the dominant

Figure 2. Aerial view of Chaco Plateau.



feature of Fajada Butte, an isolated remnant of Chacra Mesa rising 400 feet above the bottom. Through the two gaps, there is very little gain in elevation from the canyon floor out onto the plain stretching 30 miles south to Mesa de los Lobos. A northeasterly dip in the rock strata contributes to differences in character between the north and south walls of the canyon. A stratum of carbonaceous shale at the base of the Cliff House sandstone lies below the canyon floor on the north, and the denser, more resistant sandstone cliff rises directly out of the alluvium. On the south side, the exposed, easily eroded shale has broken down into a sloping talus littered with colluvial boulders fallen from the undercut sandstone above (De Angelis, 1972; Hodges, 1974; Siemers and King, 1974).

The climate of the Chaco country is that of a cold desert, or steppe (Brand et al., 1937). Summer travelers often come away with an impression of heat, but what they are probably influenced by is a lack of shade. Shade temperatures rarely exceed 100 degrees, but frequently drop well below zero. Intervals between frosts average 150 days. Precipitation varies widely from year to year, but it is seldom too much, and is frequently too little for even xerophytic plants to make seed. It averages a little over 8 inches and ranges from about $3\frac{1}{2}$ to almost 18 inches. About half of the year's moisture comes in the thunderstorms of July, August, and September. The scant, ineffective spring and fall showers usually fall on dry ground, and quickly evaporate. Winter snows are more useful. Slow melting can put enough moisture into the soil for seed germination.

Most of the country can be classified as savannah, or shrub-grassland (Potter, 1974). Galleta grass and gramas, with scattered saltbush and some sages, dominate the stabler soils of the mesas, with dropseed, rice-grass, wolfberry, and greasewood in the looser soils of the dunes and canyon bottom. Patches of sacaton occur on tight clay where flood waters have spread. In the 1940's, tamarisk, cottonwood, and coyote willows were planted in that part of the stream channel lying within the Monument; the latter two trees, along with sedges and rushes, may also have been there prehistorically. Widely scattered junipers occur on the uplands, particularly on the extensive areas of slickrock on the benches, or on thin soil near them. On the north-facing slopes

of Chacra Mesa, junipers, with lesser numbers of pinyons, become thick enough to constitute a "woodland." Ponderosa pine was formerly present, as discussed by Judd (1954) and Vivian and Mathews (1965).

Even with the possibility of shallow wells, domestic water must have been a major problem for the substantial prehistoric population. At numerous cavate overhangs at the contact of sandstone and shale beds, there are slow seeps, and at many more, where no moisture can be seen today, the growth of carrizo, woodbine, or other water-loving plants indicates that subsurface water might be developed by cleaning out the soil to bedrock (Fig. 3).

Previous Archeology

The history of research in Chaco Canyon was written by Donald D. Brand et al., (1937) and updated by Pierson (1956), and by Vivian and Mathews (1965). I review only the high spots, with particular emphasis on earlier surveys.

The first printed reference to the area is that of Josiah Gregg, a Santa Fe trader, in New Mexico from 1832 to 1840, who described "... Pueblo Bonito, in the direction of Navajo ... built of fine-grit sandstone ... massive and spacious ... cut up into small, irregular rooms ... with the *vigas*, or joists, remaining nearly sound under the azoteas of earth ..." (Gregg, 1844). If Gregg himself was not there, he was closely quoting an excellent observer who had been—perhaps one of the several hundred Mexican participants in the military campaign of 1823. José Antonio Vizcarra's journal of the expedition clearly describes Pueblo Pintado and the canyon, and refers to Mesa Fajada (Brugge, 1964).

The 1849 military expedition into Navajo country led by Col. John Macrea Washington was guided through the canyon by one Carravahal of San Ysidro, who was obviously no newcomer. But it was Washington's surveyor, Lt. James H. Simpson of the Topographical Engineers, whose account was the first published description of the canyon and its ruins (Simpson, 1850). Crossing the Continental Divide from the east on August 26th, the party camped at Pueblo Pintado at the head of the canyon. Simpson wrote descriptive notes about the ruin, while the expedition's artist, Richard H. Kern, made sketches (Fig. 4). The next day the party moved down the canyon, the

lieutenant noting several small sites, and "a number of hieroglyphics" on the boulders. One of the latter, sketched by Kern, was the "Sun Rock" just under the ridge of Shabikeshchee. Both were apparently unaware of this large early Pueblo village. Stopping briefly at Wijiji, they moved into camp under Chacra Mesa opposite the mouth of Gallo Canyon. The main force left the canyon the morning of the 28th, crossing the low divide between Fajada Butte and Chacra

Mesa. Simpson with his guide and Kern, and seven militiamen of the New Mexico Mounted Volunteers, spent the day investigating the ruins between Fajada Gap and the mouth of the Escavada. With Carravahal supplying the names, and Kern making drawings and ground-plans, Simpson described Una Vida, Hungo Pavi, Chetro Ketl, Pueblo Bonito, Pueblo del Arroyo, and Peñasco Blanco. On the way, he also briefly noted, without naming, Casa Chiquita and Kin

Figure 3. Seep at foot of cliff.



Kletso. The small party rode into the night to overtake the main body of troops, catching sight of, "about three miles distant . . . the ruins of an old pueblo"—undoubtedly Kin Klizhin. Simpson had recorded 11 of the major pueblos, and applied names to eight of them. With minor variations in spelling, the names still stand (Table 1).

William Henry Jackson, photographer with the Hayden Survey, spent several days in the canyon in 1877 (Jackson, 1878). He visited all

the sites seen by Simpson, and assigned a series of numbers to them. Having more time, he also noted, sketched, and photographed other features, including carved stairways and the numerous smaller ruins (Fig. 5). Unfortunately, his photographs were destroyed. Climbing out of the canyon, he discovered and named Pueblo Alto. One of his guides was Hosta, from Jemez Pueblo, who had accompanied Simpson 29 years before. Hosta had a reputation for being something of



Figure 4. Pueblo Bonito according to Richard Kern's drawing.

Figure 5. Stairway near Chetro Ketl according to W. H. Jackson's sketch.

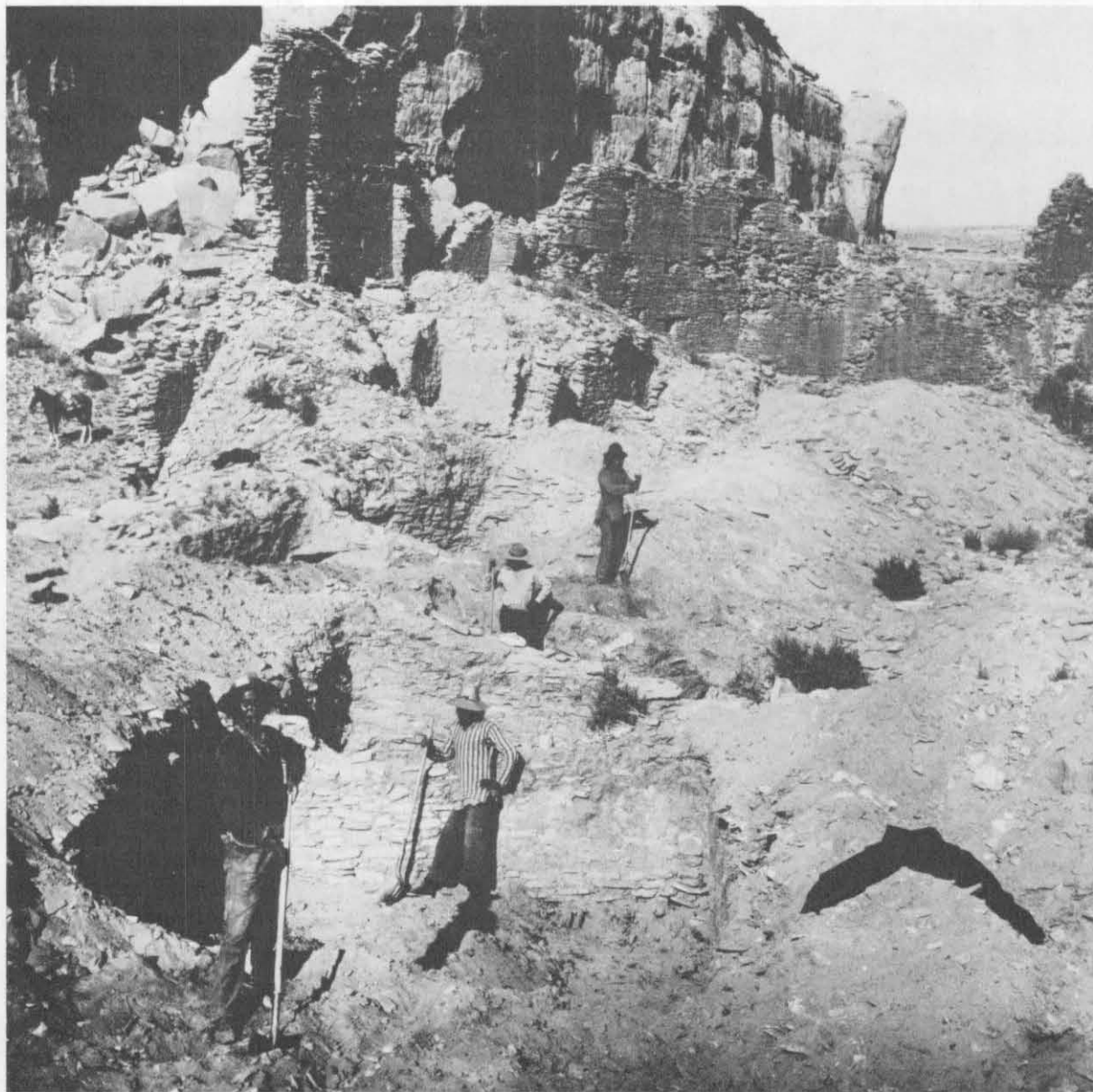


a windbag, and Jackson treated as an invention the old man's name for the pueblo—"El Jugador," meaning "the gambler." But the name was not Hosta's invention. He was repeating a translation of the Navajo name for the place, taken from a myth about a man who lived at Pueblo Alto and gained control of the people in the other villages by gambling (Chapin, 1940). Pueblo Alto is still known to the local people as *niyiilbiihi bighan*, or "home of the one who wins you by

gambling" (Fransted and Werner, 1974), and they describe it as the chief village of the Anasazi.

In 1896, fresh from his explorations on Mesa Verde and in Grand Gulch, Richard Wetherill homesteaded at Pueblo Bonito. With the backing of the Hyde Exploring Expedition and the supervision of George Pepper, he started excavation of the ruin (Fig. 6). Several articles of Pepper's, principally his "Pueblo Bonito" (1920),

Figure 6. Wetherill-Perry crew at work in Pueblo Bonito.



8 Archeological Surveys of Chaco Canyon

Table 1 Correlation of Site Names and Numbers

Chaco Center	BC No.	Other No.	Names
SJ101	282		
104	147		
105	148		
106	149		
107	150		
108	151-2		
109	109		
124	278-9		
131	104		
142	316		
143	315		
199	345		
200	113-5		Anna Shepard's Dig
238	336		
245	426		
246	426		
248	425, 427		
253	424		
257	406		
263	196		
264	197		
266	198		
272	106		
274	107		
275	358		
278	284		
293	241		
295	374		
297	383		
298	238		
301	155		
302	7154		
305	7157		
330	88		
332	410		
333	409		
349	417		
350	392-3		
352	395		
353	398		
365	365		
366	168		
372	167		
375	448		
376	173	"BC 449"	
383	117-8		
385	258	5(F)	Tsin Kletzin, Paqakin, Hermoso
386	255	LA 841, NA 3663, 2, 6(F)	Casa Rinconada
387	253	LA 226, NA 2306, 6(J), 2, 8(F)	Pueblo Bonito, Tse Piniyahe
388	252	LA 662	New Alto, Alto Chiquito, Ki-a-a
389	251	LA 661, 11(J), 4(F)	Pueblo Alto, Niyitbihi biqhan
390	105		
391	259	LA 143, 5, 8(F), 3(J)	Una Vida, Tsedeqil
392	249	LA 152, 9(F)	Kin Nahasbas
393	248	LA 2464, 8(J), 7, 11(F)	Kin Kletso, Yellow House
394	50	NA 3531 B:13:4"	Tseh So
395	51		
396	53		
397	57		Robert's Site (Frank H. H. Roberts)
398	58		
399	59		Tom Mathew's Dig
400	52	"BC 54"	Casa Sombreada
410	250	LA 225, 10(J), 13(F)	Peñasco Blanco, Taalakín
411	170		
417	171		
423	422		
424	7421		
431	364		
432	7172		
446	411		
451	416		
454	414		
459	415		
460	416		
463	402		
467	403		
474	400		
478	401		
489	437		
494	433		
495	433		
498	434, 438		
503	212		
506	405		
511	408		

(J) = Jackson's Numbers
 (F) = SAR Survey
 (C) = Corbett's Hogan Survey
 LA = Museum of New Mexico
 CM = Gwinn Vivian's Navajo Survey
 NA = Museum of Northern Arizona
 * = Arizona State Museum
 ** = BLM Number

Chaco Center	BC No.	Other No.	Names
513	384		
515	211		Headquarters Site
516	210		
518	280		
523	293		
524	376-7		
526	7215		
529	214		
530	378		
531	379-82		
540	288, 347, 349		Gallo Cliff Dwelling, Tsé yaakini
542	216		
543	303-4		
544	217, 305		
546	218		
547	307-8		
548	307-8, 325		
553	326		
554	219		
555	327		
556	328, 330-1		
557	328		
558	332-3		
559	333		
562	334		
566	335		
567	338		
569	220		
570	339-40		
571	221, 341, 389		
572	390		
577	260	2(J), 9(F)	Wiji, Kin Dotliz, Bitseql, Tuwizhizhin
579	222		
580	223		
581	224		
589	236		
597	213		
609	404		LC Ranch, Wello's Cabin
610	169		
625	243		Three-C Site
633	187		
638	186		
639	185		
644	181		
646	354		
648	158		
657	375		
663	156		
712	355	CM 36	
713		CM 36B	
719	179		
720	180		
721	164		
722	165		
723	163		
724	159, 161-2		
725	160		
730	162		
731	183		
732	184		
733	356		
738	69		
740	? 70		
744	352		
745	144		
746	144		
747	145-6		
748	74-5		
749	76-7		
750	26	LA 4050, 24, 26(F)	Leyit Kin, Tleyit Kin
753	56, 79-83		
754	66-7		
755	65		
756	7132		
758	85		
759	72		
761	351		Zuni Trail
763	71		
798	63	"BC 61"	
799	60-1	20, 21, 27(F)	Kin Chinde
802	7112		
804	110		
805	111		
806		30-1(C)	Tomasito's Hogan
810	429		
811	430		
812	432		
813	431		
816	359		
817	116		
820	73		

Chaco Center	BC No.	Other No.	Names
823	263	"BC 53", 20-1(F) "BC 250"	Kin Sabe
827	362		
830	119		
832	120-1		
834	122		
835	7123		
836	7124		
837	7125		
838	126	8(F)	Hutch's Site (Charles Hutchison)
839	7127		
840	129		
841	128		
842	361		
843	360		
864	436		
869	131		
871	435		
885	96-7		
886	412		
901	297		
930	337		
983	350		
1004	7413		
1010			Poco Site
1031	178		
1033	440		
1034	439		
1041			Rafael's Hogan
1042	7177		
1043	7176		
1051	441		
1052	175		
1054	363		
1055	174		
1057	443		
1058	443		
1059	7442		
1060	444		
1061	420		
1063	445		
1064	446		
1080	7447		
1086	419		
1088	428		
1095	364		Bromberg's Ditch (William Bromberg)
1119	391		
1130	100-1		
1156			Atlatl Cave
1167	245	9(J), 12(F)	Casa Chiquita, Tsekyiskin
1170	140		
1171	7136		
1174	366		
1175	95		Hillside Ruin
1200	64		
1214	291		
1237			UNM Research Station
1251	357		
1253	242		
1272	237		
1278	239		
1297	369		
1302	370		
1311	7371		
1315			CM 14
1318	234		
1319	235		
1360	240		
1362	367		
1387	232		
1389	231		
1390	233		
1396	230		
1413		LA 4975	Kin Klizhin
1420	292		
1456	281		
1476	202		
1504	289		Hungo Pavi Stairway, Hatastsele
1505	300		
1509	298		
1524	302		
1525	301		
1526	273		Jackson Stairway (Wm. H. Jackson)
1527	272,310		
1529	314		
1532	310		
1534	321		
1555	274-6		
1562	277		
1563	278		
1565	271		
1566	306		Cave of the Red Hands
1577	343		

Chaco Center	BC No.	Other No.	Names
1580			Kin Bineola, Whirlwind House
1589	317		
1600		CM 15	
1601		CM 15	
1602	229		
1613	386-8	CM 23	
1614		CM 23	
1633	227		
1638	228		
1640	225		
1641	368,385		
1642	226		
1648	372		
1655		CM 22	
1657	244,373	Half House	
1659	256	LA 530, B:13:1*	Shabikeshchee Village
1678	194	Judd's Pithouse No.2	
1681	209		
1682	208		
1683	287		
1684	207		
1688	206		
1694	285		
1695	205		
1696	204		
1697	203		
1705	353		
1706	62		
1713	135		
1714	142		
1732	109		
1733	108		
1761	48		
1774	142		
1775	143		
1789			Dan Cly's Hogan
1834	49	CM 13	
1869	7394		
1900	286		
1903	290		
1907	200-1,294		
1908	295		
1910	199		
1911	195		
1912	193	"BC 192"	Lizzard House
1914	192		
1915	191		
1916	190		
1917	189		
1918	247	LA 2463, 4(J), 7(F)	Hungo Pavi, Kin Lokay (White House)
1919	188		
1921	55		
1922	54		
1924	86		
1925	87		
1926	88		
1927	89		
1928	246	LA 838, NA 2307, B:13:3*, 5(J), 1(F)	Chetro Kefi, Rain Pueblo, Nastla Kitsiyle
1929	90-3		
1930	257	LA 2470, 4(F)	Talus Unit No. 1
1931	322		
1932	323		
1933	94,324		
1935	348		
1936	98-9		Talus Rock Shelter
1938	102		Cemetery Ruin
1939	103		
1940	346		
1944	130,133 UI-II		Hurst Julian's Niches
1946	270		
1947	254	7(J), 3(F)	Pueblo del Arroyo, Tabakin, Tri-wall Structure
1948	134		
1951	141		
1953	299		
1959	318		
1963	319		
1975	313		
1976	312		
1980	309,311		
2157	399		
2375			Bisa'ani
Mc 4		LA 6022	Haystack Mesa Site
108		LA 8978, NA 967	Kin Ya'a, Pueblo Viejo
166		LA 574, 1(J)	Pueblo Pintado, Pueblo Bonito, Kintseel
186		LA 8778, AR-30-01-144**	Casamero Site, Casa Morena

were the first detailed accounts of Chaco archeology.

During the Wetherill-Hyde days, reports of improper use of public lands prompted the General Land Office to send S. J. Holsinger to Chaco Canyon as a special agent to assess the situation. Holsinger spent a month in the spring of 1901 in the area, during which he revisited all the sites described by Simpson and Jackson, and added information about Tsin Kletsin, Kin Klizhin, Kin Bineola, Casa Rinconada, and Kin Ya'a. His is the earliest reference we have to names for these ruins, as well as the names Kin Kletso and Casa Chiquita for Jackson's Ruins 8 and 9, although he undoubtedly got them from Richard Wetherill, or from his Navajo guide. Holsinger also noted the irrigation systems near Una Vida, Kin Klizhin, Kin Bineola, and in the canyon opposite Peñasco Blanco; a "canal" at Kin Ya'a; and he described additional stairways, and the prehistoric road between Chetro Ketl and Pueblo Alto (Holsinger, 1901).

Holsinger also listed a "Casa Moreno" among the large pueblos, locating it 11 miles east of Kin Ya'a and Crownpoint. Following the legal land description provided by Holsinger, Congress withdrew the land and included it in Chaco Canyon National Monument. However, there is no site on that ground, and Chaco hands have been searching for Casa Morena ever since. Holsinger did not personally visit Casa Morena, but heard of it at the depot in Thoreau while waiting for a train to take him out of the country. Probably in his haste, and through a slip in communication, something was lost in his description of the Casamero Ruin 10 miles northeast of Thoreau, named, not for a "brown house," but for a local 19th-century Navajo leader. This Chacoan pueblo could fit Holsinger's secondhand description as similar to Kin Ya'a, "but larger and in a like ruinous condition."

Edgar L. Hewett of the School of American Research started the excavation of Chetro Ketl in 1920. That same year, Neil M. Judd, for the Smithsonian Institution and the National Geographic Society, did some minor testing in the canyon in preparation for continued digging at Pueblo Bonito. Hewett agreed to defer further work for as long as Judd's larger joint expedition was in Chaco.

Between 1921 and 1927, Judd completed the uncovering of Pueblo Bonito (Judd, 1954 and

1964), and excavated Pueblo del Arroyo (Judd, 1959). Also during this period, he and participating scholars tested the trash piles at Peñasco Blanco and Pueblo Alto, studied the problems of erosion and alluviation (Bryan, 1954), and dug a small, earlier pueblo $1\frac{1}{2}$ miles above Wijiji. This last dig led to the discovery, on a ridge above the small pueblo, of the Basketmaker village of Shabikeshchee, which was excavated in 1927 by the Bureau of American Ethnology (Roberts, 1929). One of the most important studies carried on during this period was that of A. E. Douglass, who used timbers from Pueblo Bonito to help build the foundations of dendrochronology (Douglass, 1935).

The years of the Smithsonian-Geographic expedition were the most productive that Chaco archeology has seen. Coming at a time when other landmark projects were underway—notably Alfred V. Kidder's at Pecos, and Earl H. Morris's at Aztec and in Canyon de Chelly—the excavations contributed significantly to the development of the Pecos Classification, which was the first serious attempt to classify Southwestern prehistoric cultures and their phases of development.

Hewett returned to the canyon in 1929 to resume his excavation in Chetro Ketl. This time, the School of American Research was joined by the University of New Mexico, with which Hewett was also associated. The cooperation of the two institutions continued through 1937. Annual attacks were made upon Chetro Ketl through 1934 (Fig. 7), the Talus Unit behind it was excavated, tests were made at Kin Kletso, Tleyit Kin was dug, and the great kiva of Casa Rinconada was excavated and stabilized. Little publication resulted from these years. Most significant was the report of Florence M. Hawley (1934), whose stratigraphic trenching of the Chetro Ketl dump permitted a seriation of local pottery types, and whose dating of the house's timbers enabled her to set up a correlation of dates and masonry styles. The only complete site report produced was Bertha P. Dutton's 1938 monograph on Tleyit Kin. One of the greatest benefits of this period was the training of many students who made later contributions to archeology, at Chaco and elsewhere, and who drew upon their notes for material used in broader studies. Among these were Edwin N. Ferdon's study of Mexican-Southwestern architectural parallels

(1955), and the description of great kivas by Gordon Vivian and Paul Reiter (1960).

An archeological survey was conducted as a part of School of American Research-University of New Mexico research. By 1930, 10 miles of the canyon were covered, for "five miles each way from Pueblo Bonito" (Fisher, 1930). A brief report on the activities of the 1934 season announced that about 200 sites had been surveyed and mapped (Fisher, 1934a). In 1936, the project

was said to have been completed, with "publication imminent" (Brand et al., 1937). However, no report was issued. I have been unable to find the field records, and can only positively identify 18 of the sites by number. In 1937, two surveys of Navajo sites were made. One, devoted to archeological sites in the canyon area, was summarized, but no detailed record and map have survived (Malcolm, 1939). The other was a survey of 150 occupied hogans, most of which were

Figure 7. E. L. Hewett at Chetro Ketl, 1932.



north or west of the Monument (Corbett, 1939). Six of the modern sites were in the canyon, and two of these, now abandoned, can be correlated with our surveyed sites.

The participation of the School of American Research ended with the 1937 season, but the University of New Mexico continued work through 1947, concentrating on a cluster of small pueblos in a rincon across the canyon from Pueblo Bonito (Fig. 8). Only two major publications resulted (Brand et al., 1937; Kluckhohn and Reiter, 1939), but many manuscripts and files of field notes still exist as a mine of valuable data.

For a time, the University continued using the series of survey site numbers used earlier by the joint project, but added a locational prefix "Bc," in which the uppercase letter stood for New Mexico, and the lowercase letter referred to Chaco Canyon. Soon thereafter, either the records and maps themselves were lost, or confidence in them was lost, and new numbers were assigned. Only Bc26 retained its original number. No new survey was attempted, and about 35 numbers were assigned only as excavations were started. In 1947, the University's last active summer in the canyon, Lloyd Pierson, a graduate student, surveyed the 10 miles of canyon within the Monument boundary, and located a total of 211 sites (Pierson, 1949).

The first direct involvement on the part of the National Park Service in the archeology of Chaco Canyon was derived from its primary mission of protection. As early as 1925, while Judd was at Pueblo Bonito, some NPS money and manpower were spent in stabilizing the exposed walls. But the first sizable project was conducted in 1933, when stabilization work was done at Bonito, Chetro Ketl, and the Talus Unit behind it, and efforts were made to control the stream channel at spots where the shifting arroyo threatened the ruins. In charge of this project was Gordon Vivian, who received his archeological training and introduction to stabilization techniques under Hewett. Concurrently, he made a survey of petroglyphs primarily in the lower 5 miles of canyon on the northern cliffs (Vivian, 1934).

The Ruins Stabilization Unit was established by the NPS in 1937. Although the team was periodically assigned to other areas, it was stationed in Chaco Canyon until 1957, and it has

done some work there every year since, except for a break during World War II.

The University of New Mexico shifted its interest to other areas after 1947, and archeological research in the canyon since then has been conducted by the National Park Service. The first excavation undertaken by the NPS was in 1939, with the salvage by Vivian of an early Pueblo II community—the 3-C Site in Fajada Gap, at the location of a planned Civilian Conservation Corps camp (Vivian, 1965). In 1950, Vivian excavated the tri-walled complex abutting the rear of Pueblo del Arroyo (Vivian, 1959). (This complex had been partially dug in 1926 by Karl Ruppert for Judd.) In 1951 and in 1953, Vivian excavated the ruins of Kin Kletso (Vivian and Mathews, 1965).

Two other NPS excavations were the salvage of small ruins threatened by the erosion of widening arroyos. Bc236, a late pueblo on the banks of Chaco Wash near Fajada Butte, was dug in 1958 (Bradley, 1971); and Lizard House, a contemporary of Chetro Ketl, and in a rincon just east of it, was excavated in 1960 (Maxon, 1963).

After the departure of the University of New Mexico, the Monument staff maintained, and doubled, the Bc survey record. Most of the additions were made by Pierson, who had done the 1947 work, when he returned as a park ranger. By the time the Chaco Center was established in 1971, 395 sites had been recorded.

An independent survey concentrating on Navajo sites representing the late 17th and early 18th centuries was undertaken in the 1960's by Gwinn Vivian (1960) on the mesas forming the south side of the canyon. A separate series of numbers was used for the 34 sites recorded. Only three of the sites already carried Bc numbers.

Recognizing the need for extensive research in the area, the National Park Service organized the Chaco Center in 1971. The prospectus which stated that need, and suggested means for filling it, set a high priority on a comprehensive survey. The existing survey was largely confined to the canyon, was not done as a systematic sweep, and thus, there was no part of the area in which all sites were detected. In addition, emphasis was on the location of sites, with less attention paid to description. The sherd collections were incomplete, and could not be re-evaluated.

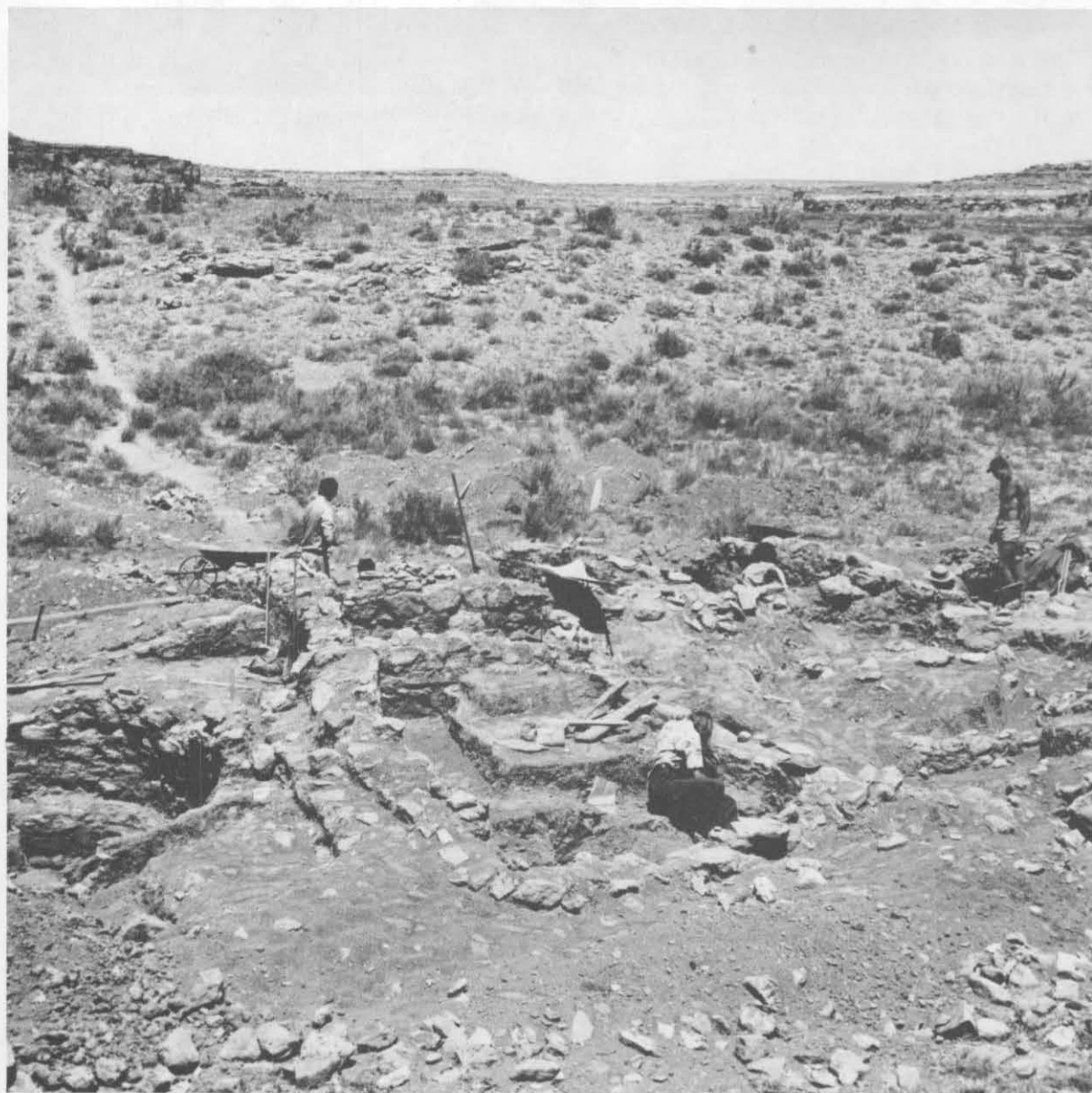
In 1971, after a 24-year absence, the University of New Mexico's interest in Chaco was

re-awakened. The University of New Mexico proposed to the Chaco Center that it undertake a site reconnaissance based on a systematic sampling technique. The goals were to test whether numbers and distribution of sites by type could be determined through sampling, to record environmental factors present, and to subject the data collected to a refined analysis that could result in the definition of problems for further research. The focus of the university's proposal

was essentially methodological, but because one of the Center's missions as defined by its prospectus was the experimentation with new methods, the proposal was accepted and funded by the National Park Service.

The fieldwork was done in the summer of 1971 under the supervision of James Judge, who divided an 8- by 16-mile area at the lower end of the canyon between the Escavada Wash and the mesas to the south of the canyon into 1,000-

Figure 8. University of New Mexico students at Bc59, 1947.



foot-wide, north-south-running transects. Twenty of the strips were selected and surveyed. Twenty-five percent of the 32-square-mile area was covered, and 300 sites were recorded. Some conclusions were reached. An important contribution was the discovery of evidence of considerable occupation of the area during preceramic, pre-sedentary times (Judge, 1972). Although the presence of ancient followers of big game had long been suspected, or inferred, no definite sites had previously been identified or described.

Summary of Knowledge, 1849-1971

The modern world has been aware of Chaco Canyon for 124 years, and as a result of all the work—Simpson through Judge—we have learned much about the area's prehistory.

The bison hunters of the Archaic Period roamed in and out of the Chaco at least 7,000 years ago, and there is reason (if no evidence) to suspect that they were in the area long before that. There was some occupation by the semi-sedentary, preceramic horticulturists of Basketmaker II times. What may originally have been a scattered and sporadic use of the country was known to have become a permanent occupation by a population of Basketmaker III people by about A.D. 700. Until the mid-1000's, the Anasazi farmers of Chaco Canyon and its bordering terrain lived their lives, built their houses, and made their tools in ways that distinguished them from their neighbors in surrounding districts of the Colorado Plateau in only the most minor respects. The 5- to 15-room pueblos of the A.D. 900's in Chaco could be duplicated for that century in Mesa Verde, or on the Little Colorado. And although the pottery of that time differed from one district to another in physical attributes imposed by the source of materials (paint, paste, temper), there was little difference from Mount Taylor to the Dolores River in those attributes that reflect traditional values (vessel shapes, design styles, firing-methods).

Sometime within 50 years of either side of A.D. 1000, something happened in the Chaco that was apparently not duplicated elsewhere. There was a sudden florescence of building, and new architectural techniques were introduced. Large communal houses of up to several hundred rooms, terraced back to three- and four-story elevations, were built in or near the canyon, many

of them by expanding or building over smaller, earlier houses. Similar construction occurred outside the immediate Chaco area—at Aztec, the Salmon Ruin near Bloomfield, New Mexico, and possibly at Yucca House near Cortez, Colorado—but this construction seemed not to be indigenous to the outlying localities, but rather to represent an expansion of Chaco influence. The entire population was not crowded into these apartment houses, however, for scores of the small, old-fashioned pueblos of the earlier days continued to be lived in, rebuilt, and added to, as they had been for centuries. The people of the small houses continued to bury their dead in trash accumulations, but no burial-ground for any of the great pueblos has been identified. Otherwise, little difference could be seen between the two types of contemporaneous structures. Other items of the material culture—pottery, tools of bone and stone—were essentially the same.

The canyon's population peaked during this period, and by the mid-1100's, it began to taper off. In the late years of that century, there was an influx of people from Mesa Verde, who occupied some of the large pueblos and built several modest-sized houses of their own. Many of the little pueblos lining the canyon continued to be occupied.

Early in the 1200's, the population again began to drop, and from the evidence of dated pottery-types found, the last few stragglers had left by about A.D. 1300. The country was then left to the packrats, the coyotes, and the wind for 200 years or more, until Navajos began to drift in from the northeast.

Procedure

The survey that is the subject of this report got underway in the spring of 1972. A 12-man crew was divided into three four-man parties, each assigned a specific tract of terrain. The parties were under the leadership of John W. Beardsley, who had worked with Judge's survey of the previous years, David C. Barde, and Thomas C. Windes. During the first season, the parties covered all of the more than 33 square miles within the boundaries of the Monument's six sep-

arated units, and about three sections at various spots just outside the fence. The first objective of the survey was reached—that of providing National Park Service management with an inventory of the prehistoric sites it is charged with protecting.

Artificial political boundaries have no meaning in relation to prehistoric land use, nor to geography, so in 1973, the survey was extended to cover that part of West Mesa and its slopes lying outside the Monument. The crew was reduced to one four-man party, in the charge of John B. Thrift who had worked with Bardé the year before. In 1974, a party of four, led by John D. Schelberg with two earlier years of survey experience in the Chaco, did the same to the southern parts of South Mesa, and also resurveyed parts of the Padilla Wash and Kin Klizhin Wash drainages to rectify discrepancies in the first season's work. In 1975, Peter J. McKenna, a member of the 1974 crew, took charge, and covered an unsurveyed pocket in the head of Weritos Rincon, after which he extended the survey north of the boundary toward Escavada Wash.

System

The usual procedure in the field called for the survey party to line up abreast at intervals of from 25 to 100 feet, depending on the nature of the terrain, and to sweep the country paralleling some recognizable topographic feature, such as a ridge-crest, wash, or cliff-face, which could serve as a guide. When a site was discovered, all members converged on it, and each performed a specific task. Although in some types of terrain it is possible to exercise control over a somewhat larger party, there is seldom enough to do while working up a site to keep more than four hands occupied.

Each site within the Monument was marked with a stake made of 3/8-inch reinforcement bar, die-stamped with the site's number. Sites outside the boundaries were marked with small aluminum tags.

A sketch map was made on a grid sheet, using standardized symbols, to show extent, locations of archeological features and their relationships to the topography, and location of the site markers. Photographs were taken, not only to show the major features, but also to relate the

site to the terrain as an aid in relocation.

Two compass azimuths were obtained, and the site was spotted on the map. In the canyon, it was relatively easy to find two prominent features identified on the topographic map. On broader plateau areas, it was often necessary to flag section-corners to which a bearing could be read.

A collection of sherds and lithic debris was made when available. Sampling was biased, in that it was slanted toward collecting the kinds of sherds that past experience had taught us would provide useful information. Thus, rims of utility vessels were preferred over body sherds, and decorated sherds over plain.

Finally, a standard form was filled out, including descriptive notes, and back in camp in the evening, all the sites surveyed during the day were plotted on the master maps. Sherds and debitage were sacked together and identified only by site number. Any other artifacts picked up were entered in a field catalog and labeled with an assigned field specimen number. Collections were taken to the Albuquerque laboratory weekly to be cleaned and stored. During the winter, the sherds were classified, and the identifications, along with the data on the survey field forms, were transferred to 3- by 5-inch punchcards.

Definitions

Probably no two surveys have collected exactly the same kinds of information, or have recorded it in precisely the same way. Different geography and various kinds of archeological manifestations often call for different approaches. More important, the objectives of the surveys and the prejudices of the surveyors tend to determine the character of the results. It was partly to make it possible to compare data from sites in Arizona with data from sites in southwestern Utah, for example, that the Southwestern Anthropological Research Group (SARG) recommended a uniform procedure, and the specific observations to be made and recorded in a standardized way and to be coded for a computer (Gumerman 1971).

We have not followed the SARG system, because we found that many of the required entries were extremely time-consuming, and irrelevant to our interests. However, the data that we re-

corded can be coded into the SARG format if anyone so desires.

After a couple of trial runs, the record form we adopted was a modification of one the Park Service had used at Mesa Verde. As we became more familiar with the terrain and the archeological features, minor changes were made in our entries and in the definitions we gave to the terminology.

The sites were numbered according to the Smithsonian Institution system, in which the states are numbered by their alphabetical position, counties by their first two letters, and sites serially within the county. Most of our territory is in San Juan County, and because three other counties in New Mexico start with "Sa," the letters "SJ" were substituted. Judge, who had used this same system, used the numbers 29 SJ 101 through 29 SJ 400. Our first numbers were 29 SJ 401 and 29 Mc 101 (in McKinley County). Table 1 correlates our survey numbers with site names and numbers assigned by other surveys. In assigning site numbers, no attempt was made in the field to make separations on the basis of phases of occupation, or to relate one site to another. A "site" was considered simply a geographic area in which archeological evidence existed that was separated from another "site" by a recognizable stretch of sterile surface. In several instances, two unit-pueblos were so close together that the debris from both merged. There was no sterile ground between them, so the two houses were considered to be one site. In other cases, a hogan at the mouth of a small rincon sat 100 meters from a corral across the wash. Although the two features were quite probably used together by the same family, the possibility of separation indicated by the apparently undisturbed area between them made them two separate "sites." In a concentrated area, a site might consist of a pueblo, a hogan, an outdoor baking-pit, a corral, and a panel of petroglyphs. Any of those features alone would be a site, if it were isolated.

Terminology

A complete glossary of the terms used and their definitions is filed with the survey record. I enlarge here only on those used in the following discussion.

"Landforms" were both primary and second-

ary. Primary landforms were either "plains," "mesa," or "bottom." The term "bottom" was applied only to the canyon, and referred to the area between the top of the inner wall and across the drainage to the top of the opposite lower cliff (Fig. 9). Secondary landforms were minor features of terrain on a primary landform, and the terms used were "bench," "cliff-edge," "cliff-face," "talus," "ridge," "knoll," "slope," and "floodplain." "Slope" was defined as the gently sloping expanse between a steeper ridge or talus and the relatively flat floodplain. Many large sites covered two or more secondary landforms, and typical entries are "mesa, bench" and "bottom, talus, ridge."

We at first attempted to squeeze all archeological sites into a classification of nine types. I had not foreseen the complications introduced by the presence of isolated corrals, sweat lodges, and improved trails, and we eventually settled on 16 categories. Although a "type" was not meant to have any cultural or temporal implications, it in effect often did, and we found it useful to be able to make the distinction between Anasazi and Navajo features under "type" as well as in determinations of "period" and "phase." We recognize that not all of these terms are necessarily the best choices of words, and that the things included under them are not always what those terms usually imply—but if one understands what meanings are arbitrarily given to them, they will serve.

Lithic: A concentration of lithic debris with no sherds, and an absence of architecture.

Sherd area: A concentration of sherds with no evidence of structures. Lithic chips may also occur.

Rock art: Includes modern graffiti.

Field-house: A single Anasazi room with a scarcity of trash or other debris, suggesting seasonal or specialized use by a few persons.

Pueblo: Two or more Anasazi rooms, or other evidence of a permanent habitation of an extended family or larger group.

Hogan: Applied to Navajo houses, whether round, polygonal, or rectangular, and includes open ramadas.

Ranch-house: Applied to any Spanish or Anglo building. Admittedly, a ranch-house could be confused with a rectangular hogan, but fortunately we found only four—two true ranch-houses, a trading post, and a dormitory-school-

house—and all were documented.

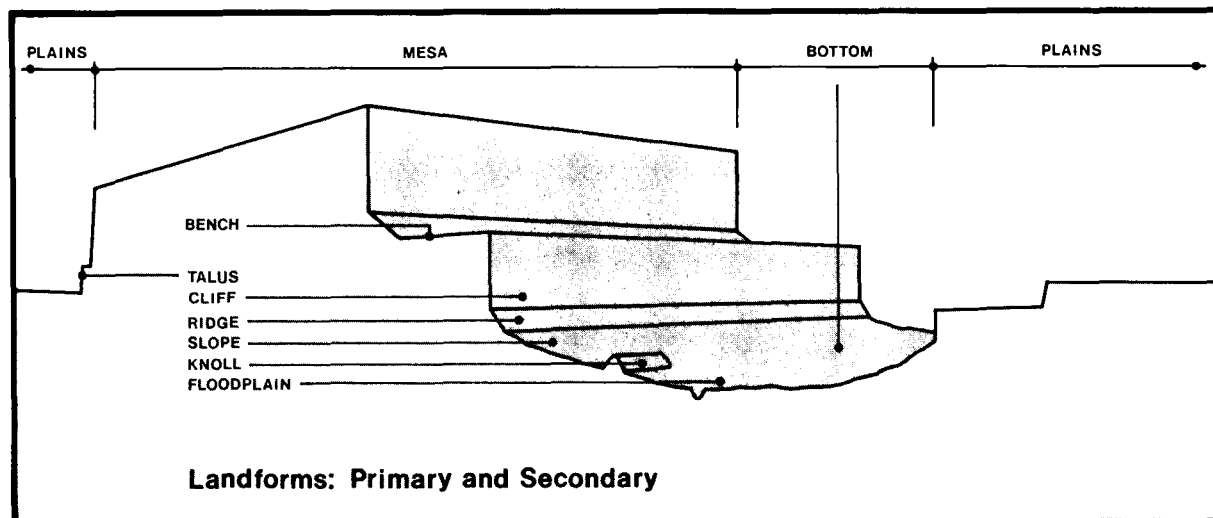
Corral: Applied to all construction designed to control the movement of livestock, including stone drift-fences and lambing-pens, as well as larger stock-pens.

Storage: An isolated storage-room or slab-lined cist.

Religious: Included under this heading were isolated kivas, great kivas, and, under the infamous “ceremonial” catchall, several ma-

tance on a specific cultural innovation. One may see the introduction of a new pottery type as the signpost of a new phase of development, while another sees more significance in a shift in architectural trends. Figure 10 is an attempt to correlate various classifications applied to Chaco Anasazi. The column at the far right is a breakdown suggested by Frank H. H. Roberts in the study of trash-mound stratigraphy he made in connection with Judd's expedition in the 1920's

Figure 9.



sonry enclosures and circles of stones of indeterminate purpose.

Cairn: The ubiquitous piles of stones of the Navajo country, as well as boxed shrines of masonry or slabs.

Stairway: Treads cut into living rock, masonry steps, toe-and-hand holds, or other aids for getting up a cliff.

Trail: Only those paths where the terrain was modified in some way by something other than traffic.

Water control: Dams, terraces, ditches.

Hearth: Isolated fireplaces, including baking-pits, and ovens not part of another structure.

Burial: Isolated finds only.

Final determinations of the periods represented, expressed in terms of the Pecos Classification, were made in the laboratory after all evidence, including pottery identification, was reviewed. Not everybody views the stages in precisely the same way, or places the same impor-

(Roberts, 1927). Although this breakdown is little known in other districts of the Southwest, it was a preliminary form of the “Roberts (1935) Classification,” and some parts of it are still used occasionally in reference to Chaco Canyon archeology. The phase system designed by Harold S. Gladwin (1945) to apply only to the “Chaco Branch”—a greater Chaco area—is shown, with some modifications, in the third column. Gladwin's suggested dates have been shifted to reflect more recent information, and his Hosta Butte and Bonito Phases are shown as contemporaneous, rather than as sequential. Although the phase system is more precise, we prefer the more general Pecos Classification at this stage of our research, leaving it to the current excavation program to redefine the phases as work progresses.

It was not possible to assign a period to every site. We did not attempt to date stairways, roads, or water-control structures, although the more

AD	PECOS	ROBERTS	GLADWIN	EARLY ROBERTS
-100	Basketmaker I (Archaic)			Pre-Basketmaker
0				-----?
100				
200	Basketmaker II	Basketmaker		Basketmaker
300				
400				
500			-----?	-----?
600	Basketmaker III	Modified Basketmaker	La Plata Phase	Post-Basketmaker
700			-----?	
			White Mound Phase	-----?
800	Pueblo I	Developmental Pueblo	Kiatuthlanna Phase	Pre-Pueblo
			Red Mesa Phase	
900	Early Pueblo II			-----?
				Transitional
1000	Late Pueblo II		-----?	-----?
			Wingate Phase	Early Pueblo
				-----?
1100	Early Pueblo III			
1200		Great Pueblo	Hosta Butt Phase Bonito Phase McElmo Phase	Classic Pueblo
	Late Pueblo III			
1300				

Figure 10. Various classifications of Chaco culture.

elaborate of these, at least, are certainly Pueblo III—in most cases, we could at least separate Navajo sites from Anasazi. We could also make this distinction in rock art. At a few occupational sites, the evidence was too scanty to allow us to make even that gross distinction, but the majority could be assigned to at least one period. It is not surprising in an area used to intensively in prehistoric times that many locations were occupied repeatedly or continuously for several hundred years. Most of the larger sites yielded evidence of two or more periods, and in the cases where we tabulated only one, it was with the understanding that the signature for another might easily lie buried.

The criteria used for dating occupations varied greatly. Intact, diagnostic architectural forms are more convincing than the random occurrence of a pottery type, and some kinds of pottery are more indicative than others. At pueblos with considerable debris and trash on the surface, we could be selective in what we considered to be good evidence, and relatively confident of the designation, while at an isolated firepit with half a dozen sherds, our conclusions were tentative and suspect.

In theory, it should be possible to reduce all data into a systematic typology, and to express the results as a mathematical formula that will have scientific endurance. Commendable efforts have been made in that direction in the past decade. But any such system requires a certain arbitrariness—"five sherds per 5 square meters constitute a 'site'; three sherds and a stone chip do not." Although it is difficult to measure the biases brought to the traditional approach to archeology, the statistical indices determined by chi-square and correlation coefficients have a ring of authenticity that is often spurious. One still doesn't know what has been left out. Ultimately, the validity of the conclusions, no matter how they are arrived at, or how they are expressed, rests on the accuracy of the field observations. In evaluating an archeological report, it is hard to escape the need to assess the reporter. Did he, whether he brought dirty fingernails to the job, or a slipstick, know what he was looking at? A good deal of the time, I think we did. I know too that sometimes we did not.

The divisions we made, and some of the reasoning behind those breakdowns, are as follows:

Archaic-Basketmaker II: Lithic sites with

no pottery were considered to be preceramic. The earliest of Basketmaker III sites will produce a greater quantity of sherds than of stone chips, and when the reverse is true, an earlier site was suspected. When the lithic preponderance was great, it was assumed to be preceramic. It is difficult to walk many yards in Chaco without seeing a potsherd, and the presence of three or four in an extensive area of chipping debris is to be expected. An unquestioned Early Archaic site found by Judge's crew on Chacra Mesa produced two Tusayan Polychrome sherds—to no one's annoyance.

Basketmaker III: These settlements show little architectural evidence beyond an occasional upright stone slab indicating a small cist, a few scattered spalls, and possibly one or more faint depressions of pithouses. Sherds are Lino Gray, and La Plata and White Mound Black-on-white. Often there are no definitive remains, but if there was an unusual concentration of sherds, the buried presence of structures was assumed.

Pueblo I: The same pottery types continued well into Pueblo I, when Kana'a Gray and Kiatuthlanna Black-on-white were introduced. The significant change was a shift from pithouse-living to the building of arcs of connected rooms on the surface of the ground behind an unlined proto-kiva. The rooms are usually revealed only by a row of slabs lining the base of a jacal, although a concentration of stone may mark the location of spall-filled adobe walls or crude masonry of small unshaped stones. When this architectural evidence was present, the site was called P-I even if definitive pottery was absent. When Kana'a Gray (neck-banded) or Kiatuthlanna Black-on-white were present, the site was classed as P-I, whether or not there was evidence of surface rooms. Housing in these early periods was relatively ephemeral, and the remains were easily covered by alluviation or aeolian sands.

Early Pueblo II: Room blocks are more likely to be linear than curved, and contain more evidence of simple masonry of selected stones. The diagnostic pottery is Tohatchi Banded. Red Mesa Black-on-white, the typical decorated type, first appears in Early P-II, along with Escavada Black-on-white and Coolidge Corrugated.

Late Pueblo II: Masonry rubble indicates more substantial walls, and kiva depressions are more obvious because their walls are lined with masonry. Tohatchi Banded is replaced by Cool-

idge Corrugated, and Red Mesa Black-on-white is much reduced. The other types from Early P-II are still found. Gallup Black-on-white and Wingate Black-on-red emerge as new types.

Early Pueblo III: Two "phases" are represented in this period. The great pueblos of the Bonito Phase, with their cored walls of fine-banded masonry, are easily recognized. The small pueblos of the Hosta Butte Phase differ little architecturally from those of Pueblo II, except for their tendency to be L-shaped and slightly more compact. Throughout most of the period the pottery was also the same, except for the introduction of Chaco Black-on-white, which was never a common type. In the later years, there was an increase of carbon paint on decorated types, and beginnings of the changes in utility ware that converted Coolidge Corrugated into Chaco Corrugated. A Hosta Butte pueblo that did not reflect the new compact architecture (and most of them did not), and that produced no sherd of the relatively rare Chaco Black-on-white, and that was abandoned before the style change in corrugated ware (and many were) could not be recognized as having lasted into Pueblo III.

Late Pueblo III: There are two indicators—compound masonry of large, shaped blocks of soft sandstone, and the presence of Mesa Verde Black-on-white pottery. Houses built during this phase are the U-shaped unit pueblos with kivas sheltered between the wings of the house or even entirely surrounded by rooms. However, many earlier sites produce Mesa Verde Black-on-white, indicating an occupation into Late P-III, but do not show any modification of the original building.

There is considerable confusion in the literature about the taxonomy of Chaco pottery types, particularly those representing Pueblo I and II. We have made no attempt to straighten things out on the dubious basis of surface collections. Our study of the survey sherds was for the purpose of dating the sites, and for gaining a familiarization that could help define the ceramic problems. There are some changes through time in Anasazi pottery that are quite consistent from one side of the plateau to the other, and this is especially true of shapes and styles of painted designs. Most sherds are at least assignable to the proper century, whether they are properly called Escavada or Gallup Black-on-white. The type-names used in the laboratory

sorting were based on Vivian's modifications (1959, 1965) of Hawley's binomial typology (1936). Pottery that seemed to bear a strong relationship to one of those types, but did not exactly fit the published description, was assigned to one of the more general classifications designed by Roberts (1927). A refinement of the taxonomy will be attempted after consideration of the pottery from the current excavations.

Area and Numbers of Sites

By June of 1975, we had comprehensively surveyed 43 square miles, and recorded 2,220 sites. The area included all of the separated units administered by the National Park Service, containing 1,751 sites within the boundaries. The largest land unit comprised 32 sections at the lower end of Chaco Canyon. We also surveyed 8 $\frac{3}{4}$ square miles outside the boundary and principally to the south of this unit, and it is this area of 40 $\frac{3}{4}$ sections, containing 1,991 sites, that is considered in the analysis presented in the following section. The site-density in the area of study is 47 to the square mile, or somewhat more than half the density on Mesa Verde, where a survey of Wetherill Mesa recorded a density of 82 sites per square mile (Hayes, 1964).

A comparison of the results of the two surveys is interesting, because they were as nearly comparable as two surveys could be. They were conducted by the same man—using the same techniques, recording the same kinds of data, and applying the same prejudices—and I don't believe that the greater number of sites at Mesa Verde was the result of any difference in the quality of the work. Both areas carried unusually heavy concentrations of the same range of Anasazi and more recent remains. However, there were differences other than density.

Chaco had a much heavier use by Navajos—16 sites to a square mile, versus a little less than one Navajo, Ute, or historic Anglo site to the mile at Mesa Verde. If only Archaic and Anasazi sites are considered, the comparison is more heavily weighted toward Mesa Verde—81 sites against 31 to a square mile.

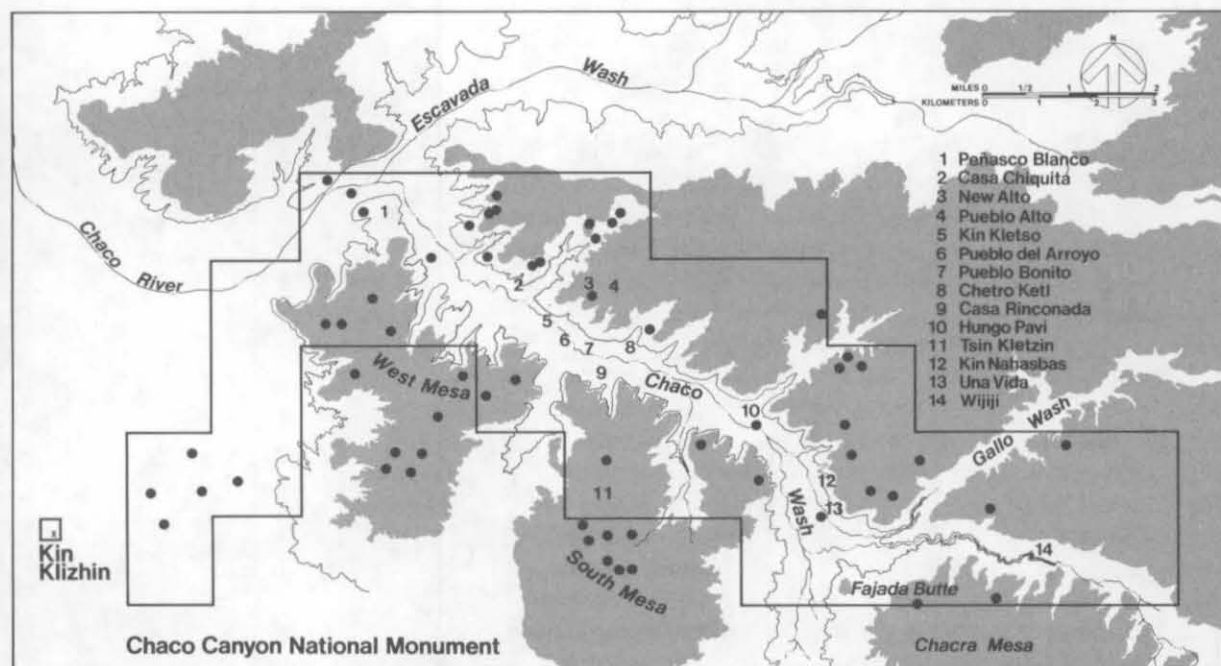
The terrain, the cover, and the soil conditions of the two areas differ. The country in Chaco is much easier to survey. Vegetation is sparser, visibility is greater, canyons are shallower, and site recognition is easier. These conditions are

reflected in the fact that while only 38 percent of the Mesa Verde sites were non-habitations, 68 percent of the Chaco sites were such things as pictographs, sherd areas, and isolated hearths. Thick brush and soil aggradation on Mesa Verde concealed many of those features, and a larger proportion of sites was missed. When the fact that more sites were missed on Mesa Verde due to soil aggradation and vegetation is taken into account, the disparity is even more impressive,

Archaic-Basketmaker II

The considerable material remains left in Chaco by the Anasazi are so diverting that archeologists have been slow to turn their attention to happenings before pottery was made. Gordon Vivian knew of non-ceramic sites on the mesas, and assumed their antiquity, but was able to give them only a passing attention (Vivian and Mathews, 1965). In 1971, Judge's crew surveyed 20

Figure 11. Distribution of Archaic and BM-II sites.



indicating a higher population density in the Mesa Verde district in the periods Basketmaker III through Pueblo II.

The Sites

For the purposes of the following discussions of periods and phases, several types of sites other than pueblos were considered: lithic and sherd areas, field-houses, isolated hearths and storage structures, and separate kivas. It was possible to assign most of these to a period, but not all. A time was estimated for 98 percent of the pueblos, but for 13, it was only possible to say that they were post-Basketmaker III.

such sites (nine outside the area of our study), and identified projectile-points found on them as representative of the early Archaic Period through Basketmaker II—or from roughly 5000 B.C. to shortly after the time of Christ.

Dennis Stanford, Judge's crew-chief, was attuned to this early era, and I'm grateful to him for teaching us to recognize the sparse litter for what it is. Within the area of our study are 70 sites assignable to the gross classification of Archaic-Basketmaker II. All but two were characterized as "lithic"—a scatter of rejected chert and chalcedony chips with an occasional knife, scraper, core, or projectile-point. A few sites produced one-hand "biscuit" manos. Slab-lined stor-

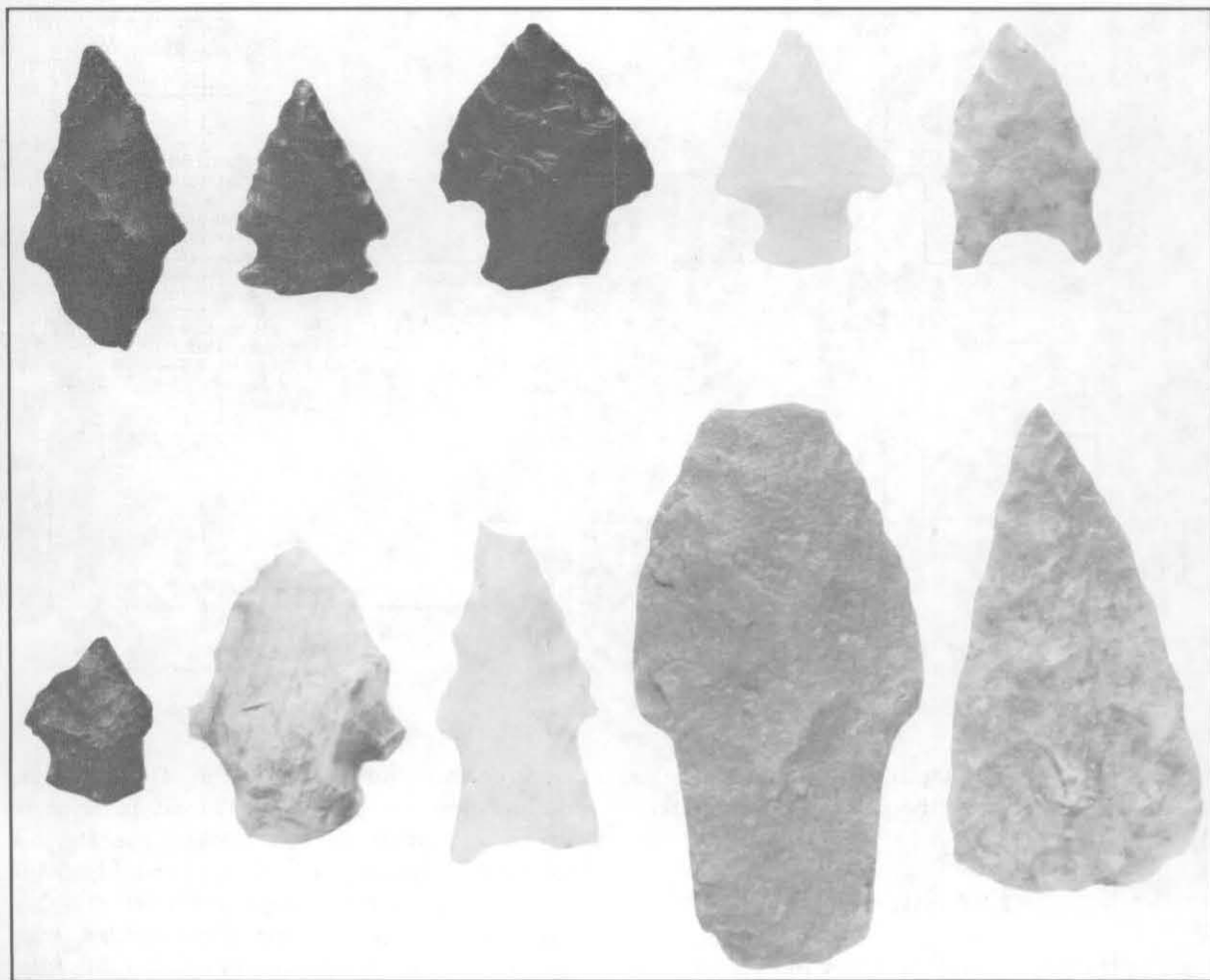
age cists were found at two sites, and hearths at 22.

Two sites assigned to this early Chaco period were overlain by Basketmaker III occupations, and two more had evidence of some Pueblo I-II use. Undoubtedly there were other preceramic sites whose presence was obscured by later deposits.

The most common location was a south-facing, exposed position near a mesa edge. Forty-

tions, but rather that the mesas are where sites could be found. Nearly a third of the sites were found on benches, which tend to be scoured to bare rock where sites can easily be seen. Relatively few sites were found on the often dune-covered, north sides of the mesas. The prevailing southwesterly winds are tripped by the high ground, and drop their loads of spring sands on the northeastern slopes. The few sites discovered on the north sides were at points on slickrock at

Figure 12. Archaic and BM-II dart points and preform.



eight sites were on the mesas (21 of these on benches), 18 on the broad plateau or plain, and only four in bottomlands. The greatest concentration—nine sites on about 300 acres of the south side of South Mesa (Fig. 11)—does not necessarily indicate that mesas were favored loca-

the toes of sand-drifts. The thick alluvial deposits in the canyon bottom would have covered any Archaic sites that might have been there, but several deeply buried hearths are exposed by recent channel-cutting. Charcoal collected from nine points (including several we had not sur-

veyed) by Stephen Hall in connection with a study of alluvial stratigraphy, were dated by radiocarbon at from about 5500 B.C. to A.D. 5 (Hall, 1977).

Four preceramic sites and two Anasazi pueblos produced 23 projectile-points identified by James Judge as dart-points of recognized types (Fig. 12). A Paleo-Indian preform was found on a Late Pueblo II house-mound, and a lithic site, (29 SJ 1431) on the plateau north of the mouth of Gallo Canyon, produced the ground base of an *affinis* Plainview type. A Folsom point was picked up $\frac{1}{2}$ mile north of the Monument boundary. "Jay" points typical of the Early Archaic Period were found at two lithic sites, and at an isolated hearth; one of the lithic sites (29 SJ 126), on the southeast rim of Clys Canyon, was excavated in 1972 by Dennis Stanford and Thomas R. Lyons (1972). Eight Pinto Basin, Middle Archaic, points were found on seven lithic sites. Six sites produced eight Late Archaic San José, or similar, points. Basketmaker II points were found at a lithic site and at a Basketmaker III habitation.

Basketmaker III

This period saw the replacement of the atlatl by the bow and arrow, with a consequent radical change in projectile-point type. Metates were deep troughs, closed at one end by a broad shelf. Houses were subcircular, semisubterranean pithouses with an antechamber or large ventilator shaft. Storage was in oval or bean-shaped, slab-lined cists behind the houses. Although a little crude brown pottery was made late in Basketmaker II (Eddy, 1961), it was rare, and it was essentially in the subsequent period that the Anasazi ceramic tradition started. Two types were made locally—Lino Gray, and La Plata Black-on-white. The latter is nothing more than some painted decoration on the former. A Mogollon-derived dark-red pottery with a black smudged interior was traded into the area. Basketmaker III is roughly dated from A.D. 400–500 to about A.D. 725 or 750.

Evidence of pithouses or cists, or abundant evidence of the appropriate pottery types with an absence of later ones, were both considered to be indicative of Basketmaker III. At multi-component sites where later construction obscured earlier architecture, only a considerable

abundance of La Plata Black-on-white would permit a Basketmaker III classification.

188 sites were identified as Basketmaker III.

21 sherd areas

4 primarily lithic, but with a few Lino sherds

2 of these also classed as Basketmaker II

21 isolated hearths or cists

11 field-houses

135 pueblos (pithouse villages)

73 of these were also Pueblo I

23 of which were also Pueblo II

5 skipped to Pueblo II

1 reoccupied in Pueblo III

15 had Navajo sites over them

57 were Basketmaker III only

In view of the sketchy nature of Basketmaker III architecture, and the ease with which it can be wiped out or buried, many, if not all, of the sites other than "pueblos"—the sherd areas, and the isolated cists—may have been pithouse villages (Fig. 13).

The locations of all BM-III sites were:

60 on mesas

38 of these on benches

40 on plains

2 against cliff at the foot of the mesa

34 on ridges

1 on knoll

6 on slope

3 on floodplain

88 in bottom

7 on talus

40 on ridges

3 on knolls

26 on slope

14 on floodplain

A consideration of dwelling-sites alone shows nearly the same proportionate distribution.

The orientation of settlements, where it could be determined, ranged from east-northeast to south-southwest, with the mean at southeast. Estimates of size ranged from 1 to 12 pithouses and from zero to 12 cists with an occasional hearth associated. The estimated size of 36 discrete sites averaged 3 pithouses and 3 cists. With the surface evidence as scant as it is, most of the sites are certainly underestimated. An illustration of the quality of our size-estimates is Site 628, excavated in 1973, where the survey had seen 1 pithouse and 3 cists, but excavation re-

vealed 6 pithouses and 6 cists. We saw only a single pithouse at Site 299, but later excavated 3 pithouses and 14 cists. The "pithouse" that was surveyed turned out to be an isolated, intrusive kiva of a later period.

An interested visitor to Mesa Verde once asked me how many undiscovered ruins there were on the mesa. It is a good question, and one that we might consider here in relation to Chaco. The number of Basketmaker III sites recorded is unquestionably much lower than their actual occurrence, almost three times as many Pueblo I sites were counted. Three factors contributed to the low figure. It takes little windblown sand to completely conceal the low-profile remains, and probably many on the mesa-tops were not seen. Many pueblos listed only as Pueblo I-III probably also had Basketmaker III structures beneath them—witness Pueblo Bonito, where unsuspected pithouses lying under the West Court were revealed by deep trenching (Judd, 1964). The presence of Basketmaker III at such sites was assumed only when La Plata Black-on-white sherds were quite numerous, because the type was made well through mid-Pueblo I. In fact, all the attributes of the earlier period are present on Pueblo I sites, and in cases of relatively few pueblos of the latter period could we safely postulate that Basketmaker houses preceded them on the same spot. Finally, the presence of 15 Basketmaker III sites exposed in cutbanks of the deep canyon-bottom arroyos indicates that many more certainly exist. A radiocarbon date of A.D. 585 ± 95 taken 4.5 meters below the surface, which seems to have been about 2 feet lower at mid-valley in the 11th century, implies a rate of deposition of about 3.9 meters (13 feet) in the first 500 years.

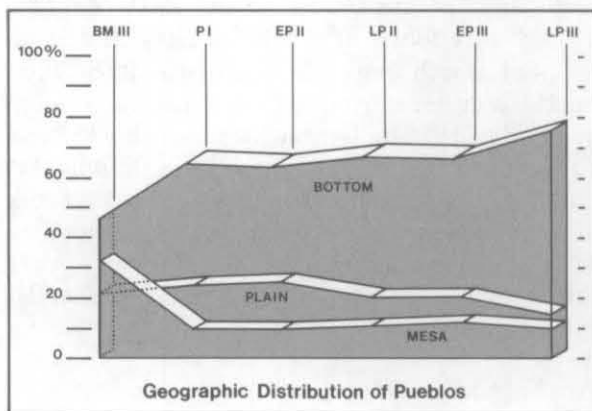
It would not be unreasonable to guess that there are in reality at least double the sites we surveyed. If half of the Pueblo I houses, where no Basketmaker III was recorded, were added to the count, and if the 15 sites buried in the floodplain were conservatively multiplied by 10, we would have a new total of 408, a number that is probably still too low.

The geographical distribution of sites listed above may also be affected by our suspicion that at least 150 sites lie deep in the floodplain of the canyon. Adjusting the graph in Figure 14 to reflect the rationalized site-density brings the bottom-located pueblos to 69 percent of the total,

very close to the proportions seen in subsequent periods.

The Basketmaker III villages plotted on Figure 13 seem to show some clustering in some locations. The largest of these clusters is at the north end of West Mesa around Peñasco Blanco, where there are 20 sites to the square mile. Two concentrations of 14 to the mile are also on and near West Mesa—one on the southeast side near the head of South Gap, and another in and above

Figure 14.



a wide rincón on the southwest side. A cluster of 14 settlements is centered on Rafael's Rincon, and there are 13 to a square mile in the Pueblo Bonito/Chetro Ketl vicinity. Although filling in the map with the "undiscovered ruins" might shift the centers of the clusters and blur their borders, they seem to be real. At the Basketmaker III village of Shabikeshchee, a great kiva was an important feature (Roberts, 1929), one that may have served as a ceremonial center for a larger community of family-sized settlements. Our survey stopped at the Monument fence, and only five contemporary sites are recorded in this vicinity, but several others are known close by. The 1973 excavation by the Chaco Center of Site 423 near Peñasco Blanco uncovered a great kiva dating about A.D. 500, which may have served a like function for that concentration.

Pueblo I

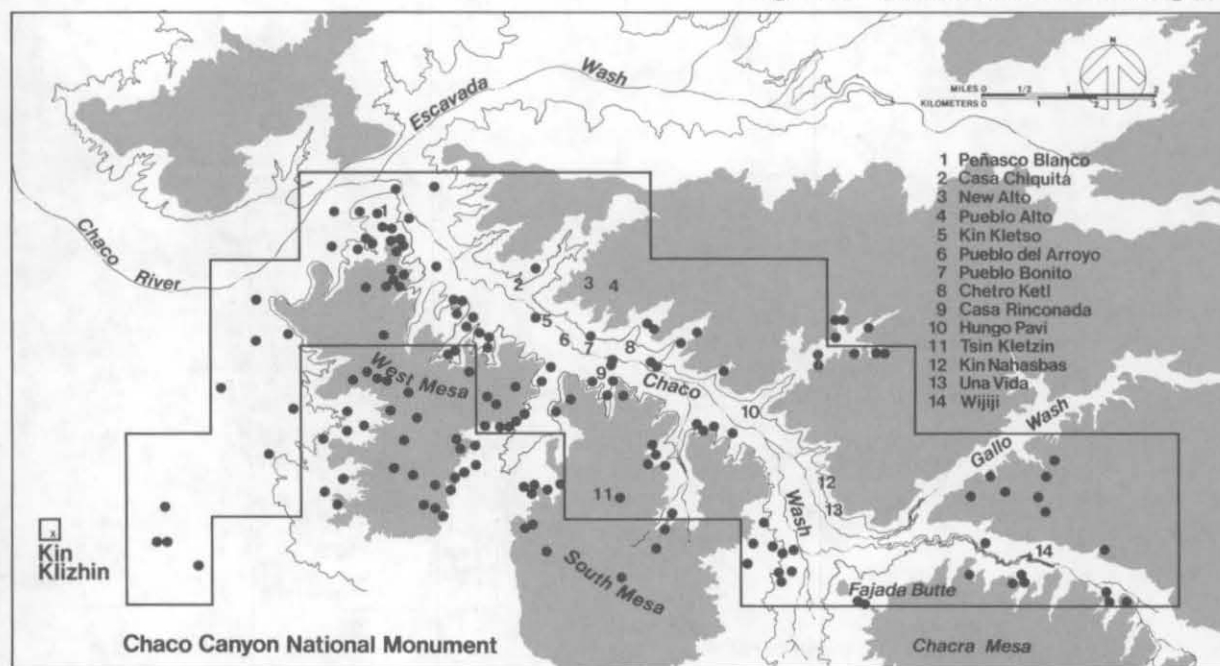
Sometime in the middle of the 8th century, there were gradual but significant changes in housing arrangements which were to set a pat-

tern for pueblo architecture that would remain essentially static for up to 600 years. The storage-cists that had backed the pithouses were joined and fronted by open ramadas with hearths. The pit structures became smaller and deeper, and antechambers were reduced to narrow shafts. The implication is that at least some ordinary household activities were taking place on the surface of the ground in the ramadas. By about A.D. 800, in neighboring areas, and presumably

still partially outline the rooms. As time went on, more and more stone was used in construction. Adobe walls were raised with a filler of small stones, of alternate courses of adobe "turtlebacks" and stones, or entirely of a rough coursed masonry. Remnants of these walls appear as a light scatter of unshaped stones on the surface.

Stone artifacts were unchanged. However, pottery underwent style changes that are helpful

Figure 13. Distribution of BM-III villages.



in the Chaco, the ramadas were fully enclosed, and the houses became true pueblos, with the pithouse having evolved into a kiva serving a largely religious function. Apartments were formed by two or three small, contiguous storage-rooms with a larger living-room in front. The apartment units were joined in an arc of three to six for each kiva.

Early in the period, construction was mostly of small jacal poles and adobe, and the remains are nearly as ephemeral as in Basketmaker times. Fortunately, the rooms were often in shallow pits, the banks of which were lined with standing sandstone slabs. At sites that are not deeply buried, the protruding tops of the slabs

in determining a Pueblo I occupation. Lino Gray was still made, but the necks of many jars were left with the broad coiling bands unscraped (Kana'a Gray)—a trait that was short-lived, and is thus a good time-marker. La Plata Black-on-white was still a common decorated type, but early in the period, or perhaps late in Basketmaker III, the White Mound artistic style gradually replaced the more open layout of La Plata. With the addition of a polished slip and a refinement of the linework, White Mound evolved into Kiatuthlanna Black-on-white. The presence of these pottery types is the only criterion for identifying Pueblo I at sites that were occupied in still-later phases.

457 sites were identified as Pueblo I:

- 45 sherd areas
- 2 storage-cists
- 1 isolated hearth
- 36 field-houses
- 373 pueblos

Of the total number:

- 73 overlay a BM-III occupation
- 20 had Anasazi use after Pueblo I
- 73 were used by Navajos

58 on talus

107 on ridges

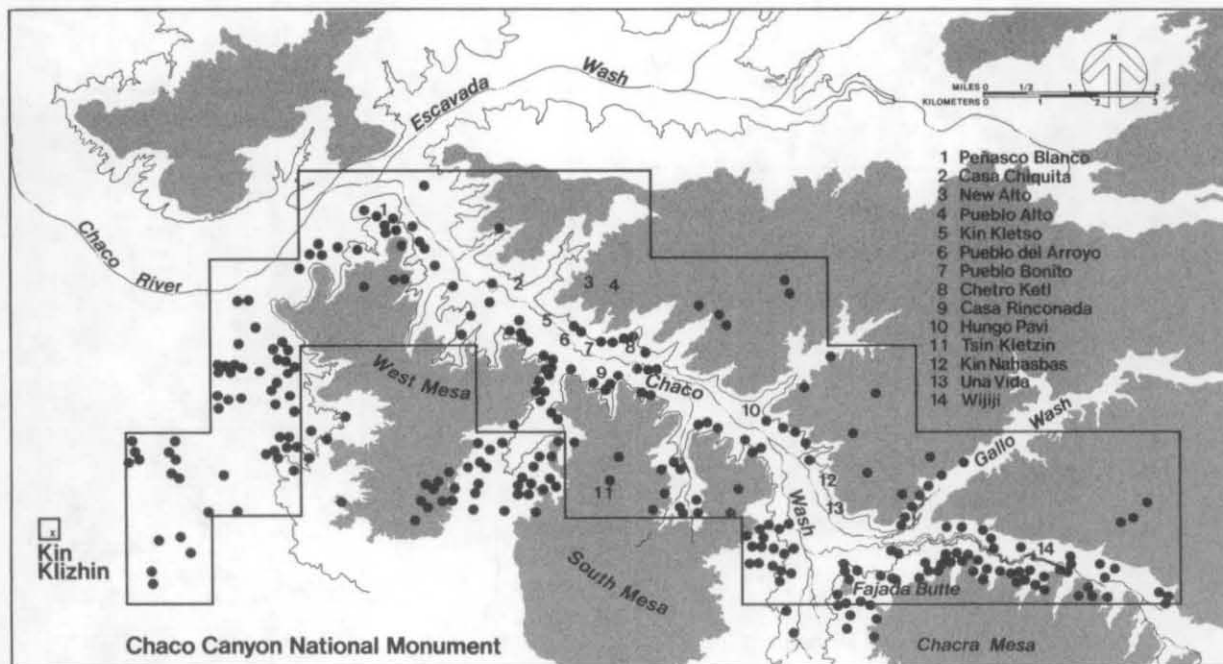
18 on knolls

60 on slope

40 on floodplain

A true distribution should be more heavily weighted toward canyon-bottom sites. Because the Pueblo I ruins are somewhat more substantial than those of the preceding period, fewer were probably concealed by sand on the mesas

Figure 15. Distribution of P-I pueblos.



47 were Pueblo I only

Locations were:

- 44 on mesas
- 35 on benches
- 2 on cliff-edge
- 1 at cliff-face
- 1 on talus
- 115 on plains
- 77 on ridges
- 6 on knolls
- 1 on talus
- 23 on slopes
- 8 on floodplain
- 303 in the bottom
- 32 at cliff-face

and slopes, although some must have been. However, the same factors that buried Basketmaker pithouses in the floodplain also covered Pueblo I sites. Pueblo I proto-kivas or pithouses exposed in vertical banks of Chaco Wash were excavated by Judd (1924) and Adams (1951). The original ground surfaces were buried by up to 3 meters of alluvium.

It was possible to plot the orientations of 35 pueblos. They ranged from northeast (1) to south-southwest (3), with 26 falling between east-southeast and south-southeast. The mode was a bit to the north of southeast (ca. 130°). Individual housing units (a proto-kiva and its associated rooms) range in size from 5 to about 15 rooms,

but often from two to four arcs of rooms are quite close together, and probably were parts of the same community.

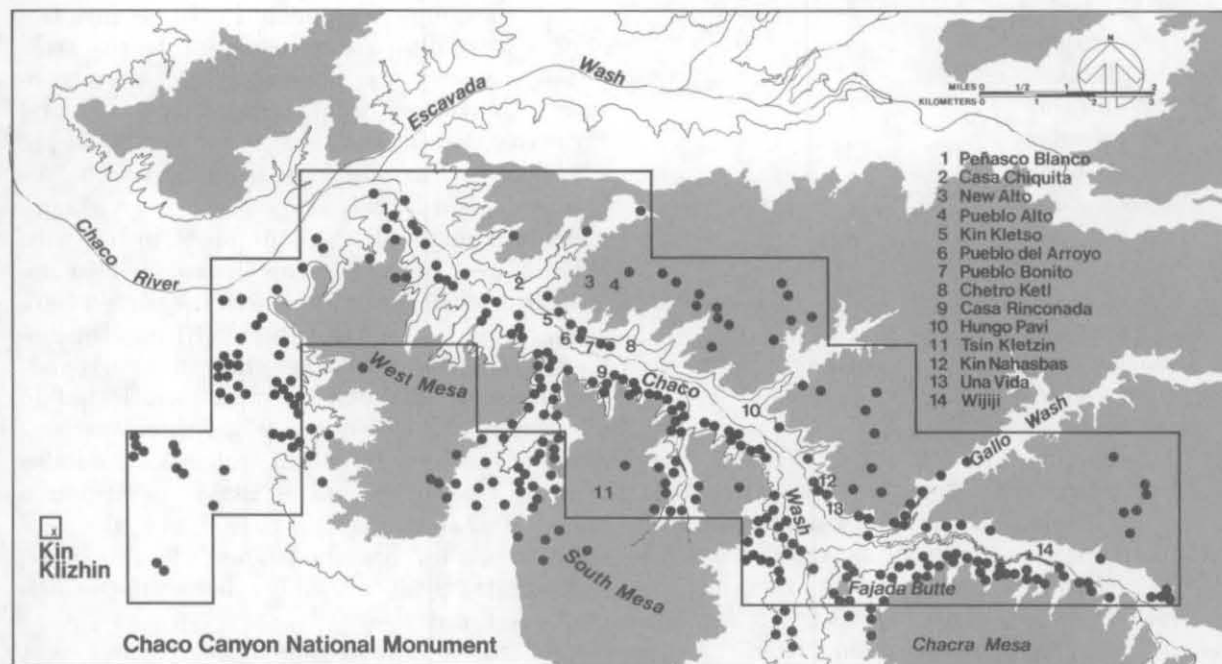
The clustering of sites seen in Basketmaker III shifted somewhat in Pueblo I (Fig. 15). The large communities on the south side of West Mesa and in Rafael's Rincon almost disappeared, and the one in the Peñasco Blanco vicinity was much diminished, but the South Gap community and those around Pueblo Bonito and both sides

equal size. The houses built in this period were straight lines of apartments rather than the arced rows of Pueblo I. Kivas were usually at least partially lined with masonry, and were built closer to the houses.

Stone artifacts remained the same, but the trough metates, open at one end, were likely to be on lighter, thinner slabs, and to have shallower proximal shelves.

The culinary pottery was Tohatchi Banded,

Figure 16. Distribution of Early P-II pueblos.



of Fajada Gap all contained more sites. An entirely new settlement appeared on Padilla Wash just west of West Mesa, where there were a total of 49 pueblos—as many as 31 to a square mile in the lower section of the drainage.

Early Pueblo II

Although earlier building techniques were still employed, Pueblo II walls were more often simple, coursed masonry of selected stones. The concept of living-rooms backed by storage-rooms was preserved; however, the living-rooms were smaller than before, and the storage-rooms larger, so that both types of rooms tended to be of nearly

with narrow, sometimes tooled bands from the rim down to the shoulder, and with the bottom left plain, hence the numerous "Lino Gray" sherds found on Early Pueblo II sites. By the late 900's, the corrugations were frequently indented in the "Exuberant" style, but the bases of the vessels were still plain. The decorated pottery was Red Mesa Black-on-white.

498 Early Pueblo II sites were recorded:

- 57 sherd areas
- 11 isolated hearths or baking-pits
- 13 storage-rooms
- 61 field-houses
- 3 isolated religious structures
- 353 pueblos

Of the total number:

- 320 overlay a P-I occupation
 - 22 of these also BM-III
- 334 were still occupied in Late P-II
 - 13 were reoccupied in P-III
- 143 had no later Anasazi occupation
 - 45 were Early P-II only (except for Navajo use at 5)

Locations were:

- 50 on mesas
 - 29 on benches
 - 5 on talus
 - 6 at cliff-face
 - 3 on cliff-edge
 - 1 on ridge
- 123 on plains
 - 2 on talus
 - 51 on ridges
 - 10 on knolls
 - 22 on slopes
 - 5 on floodplains
- 325 in the bottom
 - 36 at cliff-face
 - 68 on talus
 - 95 on ridges
 - 15 on knolls
 - 53 on floodplain

Fifteen pure Early Pueblo II pueblos averaged an estimated 4.3 rooms. Two of the best preserved in scoured locations on the mesas have from 5 to 6 rooms in a line. As was the case for earlier phases, these estimates are certainly far too low. The survey estimate at Site 627 was "3+ rooms"—all that could be defined from the surface—but excavation of the house in 1974 uncovered 19 rooms. There were 9 rooms in the excavated 3-C Site (Vivian, 1965), and in the original form of the "Old Bonitian" section of Pueblo Bonito (Judd, 1964), there were from 20 to 25 rooms. Both of these were Late Pueblo I-Early Pueblo II houses.

The orientation of 10 pueblos having no later occupation ranged from east to southwest, and averaged south-southeast (165°). The figure is skewed by one site facing southwest, a placement forced by the nature of the terrain. If this odd one is removed, the average becomes 100°, and the mode is at 145°, or about southeast.

The South Gap community of sites was apparently somewhat smaller, and concentrations in Fajada Gap were slightly reduced, but the Padilla Wash area still contained as many as 27

pueblos to a square mile, and the Bonito/Chetro Ketl/Rinconada vicinity had grown, with 38 pueblos in 1 square mile. The area at the north-western foot of Chacra Mesa also had a larger concentration than previously. There seem to be fewer, but larger, communities. When pueblos alone are considered (Fig. 16), we can see that the canyon was definitely favored, and that mesas and plains were largely abandoned, except for the large group in lower Padilla Wash.

Late Pueblo II

Our attempt to separate Pueblo II into two phases was only partly successful. In the later phase, masonry was generally a bit more substantial, adobe and jacal walls less common, and kivas completely lined, but these attributes were not often easy to determine from the rubble. We had to depend largely on pottery for an assignment to a period. Part of the problem lies with the unique situation in the Chaco wherein the flowering of the Bonito Phase in the early 1000's brought the attributes of Pueblo III into the district about 50 years earlier than into surrounding areas. "Late Pueblo II" may have lasted no more than 30 to 50 years. When there was evidence of an Early Pueblo II occupation and also of Early Pueblo III, and no reason to suspect a period of abandonment, a Late Pueblo II use of a site was often assumed. The difficulty in assessing sites of this period is reflected in the lowered site count.

There was little change in stone tools, except for the introduction of the side-notched arrowpoint. Red Mesa Black-on-white pottery was supplanted by Escavada and Gallup Black-on-white. The cooking-ware was Coolidge Corrugated, in which the entire surface of the vessel is corrugated, usually with rather wide, even coils, patterned by alternating indented and unindented or tooled areas.

449 sites were identified as Late Pueblo II:

- 44 sherd areas
- 3 hearths
- 6 isolated storage structures
- 70 field-houses
- 3 great kivas
- 323 pueblos

Of the total number:

- 334 were also Early P-II
- 310 were still occupied into P-III

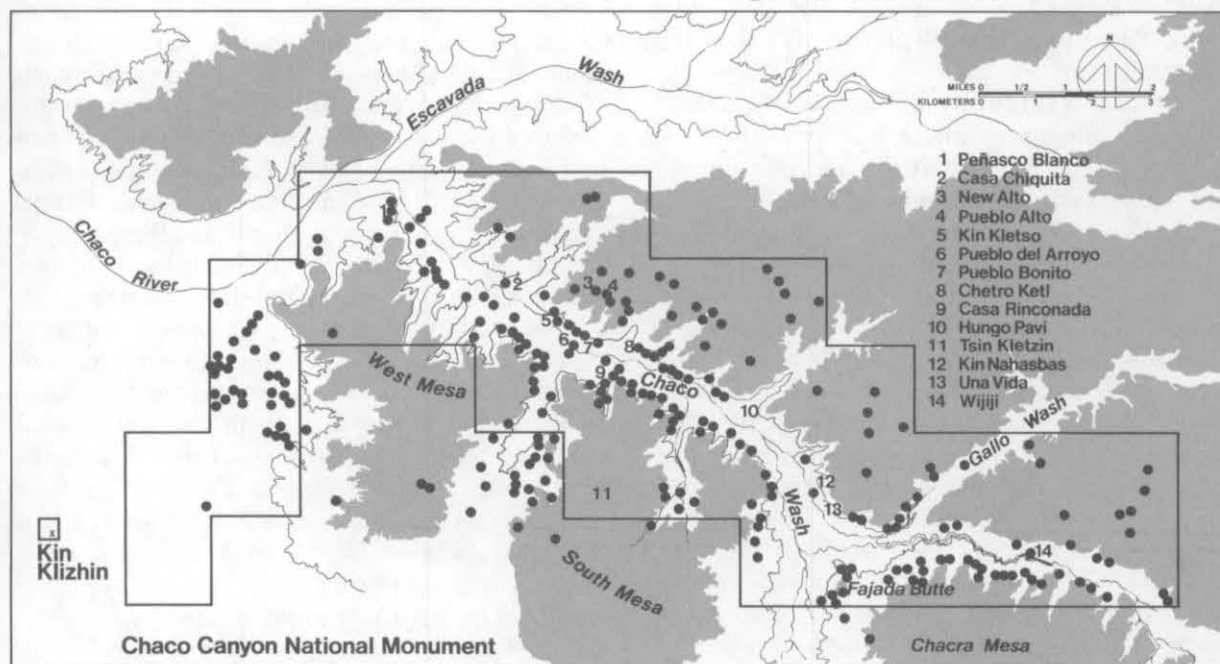
- 39 were Late P-II only
 - 2 of these were reused by Navajos
- Locations of all sites:
 - 48 on mesas
 - 25 on benches
 - 11 at cliff-face
 - 2 on cliff-edge
 - 7 on talus
 - 1 on ridge
- 93 on plains

pied into later times, and it could not be safely assumed that they had attained maximum growth by Late Pueblo II. Nine "pure" pueblos averaged only 3.5 rooms.

The orientation of the same nine sites ranged from east to south. Seven of these faced between southeast and south-southeast, with the mode at about 150°.

The "communities" of pueblos underwent a drastic shift, as one can see on Figure 17. There

Figure 17. Distribution of Late P-II pueblos.



- 3 on talus
- 58 on ridges
- 6 on knolls
- 24 on slope
- 2 on floodplain
- 308 in bottoms
 - 52 at cliff-face
 - 90 on talus
 - 96 on ridges
 - 14 on knolls
 - 56 on slope
 - 66 on floodplain

Estimates of the sizes of pueblos are no more reliable than they were for preceding periods, because most of the larger sites were still occu-

was still a large concentration on Padilla Wash, where there are 37 pueblos on little more than a section and a half. The mesa-tops and the plains north and south of the canyon were virtually uninhabited, and the canyon-bottom population, rather than clustering at several definable locations, was nearly evenly strung along the length of the canyon.

Early Pueblo III

Sometime in the first half of the 11th century, some new stimulus struck the slow, even progression of Anasazi culture in the Chaco. This was the time of the erection of the great, multi-

storied pueblos, which Gladwin (1945) labeled the Bonito Phase. Contemporaneous with the large houses were many smaller pueblos with the more modest attributes one would expect from the successors to Chaco's Pueblo II population. The small sites represent Gladwin's Hosta Butte phase. The term "phase" is unfortunate here because of its connotation of time, but Gladwin saw Hosta Butte as Early Pueblo III and the Bonito Phase as Late Pueblo III, arguing against Kluckhohn's contention, in his summary of the Bc51 report (Kluckhohn and Reiter, 1939), that the two "phases" were concurrent. Vivian and Mathews (1965) convincingly support Kluckhohn. There will be more about this cultural dichotomy later.

It may eventually be possible to define a third contemporary phase in Early Pueblo III. Some traits diagnostic of the McElmo Phase in the Mesa Verde area began to filter into Chaco in the late 1000's. Vivian and Mathews dated the start of this intrusion at about 1050, and pointed particularly to the presence of McElmo Black-on-white pottery and the architecture of Kin Kletso, Casa Chiquita, and New Alto. However, the "McElmo" pottery from Kin Kletso is mostly late McElmo or classic Mesa Verde Black-on-white typical of the later Mesa Verde Phase, and which, like the architecture, is confidently dated at Mesa Verde no earlier than the late 1100's. Most sites representing both the Bonito and Hosta Butte Phases produce a small amount of Wetherill Black-on-white sherds and an early form of McElmo imported from the Mesa Verde area, as well as what seem to be Chaco-made copies. From the position these types occupy at Mesa Verde, I would expect them to date no earlier than 1075. They are found in smaller percentages, but are ubiquitous, and there is no evidence yet available to prove that people, rather than a drift of traits, are responsible, or that any particular sites were more affected than others.

Architecture in the Hosta Butte pueblos differed little from that of Late Pueblo II; in fact, the majority of them *were* Late Pueblo II, with no break in occupation. Houses tended to be somewhat larger, new walls were often compound masonry of randomly selected stone presenting a relatively plane face on both sides, and kivas were still closer to the rooms. The same linear arrangement of rooms prevailed, but

sometimes with the addition of an ell, which partly enclosed the kiva.

Bonito Phase houses of the same period were large, compact structures rising in tiers up to four stories in the back, and usually enclosing a plaza. Massive walls were built of unshaped slabs of sandstone or rubble, faced with an ashlar veneer of carefully fitted small spalls, often banded with contrasting courses of larger stones (Fig. 18). The stone used was a dense, chocolate-colored sandstone from a 30-150-cm. stratum in the Cliff House (or Chacra) member of the Mesa Verde group, which is exposed on the first bench above the canyon's inner wall.

Other items of material culture were the same for both phases. During this period the deep trough metate, closed at one end, was gradually replaced by a shallow metate, open at both ends and set into adobe in a bin. Escavada and Gallup Black-on-white were the principal decorated pottery types, with the latter becoming increasingly important. Chaco Black-on-white, a refined version of Gallup, was introduced, but it was never common. At about midperiod, Chaco Corrugated replaced Coolidge. Common trade-wares are Wingate and Puerco Black-on-red from the south; McElmo Black-on-white from the north; and trachyte-tempered, carbon-painted black-on-white types from the Chuska Valley.

400 sites were identified as Early Pueblo III:

- 33 sherd areas
- 8 isolated hearths
- 8 isolated kivas and shrines
- 1 storage-room
- 68 field-houses

282 pueblos

Of the total number:

301 were also Late P-II

98 were without a Late P-II occupation

8 of these skipped from Early P-II

18 were occupied in P-I

2 were used in BM-III

71 had no earlier occupation

185 were still occupied in Late P-III

47 were Early P-III only (except for Navajo use of 4)

15 of these were pueblos

Locations of all sites:

47 on mesas

22 on benches

4 on cliff-edge

12 at cliff-face

- 9 on talus
- 2 on ridges
- 79 on plains
- 3 on talus
- 27 on ridges
- 4 on knolls
- 7 on slope
- 1 in floodplain
- 274 in bottom
- 52 at cliff-face

the west. If these pueblos were removed from the count, the emphasis on the canyon would be still greater. The clusters in the canyon that were noted in earlier phases disappeared, and the balance of the pueblos were distributed more or less evenly along the length of the canyon. In a consideration of *population* versus *sites*, however, there was a concentration in the general vicinity of the mouth of South Gap where larger pueblos are found.

Figure 18. Kin Bineola Bonito Phase Pueblo.



- 86 on talus
- 76 on ridges
- 13 on knolls
- 42 on slope
- 66 in floodplain

The locations of pueblos alone, as shown on Figure 19, clearly indicate a different distribution. Whereas 12 percent of all sites were on the mesas, only 6 percent of the pueblos were. There were still 27 pueblos in the Padilla Wash settlement. This area was classified as "plain," although it is partly enclosed by high badlands on

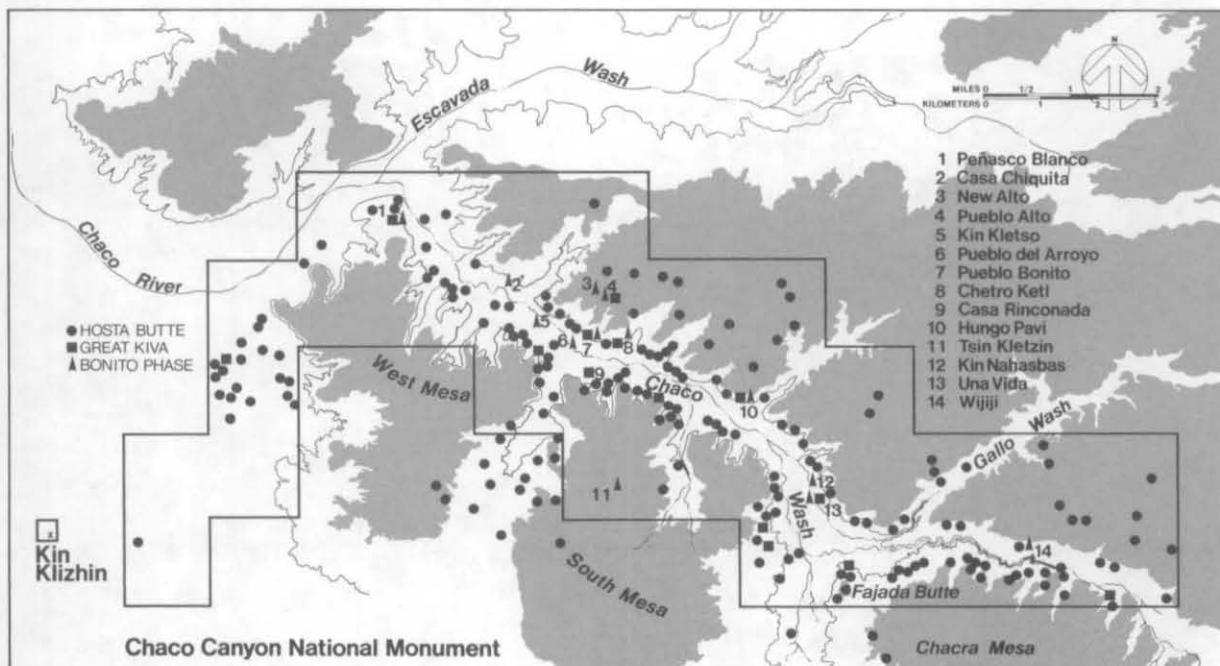
Using the same criterion for estimating size as we have used above—that of considering only "pure" sites—15 pueblos averaged 5.5 rooms, which is a slightly larger figure than for Late Pueblo II. Again, the figure is distorted by failure to include the great pueblos, which were still occupied in Late Pueblo III. Early Pueblo III saw the peak of population in Chaco, and although there was certainly remodeling, there was no later expansion of the room total. A more valid estimate could probably be reached by a room count of all Early Pueblo III pueblos, whether

they were still in use in the subsequent phase or not. This approach gives us an average of 28 rooms. If houses of the two contemporary phases are reckoned separately, their dissimilarity is marked. The Hosta Butte pueblos averaged 10 rooms. The Bonito Phase pueblos averaged 288.

Another striking difference in the two phases is illustrated in their orientations. Hosta Butte pueblos ranged from northeast to southwest, with the mode at 132° . Bonito Phase houses, with

much of the remnant Anasazi population was apparently living in sections of the largely abandoned houses of the Hosta Butte and Bonito Phases. Architectural preference was for even more compact structures, without plazas, and with kivas incorporated into the house-blocks. The distinctive masonry reverted to the lighter colored, softer, basal rock of the Cliff House. The individual stones were large, shaped blocks. Kivas were the high-benched, pilastered keyhole

Figure 19. Distribution of Early P-III pueblos.



a narrower range of east-southeast to south-southwest, averaged between 162° and 186° , depending on how one interprets the orientation. L-shaped Una Vida is facing either southeast or southwest.

Late Pueblo III

The late 1100's saw a decreased population in Chaco Canyon. There was much new construction at New Alto, Kin Kletso, and Casa Chiquita (if they weren't entirely constructed in this phase), and there were additions to Pueblo del Arroyo (Vivian, 1959). A few more modestly scaled pueblos were built (Bradley, 1971), but

kivas of the Mesa Verde tradition.

McElmo and Mesa Verde black-on-white, and an inadequately described melange of related carbon-painted pottery generally lumped under the heading of "Chaco-San Juan," were typical. Metates were made with flat surfaces and set in bins, but shallow, open-ended metates, probably heirlooms, were still in use.

221 sites were occupied in Late Pueblo III:

- 14 sherd areas
- 5 hearths
- 3 storage structures
- 20 field-houses
- 7 isolated religious structures
- 172 pueblos

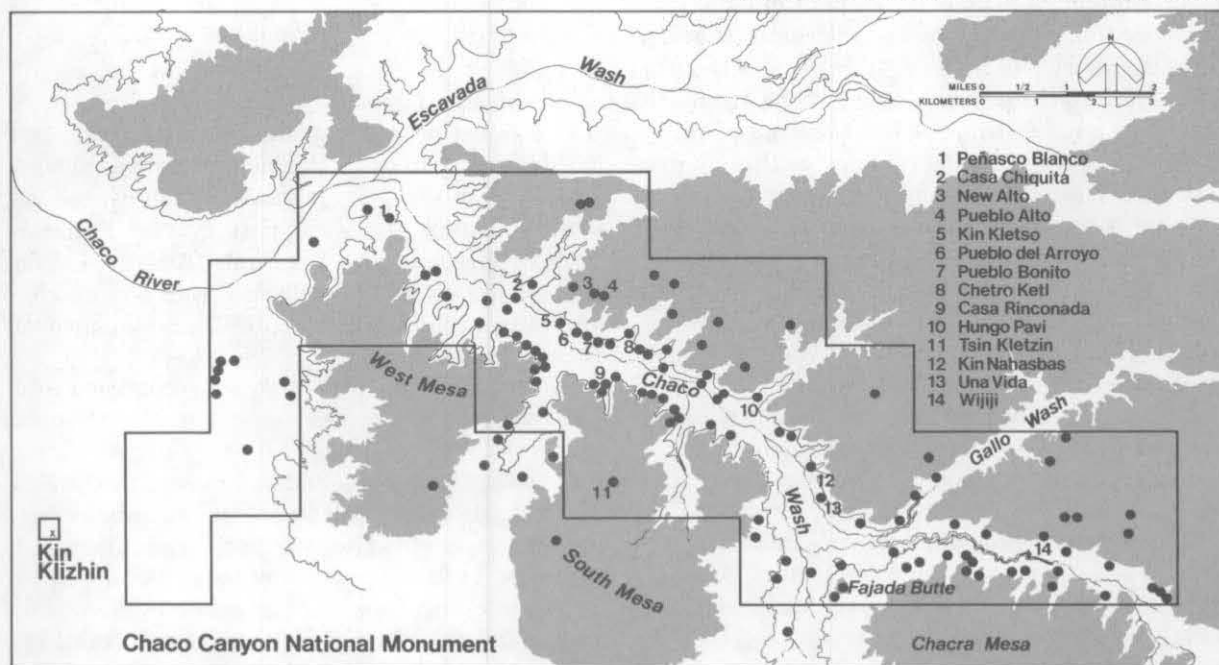
Of the total number:

- 36 had no evidence of *Early* P-III
 - 3 had skipped from Late P-II
 - 3 were occupied in Early P-II
 - 6 had a BM-III occupation
- 24 had no earlier occupation
 - 14 of these were pueblos (3 with Navajo use)
- Locations of all sites
- 21 on mesas

The locations of pueblos closely followed the distribution of all sites, with a slightly greater emphasis on the canyon bottom (Figure 20).

During the fieldwork, some of us were struck by the fact that houses built against a cliff—some in rather precarious situations—were very likely to produce McElmo or Mesa Verde Black-on-white pottery. It seemed appropriate that migrants from Mesa Verde's canyons would select sites similar to those they had left. A cliff-face

Figure 20. Distribution of Late P-III pueblos.



- 10 on benches
- 5 at cliff-face
- 4 on talus
- 3 on cliff-edge
- 1 on ridge
- 31 on plains
 - 11 on ridges
 - 1 on knoll
 - 5 on slope
- 169 in bottom
 - 36 at cliff-face
 - 58 on talus
 - 49 on ridges
 - 25 on slope
 - 40 on floodplain

location was recorded for 19 percent of the Late Pueblo III sites—the highest for any period—but our horseback impression of a sharp rise is not borne out by the graph, Figure 21, which shows that there was a steady increase in use of such locations from none in Basketmaker III.

Although total numbers of pueblos were fewer, the distribution through the canyon remained the same. Thirteen sites in Padilla Wash were still occupied, and the only hint of clustering is in the Pueblo Bonito/South Gap vicinity, where there were 30 to a square mile.

The orientation of six "pure" pueblos was east-southeast to south, centering at about 151°. Nine sites averaged 16 rooms and two kivas.

The evidence is that by Late Pueblo III, Chaco Canyon had passed through its days of glory. The population was much reduced, and was continually dwindling, but rare sherds of imported polychrome redwares from the Zuni area indicate that a small group of hangers-on was still breaking an occasional pot in the 1300's. Mid-century probably saw the last of the Anasazi.

Navajo

Although the period of the Navajo occupation of the Chaco is no longer than that of the Basketmaker III people, the total number of sites showing some Navajo use is far greater than for any other period of history—this despite the possibility that there were never more than 100 people at a given time within the area of study. One reason for this discrepancy is the obvious fact that the Navajo remains are more recent; another is the result of an economy that required a more scattered distribution of population.

The first penetration of Navajos from the Dinétah in the northeast is not precisely dated, but sherds of the Rio Grande and Zuni glaze pottery, which went out of fashion about 1700, are not found, whereas an occasional Ashiwi Polychrome, an early prototype of modern Zuni-Acoma ware, does show up. There is evidence of Navajos in the area by the early 1700's. The last resident within the Monument boundaries, Tomasito's daughter, moved from her hogan in South Gap in 1948 (Thomas W. Mathews, personal communication).

The total number of Navajo sites surveyed was 659. Refuting the supposed Navajo avoidance of ancient ruins were 143 Navajo sites on or adjacent to Anasazi sites, including five hogans, a storage room, and a sheepfold in the courtyard of Una Vida, where the old rubble provided easily gathered building material. Navajos probably used not only stones, but also timber, from the larger pueblos.

The 659 Navajo sites were:

- 377 home sites, containing:
 - 735 hogans
 - 18 ramadas (including windbreak shelters)
 - 247 storage rooms
 - 138 corrals
 - 22 sweat lodges
 - 53 ovens (Spanish-style *hornos*)
 - 50 hearths (including baking-pits)

- 68 cairns
- 24 trails or roads (improved)
- 13 "pebble caches"
 - 1 set of mealing bins
 - 1 checkdam
- 282 sites without dwellings included:
 - 148 storage rooms
 - 69 corrals
 - 17 sweat lodges
 - 2 windbreaks or ramadas
 - 1 water control structure
 - 24 ovens
 - 35 hearths
 - 82 cairns
 - 49 trails
 - 9 "pebble caches"
 - 6 sherd areas
 - 1 set of mealing bins

Navajo or historic Pueblo pottery was picked up at 115 of the Navajo sites. Pueblo wares included Acoma and Zuni pottery and Puname Polychrome from the Zia/Santa Ana area. The same types were also collected from 65 non-Navajo sites that produced no other evidence of Navajo occupation.

One would suspect that we recognized and recorded a larger proportion of the Navajo sites that existed than of the Anasazi, but we didn't find them all. A photograph taken in the 1920's looks southeast from Hungo Pavi and shows two roofed and occupied hogans on the floodplain, but we failed to find any trace of them. An occupied hogan in South Gap, photographed by S. J. Holsinger in 1901, has also disappeared. Another, which I remember from 1936, with smoke rising from the center of the roof, is now marked only by a faint grassless disk on the ground. After the house was abandoned, the stones were probably hauled away in a wagon for re-use in a new structure.

We found only one hogan of the old forked-stick style. Rock is easier to come by in Chaco than wood. All others were circles of masonry up to 3 feet high, which once supported cribbed roofs. Many were backed against a colluvial boulder or a ledge of rock to reduce the amount of laid wall (Fig. 22). Even recently abandoned hogans rarely contained any wood, and it is obvious that its scarcity caused it to be removed for reuse in new construction, or for firewood. A variation of the usual ring of masonry was a figure-8 outline—or two round hogans with connecting door-

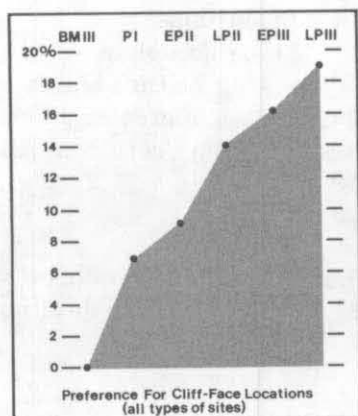


Figure 21.

ways—found at two sites.

The “pebble caches” referred to earlier were 22 collections of one or two dozen brightly colored, stream-washed pebbles from disintegrated Ojo Alamo sandstone. These gravels pave some areas of the mesa-tops, and are the result of the weathering away of the softer sands of that overlying conglomerate formation, allowing the heavier particles to remain in place. The caches were sometimes found in the corner of a struc-

Figure 22. Abandoned hogans.



ture, but more often in association with a cairn, and most frequently in a cavity in an exposed sandstone ledge. At first, thinking that the collections were an offering of some kind, we categorized the finds with cairns and shrines. However, they may just as well be the playthings of a small sheepherder.

Considering all sites, the settings were:

339 on mesas
240 on benches

13 on slope

31 on floodplain

Looking at the figures for dwelling-sites alone, we see a greater difference from the "all sites" total than is seen in Anasazi statistics:

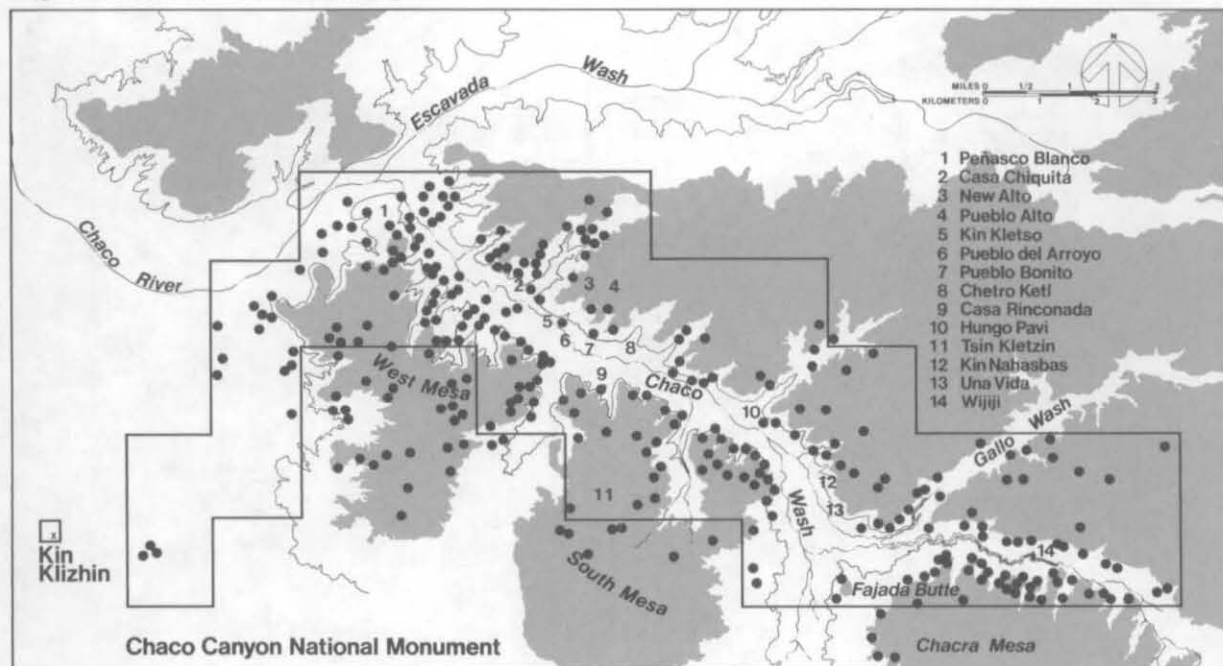
169 on mesas

28 on plains

180 in bottom

Thus, while 60 percent of *all sites* are on mesas, only 49 percent of the dwellings are on the high

Figure 23. Distribution of hogan sites.



45 on talus

48 at cliff-face

33 on cliff-edge

54 on plains

1 on low bench

2 at cliff-face

14 on talus

11 on ridges

4 on knolls

13 on slope

266 in bottom

53 at cliff-face

105 on talus

51 on ridges

8 on knolls

ground, and it is probable that many of the hogans on the mesas are only summer sheep-camps (Fig. 23). An affinity for rocks and canyons is indicated by the low percentage of sites on the plains—at 7 percent, it is a lower figure than for any Anasazi period. When sites *were* situated on the plain, half of them were placed close under the mesas on the talus or against the cliff-face. Only 2 percent of the Anasazi sites on the plains were similarly situated. In the canyon also, Navajos more often chose a spot against a cliff-face or high on the talus. The reason for this definite preference may lie in the need to use rock ledges and available building-stone for fences to control livestock. Lacking wire and timber, fences would

be hard to construct in open country. Small, widely scattered groups of Navajos might have a greater need for easily defended positions than the larger, more compact Anasazi populations, and once the tradition was established, would tend to perpetuate it after the need had vanished. Defense was unquestionably a factor in the selection of some of the sites. A notable example is a small butte in the head of Rafael's Rincon in West Mesa, where three hogans and several

small storage-rooms have been tucked into crannies in and near the top. Every crack and chimney that could provide access was walled up, and all approaches are commanded by some vantage-point (Fig. 24). Gwinn Vivian (1960) has described similar so-called "refugee sites" on Chacra Mesa.

Our survey made no attempt to define specific outfits, or to relate Navajo features one to the other. David Brugge, in another of the Chaco

Figure 24. A fortified Navajo site, 29 SJ 1838.



Center's projects, combined survey data with ethnographical research and excavation to do a comprehensive study of the Navajo history of Chaco Canyon (Brugge, this volume).

Miscellany

In addition to the types of sites considered in the foregoing discussion of phases, there were others that were undated, or which, although included above, merit some description exclusive of their period.

Rock Art

Petroglyphs, pictographs, or graffiti were found at 404 sites. Many occurred at pueblos, sherid areas, and hogans, but almost a third were isolated from any other archeological feature.

It was possible to attribute all but 4 percent of the rock art to either an Anasazi, Navajo, or Spanish-Anglo origin. The Anasazi accounted for more of the art than other peoples who had spent less time in the country, and they were more apt than Navajos to peck or incise the rock at spots removed from their houses.

Anasazi rock art is mostly in the form of pecked or incised petroglyphs. Painted figures are rare. The most commonly recurring motif is a spiral (26 percent of those we recorded).

Navajo petroglyphs are much more likely to be incised, probably because of the availability of steel tools, and painted pictographs are somewhat more frequent. Navajo motifs are almost exclusively representational, with animals, mostly horses, making up 38 percent of the recorded pictures. Human figures or anthropomorphic *yei* were nearly as popular, with 32 percent. These included horsemen, dancers, women with children, and people in wagons. "Things," such as a boot, a locomotive, a cornstalk, a bow with arrows, a shield, a flower, or a house, were a poor third. Symbols and pure design are quite rare.

All of the European work on the rock was incised, and consists mostly of names and dates, but eight livestock brands were recorded, and a soldier passing through in the 1850's drew a cannon and a saber. Some glimpses of the canyon's recent history can be seen in these inscriptions. The earliest are the names of 10 soldiers in the Regiment of Mounted Rifles on an expedition

from Ft. Garland, Colorado, into the Navajo country in the fall of 1858, who paused near Chetro Ketl long enough to leave their names. General Ellsworth H. Bradley, 3rd Infantry, appeared to be the ranking member of the party, but archival research by Gordon Vivian (1948a) revealed 18-year-old Private Bradley's mildly fraudulent bombast, and the fact that he managed to make sergeant during the Civil War. A companion of his, the Bavarian-born Private Winsbacher, became a captain in the 3rd New York Cavalry a few years later. The Mounted Riflemen, in a somewhat controversial campaign from August to November, fought several small engagements, killed a few Indians, lost a man or two, and recovered some stolen stock.

The next tourist to leave a name was Norberto Martines, who apparently sought shelter in an overnight camp in the head of Werito's Rincon on the "day Dicenber 1884." That's all we know about him.

By this time, a main route leading from fords on the Rio Grande at Alameda, Bernalillo, and Albuquerque, to Farmington and Durango came through Chaco Canyon, and a favorite camp was at the foot of the cliff on the north side, about $\frac{1}{2}$ mile downstream from Casa Chiquita. Here, on February 20, 1887, an advertisement was scratched into the rock for "H L Haines store lo miles down canyon." This would put Haines at the now-abandoned Tsaya Trading Post, although it is known to have been owned by Blake in the 1890's. Among the many names of teamsters and other travelers in this same vicinity is this intriguing message: "Gean I cannot get no feed I cannot wait for you."

The Wetherill era at Pueblo Bonito is marked by "C. Wetherill 1896" at Hungo Pavi. This was Clayton, Richard's younger brother, who, of all the family, found it the most difficult to resist leaving his name during their explorations at Mesa Verde (Hayes, 1964).

For the next 30 years, the most frequent name-droppers were sheepherders who wintered large herds in the area. These men, from the north end of the Jemez Mountains, from Cuba around to Chama, were probably a close-knit, related fraternity jealous of their calling, for the same names appear year after year. Cesario and Thomas Martinez came in 1901; Cesario returned in 1908, and again in 1917 (accompanied by another Martinez, Donaciano of Tierra Amar-

illa). A Cesario A. Martinez who inscribed his name in 1930 and 1937 may have been a son. Presiliano Martinez of Chama, perhaps a relative, left numerous records of his visits from 1915 through 1926. The earliest Archuleta we saw evidence of was Candido of Parkview, in 1908, but if the record is complete, Sylviano Archuleta of Canjilon was the most experienced winter herder, having scratched his name in 6 years from 1917 to 1928.

The scientific period is represented by the names of two prominent archeologists and a historian about whom no more will be said, at least in this connection.

The petroglyphic record deserves a more thorough study than we were able to give it, and using the locations provided by the survey, a more complete recording for the Chaco Center is now being undertaken by Clarion Cochran, and the Archaeological Society of New Mexico.

Water Control

The existence of water-control devices in Chaco has been known for 100 years, but until recently, little was known about their extent or function, and much remains to be learned.

In 1875, a cavalry lieutenant attached to the Hayden survey made a quick trip through the canyon, and at Kin Klizhin, just west of the area of our intensive survey, noted that "from opposite the face of the [ruin] ran a built wall of earth, with stone revetment across the drain, possibly a roadway, but more probably a dam, 10 feet across the top, 5 feet high, and 15 feet across the base" (Morrison, 1879). The dam is still identifiable today, but has unfortunately been partly obscured by recent improvements. It was certainly a dam, and was possibly also a roadway. This dam, and others at Kin Bineola and near Peñasco Blanco, were noted by Holsinger (1901) and Hewett (1930). Peñasco Blanco dam was destroyed by floodwater in 1910 (Judd, 1954), and in 1960, to salvage the rapidly eroding remnants of a ditch associated with it, Park Ranger William Bromberg traced over 170 feet of a masonry-lined trench laid out on the contour.

Through fieldwork in 1971 and 1972, R. Gwinn Vivian identified 11 water systems from Pueblo Pintado to Kin Bineola, and identified 75 individual features. He excavated several sections of masonry and flagstone lined ditches, gates, and intakes, and concluded that the north

side of the wash from Una Vida to the mouth of the Escavada was essentially a single system designed to catch water—not from the Chaco, but from the short tributaries—and to divert it upstream to be let out under control onto fields in the floodplain. This complex feat of irrigation seemed to be associated with the great houses, and almost certainly required sophisticated intercommunity cooperation (Vivian, 1972).

One purpose of our survey was to identify sites to be investigated further. We certainly did not find all of the water-control sites, and many that we identified as ditches may be something else or nothing at all. We did not attempt to separate Anasazi from Navajo work, but only excluded obviously recent dikes or revetments built by the Soil Conservation Service.

Four of the sites we recorded were developed seeps or springs, and three were garden plots. There were 21 locations where small stone check-dams crossed a shallow drainage. Three of the checks were possibly built by the Civilian Conservation Corps in the 1940's, and two more questionable ones may be no more than fortuitously aligned water-carried stones. Four are certainly Navajo. It seems that this method of retaining soil and moisture was of minor importance at Chaco compared with the extensive use of such structures on Mesa Verde (Hayes, 1964), at Point of Pines (Woodbury, 1961), and in parts of the Kayenta area (Lindsay, 1961).

Twenty-two dams were surveyed. Three were diversion dams, the most impressive of which is a massive earthwork near the mouth of Cly's Canyon. All others were for storage. Four of the storage dams are *tinajas*, or deep potholes in the bedrock, artificially built up at their lower edges to increase the capacity. At least 11 of them were recent Navajo structures, although they may have been older works that had been repaired or improved.

Ditches were found at 69 sites (Fig. 25). Thirteen were at sites that Bromberg or Vivian tested, and some of these were probably dry holes. Contrary to Vivian's conclusions, nearly two-thirds were on the south side of the canyon, but I must admit that at least 41 of the 69 are highly questionable. "Ditches" were characterized by alignments of stone on terrain where it seemed possible to divert floodwater. Many may be no more than freshet-borne stones out of the short re-entrants. All are likely places for testing.

Isolated Religious Features

At 104 sites separated from any pueblo, there was some sort of feature of a religious or esoteric nature. Fifty-one of the sites consisted solely of one or a series of stone cairns. Cairns occurred at 14 other Anasazi sites, in addition to those reported above in Navajo sites. Altogether, there were 297 cairns at 165 sites (Fig. 26). They ranged from low mounds of carelessly piled stones to carefully constructed, truncated,

them, but three possibilities come to mind: a passerby may add a stone with an informal prayer at a way-station; cairns may be erected to mark the boundaries of a family's sheep range; or someone watching a grazing herd might collect stones to help the afternoon go by—a three dimensional doodle.

On the plateau north of the canyon and east of Mockingbird is an isolated Mesa Verde style kiva with six pilasters and one or two attached

Figure 25. Profile of exposed ditch in arroyo bank.



Figure 26. Stone cairn.



cone-like pylons up to 1.8 meters high, and they probably filled a variety of functions. At least two were suspected of being recent survey monuments. At two or three areas above the cliffs where rock had been quarried, the cairns may have been stockpiles of building-stone that were never used. Cairns are frequently found as trail-markers at the head of a stairway or other access-route down a cliff. They occur in association with some of the "stone circles" described later, and also at petroglyph sites. Most of these are probably Anasazi, although the trail-markers have likely been freshened by Navajos, and by others who still use the trails. The high incidence of cairns at Navajo sites suggests that the remaining majority are Navajo, but even these may not all have the same purpose. Little is known about

rooms. Five isolated *great* kivas were recorded, each situated in the midst of a cluster of contemporary pueblos (Fig. 27). Although all five were Pueblo II and III in age, we know from the old excavations at Shabikeshchee (Roberts, 1929), and from the 1973 excavation of 29 SJ 423 by the Chaco Center, that the great kiva was common in the canyon from Basketmaker III times. Tree-ring dates from the latter site indicate an initial construction at about A.D. 500. Another 20 great kivas were counted at 15 pueblos. There must be others from the earlier periods which are now obscured, but probably few Pueblo III great kivas escaped us, and those are plotted on Figure 19 with the Early Pueblo III houses. It can be seen that almost everybody in the area during that stage lived within a mile of a great

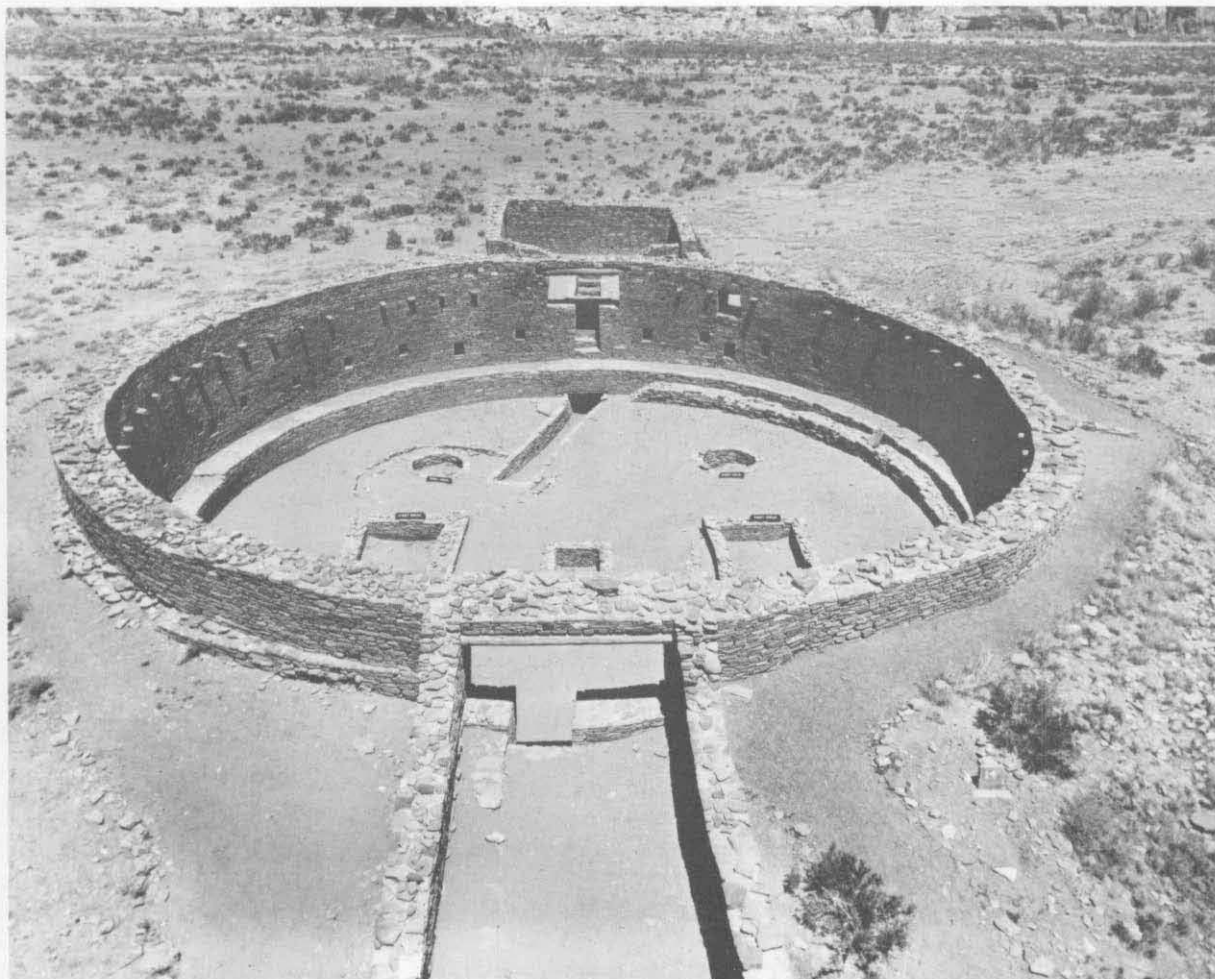
kiva. Only half a dozen small pueblos at the upper end of South Gap lie more than 2 miles away from one.

Another feature that was probably religious in nature was an open-faced box of slabs or masonry, about a meter square, and not so high, resembling a common style of Pueblo shrine used as a repository for prayer-sticks (Stevenson, 1904). There are 13 of these structures at nine sites. Three of them appear to be Navajo, one at

a hogan site, and two more built atop the rubble of a ruined pueblo. I don't know of any reference to Navajo use of the pueblo-type boxed shrine, and these three may be something else. The other shrines are all isolated from any habitation. Two are on high points of land, and one is near a spring.

Still another type of shrine is an arc or U-shaped wall of masonry about knee-high, and about 30 feet across the open end (Fig. 28). Six

Figure 27. Casa Rinconada.



were found at high points on South and West Mesas, and another on Chacra Mesa, outside the area of intensive survey. All faced east. The nature of the first three was discovered during the 1973 excavation of Site 29 SJ 423 on the mesa above Peñasco Blanco. A stone-lined cache of turquoise beads surrounded by scattered chips of turquoise suggested a religious function, and the exposure of the wall called to mind two similar structures on South Mesa which we had been unable to classify when they were surveyed the previous year. Upon revisiting them, we found small scraps of turquoise and broken-down cairns of rock in positions like that of the cache at the first site. The three shrines, with 5 miles between the outermost, are all in sight of each other, and among them command a view of all the major pueblos in the canyon, as well as Pueblo Alto to the north, and Kin Ya'a 27 miles to the south. The fact that these odd structures were placed at the few limited points and within the narrow, restricted areas that permitted that intervisibility led us to refer to them as possible relay-points for signals (Hayes and Windes, 1975). If this supposition were correct, there should be another at some point that could tie Pueblo Pintado into the system. In the spring of 1975, it was found on the only 1-acre tract on Chacra Mesa from which Pueblo Pintado, Kin Ya'a, and Tsin Kletzin can be seen. The Chacra station does not command a view down into the canyon, but is visible from a fifth arc, located at the only point on the southeastern edge of South Mesa from which Kin Ya'a can be seen to the south, and Una Vida and Kin Nahasbas to the north. Another shrine, $\frac{1}{2}$ mile west on South Mesa, commands a view of the Chacra point, Kin Ya'a, Kin Klizhin to the west, and the mesa immediately above Kin Bineola. The seventh wall arc, on the southwestern edge of South Mesa, was in a position to communicate with those same three pueblos, but not with the Chacra shrine, nor with anything in the vicinity of the canyon that I have been able to determine.

From these points, it would be possible to link the entire population within an area about 30 miles square with three to four fires or smokes, in spite of the broken terrain. If signals were the function of these sites—and it is hard to believe they were not—one would expect to find a similar one on Huerfano Butte, about 30 miles north of Chaco, which is visible from several spots on the

San Juan River, from Aztec, and even from Mesa Verde. Unfortunately, the erection of radio relay towers and a maintenance road on Huerfano has erased anything that might have been there.

In connection with his study of Pueblo Bonito architecture, Neil Judd (1964) describes, near the head of the Bonito stairway, "... a wind-swept area 50 by 30 feet, ringed with piled stones and with three 5-inch deep dug basins in the middle." He wisely attributes no purpose to the

Figure 28. Shrine on West Mesa, 29 SJ 1205.



feature, nor were we able to after recording 20 of them at 15 sites. The "piled stones" that make the circles are what remain of compound masonry walls up to 2 feet high. The 20 "stone circles" (Fig. 29), as we called them for want of a better term, have some aspects in common. All are on bare rock near a cliff-edge, and all but one near Peñasco Blanco lie on the north side of the canyon—from near Wijiji to Cly's Canyon. All lie within about $\frac{1}{2}$ mile of one of the large Bonito Phase pueblos, and each surrounds one or more of the basins described by Judd. Further investigation of these abstruse circles was made in 1974 (Windes, 1975).

One remaining site defied any classification beyond the gross category of "isolated religious features." It is unquestionably isolated, but its religious nature can only be guessed at. On the extreme western tip of West Mesa, overlooking the mouth of Padilla Wash 500 feet below, is a

ring of compound masonry 1 meter high with a doorway on the east side (Fig. 30). The wall makes a nearly perfect circle 8 meters in diameter. The masonry is well-laid, apparently without mortar (although the mud may have washed out). A series of 13 carefully made cairns lines the cliff-edge at intervals of 10 to 40 meters, and runs from the enclosure to almost $\frac{1}{4}$ mile southeast. Most of the cairns are cone-like walls of fitted stones around rubble cores. The largest

is 1 meter wide at the base and 1.8 meters high. The eastern orientation and the shape suggest an unusually large hogan, but the masonry of the wall and cairns looks more like Anasazi work. Local Navajos deny any knowledge of the site, and believe it to be Anasazi. There was no refuse of any kind, save one Pueblo II potsherd.

Quarries

Among the several grades of rock that make

Figure 29. Stone circles above Chetro Ketl.



up the Cliff House sandstone is a dense stratum of chocolate-brown rock, contrasting with the lighter shades and softer stone both above and below it. It occurs above the inner canyon wall, in layers from a few centimeters to over a meter in thickness. It is exposed for nearly the full length of the north side of the canyon, but in relatively few spots on the three mesas on the south side. This stone was the preferred material used by the builders of the large Bonito phase

in a rough wall, but were not carried away. There was nothing to indicate the methods used, but presumably long oak wedges and a stone maul would do the job.

In addition to the rock quarries, there were two coal mines where the soft lignite in the Menefee shale was primitively wildcatted. One of these is at the foot of Chacra Mesa across and a little upstream from Wijiji, and the other is at the head of Rafael's Rincon on West Mesa. The

Figure 30. Site 1088 on West Mesa.



houses, although it required quarrying and transporting to the building sites. Convincing evidence of this quarrying was seen at only 21 sites, but along extensive stretches just back from the top of the cliff between Hungo Pavi and Cly's Canyon, where no direct evidence was noted, the rock seems to have been removed. Indications of quarrying are areas showing angular breaks in the exposed stratum where rock has been removed, but where there is no slumped rock indicating a natural fracture. At three locations, the broken stones were stacked, or set

latter was used by the University of New Mexico to fuel the kitchen range at its field school, and it was possibly used earlier by the Wetherills. There is no evidence of Anasazi use of coal for fuel. Pepper (1920) describes two fireplaces in Pueblo Bonito filled with lignite, but he does not say whether it was burned. Lignite was used to seat roof-support posts, to fill floor vaults in great kivas (Vivian and Reiter, 1960), and as packing around posts in Basketmaker III pithouses excavated by the Chaco Center in 1973.

Across the canyon from Chetro Ketl, at the

foot of South Mesa, a deep pocket in the talus slope has been formed by the removal of several yards of light-gray clay—a decomposed shale. The size of the brush that has healed the scar suggests a considerable period of time since the quarrying was done, and that it was possibly a source of potter's clay.

Roads, Trails, Stairway

"Their trails are remarkable, extending as they do in a straight line from one pueblo to another, and even traced from ruin to ruin. These deeply worn paths, even on the rocks, passing without swerving to right or left, over valley, plain, or ascent of mesa—as though the trail, was older than the mesas..." (Thompson, 1879).

The author of those words, a member of the Wheeler Survey, was speaking in generalities of New Mexico, although he might well have had Chaco Canyon specifically in mind. Another member of the party in that year of 1874 was particularizing Pueblo Pintado when he stated, "... there are traces of former road to Abiquiu, sixty miles off, where ruins have also been found..." (Loew, 1879).

Surface evidence of the construction of a remarkable system of prehistoric roadways was evidently more distinct before the increased activity, the introduction of wheeled vehicles, and the impact of livestock around the turn of the century. Marietta Wetherill, the widow of Richard, in an interview with Gordon Vivian, described a wide roadway running down to the Escavada from Pueblo Alto, stating that "in the old days this was clearly defined in the spring or early summer because the vegetation on it was different from any other and it could be traced clear to the San Juan" (Vivian, 1948b).

References made by subsequent investigators tended to be more modest, and were confined to short stretches clearly evident in the canyon itself. Jackson (1878) was the first to call attention to elaborately carved stairways over the cliffs, and Holsinger (1901) provided the first description of a prominent stone-bordered roadway over the bench between Pueblo Alto and Chetro Ketl. Judd (1964) was impressed by that same road, and also by a similar route up the cliff across the canyon from Chetro Ketl to cross the mesa toward Tsin Kletzin, and a deep cut running southwest through South Gap for several hundred yards. These features, still clearly

evident today, have in the past half-century been thought of as local, intra-community roads, or as "ceremonial race-courses."

It was Vivian's conversation with Mrs. Wetherill that marked a turning-point in the conceptions of these roads. Her account of the crossing of the Escavada must have spurred him to get out on foot and find it, for a year after that interview he was pointing out the visible traces on the ground of the ancient track on both sides of the wash (Thomas W. Mathews, personal communication). In 1950, Vivian assembled a mosaic of aerial photographs from the Soil Conservation Service, on which the same roadway, and others, are traceable as "wide, straight courses where minor alterations have been made to the natural terrain over a distance of several miles" (Vivian, 1959). He then turned his attention to the possibility of the detection of other features through aerial photography, and it was his pioneer work that stimulated the Chaco Center to explore this field further.

A project in "remote-sensing" was one of the Center's first priorities, and a study of more advanced imagery than was available to Vivian has made it possible to plot over 200 miles of prehistoric roadways radiating from the Pueblo Bonito/Chetro Ketl/Pueblo Alto center, some of them without a break up to a dozen miles, and others that can be inferred up to 35 miles by plotting intermittent, visible sections on the same axis with obscured areas in between them (Lyons and Hitchcock, 1976). Using the plottings of roads determined from the air, the surface survey was able to identify several segments that would certainly have been missed otherwise. However, a larger number of lineaments, clearly seen in the high-altitude photography, cannot be picked out on the ground, even when careful orientation with tape and compass tells the "observer" that he is standing in the track. In broken areas of rock, the surface crew was able to detect a few short sections of roadways that were not identifiable from the air.

Identified were 104 segments of roads or trails: 56 were Navajo; 48 were Anasazi.

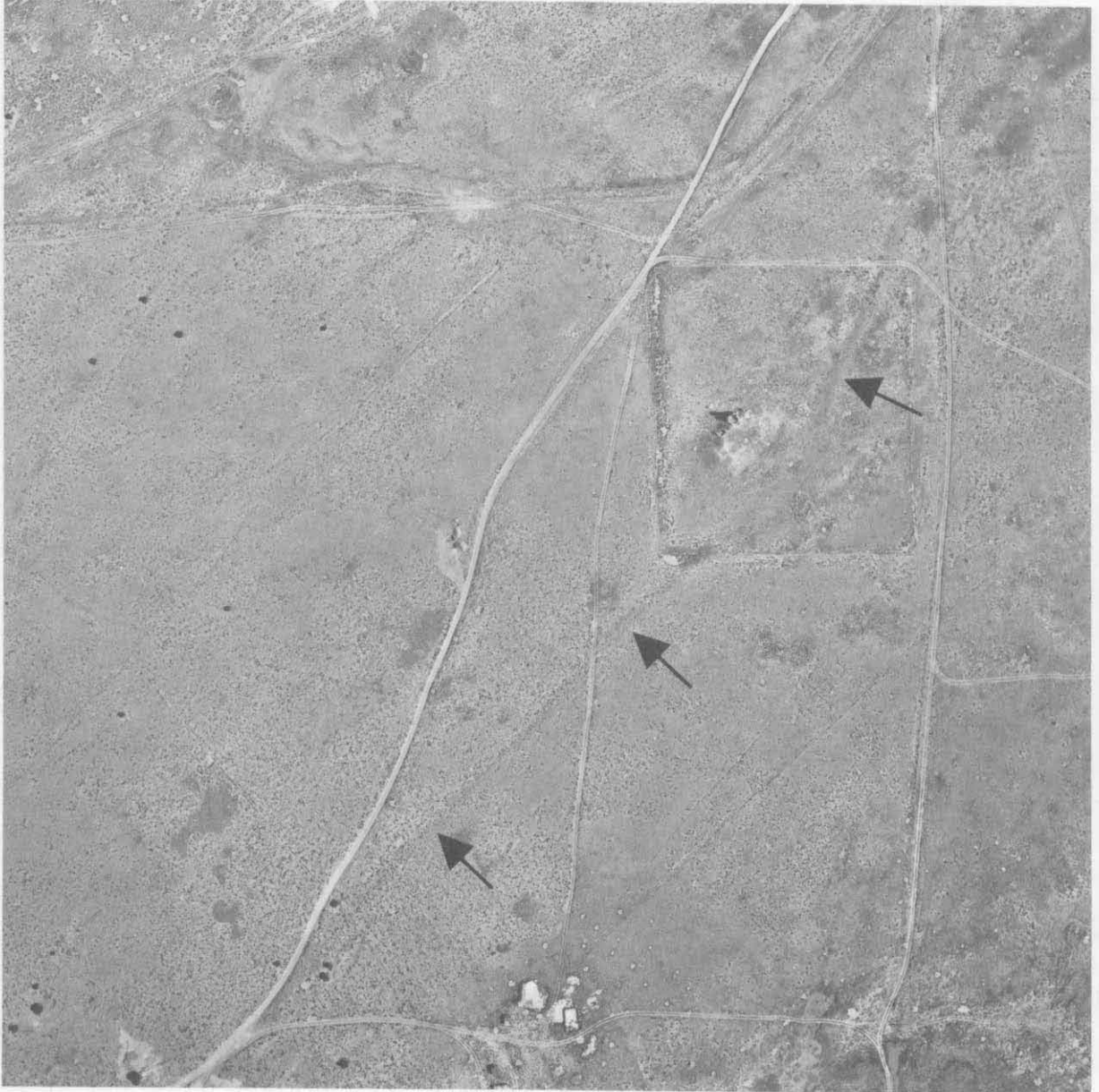
The Navajo trails curl up the slopes, seeking easy grades suitable for horseback and wagon traffic. The worn tracks of iron tires are often apparent on expanses of slickrock, but there is seldom any designed improvement other than an occasional crude stone wall at switchbacks or on

the downhill side of a slope. On two of the trails are water throwouts of stones or logs held in place with steel bars, and at several others, there is evidence of the reduction of rock ledges with a cold chisel.

There are no sweeping curves or lazy bends in the Anasazi roads. They are straight for long stretches. (Fig. 31) When it was necessary to change direction, it was done with an angle. There was little regard for terrain. The only di-

version from an air line was made where a sheer cliff required a short jog to an access up a chimney. An exception is under the upper cliff on the right-hand side of the rincon behind Chetro Ketl. Here, about $\frac{1}{2}$ mile of stone wall up to 3 meters high follows the line of the cliff to hold up soil fill, making a broad esplanade. A similar earth-filled wall stretches for nearly $\frac{1}{2}$ mile in the same location in the next rincon to the east. The two segments do not connect, and either they were

Figure 31. Prehistoric roads at Kin Ya'a.



unfinished, or were, as Vivian (1972) has suggested, intended for garden terraces.

Although the engineering required to lay out the roads was relatively sophisticated, construction was simple. On the soil-covered mesas are long swales or depressions, where trenching reveals that the shallow soil and scurfy rock has been scraped aside to make a low berm at either side of a track 8 to 12 meters across (Gumerman and Ware, 1972). Where roads cross the benches,

Figure 33. Line pecked in bedrock at edge of prehistoric road.

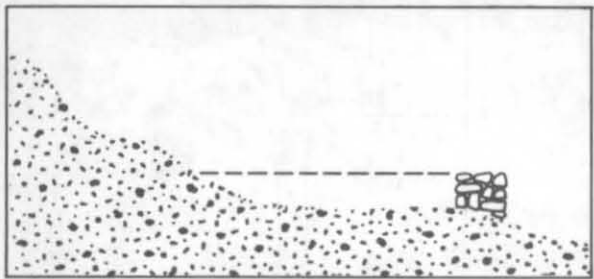


Figure 32. Cross-section of road.

particularly in passing over bare rock, they are bordered by low masonry walls, or in some instances, by lines of large boulders. When the rock slopes to the side, the wall often retains fill that leveled the roadbed (Fig. 32). In a well-known example of the latter technique between Chetro Ketl and Pueblo Alto, the upper side of the roadway is marked by a line pecked deep into the rock. A similar pecked groove is a feature of a segment crossing slickrock just above the pour-off at the head of the rincon northwest of Casa Chiquita (Fig. 33).

No segments of roads were identified in the canyon bottom, which is covered by alluvium, but a stone-bordered road leading east from Peñasco Blanco ends abruptly at a sheer cliff-edge. Judd (1964) quotes an old inhabitant, Hosteen Beyer, to the effect that a stairway here was destroyed by the caving off of the cliff "several years ago." Directly across the canyon, the road can be picked up again, in a series of carved treads, masonry steps, and short stretches paved

Figure 34. Carved steps near Casa Rinconada.



with flagstones. An interesting section of this road crosses about 300 meters of bare whitish rock. There is no border or berm here, and no feature can be distinguished by a man afoot on the locale but with the sun at the proper angle, a faint, light line connecting two sets of stairs is easily visible from the mesa at Peñasco Blanco.

Stairways are commonly associated with roads, but in many cases, rather elaborate arrangements for getting up or down a cliff were found where no other evidence of a road was found either above or below. Steps were also found in other situations.

148 sites had some form of steps or stairs:

- 15 were closely associated with pueblos
- 10 of these were the only access to upper rooms
- 4 provided access to Navajo storage-rooms
- 26 were part of an identified road system
- 6 of these were Navajo trails
- 45 had pictographs associated with them
- 15 of these were only accesses to the panels

6 provided access to waterholes in the rock
4 were associated with one-room houses

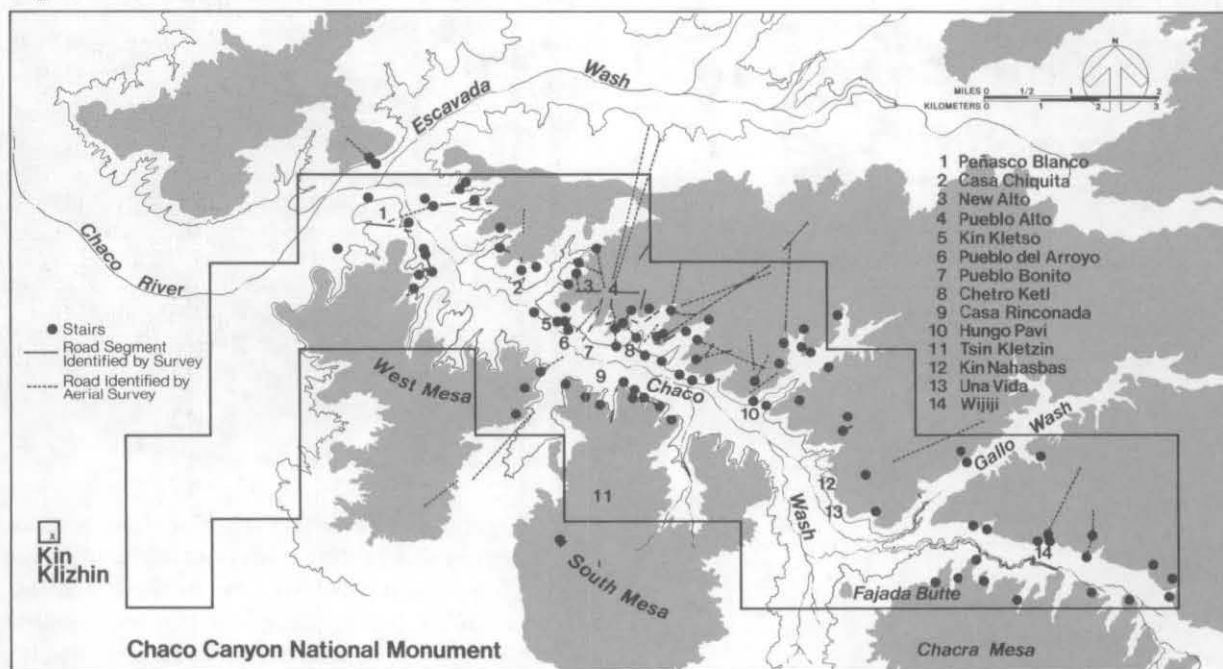
There were three types of steps. The most common, occurring at 85 sites, was a shallow, pecked cavity just large enough to accommodate fingers or toes. Masonry steps were seen at 64 sites, and ranged from two or three stones piled at the foot of a rock ledge to formally laid flights of wide stairs. Wide steps, with tread and riser cut out of the bedrock, were noted at 45 locations

The Conclusions

A New Summary

Our survey added little to the summary of conclusions that had been reached before it started, as related earlier. But, it brought to prior knowledge a new mass of data that largely substantiates, and, to a lesser extent, refines this existing body of knowledge.

Figure 35. Distribution of roads and stairs.



(Fig. 34). At 11 sites, an earth-filled masonry retaining-wall was placed at the foot of a stairway, probably for use as a ramp or landing-stage. All of these were associated with roadways. Twenty stairways were marked with stone cairns.

Figure 35 shows the distribution of stairs, and the road segments identified by the survey. Dotted lines connecting the surveyed segments represent stretches recognized on the aerial photographs. The many other sections of roads, remotely sensed, but not seen on the ground, are not shown.

Although in some instances we interpreted things a little differently, the survey essentially bore out Judge's conclusions, thereby proving the efficacy of his sampling technique. To his discovery of sites pertaining to the pre-agricultural Desert Culture and the first farmers of Basketmaker II, we added numbers, and extended the geographic distribution to the canyon bottom where, as a bonus of Stephen Hall's (1975) palynological study, we have C-14 dates of 145 B.C. from a baking pit, and of 5300-5500 B.C. from a hearth.

The earliest date, derived by Gila Pueblo, for Basketmaker III in Chaco had been set in the mid-700's by timbers from Shabikeshchee's great

kiva (Bannister, 1965). These comparatively late dates, from a site lacking banded-neck pottery and characterized by shallow pithouses with antechambers, did not seem right. They meant that either Chaco was in a backwash during that period, and slow to adopt innovations, or that the building of the great kiva was a later use of Shabikeshchee, and one not associated with the houses. To solve the problem, the survey crew recleaned the floors of several pithouses excavated by Roberts, hoping to find the burned clay rim of a firepit that could be plugged for archeomagnetic dating. All of the firepits were found to have been dug into bedrock, and there was not enough clay in any of them for sampling, but with a couple of quick tests at the west end of the village, we found two unexcavated pithouses. Wood from the firepit in Pithouse Y yielded a date of 537v. The subsequent publication of the results of a re-examination of Roberts' great-kiva specimens corrected those dates to point to construction at about A.D. 600 (Robinson, Harrill, and Warren, 1974); thus, there was no longer any doubt that Shabikeshchee was "normal." The age of Chaco Basketmaker III was pushed back still another century with the 1973 excavation by the Chaco Center of a shallow pithouse and a great kiva near Peñasco Blanco. Dated timbers from the great kiva are interpreted as indicating an initial construction around A.D. 500.

A review of the entire Anasazi era within the boundaries of the survey shows some demographic shift. The canyon bottom, from cliff-edge to cliff-edge, was always the favored location, with a slight but steady increase in popularity from early to late. The indication of dramatic movement from mesas to canyon between Basketmaker III and Pueblo I shown on the graph (Fig. 14) is unreliable, because it fails to reflect the certain concealment of many pithouse settlements under the alluvium and under the rubble of later houses. Use of the mesas was relatively limited but remained nearly constant. There was a gradual movement from plains and plateaus in favor of the canyon after Pueblo I. A comparison of the figures of *all* sites for a given period, with pueblos only, shows parallel shifts, but with an emphasis on the movement of dwellings. In Early Pueblo III, 12 percent of *all* sites were on the mesas, but only 6 percent of the *pueblos* were. The discrepancy would have been

even greater if roads and religious sites had been included.

There is evidence of a gradual increase in total population through Pueblo II, and a sharp increase in Early Pueblo III, followed by a decline in Late Pueblo III. There is nothing new in this observation, but the additional data support previously reached conclusions.

The first attempt to wrestle with an estimate of the population in Chaco Canyon was undertaken by Reginald Fisher (Hewett, 1936), who approached the problem from two angles: by calculating the amount of arable land available, and by estimating the holding capacity of the ruins. Considering only the classic period, he concluded that population between Pueblo Pintado and Kin Bineola was "probably never greater than 25,000." One would have to agree with him.

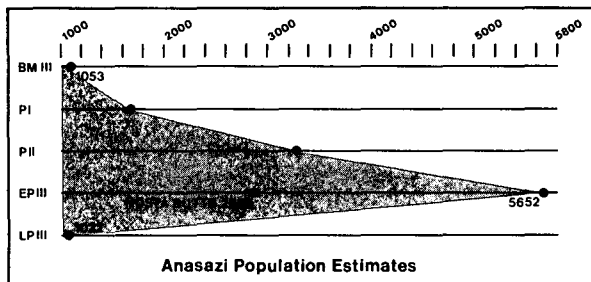
Lloyd Pierson (1949), after his survey, went at the inquiry more systematically, and arrived at a peak figure of 4,400 people early in the time of the great pueblos. Pierson's area did not include the important community on Padilla Wash, and we did not go through precisely the same contortions of rationalization, but our conclusions were remarkably similar. He postulated a smaller Basketmaker III base than I did, and a deeper and steeper valley this side of Early Pueblo III, but we both arrived at about the same maximum for about the same time (Fig. 36).

To get an estimate for each period, two constant assumptions were used. The first was a figure of 4.5 individuals to a family, based on ethnographic material from modern pueblos. The data collected by Pierson from the United Pueblo Agency for Zuni and the Rio Grande Pueblos for the period 1880 to 1951 showed a range of 4.0 to 7.3 (an average of 4.4). Information from Cochiti gathered by Charles Lange (1959) shows the average household, in nine different years between 1744 and 1952—the only years for which figures were available—ranges from 2.8 to 5.2 (an average of 4.1). Also from Lange are figures from 1952 showing the average number of occupants in 62 houses to be 4.2. At Jemez in the 1920's, 4.6 people occupied a house (Parsons, 1925). An estimation of a family consisting of two parents, a couple of living children, and half a grandparent or stepchild may be too large, because infant mortality was probably greater in 1030 than in 1930. However, I would rather err

on the generous side to make my low estimate more acceptable, because prehistoric populations have commonly been greatly exaggerated.

The second constant in these calculations used a suite or apartment of three rooms as the basic housing unit. This base was derived from both ethnographical and archeological sources. An average size for 62 houses at Cochiti in the 1950's was 2.3 rooms (Lange, 1959). About 25 years earlier, houses at Acoma and Zia averaged

Figure 36.



three rooms (White, 1932 and 1962), and at Jemez, they were "from two to four" (Parsons, 1925). When Anasazi architecture moved above ground in the 8th century, a pattern of pueblo housing was established that was to last for 1,200 years. The first surface dwellings in Pueblo I typically consisted of a large living-room with a firepit, backed by two smaller storage-rooms. Village plans for this period are remarkably consistent from southeastern Utah (Brew, 1946), across Goodman Point (Martin, 1939) and Mesa Verde (Hayes and Lancaster, 1975), to the valley of the La Plata in southwestern Colorado (Morris, 1939). The survey record, and excavations done in the summer of 1974, indicate an identical pattern in Chaco Canyon. Numbers of rooms decreased somewhat and the size of auxiliary rooms increased in Late Pueblo I and Early Pueblo II, but by Pueblo III, again averaged about three rooms (for example, Lister, 1964). At Mug House on Mesa Verde, Rohn (1971) found suites of rooms averaging a little over four rooms, but the need to adapt architecture to the restrictions of a shelter cave resulted in the construction of smaller rooms.

For other factors beyond household and apartment size, a different rationalization was used for each period. The 21 sherds areas were

added to the 135 Basketmaker III villages, and then the total was doubled, based on the supposition that the survey had missed half of the sites due to duning on the mesas and alluviation in the canyon. Because of the experience gained through excavation, I doubled the estimated number of pithouses at each site from three to six. We are dealing with a 200-year period, so, on grounds that may be difficult to support, I guessed that a pithouse might be occupied for no more than 25 years, and I divided the number by eight. If the maximum estimated total population of 1,053 is hard to support, it is equally hard to disprove.

The 373 Pueblo I houses ranged in estimated size from three to 15 rooms. I guessed an average of nine rooms, then increased the count by 33 percent to make up for buried sites and uncounted rooms. Excavations at Chaco and at Mesa Verde have shown that surface evidence of Pueblo I structures is almost universally little more than half of what lay below the ground. Although surface indications of Pueblo I structures are more substantial than those of Basketmaker III, I believe the numbers arrived at for both periods are more likely to be short than to be exaggerated. Again we have a 200-year period, but, reasoning that the adobe and crude masonry walls might have a longer life, I calculated that 25 percent of the rooms were contemporary. This produced a maximum population figure of 1,674.

Early and Late Pueblo II were lumped to obtain a total of 417 pueblos occupied at some time during the period. Masonry walls were becoming increasingly substantial, and our count was probably more accurate than that for the earlier periods. The figure was arbitrarily increased by 15 percent, however, because Pueblo II could not always be identified when it lay beneath a later occupation. We certainly missed some such cases, and pueblos were still being buried in the canyon bottom. Profiles at Pueblo Bonito drawn by Judd show that about 6 feet of soil had washed down the talus to pile up against the back walls of the "Old Bonitian" section, built in the mid-900's, before the first walls of the Bonito Phase addition used that alluvium for a footing in the early 1000's. The average number of estimated rooms in 36 strictly Pueblo II houses was only four, but the larger sites were probably still occupied in Pueblo III, and their earlier

spread could not be safely estimated. There was an average of 14 rooms in two excavated sites—the 3-C Site with nine rooms (Vivian, 1965), and 29 SJ 627 (excavated by the Chaco Center in 1974) with 19 rooms. Splitting the difference between the survey's surface estimate and the two excavated sites gives us nine rooms—the same figure used for Pueblo I. The time involved was shorter by about 150 years, and if a room had a 75-year life, half the rooms were contemporaneous. This devious shuffling brought a maximum population of 3,240.

Early Pueblo III saw the peak of both construction and population, and estimates for this period have the firmest bases. The two phases were estimated separately. A survey estimate was made for 254 Hosta Butte Phase sites, indicating an average of 10 rooms. By applying the same average to the 16 unestimated sites, I got a total of 2,700 rooms, which was increased by 7 percent—a number pulled out of the air to cover sites in the bottom buried by shallow alluvium. A few sites in the cutbank that have nothing showing on the surface suggest that some of even these late sites were missed. The time was from about A.D. 1050 to A.D. 1175, and again contemporaneity of rooms throughout the period could not be assumed, and the count was reduced by one-third, yielding a total of 2,889.

The Bonito Phase houses within the area of consideration had an estimated 2,748 rooms. Certain that none escaped us, I did not amplify the number, but reduced it by one-third to account for rooms abandoned and trash-filled during the 125-year period. Application of the two constant factors gives us 2,763 people, and a total for both phases of 5,652.

The 172 pueblos for which we postulated a Late Pueblo III occupation were largely adduced by the presence of Mesa Verde Black-on-white pottery. These included most of the large Bonito Phase houses, but the relative scarcity of the late sherds gives us reason to believe that the last occupation was short, or did not completely fill those houses. Except for remodeling, there is evidence of little new construction. The contention that occupation was light is supported by the fact that although Mesa Verde Black-on-white is well-dated at Mesa Verde, with a beginning at or slightly after A.D. 1200 (Breternitz, Rohn, and Morris, 1974), the latest tree-ring date taken from an Anasazi site in Chaco is 1178v from Kin

Kletso (Robinson et al., 1974), and this was from firewood high in the fill of an abandoned room. Apparently there were enough abandoned houses in the canyon to provide all the timber necessary. There were certainly fewer people, but it is difficult to find a basis for an estimate of how many rooms were used. I included the total room-count for Casa Chiquita, New Alto, and Kin Kletso; half of that in Pueblo del Arroyo; and one-third of the rooms in the other Bonito Phase houses. All but about a dozen of the remaining Late Pueblo III houses were Hosta Butte pueblos that were still occupied, and the same average of 10 rooms was used for the later period, enabling us to arrive at a total of 1,889 Late Pueblo III rooms. Suspecting that chances were good that some late sites failed to produce any of the diagnostic pottery on the surface, I increased the count by 7 percent (and I can produce no good reason for selecting that particular percentage). There again was a 125-year period in which there were people in the canyon, and using the same rationalization as before, I reduced the total room-count by one-third. The estimated population figure was 1,022—even lower than that for Basketmaker III. I believe that an actual population at any given time within the phase might have been still lower. The evidence at Mesa Verde is that there was no sudden exodus from that area, but rather a dribbling away over a hundred or more years. Many of the migrants apparently reached various localities east of the Continental Divide, also in small increments. If the Chaco district were a way-station, it may have been occupied for relatively short periods by small groups, with never a large aggregate population.

I'm aware that the convoluted reasoning and the juggling of figures is reminiscent of haruspicy or astrology, but given the kinds of data available to us, I'm convinced the results are as close to the mark as the trajectories launched by more sophisticated, mathematical range-finders.

The Hosta Butte / Bonito Phase Dichotomy

Introduction

The excavation of two small pueblos across the canyon from Pueblo Bonito by the University of New Mexico provided the inescapable evidence that they were contemporary with that grander pueblo—a fact first pointed out by Florence Hawley Ellis (Brand et al., 1937). Summarizing the

work at Bc50 and Bc51, Clyde Kluckhohn (Kluckhohn and Reiter, 1939) sought an explanation for the disparity in sizes and techniques of construction, and offered three alternative speculations, all of which saw the Bonito Phase development as a burgeoning of an autochthonous culture. One possible explanation had the smaller houses as outlying farmhouses, perhaps only seasonally occupied, but Kluckhohn pointed out that temporary shelter so close to the large pueblos was needless, and that the small settlements, with considerable trash deposits and the presence of burials, possessed all the attributes of hearth and home. A second explanation had the occupants of Bc50 and Bc51 and the other little pueblos as "'poor relations' or conservatives who refused to adopt the progressive architectural styles of their congeners." The third alternative presented was that the Bonito Phase was the precocious flowering of an indigenous culture, and that the small sites represented an influx of migrants drawn into the canyon by the prosperity, or the power of ceremonialism of that culture.

The excavation of Pueblo Bonito revealed that a one-story, southeast-facing arc of crude masonry rooms was built roughly between A.D. 919 and 936, with a similar block of rooms added later at the east end. At about A.D. 1030, the first addition of cored, veneered masonry was made in the form of a three-story backing of the original arc. Judd labeled the owners of the older house the "Old Bonitian," and saw them—certainly correctly—as an indigenous population. He believed that the builders in the new style, who continued to expand until the pueblo attained its final form about 50 years later, were a new, progressive people coming in from north of the San Juan by invitation (Judd, 1925), who "proceeded immediately to usurp leadership of the community and shape it to their desires." Because there was no evidence of appreciable changes in pottery and other household equipment, he had the original inhabitants remaining to share the space with the newcomers, as a parallel, rather than a merging, population (Judd, 1964).

Gordon Vivian applied himself to the problem in his report on the excavation of Kin Kletso (Vivian and Mathews, 1965). He, too, visualized two groups in the canyon with an association dating back 200 to 250 years prior to the building

of the large pueblos. The people responsible for the developments of the Bonito phase had a basic San Juan tradition, but accepted new traits through Mesoamerican contact. He saw the inheritors of the Hosta Butte phase culture as having possible associations with Little Colorado traditions, and as developing a symbiotic relationship in which they depended on their more progressive neighbors "for ceremonial direction of a higher order." The growing measure of specialization, social control, and inter-pueblo cooperation was not compatible with the Desert Culture-Basketmaker-Pueblo continuum, and when the people abandoned the area for the Rio Grande, they left "cultural experiments or deviations that failed."

Vivian's admission that the possibility of contact with Mexico was an explanation for the floruit of new traits in Chaco was an idea first presented formally by Edwin N. Ferdon (1955), although it had undoubtedly been the subject of many an impassioned discussion after a day of dust-eating ever since Lt. Simpson's visit. Ferdon had worked with Hewett during the School of American Research days in the canyon, and later in Mexico, and he was struck by some of the parallel architectural traits, the source of which he attributed ultimately to the Toltec Tula-Mazapan horizon. He maintained that direct people-to-people contact was probably necessary to account for the transfer, and submitted three hypotheses. He dismissed as improbable the possibility that innovations were introduced by Anasazi traders returning from Mexico, and he saw no evidence of their being forced on the local people by any strong invading force. But, he proposed that a group of *pochteca* traders, perhaps operating out of the La Quemada/Chalchihuites area of Zacatecas and Durango, might be responsible for the changes.

It is the possibility of a specific relationship of Pueblo III Chaco and Mesoamerica that we are concerned with here. More general explorations of Southwest/Mexico relations have been a long-standing interest of Americanists. They were the subject of a Mesa Redonda conference in 1943, in which the participants all agreed that the influence from the south was considerable; that there was no evidence of large-scale migrations; that there were local adaptations of elements of Mexican culture rather than wholesale adoption of a pattern; and that more work was

needed in northern Mexico before routes and way-stations could be identified (Beals, Brand, Haury, and Kelly, 1943; Haury, 1945). Some information from that *terra incognita* had already been contributed by members of the Mesa Redonda. In 1936, Donald D. Brand had identified in the sites around Zape in northern Durango an attenuation of the Chalchihuites culture of Durango and western Zacatecas—a culture representing the northernmost tip of the civilization of the central Mexican highlands. Zape was contrasted to Casas Grandes, in northwest Chihuahua, which was still seen as the southern lobe of the American Southwest (Brand, 1939). Somewhat later, a student of Brand's, Robert H. Lister, amplified a description of Chalchihuites culture as the northern extent of direct Toltec influence, and referred to some intriguing trait correlations with the greater Southwest (Lister and Howard, 1955).

Ferdon's thesis attracted considerable interest. Jesse Jennings and Erik Reed (1956) admitted that the enclosed plaza was possibly introduced from Chalchihuites into the Southwest, and that a peripheral manifestation of Tula-Mazapan might be identified in the Hohokam, where Mexican traits were at a height in the Sacaton Phase, between A.D. 900 and 1100. In their opinion, the coincidence of many Mexican trade-items and new architectural forms in the Chaco area merited "further and more penetrating investigation." Fred Wendorf (1956) did not reject the possible role of strong outside influence on the Pueblo III development, but pointed out that the necessary foundation was already present in earlier Anasazi tradition, and asked whether foreign influence played a causative role, or if the traits might not have been drawn in or attracted by the large population concentrations which resulted entirely from internal factors.

Among others who concerned themselves with the Mexican hypothesis was Florence Ellis, who equates the god Quetzalcoatl, the patron of the *pochteca*, with the Horned Serpent and Poshaiyanne of the Anasazi, and who sees southern influence on the northern Pueblo area as continuous, with several peaks—one at the Bonito Phase (Ellis and Hammack, 1968). Bertha Dutton (1963) thought it "entirely possible that Toltec peoples themselves migrated into northwestern Mexico, carrying with them a complex social organization with priestly officials." In a

later enlargement of this theme, Dutton (1966) saw the influence of a warrior priesthood on Chaco culture in the early 1000's. Albert Schroeder (1966) postulated *pochteca* colonies moving into the Salt and Gila valleys in the early Colonial Period, and eventually extending into the north out of a Hohokam base.

One of the most enthusiastic proponents of the Mexican diffusion theory has been J. Charles Kelley, who, after cutting his teeth in Chaco Canyon along with Vivian and Ferdon, made northern Mexico his *querencia*. His surveys in Durango and Zacatecas confirmed the penetration of central Mexican culture as evidenced by pyramids, platform mounds, and rows of masonry columns surrounding open squares at La Quemada, Chalchihuites, and the Schroeder Site near Durango. Kelley, too, related the development with the post A.D. 900 Tula-Mazapan horizon, and in view of this northern tongue of the Toltec empire, suggested that the presumed Puebloan nature of Casas Grandes should be re-examined (Kelley, 1956). During this same period of investigations, Lister, having completed four seasons of fieldwork at Mogollon sites in northwestern Chihuahua's Sierra Madre, endorsed Kelley's suggestion, and predicted that central Mexican elements would be found there (Lister, 1958).

The Schroeder Site near the Mexican city of Durango is particularly interesting in light of possible influences on the Southwest. It is described as a large ceremonial and residential center connected by roads (which also occur at La Quemada and other sites of the Guadiana Branch) to many smaller, outlying villages. Like many of the roads in the Chaco, these are parallel masonry walls filled with soil (Kelley, 1971). A common pottery type of the Rio Tunal Phase (also represented at Zape) is Otinapa Red-on-white, characterized by design elements employing stepped triangles, wavy lines, and interlocking scrolls. Kelley suggests that Otinapa was an inspiration for Three Circle Red-on-white, a 9th-century Mogollon type of southwestern New Mexico. Three Circle has been suggested as a source for the use of these same elements when they appear on Kiatuthlanna, Red Mesa, and Cortez Black-on-white on the Colorado Plateau. Kelley's dates for the Rio Tunal Phase, 950 to 1150, are 200 years too late for any postulation of a south-to-north movement of the trait, be-

cause 950 is given as the terminal date for Three Circle, and the northern "copies" of the style were being made as early as 900 (Breternitz, 1966). It is possibly the imprecise dating of the Mexican sites that lies behind this seeming discrepancy, although in an earlier paper, Kelley (1966) had suggested that the style may have stemmed from an earlier Mexican source to the Hohokam, thence to Mogollon and Anasazi, and ultimately back south again to Durango.

The Chaco problem was attacked by R. Gwinn Vivian in a doctoral dissertation, which, incidentally, contains an excellent summary of Chaco archeology and presentation of the problems (Vivian, 1970a). He presents for examination six hypothetical explanations, and a series of test implications for each. He found that the case made for four of them, including the *pochteca* concept, was unconvincing. The two hypotheses that stood up the best under his testing were: 1) there was a single social system dominated by a ranked priesthood; and 2) that there was a local development of two different systems. He admitted that both were largely untestable for lack of empirical data. He offered a discussion of the second hypothesis in published form (Vivian, 1970b), not so much as an explanation of the differences in the communities as an example of experimental method.

Another solution was proposed by Paul Grebinger (1973), who re-examined two of R. Gwinn Vivian's hypotheses. He finds a ranked society evolving locally, the higher status people in the large pueblos, or "towns," achieving the favored position because of their occupation of the choicer environment.

The *pochteca* idea introduced by Ferdon was developed further by Charles Di Peso (1968), whose excavations for the Amerind Foundation at Casas Grandes in 1958-1971 uncovered in plenty the predicted Mexican nature of the site. During the Viejo Period at Casas Grandes, the Paquimé of the *conquistadores*, a small pithouse village of indigenous farmers, existed from A. D. 700. In A.D. 1060, the beginning of the Buena Fé Phase, Medio Period, intruders in small numbers changed the entire culture-pattern within the short space of 5 to 10 years. Clusters of small, one-story adobe houses fronted by rows of columns were built around plazas; an extensive water-control system was introduced; and roads were built to radiate out from the town. "The

cultural transition was so rapid and the material inventories so vastly altered that it would be difficult to postulate these modifications in terms of endemic growth" (Di Peso, 1974). The town became the commercial and political center for the surrounding lesser villages, which "supplied surplus goods and population" in return for "military protection and religious inspiration." The satellite settlements often show a 200-year lag in architecture.

It is Di Peso's thesis that the cultural explosion at Casas Grandes, as well as the one in Chaco, resulted from a penetration by which "... alien exploitative economic units ... were ... purposefully transplanted into the Gran Chichimecan frontier by various Mesoamerican merchant families. These formed cultural islands that were not only conducive to the donor's specific commercial needs, but also modified the indigenous life patterns ... " (Di Peso, 1974).

Chaco and Casas Grandes undeniably exhibit interesting similarities—a sudden spurt of growth in the 11th century with an overlay of apparently exotic traits, large communities surrounded by smaller satellites, the development of sophisticated water-management systems, and planned networks of improved roads. If the dating of both areas is accurate, the package reached Chaco a generation earlier than it did northwestern Chichuahua. It wasn't until the Paquimé Phase at Casas Grandes—A.D. 1205 to A.D. 1261—at least 150 years after the erection of the great houses at Chaco—that multi-storied housing complexes were erected and a series of signal towers was established on the commanding hills (Di Peso, 1974). Paquimé reached its peak when Pueblo Bonito's prestige was waning. If we are to accept the concept of *pochteca* influence on Chaco, it might be seen as emanating from the same source as the one that affected Casas Grandes, rather than as stemming from a base at that site.

Despite the varying interpretations, there is a general concurrence that many new traits were introduced in Early Pueblo III, that there were differences other than size between the large and small pueblos, and that both kinds of pueblos were largely contemporary. Both Vivians, however, believe that the divergence had its beginnings as early as A.D. 850. The assumption is apparently based on the presence of the "Old Bonitian" nucleus in Pueblo Bonito. As we have

seen, the first construction of the complex consisted of a 25-room, one-story house built in A.D. 919. Nothing about this structure is incompatible with the Early Pueblo II San Juan pattern. Additions to the block, using the same kind of crude, simple masonry, in at least four increments, were extended to the east, until a total of about 75 rooms was reached. Rooms along the rear of the second addition were partly razed and remodeled with a row of two-story rooms. Two

about A.D. 1030 (six tree-ring dates from these rooms range from 1029 to 1047), and before the 1048 construction of a room abutting the third increment. At any rate, the pre-Bonito Phase features of unusual size and height pre-date that phase by no more than 50 years—quite possibly by much less—and may represent the first attempts at expansion by the same instrumentality that was responsible for the ultimate Bonito, whether that force was endemic or foreign.

Table 2 Bonito Phase Sites

	House or Ceremonial	Number of Rooms	Number of Kivas	Great Kivas	Tower-kivas	Orientation	Roads	Date
Pueblo Pintado (Mc166)	H	123	6	2	1	160°	yes	1060
Wijiji (SJ577)	H	180	2	?(1)	?	172°	yes	1110
Una Vida (SJ391)	H	160	5	2	2	230°	?	1056
Kin Nahasbas (SJ392)	C	17	1			190°	?	
Hungo Pavi (SJ1918)	H	200	1	1		185°	yes	1054
Chetro Kettl (SJ1928)	H	500	15	2	2	161°	yes	1028
Talus Unit No. 1 (SJ1930)	C	30	5			175°	yes	1032
Pueblo Bonito (SJ387)	H	800	32	2		180°	yes	1029
Pueblo del Arroyo (SJ1947)	H	284	16	?(2)	(3)	113°	yes	1065
Casa Rinconada (SJ386)	C	8	1			175°	yes	1054
Pueblo Alto (SJ389)	H	118	6	?	2	177°	yes	
Tsin Kletsin (SJ385)	H?	100	2	?	2	192°	yes	1113
Peñasco Blanco (SJ410)	H	250	7	2	1	130°	yes	1061
Kin Klizhin (SJ1413)	C?	19	2	?	1	112°	?	1087
Kin Bineola (SJ1580)	H	194	10	?	?	170°	?	1124
Kin Ya'a (Mc108)	C?	39	2	?	1	137°	yes	1106
Casamero Ruin (Mc186)	H	32	2	1		116°		
Haystack Mesa Ruin (Mc4)	H	21	2	1	1	110°		
Village of Great Kivas 29SJ1010	C		6?			?	yes	
Bisa'ani (SJ2375)	H?	?	5			177°		
Aztec Ruins	H	440	25	1		150°	yes	1111
Salmon Ruins	H	290	12	1	1	160°		1089
Chimney Rock Pueblo	H	50	2			158°		1076
Bldg 1, Site 39 (La Plata)	H	35	2			166°		

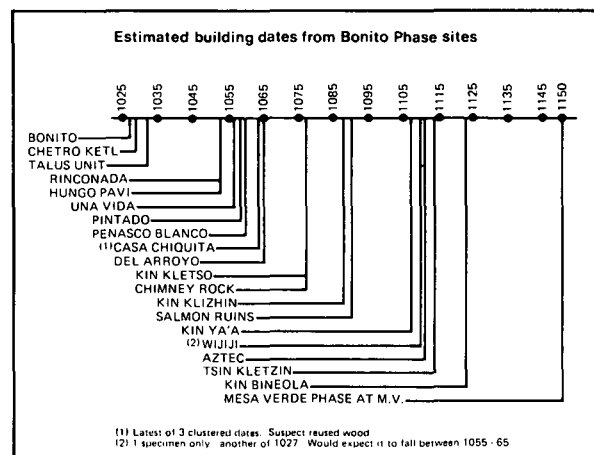
(1) Morris (1921) records great kiva, but not evident today.

(2) Judd (1959) presumed presence of great kiva, but area not tested.

(3) North wing possibly built first with orientation of 200°

aspects of the additions are not typical of Pueblo II: the unusual size, and the presence of a second story. Unfortunately there are no tree-ring dates from any of these rooms, although there is a 977vv date from a kiva associated with the second increment. If we can assume that the kiva was coeval with the building of the second increment, we can say that the two-story remodeling was post-977. But, all we can substantiate is that it was all built before the "curtain wall" of rooms with veneered masonry was erected

Figure 37.



The New Traits

Between A.D. 1030 and A.D. 1100, a large assemblage of new traits was introduced to Chaco Canyon. All signs point to rapid acceptance. Table 2 lists 25 sites identified as Chacoan Bonito Phase. Although the confidence one can place in tree-ring dating varies from site to site, 19 have produced dates, and 14 of those fall between 1028 and 1089. Eight of the sites, including the two largest pueblos, Chetro Kettl and Pueblo Bonito, were started within the first 30 years (Fig. 37). The lesser traits of material culture cannot be so precisely dated within the 70-year span, but the implication is that they were all part and parcel of the architecture, and that the entire complex was well-entrenched by 1050.

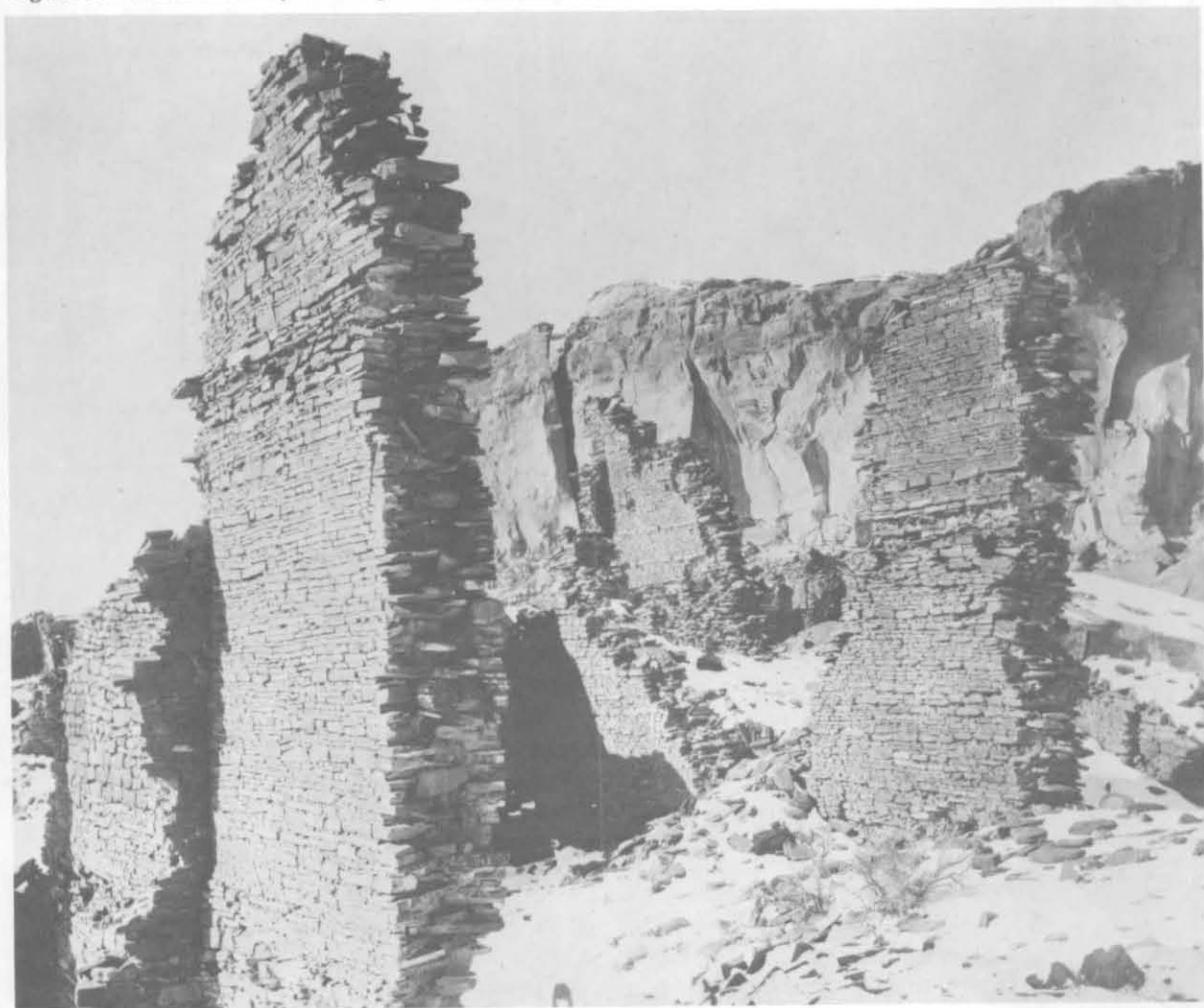
Large, Planned, Multi-storied Structures: In the previous chapter, I gave the average size of the Bonito Phase pueblos within the area of the survey's consideration as 288 rooms. Taking in the larger area from the Zuni district to southern

Colorado to include all the known sites, brings in several smaller habitations, but they still average 216 rooms, in marked contrast to those of the preceding period, in which a dozen rooms was a respectable settlement. The ground-plans have a symmetry that indicates adherence to preconceived designs, and when additions were made, they either conformed to the earlier plan or followed a new scheme and a new symmetry. Earlier building was all of a single story, but with

the Bonito Phase, multi-storied construction of up to at least four floors was the rule.

Cored, Veneered Masonry: The typical Anasazi wall in Pueblo II times was simple masonry in which a single stone was exposed on both faces of the wall. The new technique was to build a weight-bearing core of compound masonry of large, flat stones in ample mortar (Fig. 38). Each stone was oriented to only one face of the wall, and either abutted or overlapped the stone on

Figure 38. Cored Masonry at Hungo Pavi (ca. 1900).



the reverse face. Such a wall is a sounder, more stable member than one of simple masonry. No effort was made to dress the faces, which were left rough to provide a good bonding surface for veneer of coursed ashlar on both sides of the wall. Veneer was often patterned with alternate bands of thick and thin stones in several recognized styles which can be roughly dated (Hawley, 1934). Veneer itself was not new. As far back as Late Pueblo I, small, tabular spalls of stone were sometimes used to face adobe walls.

Plazas: Earlier pueblos were southeast-facing rows of rooms, with an open use-area surrounding the kivas between the house and trash-mound. In 16 of 19 habitation sites representing the Bonito Phase, this area was enclosed, either by a high wall or by a single row of rooms. In two others, a plaza was open at one end, but defined by the wings of the house-block. Two sites that were considered to be largely ceremonial also had enclosed plazas. This trait, unknown before, was gradually adopted in a modified form in some Hosta Butte pueblos, and in the Mesa Verde area.

Tower-kivas: A conventional circular kiva topped with one or more stories is a Bonito phase attribute. Some of these are free-standing, but more often they are enclosed by rectangular walls with rubble filling the intervening space, and the entire structure more or less concealed within the house-block. Fourteen tower-kivas have been identified at 10 sites, and are suspected at two more. Others may be concealed by fallen rubble.

Separate, Esoteric Sites: Small, simple shrines may well be an old Anasazi trait, but if they existed, they can seldom be dated. With the Bonito Phase, isolated, elaborate ceremonial sites in varied forms became common features of the Early Pueblo III landscape. Six of the 25 sites listed in Table 2 fall into this category, including the two great kivas of Rinconada and Kin Nahasbas. The latter has about 17 attached rooms, and was counted as a "pueblo" in the second section of this report. Although somebody may have lived there, it is a case of rooms attached to the great kiva rather than the reverse. Other isolated great kivas of the Pueblo III period are near Peñasco Blanco; between Rinconada and the mouth of Werito's Rincon; in Fajada Gap; under Chacra Mesa near Shabikeshchee; and near Kin Ya'a. These great kivas are of course

in addition to those directly associated with, or encompassed by, pueblos. Other isolated Pueblo III great kivas have been reported in outlying areas, but I do not have precise information on them. Although great kivas were present from the 6th century, they seem to be more numerous in Chaco Pueblo III.

Talus Unit No. 1 has five kivas to only 30 rooms—an unusually high ratio for habitations of this phase—and it contains the unroofed, 20-by-30-foot enclosure described by Ferdon (1955) as a modified platform mound. The floor is split-level, with broad steps rising to the higher floor. The complex was built against the cliff, where its three-story height provided a landing at the end of the roadway from Pueblo Alto on the mesa-top.

A unique site, 29 SJ 1010, is on the crest of the plateau 2 miles north of the canyon, where it overlooks the slope into the Escavada. Passing through here, one of the ancient roadways connects Chetro Ketl with a cluster of Hosta Butte pueblos on the south bank of the Escavada. The road divides at the site, each fork running between long, low, artificially raised mounds, to reunite at the north end. The mounds create two plaza-like areas of about 20 by 40 meters, through which the roads pass. Six roundish masonry structures do not appear to be kivas and are too low to be towers.

I have classed two other listed sites as ceremonial—perhaps incorrectly. Kin Klizhin, in an open area to the west of the canyon, and Kin Ya'a, at the foot of Mesa de los Lobos near Crownpoint, are both small houses with 19 and 39 rooms, respectively. Each has two kivas, and a tower-kiva of three to four stories. Kin Klizhin is in an area of irrigation ditches, a diversion dam, and several scattered farm-houses. Kin Ya'a is in the midst of an aggregation of small Hosta Butte pueblos. There are trash deposits at both sites, and it is obvious that the houses had small resident populations of up to two or three dozen people, but they have the appearance of religious or administrative centers rather than of basic housing.

Other esoteric sites not listed on the table are the "stone circles" described earlier. They were not listed as Pueblo III in the second section of this report because the evidence wasn't apparent to the surface survey. Subsequent excavation revealed the compound and cored masonry.

Roads: None of the Anasazi roads have been accurately dated, but they connect the Bonito Phase sites, and there can't be any doubt that they were associated with the Pueblo III occupation. There is no evidence of such public works in earlier times, or even evidence of the type of intercommunity cooperation that would be required to lay them out.

In addition to the roads described within the circumscribed area of the intensive survey, there were road segments recorded in outlying areas. A well-defined road can be easily followed from Pueblo Pintado for 2 miles west, where it drops over a short flight of carved steps into the canyon bottom, after passing by a long line of small Hosta Butte Phase houses. Two roads leave Kin Ya'a. One, heading directly toward Fajada Gap, over 25 miles distant, is deeply entrenched close to the ruin, and can be traced on the ground intermittently for 3 miles where it crosses a low saddle. Aerial photography reveals it for another 9 miles. The second entrenched road runs west from Kin Ya'a for several hundred feet in the direction of the end of a long point on Mesa de los Lobos. A bordered roadway has been reported to run up the Animas Valley from the vicinity of Aztec Ruins (Henry Jackson, Aztec, New Mexico, personal communication), and I am confident that more will be added, both north and south of Chaco, when concentrated aerial and ground surveys are made.

Signaling Stations: The arc-shaped "shrines" at surrounding high points (described as "isolated religious features" earlier in this report) can be dated as Pueblo III by the compound masonry in the walls, and by the pottery types present at the Chacra Mesa site. Their line-of-sight visibility is with the Bonito Phase houses, and, like the roads, their placement required a degree of social control that is manifested only in the Bonito Phase. In fact, the sight-line from the two easternmost stations on South Mesa to Kin Ya'a lie directly over the Kin Ya'a-Chaco Canyon Road for 3 miles, and may have been part of the same engineering project.

Water Control Systems: Like the roads and signal relays, the dams and ditches, although not directly dated, appear to be associated with the big pueblos, and to have required the same social control for both building and maintenance (Vivian and Mathews, 1965; Vivian, 1970a). There is no evidence of large-scale water control devices

in earlier times on the Colorado Plateau.

Masonry Columns: Along the front of Chetro Ketl's principal house-block is a row of 15 masonry columns based on a low wall. In later construction, the openings between them were filled with masonry to make a solid wall. The architecture of Chetro Ketl has not been described in detail, but a study of the ground-plan and available dates suggest that the original construction was an east-west-running house three rooms deep. These first rooms may have been fronted by a plaza closed off with a row of columns, which was obliterated when the old plaza was filled with rooms and added kivas. Regularly spaced mounds of rubble in the arced wall enclosing Pueblo Alto's plaza suggest that columns may once have stood on the low wall, and at Bc51, a contemporary Hosta Butte pueblo, a row of five columns created an open room facing the south side of a placita. Like Chetro Ketl's gallery, this too was later plugged with masonry to create a solid wall.

Minor Architectural Innovations: Kiva roofs in earlier periods were supported either by the top of the wall or by posts set into the floor near the wall at the four quarters. During Pueblo III, low benches were introduced. On the benches, masonry-encased logs were inserted into the wall at evenly spaced intervals to create low pilasters for the support of the cribbing timbers. This trait seems to be confined to Bonito Phase kivas.

Great kivas had their origin in the distant past, but in Pueblo III, the circular firepit was pulled out of the floor and raised in the form of a rectangular masonry box, and the earlier subfloor pits that flanked it were built as masonry vaults above the floor. It was a frequent practice from the earliest times to place an unshaped flat stone at the bottom of a post-hole. In the Bonito phase great kivas, the massive timbers rested on a series of carefully worked seating disks of sandstone from 3 to 5 feet in diameter (Vivian and Reiter, 1960).

Other Items of Material Culture: Several smaller things, usually in the form of luxury goods, first appeared in Early Pueblo III. These include:

- Inlay of selenite, mica, or turquoise on shell, wood, or basketry
- Painted tablets and effigies of wood
- Copper bells
- Macaws

Strombus or *Murex* shell trumpets
Walnut-shell beads
Seated human effigy vessels and
cylindrical vases made of local pottery
types

The Differences

Table 3 lists the most obvious differences in the traits of the two contemporary phases. Some of these should be examined in more detail.

which faces east-southeast, was apparently constructed in Late Pueblo III, and there is a hint in the ground-plan (Judd, 1959) that the first construction during the Bonito Phase was the south-facing east wing. Despite the few exceptions, the trend is definitely to the south, in contrast to Hosta Butte sites and the pueblos of both the earlier and later phases, as is shown graphically in Figure 39. The same shift in orientation applies to kivas and great kivas. In the earlier

Table 3 Comparisons: Hosta Butte and Bonito Phases

Trait	Hosta Butte Phase	Bonito Phase
Orientation	southeast	south
Placement in canyon	108 south side, 58 north	7 north, 1 south
Architecture	single story, accreted	multi-story, planned
Size of pueblos	ave. ca. 16 rooms	ave. ca. 235 rooms
Room size	small area, low ceiling	larger area, high ceiling
Room/kiva ratio	6.5 rooms to 1 kiva	29 rooms to 1 kiva
Plazas	open	enclosed
Kiva roof supports	vertical posts, pilasters	horizontal log
Tower-kivas	absent	present
Masonry	simple, compound	cored veneer
Doors	small, high sill	large, high sill or none
Corner windows	apparently absent	present
Seating disks	absent or unshaped	carefully shaped
Isolated ceremonial sites	absent?	numerous
Burials	in refuse or subfloor	?
Riches	scant?	abundant
Tcamahias	present	scarce

Orientation: Basketmaker III pithouses were dug southeast of the small storage rooms. Their entryways were at the southeast side of the pithouse, and trash was deposited southeast of the complex. This is a pattern that was to continue unchanged for centuries, except for the unexplained southern orientation of the Bonito Phase houses. Of course, there are exceptions, notably Peñasco Blanco, Kin Klizhin, Kin Ya'a, Haystack, and Casamero. Much of Pueblo del Arroyo,

periods, and in the Hosta Butte sites, the kiva ventilator (a vestigial antechamber), and the firepit and entry to great kivas are to the southeast. In Bonito Phase structures, this axis is swiveled south to conform to the orientation of the houses themselves.

The significance of this phenomenon remains a question, but the orientation is too consistent to be a coincidence, and it is pointed up by the fact that after the Bonito Phase, Anasazi

orientation swung back toward the east. For a time, there was some ambivalence in the McElmo-Mesa Verde structures built late in Chaco Canyon chronology. Kin Kletso and its four kivas face south. Casa Chiquita's long axis is east-west, and it appears to be a smaller copy of Kin Kletso. Most of the smaller sites, however, that appear to have been built in Late Pueblo III carry the same southeast tradition that was known in pre-Bonito and Hosta Butte Chaco, and always on Mesa Verde.

Room-to-Kiva Ratio: Another intriguing difference is revealed by the ratio of rooms to kivas. The ratio for 154 Hosta Butte pueblos within the circumscribed survey area for which we were able to make a reasonable estimate was 6.5 rooms to one kiva. The room-count is more likely to be low than the kiva count, and a figure of 12 to 15 rooms to a kiva is about what one expects in Anasazi sites. The nine Bonito phase pueblos within the same area, not counting the specialized or ceremonial sites, have a total room-kiva ratio of 30:1, with a range of 20:1 to 200:1. The greatest kiva density for the Bonito Phase, at Pueblo Alto, is less than half that seen at the average Hosta Butte settlement.

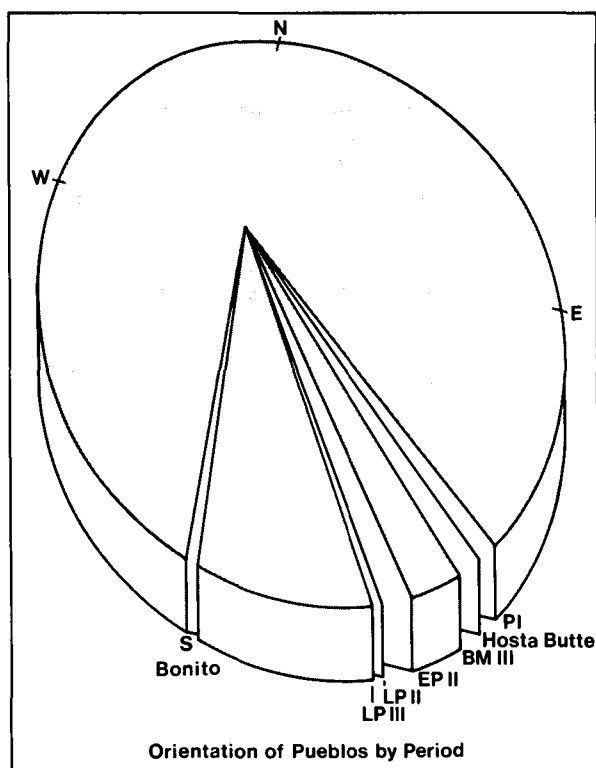
To explain the apparent shortage of kivas in the big houses, one can speculate about whether great kivas might have assumed some of the function of the smaller conventional kivas. There are at least nine great kivas in the nine Bonito Phase pueblos, and there is no such proportion with the Hosta Butte sites. However, there are five isolated Pueblo III great kivas, and five more associated with Hosta Butte pueblos, all of which were presumably accessible to the people of those pueblos. The number of people per *great* kiva would seem to be about equal for both populations.

It is possible that two different peoples lived in Chetro Ketl and the other great pueblos—one group that used the kivas in the Anasazi tradition, and another that did not. It is also possible that the great houses were occupied by an elite stratum of society whose apartments were larger than the three-room average we postulated in the population estimates, and that the family-kiva ratio was actually the same as for the other sites.

An alternative explanation might be that not all of the rooms in the Bonito Phase houses had a conventional function; that the number of

people per kiva was the same as it had been; and that the extra rooms were workshops, or were used for bulk storage. If either of the last two propositions should be the case, our population estimates would be affected. By estimating population on the basis of kivas rather than rooms, the doubled numbers from Pueblo II to Pueblo III shown in Figure 36 would be reduced by more than half, and the added bodies would total less than a thousand. As the graph shows, the total

Figure 39.



from Pueblo II times into the Hosta Butte Phase actually dropped, which might be interpreted to indicate that some of the people from the smaller pueblos moved into the newly constructed big houses. The remainder of the increase is no more than could be expected without immigration.

Room Size: Enough has been said of the comparative sizes of pueblos—the numbers of rooms—but it should be noted that the sizes of the rooms themselves also differed significantly. One-hundred “Late Bonitian” rooms in Pueblo Bonito average 18 ft. 3 in. by 9 ft. 8 in., by 9 ft.

in height to the vigas. Thirty-nine rooms at Bc50 and Bc51, Hosta Butte phase houses across the canyon, average 9 ft. 3 in. by 7 ft. 3 in. No ceiling heights were measurable in these one-story rooms, but when they are determined in Anasazi houses, they are notably low, such as in Mug House at Mesa Verde, where ceilings averaged between 5 and 6 ft. (Rohn, 1971).

Site Location: Almost everyone who has worked in Chaco has remarked that the big houses are on the north side of the canyon and the small ones on the south. The situation is not quite that clear-cut. In the 10-mile stretch of the canyon from the east boundary of the Monument to the mouth, one-third of the recorded canyon-bottom Hosta Butte pueblos are north of the wash. The same pertains to the distribution for all periods from Pueblo I, but it is largely illusory. The tilt of the rock strata, described earlier, has resulted in the exposure of broken ridges of eroding shale at the foot of the southern cliffs, and deep alluviation on the north side where the floodplain in some places laps the foot of the rock. I have referred to this factor in the discussion of sites of the various periods, with the warning that our counts were certainly incomplete along that heavily alluviated axis. This was still true of Early Pueblo III. Soil deposited around the walls of Bonito and Chetro Ketl and stratigraphy exposed in the channel demonstrate that from 2 to 5 feet of soil were added since those walls were erected. This is enough to hide a collapsed one-story structure, turning a "pueblo" in the survey's classification to a "sherd area," or to nothing at all. I believe the real prehistoric north-south division was more nearly equal.

However, the fact remains that the north side was favored by the Bonito Phase people. If all the Hosta Butte pueblos were on the south, we might interpret this to mean that the new builders just took what was left; in any case, that is where they built. The reason is still moot. When the wash was still a shallow channel, occupants of the north side were more subject to the danger of occasional high water than the people across the valley, but the southern exposure made for shorter winters. I hesitate to suggest that it was pertinent, but it is a fact of topography that if the great pueblos were all on the south, a relay of signals from the outlying pueblos from Bineola around to Pintado would have been impossible without a vastly compli-

cated insertion of additional signal-stations on the north plateau. It is only the higher altitudes of South and West Mesas that command views of both the large canyon-bottom pueblos and those outliers.

Luxury Goods: The exotic items listed with Pueblo III's new traits have for the most part come from the big houses. Their numbers have been exaggerated, as Vivian and Mathews (1965) have pointed out, particularly in the matter of turquoise. It was not produced by the bushel in the Pueblo Bonito excavation, or in any other, and it is found in all sites from Basketmaker III on. More painted wood, shell or stone tesserae, shell trumpets, and macaw bones have been found in the big houses than in the small, but it is well to remember that preservation is better in the deep fill of Bonito phase houses, and that many more cubic yards of fill have been removed from them. Still, these goods appeared on the scene at the same time as the massive architecture, and there seems to be a relationship.

If a surplus of riches is a Bonito Phase trait, Earl Morris (1919) observed that *tcamahias*, the stone tips for farmers' digging sticks, are not found in the big ruin at Aztec, but are numerous in the smaller sites. An inference might be drawn that those living in the latter sites had a lower status.

Burials: One of the more intriguing mysteries of Chaco Canyon is the relative absence of burials associated with Bonito Phase houses. Burial customs in the Hosta Butte Phase were unchanged from earlier times in the Chaco, and followed the general Anasazi pattern of burying flexed bodies in the refuse, under the floors of the rooms, or, less frequently, on the floors of abandoned rooms. To date, about 325 burials have been excavated in the canyon—only about one-third of them from the great houses, even though much more fill has been removed from those sites, and not all of these pertained to the Bonito phase.

In Frank McNitt's interpretation of the excavation records of Pueblo Bonito, he counted 91 burials from that site (McNitt, 1957). Some of these individuals were represented by only a stray bone or two, but from Pepper's (1920) and Judd's (1964) reports, one can identify 70 burials that clearly represent 70 dead bodies. One of these, an infant buried below the floor of an "Old Bonitian" room, is almost certainly a Pueblo II

burial. An infant in a room at the east side of the east court that appears to be a Late Pueblo III addition, and an adult accompanied by Mesa Verde Black-on-white pottery would both belong to the period of the late Mesa Verde intrusion. Forty-seven men, women, and children in five trash-filled "Old Bonitian" rooms were buried with quantities of grave goods, including pottery of types which would place them definitely in the Bonito Phase. In addition to these "status" burials were three others whose position in the house implies the same phase assignment. The remaining 17 burials could have been from any of the three phases involved. Thus, something between 50 and 67 individuals represent the dead of a 150-year occupation of an 800-room pueblo. Judd estimated that Pueblo Bonito should have experienced between 4,700 and 5,400 deaths in that time, and gave much thought to the matter. One of his speculations was that perhaps the bodies were cremated and the ashes scattered.

Two of the presumed Bonito Phase burials from that pueblo were burned, although it was unclear if they had been purposefully cremated and buried or were the unburied victims of accidental fires. In the same category was a matting-wrapped body excavated by Thomas Matthews (personal communication) from a trash-filled room at Bc59 near Casa Rinconada. It had been burned *in situ*, with only the top of the skull and the tips of the fingers and toes unburned. In connection with his excavation of the "Northeast Foundation Complex" at Bonito, Judd cleaned out six sunken masonry fireboxes running from 3 to 4 feet square and from 1 to 2 feet deep. The interiors were fire-reddened from exposure to extreme heat. The fill contained some charcoal, but no bone or sherds. The fireboxes were of an unconventional type, neatly spaced in a line at the foot of the Hillside Ruin, and obviously served some special purpose. The Chaco Center re-excavated these in 1974, sifting for pieces of calcined bone that may have been missed. Nothing was found, and the results were inconclusive.

Discussion

Earlier in these pages, I admitted that the survey did not learn enough to make a definitive history of the Anasazi possible. Although the following might seem to belie that admission, it is offered, not as a theorem, but as a hypothesis—one which has much to support it and little to

refute it, and which deserves a thorough testing.

Among those who have applied themselves to the Pueblo III Chaco phenomenon, there is general agreement that it is partly foreign, and probably Mexican, and that there were either two social systems operating, or one stratified society. But some commentators are reluctant to see anything but a continuation of "soft" diffusion of alien traits, and view the classic period as a local evolution of a largely indigenous Anasazi culture.

I would agree that the *population* was largely indigenous. However, the aggregation of traits having no apparent root in previous Anasazi tradition is so great, and they appeared on the scene so rapidly, that it is difficult to see them as anything but "hard" diffusion through the agency of a group of determined political entrepreneurs, some of whom must have been physically present and in residence. Given the proper social conditions, a small band could effect telling changes in the economy and on other aspects of society. Witness the Spanish colonization of New Mexico among descendants of the same people.

The presence of a minor fragment of the total population, consisting of administrator-trader-priests contributing engineering know-how, astronomical knowledge for the control of the solstice and the equinox, and an inside track to the ears of the gods in exchange for labor, could explain the new, alien forms adapted to indigenous patterns and executed with local materials. One of the tactics of asserting authority would be to permit a minimum of disruption of old ways. Thus, kivas and great kivas remained when their uses could be warped to the purposes of the masters, and traditional settlement-patterns and house-plans were only subtly changed. Vessel forms required for some purpose by the newcomers—cylindrical vases, and squatting human effigies quite reminiscent of Mexican forms (Pepper, 1906)—were made by local potters, using their traditional pastes, slips, and painted designs.

The roads, irrigation systems, shrines, and isolated great kivas indicate that what had been an area populated by clusters of neighboring, but independent, family groups became a single community, still living in separate apartment houses, but bound together by subordination to some larger authority.

If the Bonito Phase is accepted as a thing

instigated by outlanders, there is no place to look for the source except ultimately in Mexico. On the basis of current information, nothing can connect Chaco directly, or exclusively, to either Casas Grandes or the Hohokam—the other contemporary Mexican-influenced cultures in this part of the world—but somewhere farther south we may find one or more centers that affected all three.

If trade were the purpose of the penetration, or were an adjunct of a more political mission, what was being exported from Chaco? From the standpoint of the interlopers, a few baubles and the security of benevolent authority were possibly enough to offer, and perhaps the mere extension of influence was enough to satisfy them in return. Empire must grow to live, and once the process is started, it expands through the force of inertia. But, if there is anything to the *pochteca* proposition, there is an implication that some material things worth all the effort were being raked in.

The sources of turquoise in Mexico are few, and it has long been supported that most of the quantities used by the Toltecs and their successors came from the American Southwest (Pogue, 1912). There is no native turquoise within many miles of Chaco, although it isn't impossible that the district served as an exchange-point into which the gemstones were drawn. A quantity—exaggerated though it is—of turquoise was found at Pueblo Bonito, but there is no evidence one way or the other that it was stored or worked up locally in any appreciable quantity.

Maize, for which one would expect to find little evidence, is reported to have been a big part of Aztec tribute (Gibson, 1971), and it may also have been for Toltecan predecessors, although it stretches the imagination to visualize porters trudging several hundred miles through mountains and over deserts with shelled corn or meal. In fact, it is difficult to see Chaco producing any surplus, even under optimal weather conditions. There are about 3,200 irrigable, canyon-bottom acres between Shabikeshchee and the mouth of the Escavada. Reginald Fisher (1934b), in discussing the agricultural potential of Chaco Canyon, stated that an average of 2 acres supported a modern Pueblo Indian family. If we divide the available land by the 4.5-member family used in our population estimates, we could feed 7,200 people—if all the ground was used, and

was equally productive, and if the rains fell at the proper intervals every year. I suspect those conditions were seldom met, and that Fisher's 2-acre average required some off-farm labor for wages, or long hours hunting jackrabbits and wild herbs. The problem of the corn-productive capacity of the land is one that should be scientifically re-explored. Until Chaco's ability to feed itself is proven, one can wonder if foodstuffs weren't imported from the better-watered San Juan Valley, and if funneling those products weren't one of the functions of such outlying Chacoan sites as Chimney Rock Pueblo on the Piedra River, and Casamero and Haystack on the San José River.

The Salmon Ruin and Aztec were more substantial outposts of empire, and it may have been through them that some attenuated form of hegemony was extended to Mesa Verde, for changes began to affect the small, Hosta Butte-like Mancos Phase settlements on the mesa and the valleys at its foot 40 to 50 years after Chetro Keti was built. These earlier effects were seen in the increased size of the pueblos, plazas enclosed by low walls at the front, multi-stories, and compound masonry. By the mid-1100's, ditches and reservoirs were present; multi-storied towers in association with kivas were common; and there was at least one road. In the 1960's, James A. Lancaster pointed out to me a section of a road several hundred yards long that has the same surface appearance of those in Chaco. It apparently ran from the Goodman Point Ruin on a detached area of Hovenweep National Monument to a large Pueblo III ruin at the head of Sand Canyon, about 6 miles away. Such esoteric sites as the triple-walled structures and Sun Temple first appear in the late 1000's also, which, in the words of Gordon Vivian (1959), were "possibly, though not demonstrably, the result of an intrusive cult practice acting on but not submerging a long established ceremonial pattern."

During this period of rapid change in the Mesa Verde area are indications of turmoil, in such defensive measures as the building of compact houses around springs, on nearly inaccessible buttes, or pulled back into shelter caves. Although some people have laid any evidence of hostilities at the door of nomadic raiders, others, including Frank H. H. Roberts (personal communication), see internecine dissension following a period of stress as the cause. The imposition

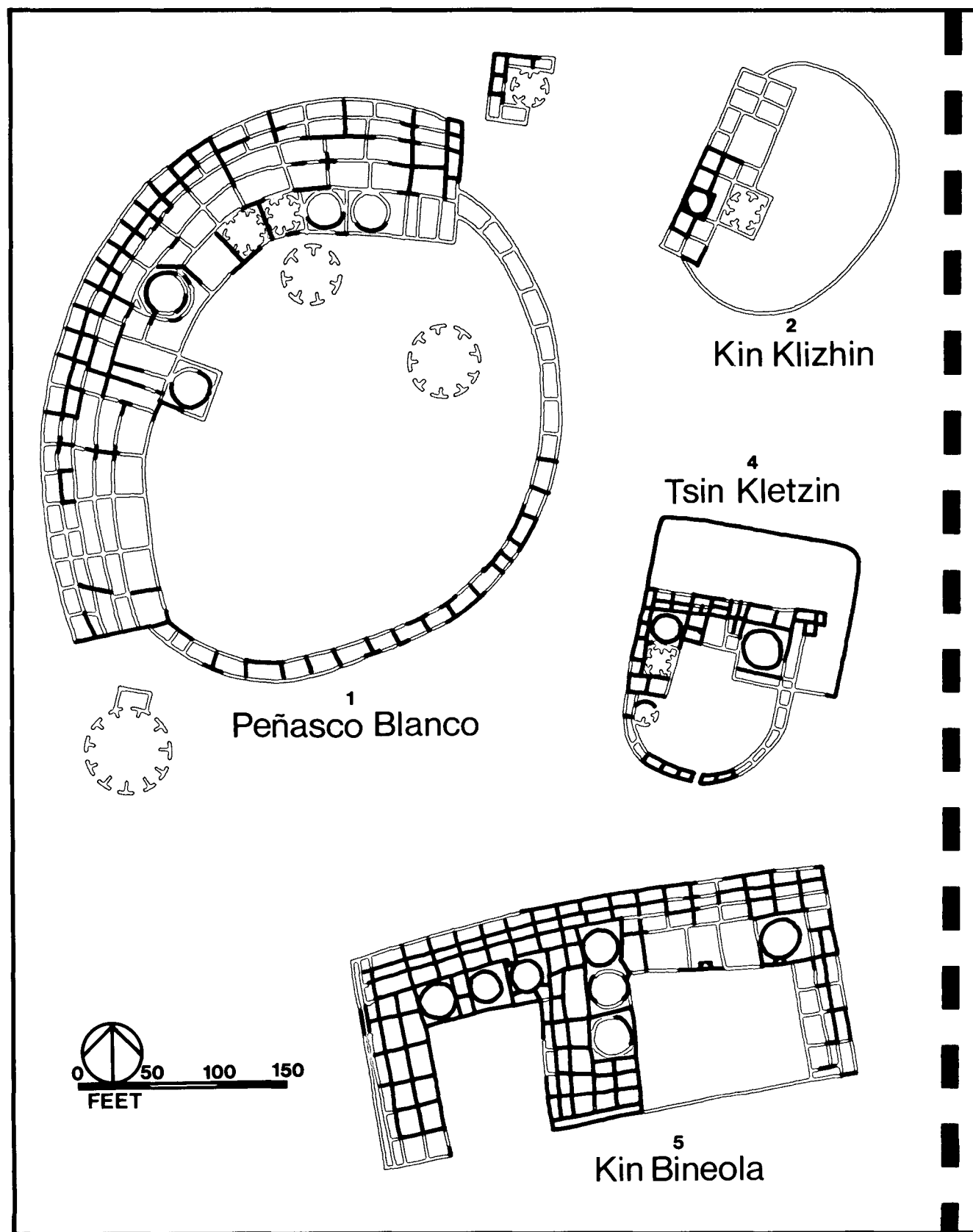
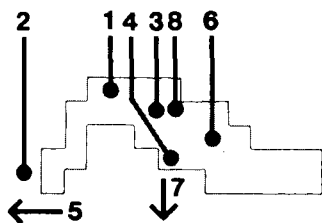
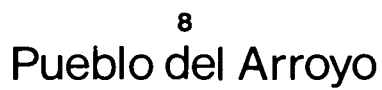
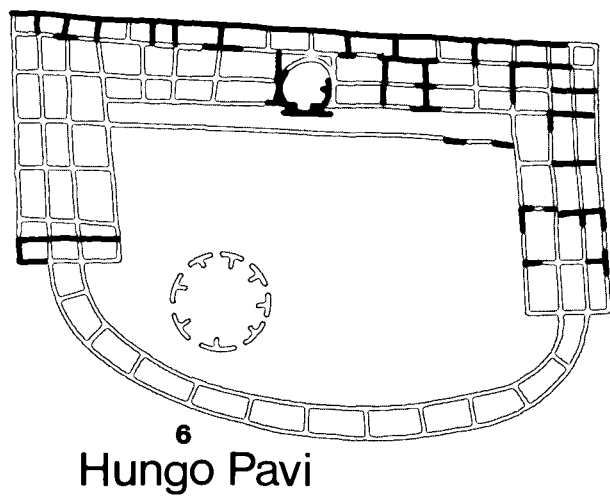
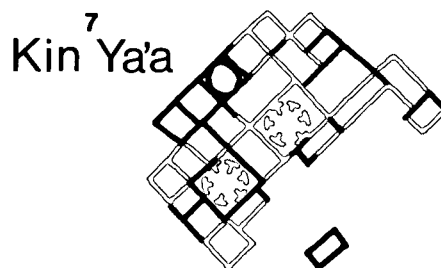
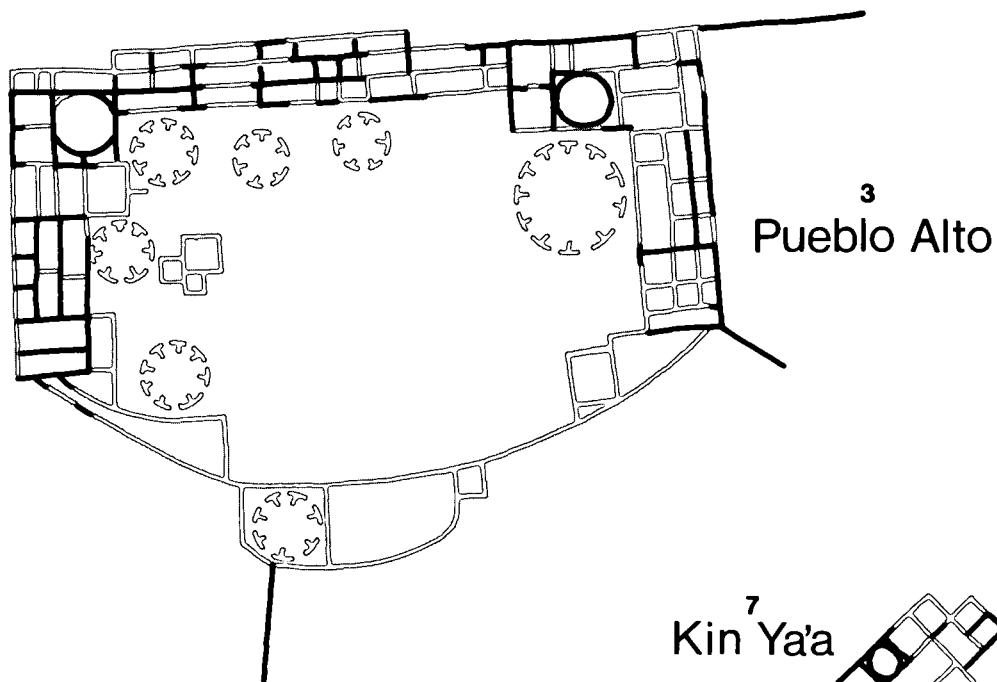
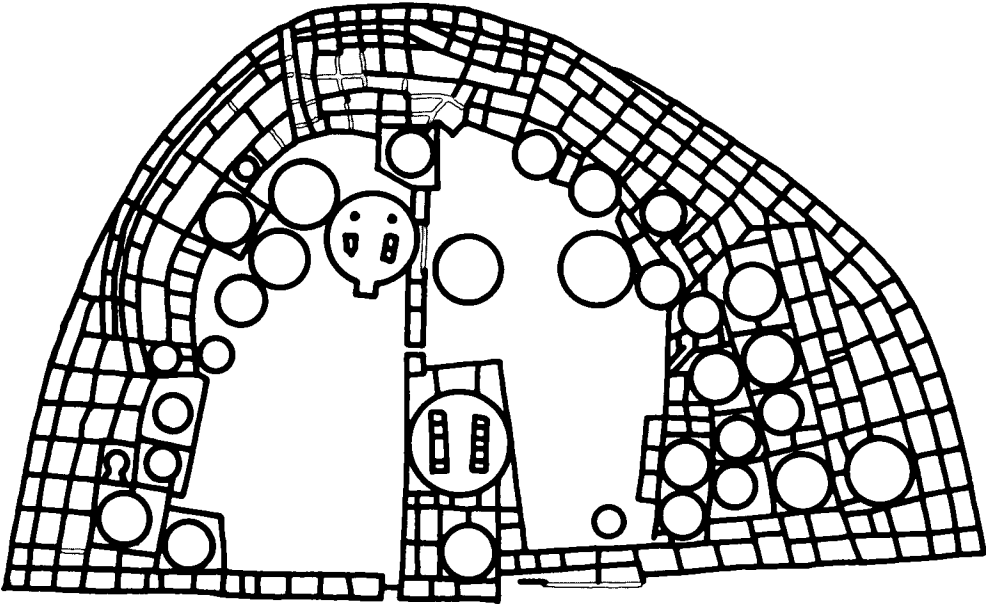


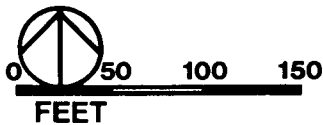
Figure 40. Ground plans of 16 major Chaco sites. Continued on next page.





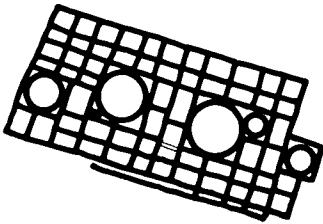
9

Pueblo Bonito



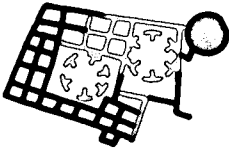
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Kin Kletso



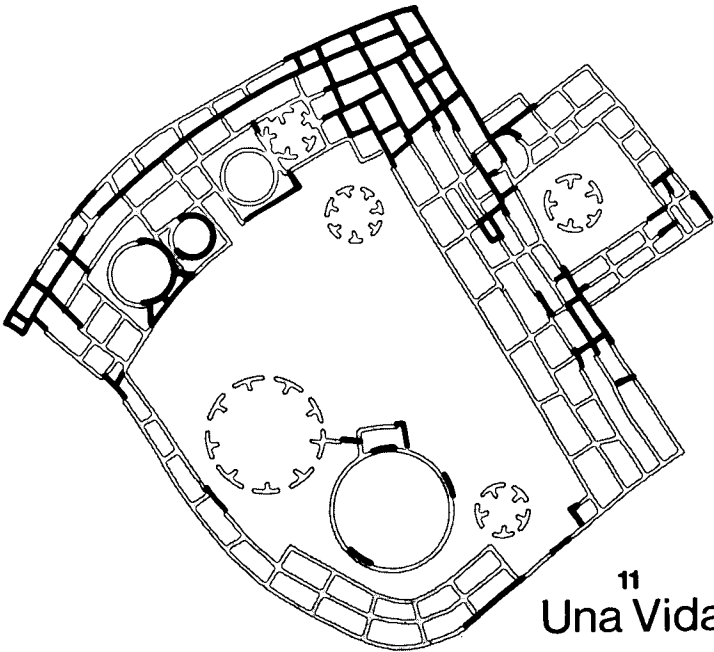
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Casa Chiquita

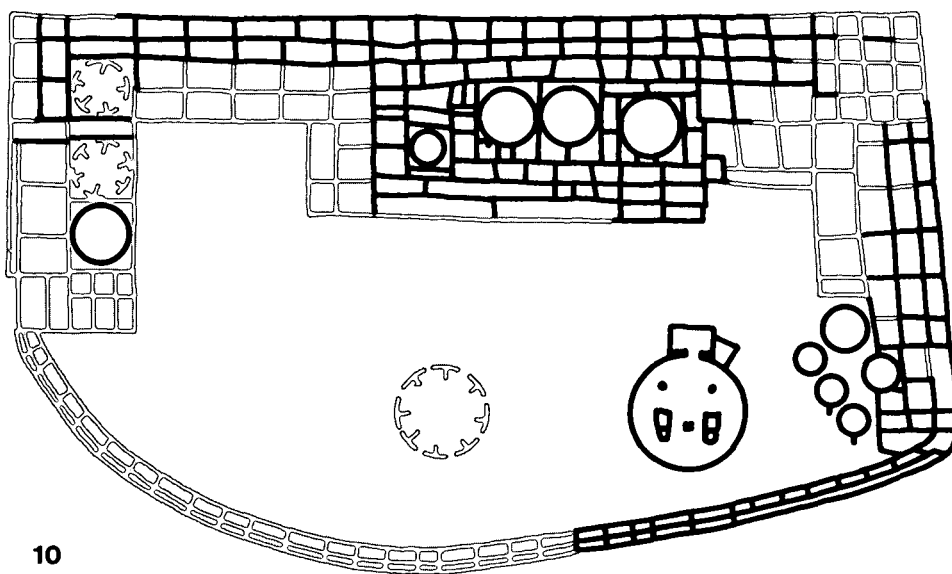


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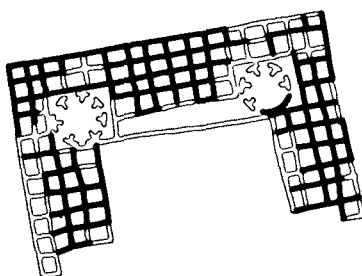
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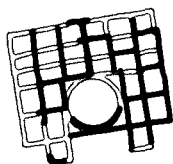
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Chetro Ketl



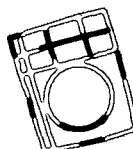
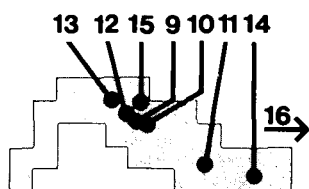
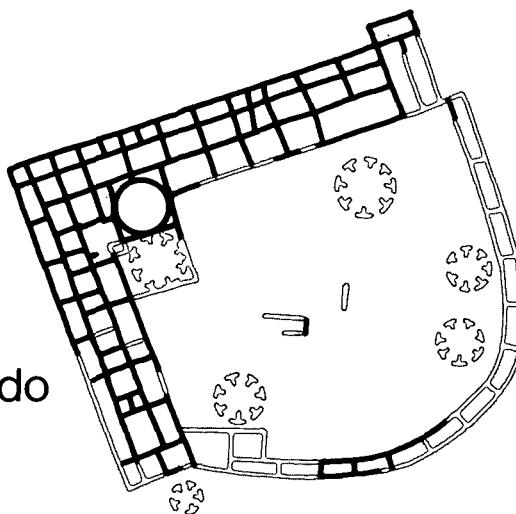
14
Wijiji



15
New Alto



16
Pueblo Pintado



of alien political or economic control might be stress enough to start "progressive" versus "conservative" friction of a kind that still typifies Pueblo society today. A shortage of corn lost through tribute could impose another stress, causing people to take measures to protect the winter's rations and next spring's seed.

Evidence of another kind of friction is seen in human remains of what seem to be ritualistic feasts. Cannibalism is recorded at several Pueblo III sites in the Mesa Verde area, and at others in northeastern Arizona (Nickens, 1975). The victims of human sacrifice were frequently eaten by the Aztecs in a ritual afterfeast (Nicholson, 1971). Aztecs had merely adopted the social organization and the religion of the Toltecs before them (Carrasco, 1971), and live bodies intended for sacrifice in the yearly round of ceremonials were a well-known object of war and trade in central Mexico. We don't have evidence at present that can disprove the supposition that transient captives were temporary occupants of Pueblo Bonito's large, bare rooms. Perhaps therein lies the answer to the absence of burials in the Bonito Phase houses—most of the deaths occurred elsewhere.

Between 50 and 100 years after the development of new traits on and around Mesa Verde, and the apparent unrest, came the immigration of groups of Mesa Verde people into Chaco with

their own versions of kiva architecture, dressing of building-stone, and pottery. Could this have been the "progressive" element, driven out of a more conservative homeland to seek refuge near "headquarters?"

By Late Pueblo III on Mesa Verde, a population which had started to drop off in the late 11th century continued to dwindle (Hayes, 1964). Concurrent with the reduction north of the San Juan was an increasing dominance of the Mesa Verde element in Chaco—although even here, the total population had dropped dramatically, and the newcomers were not filling the space as fast as it was emptied. When new structures were raised, it was largely with materials salvaged from abandoned houses. Of the hundreds of dated timbers from Chaco ruins, the latest date for construction-timber is 1129vv (Robinson et al., 1974), at least two generations earlier than the beginning date (Breternitz et al., 1974) for the classic Mesa Verde Black-on-white pottery found on sites of this period in the canyon.

These last Anasazi inhabitants of Chaco lived among the ruins of an ambitious scheme that had come apart after little more than 100 years. The complex system of the Bonito Phase may not have been so much an apex of indigenous cultural growth as a cancerous contributory cause of its disintegration in the Four Corners area.

Part Two

The Historical Archeology of Chaco Canyon

Introduction

About a third of the sites surveyed in or adjacent to Chaco Canyon National Monument had evidence of historic components. The overwhelming majority of these sites had Navajo occupation, but the well-documented presence of Spanish-American and Anglo-American travelers and settlers is also clear in the archeological record. The following brief analysis attempts to present the data for dating these sites and identification of the ethnic groups represented.

The number of sites is modified somewhat from that recorded in the field by combining some sites that appear to represent one component of historic occupation for purposes of analysis. This resulted in a total of 845 sites. No effort was made to separate features representing more than one historic component within a site, as collections were labeled by site, not by structure.

Definitions of structural types have been modified somewhat from those used in the survey. In particular, all rectangular structures have been excluded from the hogan category and listed as pueblitos or houses. A new type, lamb pen, not recognized in the field, was included. Where data were adequate, some of the field identifications of types have also been altered in individual cases.

The first section presents a description of the kinds of features found on the sites, the most important of which are the architecture and the rock art. The second through fourth sections discuss the portable artifacts. The fifth presents evidence for dating the sites and the occupations they represent.

Additional kinds of analyses could be applied to the survey material, but used by itself,

it is felt that a point of diminishing returns would soon be reached. Once other avenues of research have been explored more fully, including a study of the documented history, an extensive survey of the surrounding region and excavation of related sites, as well as research in ethnogeography, land concepts and use, and social organization (some of these studies have already been initiated), it may be worth returning to the information provided by the intensive survey of the monument for a second look.

Features

Hogans

The survey of the historical archeology of Chaco Canyon produced 320 sites with structures that appear to be hogans (Figs. 41 and 42). A minimum of 652 Navajo hogans was recorded from 319 sites. The remaining site is the old University of New Mexico field school, where hogans were used for student housing, and this site is not further considered in the hogan listings. Of Navajo sites producing hogans, there was an average of slightly more than two hogans per site, the minimum number being one and the maximum being 14. There was a definite tendency for large clusters of hogans to be early. All sites with 10 or more hogans had occupation in the 18th or very early 19th centuries. Some of these sites also produced evidence of late occupation—late 19th century or 20th century—and these may be two-component Navajo sites, or perhaps two sites inadvertently united in recording due to proximity. The largest site that produced evidence of only late occupation had eight hogans. Small sites were the most common throughout, however.

Only structures that are believed to have fit the strict definition of *hogan* are included in the above totals, and all square or rectangular structures were excluded, as were all that appear to have been mere camp or temporary shelters. In general, to fit these criteria, a structure was expected to be round, oval, or polygonal, with five or more sides; to be at least 2 meters in at least one interior dimension; and to have an entry oriented in an easterly direction. It was not al-



Figure 41. Masonry hogan, 29 SJ 135 viewed from the northeast.

Figure 42. Early 20th-century hogan, 29 SJ 1604, viewed from the northeast.



ways possible to be certain from the site descriptions that all hogans met even these minimal standards, and considerable use of subjective judgment had to be made, relying to a degree upon the opinions expressed by field workers. Attention was also given to identifying structures that had hearths and were associated with ash dumps, but these data were noted in relatively few cases. Poor preservation made detailed observations impossible on many sites.

Most of the hogans found were of masonry construction, and many incorporated talus boulders, rock shelters, outcrops, and cliff walls as

a part of their walls. This use of natural features seemed most common in the 19th-century, appearing infrequently in the 18th century, and little if at all in the 20th century.

The very few wooden hogans were found in the eastern end of the survey area and were too poorly preserved to permit identification of the kinds of construction employed. None could be positively called forked-pole hogans, and the few where any indications of structural type remained were probably built with uprights supporting a cribbed roof.



Figure 43. Small two-room pueblito, 29 SJ 1613. Note the use of selected tabular rocks for the masonry, dating probably from the late 18th-century.

vajo country, and it is somewhat a matter of preference what terminology is used to distinguish this variation. For present purposes, I consider any rectanguloid structure with at least two rooms, one opening into the other, to be a pueblito. Two rooms sharing a single wall but each with its own entry to the exterior are classified as two hogans. In all cases of this sort reported by this survey, the two rooms were round to oval. More elaborate pueblito structures are found not

Figure 44. Ranch-house, 29 SJ 609, of late 19th-century Anglo-American construction, with Navajo use and maintenance into the early 20th-century.



Pueblitos and Houses

Within the survey area only three structures that might be termed pueblitos were noted (Figs. 43 and 44). These have been called "pueblid" structures by R. Gwinn Vivian (1960) because of their small size. There is indeed an almost imperceptible gradation from the larger pueblitos of the Dinétah (the area from about Blanco Canyon northeastward to about Cabresto Canyon southeast of the San Juan River) through small rectanguloid, multiroom structures to individual round stone hogans, when viewed in the entire range of variation found throughout Na-

far outside the survey area, built by people close enough to have probably considered themselves part of the same "band" or community as those who built the few examples within the national monument. All seem to date from mid- to late 18th century in this area.

The distinction between pueblitos and houses is based in part on the age of the structures, but detailed architectural differences also exist. These cannot be defined reliably on the basis of the brief descriptions in the present survey. The most consistently noted distinguishing features aside from age were the use of dark, thin, tabular sand-

stone masonry in the pueblitos and a frequent use of compound masonry, often of shaped blocks, in the houses. A very few single-room pueblito-style structures have been included as "houses," however.

Houses are best defined as square-to-rectangular structures of one or more rooms. Connection between rooms and access to the exterior varies. Most post-date the return of the Navajos from Fort Sumner in 1868. These structures are sometimes part of Navajo sites, and sometimes ranch-houses, trading posts, or other buildings used or occupied by non-Indians. By the 1880's, some wealthier Navajos were hiring Spanish- and Anglo-Americans to build houses (Parsons, 1886), and Navajo use of abandoned white ranches is also reported (Judd, 1954) in the Chaco region. Only 24 structures were classified as houses, and of these only five are of such size and complexity as to suggest construction by whites. The remainder are small, usually one-room, buildings that superficially differ but slightly from hogans. The cultural implications regarding Navajo reaction to acculturational pressures are of sufficient significance, however, to render the distinction an important one.

Ramadas

Following the decline of pueblito architecture, the only native rectangular structure in common use among the Navajos was the ramada. Consisting of a roof supported by posts with, at most, a few branches to help give shade and break the force of the wind on the sides, ramadas would appear more properly camp shelters than dwellings. While sometimes built for temporary use, ramadas were not infrequently also a part of the complex of structures at permanent homesites. Preservation of ramadas is poor, and the numbers identifiable in surface remains, particularly in the older sites, may be far below the proportions formerly in use. Only seven structures that might have been ramadas were identified in this survey.

Windbreaks

A windbreak differs from a ramada in that the primary protection from the elements is on the sides, the top being open or giving minimal shelter, as when the windbreak is built under a tree. Navajo windbreaks are circular or oval in groundplan, and are temporary camp structures,

being used most frequently in sheep camps, hunting camps, and pinyon-picking locations. They were also often built at major ceremonial gatherings. Identification of windbreaks and related shelters was rather uncertain in most cases in this survey. Generally built of brush, they may be expected to have been especially poorly preserved in country as devoid of woody vegetation as the Chaco region has been throughout historic times. Some of the many small stone wall segments recorded by the survey may have served a similar function, but if so, this was seldom evident from the descriptions. Of seven windbreaks tentatively identifiable in the field reports, only one was built of stone. The others are of brush and poles, set either vertically or horizontally. The shelters built of brush may be presumed to be of Navajo origin. The other is more suspect, and may well have been an expedient utilized by a white shepherd or cowboy.

Tents

Tents result in little disturbance of the soil, and only six presumed tent bases were noted. All are rectangular or square areas cleared of rocks to provide smooth floor spaces for wall tents. Tents of this sort were regularly used by Spanish shepherders, as well as by Anglo-American tourists and archeologists. Navajo use of tents, especially in summer camps, has been noted in the area in the 1930's (Hayes, personal communication) and the 1970's, with no reason to suspect any lapse during the intervening period. The frequent moving of herds by Spanish-American herders (Lobato, 1974a) should have resulted in far more tent sites than were found, but sites occupied only a few days, unless revisited regularly over the years, might well be impossible to distinguish. Despite some Navajo and Anglo use of tents, most tent sites must have been part of Spanish sheep camps.

Corrals, Sheep Beds, and Lamb Pens

Most historic period sites with evidence of habitation, whether permanent or temporary, also produce evidence of livestock in the form of corrals, sheep beds, or lamb pens (Figs. 45 and 46). Corrals are defined as large, completely enclosed fenced areas in which stock might be penned. Most corrals were certainly for holding sheep and goats. Preservation was frequently so poor that it has not been possible to draw a sharp

distinction between corrals and sheep beds. The latter may be no more than completely open areas where herds could be bedded overnight in temporary camps or semi-enclosed by natural or artificial barriers to give some protection to the stock. Most fences were simple stone walls, and the many gaps in these on the survey sites may once have been fenced with brush or wire or the rocks removed for use elsewhere. The more complete corrals are thought to be predominantly of

Navajo origin. Sheep bedding areas were utilized both by Navajos and Spanish *partidarios*. The latter, because of frequent movement of their herds, seldom built a corral in the Chaco region except when needed to separate flocks that became accidentally mixed (Lobato, 1974).

Lamb pens are small enclosures, large enough to hold one or a few lambs. Most structures called "storage rooms" in the site descriptions, which are simple masonry-walled areas

Figure 45. Navajo corral, 29 SJ 1019. Similar corrals with easterly to southerly exposures found at many Navajo sites.

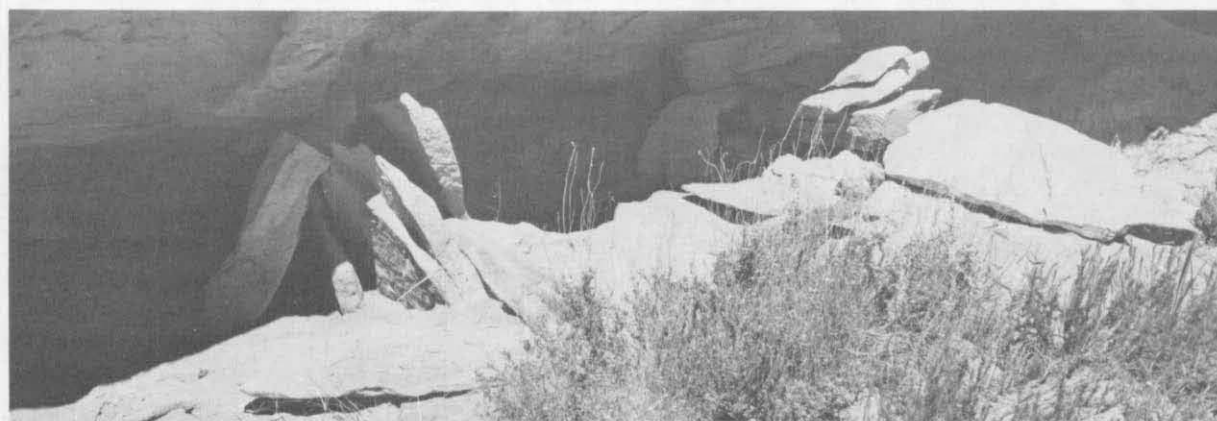


Figure 46. Small structures, 29 SJ 431. While generally recorded as storage structures in the surveys, they are more frequently identified as lamb pens by Navajo guides. Site exposure is to the east.

with open tops, have been reclassified as lamb pens. Traditional Navajo herding techniques did not include any effort to time the breeding of sheep. As a result, a lamb or two might be born at any time during the year, and these small pens might be in almost constant use if a family had a large herd. As European stockmen timed the breeding of their sheep so that all lambs would be born within a very short period in the spring, lamb pens are good indications of Navajo

Figure 47. Recent Navajo sweat-house, 29 SJ 280. Forked stick to right of entry probably used for placing hot rocks in the structure.



These were small logs hollowed along one side in which salt was placed (Lobato, 1974).

Sweat Houses

Navajo sweat houses are fairly common throughout the area, usually located along small arroyos where some privacy was possible and some natural shelter from the winds might be obtained. A total of 48 such structures in all states of preservation was recorded (Fig. 47).

Figure 48. Navajo bread ovens, 29 SJ 961. Absence of associated structures suggests this was the site of a large ceremonial gathering.



occupation at sites that lack more diagnostic features. Timed breeding has now been introduced among the Navajos, and once the date of its acceptance in the Chaco region is determined, the pens will also be useful for dating purposes.

A total of 389 features that could be called corrals, sheep beds, or lamb pens was noted during the survey. A large number of short wall segments and similar poorly defined remains are probably also indications of stock raising, but were excluded because they were too poorly preserved to permit any confidence in their identification.

Salt Troughs

Two log troughs of the sort used by Spanish herders for salt for stock were noted at one site.

Most were of the classic type—a miniature forked-pole conical structure oriented in an easterly direction, with an open hearth area a few feet to the east and a discard pile of burned rock on the north side. A few, however, were of the dugout style (Brugge, 1956). In many cases, only the discard pile could be discerned on the surface, and the inference that there was once a sweat house present is not as strong as might be desired. A number of piles of burned rock that may very well be discard piles were excluded from the total due to extreme uncertainty.

Ovens

Domed stone ovens of the Mediterranean *horno* style were common. A total of 79 such ovens was recorded, in most cases in association

with hogans (Fig. 48). Isolated ovens are probably indications of ceremonial gatherings where large numbers of people had to be fed. Although the Navajos grew some wheat even prior to the Fort Sumner exile (McNitt, 1972; Hill, 1938), it is likely that methods for its use were based entirely on techniques utilized with corn and wild grains until after the return from captivity. *Hornos* might be expected at early Spanish-American settlements, but none was associated with

uous courses, often including zigzag switchbacks on steeper slopes; by rock retaining walls along the lower slope sides with excavation on the upper side; and in some cases by water bars—simple checkdam-like structures—across the road bed to impede erosion. Any of the three ethnic groups might be responsible for these trails, but most are probably the result of Navajo initiative. Several segments of horse trail found near the monument boundaries are undoubtedly parts of the

Figure 49. Former wagon road, 29 SJ 1046, ascending slope diagonally in center of picture.



features suggesting Spanish construction. The camp cookery of Spanish sheepherders did not include such elaborate arrangements (Lobato, 1974 a and b).

Trails and Roads

Numerous road and trail segments were recorded on the survey (Fig. 49). In most cases, it is difficult to separate foot paths, horse trails, and wagon roads in the descriptions available, and none was followed for any significant distance for complete mapping. Most records are of those portions ascending mesas or crossing other relatively rough terrain where improvements were needed to facilitate travel. Historic trails differ from prehistoric roads in their lack of straight routes. They are characterized by sin-

boundary-patrol trail built by the Park Service since 1930; the use of water bars seems especially to suggest this origin. Several records under different site numbers thus seem to record different portions of the same route, and total number of sites is of little significance.

Cairns

One of the most common features in the Chaco region is the cairns that appear on many elevated points. Several different phenomena appear to be represented by the features lumped under this descriptive term. Some may be the old stone and stick pile shrines that are found throughout Navajo country (Van Valkenburgh, 1940), but none can be definitely identified as this type in the field descriptions. A large number

are closely associated with the places where roads and trails cross rims and seem to have been intended primarily as landmarks to help travelers find their way. Cairns of this sort are likely to have been built by the builders of the trails, regardless of ethnic affiliation. Others, generally built in columnar form on top of Anasazi ruins with pieces of fallen masonry, appear to be the result of pastime activity by sheepherders, and both Navajo and Spanish origins are probable. Some rock piles called cairns in the field notes would appear to be the result of random play by Navajo children, in some cases near home, in others while out with the sheep. Vagaries of preservation and description preclude any count of these various types of "cairns," but at least 160 features of this sort were noted that appeared too recent to attribute to Anasazi origins or that were obviously associated with other historic remains. Aside from the shrines, if any are included in the total, all or most probably date from the late 19th century or later. Prior to the end of the wars, it would certainly have been a disadvantage to the Navajos to have too many unneeded landmarks that might help strangers find their way around their country.

Pebble Caches

Two dozen features that were labeled "pebble caches" or "colored pebble caches" were noted during the survey (Fig. 50). These consisted of concentrations of small water-worn pebbles of quartzite and other hard rocks, often but not always close to hogan clusters. They were sometimes found in the open, and at other times squirreled away in small natural cavities under rocks or in the sides of outcrops. Local Navajos identify these as play "herds" used by children to represent livestock in games. Pebble caches not found near hogan sites seem frequently to be at locations that might make good stations for watching a grazing flock.

Storage Rooms

A great many chambers that do seem properly called storage rooms were recorded on the survey (Figs. 51 and 52). All that were walled natural cavities were retained under this heading, as were some others that seemed too big to be lamb pens. Some did produce small quantities of cached goods, in most cases items such as baskets, a rattle, weaving tools, and the like, which

would indicate Navajo use. Association with hogan sites and likely locations for sheep camps were common, but another favorite association seems to have been with trails. A total of 215 such structures was given the designation, but identification as Navajo, or even as historic, is uncertain in many cases.

Figure 50. Pebble cache, 29 SJ 496. Pocket knife added for scale.



Dams

Dams of at least three kinds were noted (Fig. 53). At many sites small checkdams were recorded. These were so numerous that counts were not kept, and all appear to have been built as erosion control devices by the Federal Government during the 1930's and early 1940's. In addition, a few dams seem to have been placed so as to store water for either livestock or domestic use. These are probably all of Navajo origin. Finally, one small feature labeled a dam is ob-

viously so non-functional that it is most likely the result of play activity by Navajo children. Navajos have used dams for water storage since at least the early 18th century (Hill, 1940:402), but whether any of the examples noted during this survey date earlier than the late 19th century is uncertain. The Anglo-American erosion control dams are small, well-preserved, and not found outside the monument boundaries. In all, 18 sites have dams associated.

Figure 52. Navajo corn granaries, 29 SJ 1614, probably associated with late 18th-century occupation at nearby 29 SJ 1613. Compare masonry style with that of figure 44.



◀ Figure 51. Small slab-walled storage room, probably of Navajo origin, 29 SJ 528.

Mines

Small coal mines date from the late 19th century and later. Of the three noted in the survey, one was used by Anglo-Americans and two by Navajos (Fig. 54). The use of coal for fuel is believed to be an Anglo introduction.

Quarries

In view of the popularity of stone as construction material in the Chaco area, the small

Figure 53. Small checkdam built of rocks placed on foundation of sticks, 29 SJ 1615, one of an extensive series on the north side of Chacra Mesa.



Figure 54. Coal mine, 29 SJ 2066. Probably the old Wetherill mine.

number of quarries for building rock—seven—seems low (Fig. 55). However, rock is so readily available without resorting to quarrying that it may be presumed that loose rock gathered from the surface sufficed for most needs. Some of the quarries used in historic times appear to have

been the same as those worked much earlier by the Anasazi.

Play Houses

Perhaps the most interesting features left by Navajos are miniature houses (Fig. 56). Only three were identified in the survey data—one an elaborate stone model of an Anasazi cliff dwelling, and one no more than a small rectangular stone outline. It is not unlikely that some other

Figure 56. Miniature Anasazi house built by Navajo stone mason as recreational activity, 29 SJ 1644. Popularly known as the "Doll House."



small rock outlines served similar functions. However, play houses are so frequently built of ephemeral materials—sticks and sand—that few survive for long.

Hearths

Hearths not a part of other features were common, both in association with larger sites and at isolated locales. Of the 80 hearths noted, 30 were at homesites where hogans were present; 29 were at campsites usually associated with indications of sheepherding, or along trails; and 21 lacked any association, and probably indicate places where individuals or small groups stopped briefly. Most sites produced only one or two hearths, but clusters of as many as four at sites with only hearths, and as many as five at hogan sites, suggest ceremonial gatherings. A few of the isolated hearths may be the only remains of long-abandoned sweat houses. Even when they are associated with hogans, Navajo origin cannot be automatically assumed, for there is suggestive

evidence that old hogan sites were sometimes later used as campsites by Spanish herders, who may have used any wood remaining on the site for their fires. However, Navajo use of exterior hearths for cooking, warmth, and at later sites for heating laundry water, probably explains their presence near hogans. Unless intimately associated with materials or features that can be assigned ethnic identifications, hearths cannot be assigned to any particular ethnic group.

and some meaningless combinations of letters and letter-like figures. Of the 266 sites where historic period rock art was noted, pictorial types were found at 119 and inscriptions at 119. A number of sites had both, and at 64 sites the types were not identified, being recorded merely as "Navajo" or "historic." The overwhelming majority of historic rock art was incised or scratched; a little may have been pecked, and some painted. However, in most of the latter two

Figure 55. Modern rock quarry, 29 SJ 1158, probably a result of Navajo use.



Rock Art

The historic rock art of the Chaco region falls into two major types: pictorial designs and inscriptions (Figs. 57-62). The former includes both realistic representations and design elements that may or may not have symbolic significance. The latter includes names, initials, dates, brands,

methods, identification as historic was uncertain.

Pictorial rock art is with very few exceptions of obvious Navajo origin, and seems to span the full range of datable Navajo occupation of the area. The earliest designs are probably those of Ye'i, the Navajo deities that often appear in masked form in ceremonies, done in sandpaint-

ing or modified sandpainting style, and stylized horse representations. A total of 26 sites included Ye'i. Horses were found at 88 sites, and range from early stylized drawings in a strongly "Indian" manner, with prominent hooves, spindly legs, and rather elongate bodies, to extremely naturalistic depictions in some of the more recent examples. At 32 sites, some of the horses had riders. A very few of these were also quite stylized with the triangular bodies and round heads so well known from early pictographs in the Canyon de Chelly area (McNitt, 1972). Weapons were uncommon. Only seven sites had older weapon types—lances in three cases, bow and arrow in one, arrows alone in two, and a shield in one. These are generally in early style, and may be presumed to date from the periods prior to the end of organized warfare. The few sites with firearms depicted may date either early or late. One, in a fairly representational style, may be a record of the killing of Richard Wetherill in 1910. At least 16 sites have panels in which Navajos are drawn in the "traditional" dress of the post-Fort Sumner era—the women in fringed shawls and long skirts, and the men in robes and hats. Half of these show the Squaw Dance of Enemyway, in each case including one girl carrying the "rattlestick" wand. The others also show gatherings of people, but are not readily identifiable as to the events intended. Wheeled vehicles appear at seven sites, and Anglo-American style two story structures with gabled roofs at two. It is of interest to note that specifically religious motifs, such as Ye'i and geometric elements reminiscent of sandpainting designs, seem to be restricted to early sites, and that the Squaw Dance, perhaps the most secular feature of all Navajo ceremonialism, appears only in the very recent examples, and is the only religious motif in the late sites. At least two panels depict the Ye'i Bichei dance, however, rather than the Ye'i themselves, and may have an intermediate date.

Schaafsma (1972) presents a classification of Chaco Navajo rock art which requires little modification on the basis of the Chaco Center data, despite her smaller sample. A gradation from her Gobernador Phase material to her Chaco Incised A seems to exist, as might be expected. Her Chaco Incised B was represented by several panels, not all of which are necessarily of ceremonial subjects. Two panels depicting the Ye'i Bichei Dance seem somewhat earlier than the

others. Schaafsma's suggestion that all panels in this group were done by one artist remains a good possibility, in which case the slight differences may reflect stylistic development through one person's lifetime, perhaps as influenced by Navajo singers and by Euro-American¹ artistic standards. Chaco Incised C remains a catchall category of diverse subjects done with varying degrees of skill. Many panels in this group approach Euro-American styles so closely that it

Figure 57. Navajo Ye'i or supernatural figure incised on rock surface, 29 SJ 1315. Dates from late 18th or early 19th-century.



often becomes difficult to decide whether some might not be the work of Spanish-American or Anglo herders and cowboys. However, her final category, painted handprints, may well be entirely of Anasazi origin. At least one panel is attributed by the Navajos to the Anasazi—a not infallible criterion, but one that requires more systematic checking.

Most of the inscriptions may be readily assigned to Spanish- or Anglo-American sources.

Figure 58. Panel of Holy People arranged much like those in Navajo sandpaintings, 29 SJ 1655.

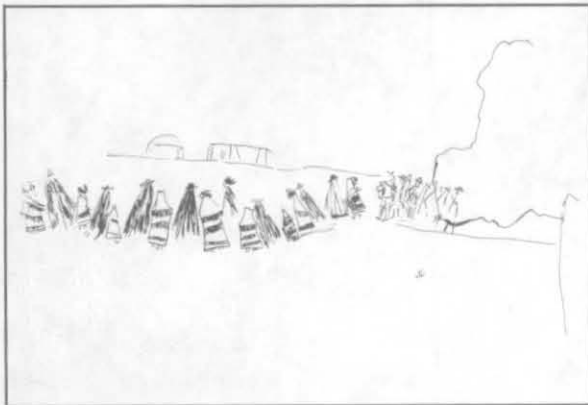
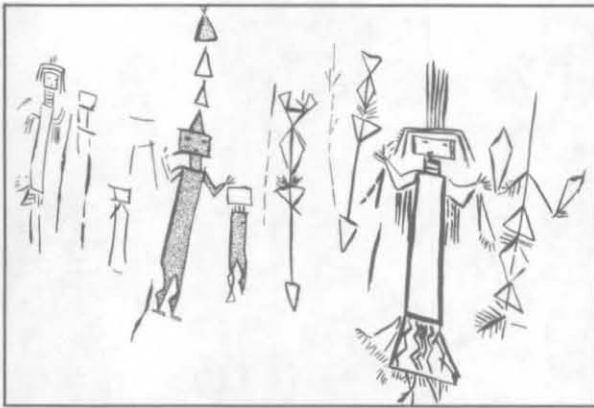


Figure 60. Petroglyphic representation of Squaw Dance, 29 SJ 1906. Dates from late 19th or early 20th-century, depicting singers, hogan, and ramada.

Spanish names are far more frequent, being noted at 64 sites, while Anglo names were recorded at only 22. However, the former show a narrower range of dates, from 1884 to 1941; the latter Anglo inscriptions range from 1858 to 1963. There are very few inscriptions of either dating prior to 1900. A heavy concentration of Spanish names between 1900 and 1941, with the names of towns in the Chama Valley and dates

in the winter months, were clearly left by *partidarios* or *caporales* while on winter range with herds from ranches far to the northeast. A *partidario* was a sheepherder who cared for a flock of sheep belonging to a different owner, receiving a share of the profits for his work. A *caporal* was a sort of foreman who oversaw the work of the *partidarios* and kept them supplied.

The nonsense inscriptions are probably the work of Navajos familiar with writing but them-

Figure 59. Incised depiction of Squaw Dance of Enemyway, 29 SJ 1516. Figure on left carrying the rattle-stick wand.

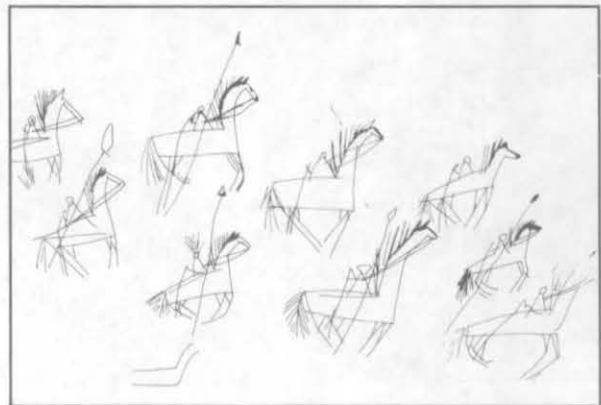


Figure 61. Incised drawing of Navajo riders with quirts and lances, 29 SJ 1379. Dates from late 18th or early 19th-century.

selves illiterate. A very few Navajo names also appear. In all, only 10 sites produced inscriptions that might be assigned to Navajo origin. Because this number is so small, the inscriptions lacking ethnic identity, including those of initials, brands,

"Euro-American" as used herein refers to cultures of ultimate European origin, generally including both Spanish-American and Anglo-American, or one of these without specifying which is involved.

and similar items, are presumed to be generally of either Spanish or Anglo origin.

Rock art seems to breed more rock art, and the impulse to draw or write on a rock where earlier peoples also left their mark is so clearly indicated by sites where a full series of entries from Anasazi times through modern inscriptions appears that associations cannot be presumed to indicate much beyond the awakening of a seemingly universal human impulse. It is in many

at what were probably no more than herding stations where a shepherd watched his flock for a few hours at most; and at least 19 are at hogan sites. It seems unlikely that Spanish sheepmen would leave their names at occupied Navajo homesites, and it is much more probable that the Spanish inscriptions were made by herders who camped at abandoned Navajo sites.



Figure 62. Inscriptions of Silvano Archuleta, January 3, 1922, 2nd Presiliano Martines, 29 SJ 2018. Archuleta's home is variously given as Canjilon and El Rito in other inscriptions. Undecipherable writing at bottom may give a different date for Martines, who was from Chama.

cases almost certain that Spanish and Anglo names mean little with regard to occupation of the site, a prime example being New Alto, where the majority of the names are clearly those of people who were just passing by. However, there is a high incidence of Navajo drawings and Spanish names in association, which seems to reflect a similar use of the land for ranging sheep. Many of these are at sheep camp locations; some are

Miscellaneous

A wide variety of miscellaneous features were noted, ranging from a garbage dump and a windmill at Anglo ranch sites to ubiquitous short segments of stone walls. Certain small dugout structures are suggestive of eagle traps (Hill, 1938), but identification is quite uncertain on the basis of surface evidence alone. More detailed investigation is needed of many indeterminate fea-

tures if their origins and functions are to be determined.

Pottery

Introduction

Ceramic data from the historic sites in this survey are relatively sparse, as is usual on Navajo sites. Only 142 sites out of 844 produced sherds of the historic period—that is, less than 17 percent. A total of 132 sites yielded Navajo sherds, while trade types were present on 41 sites. One site had Jicarilla Apache sherds. All other trade wares were of Pueblo origin. In order of popularity, the trade sherds were of the Ashiwi Series, the Puname Series, the Tewa Series, and the Northeastern Keres—the rarity of the last being quite unexpected (Table 4). Navajo types and varieties are based on the descriptions in Brugge, 1963.

A major portion of the ceramic collections seems to date from the period of transition from the early Dinétah utility and Gobernador polychrome to modern Navajo utility and Navajo painted. As a result, the variability of the collections is extremely great, and many sherds could be assigned to specific types only with the greatest uncertainty. The Transitional variety common in many sites dating in the 1760's to the south and west is represented, but other transitional variations that do not fit this variety are also common. Rather than create a proliferation of new varieties of dubious validity, most sherds were assigned to the types they most resembled. The combination of thin walled vessels with fillet decoration and sand temper shows a temporal overlap of traits that defies classification. In all cases where fillet decoration was present, the sherds were listed as Navajo utility, and are believed to date no earlier than the very late 18th century, but more probably after 1800. Lots lacking neck sherds adequate for ascertaining the presence or absence of the fillet decoration, while conforming in all other respects to Dinétah utility except for minor variations in the kind of sand temper, have been included with the earlier type; however, the high probability that in doing so some Dinétah utility identifications might date after 1800 must be recognized.

The relatively high proportions of Dinétah utility, Transitional variety, and Pueblo trade

types dating from the late 18th and early 19th centuries are consistent with the above explanation of the variability in native sherds, and are suggestive of extreme experimentation as the ceramic art introduced by the Pueblo refugees about the end of the 17th century began to be internalized in Navajo culture. Pueblo types are based on the descriptions published by Harlow (1973). Additional temporal data are available in sherd material by noting the changes in colors used for rims and bases and the use of slip over only a part of the base. These changes do not coincide with the changes in type as defined by Harlow, but are often easier to observe in sherd collections than are his type diagnostic characters based on entire vessels. The temporal ranges indicated for some sites by the ceramic data are greater than expected for Navajo sites. It is difficult to determine to what degree this is the result of long occupation, the presence of heirloom pieces, or the imprecision of ceramic types for the kind of close dating desired when dealing with sites of the historic period, although the last is probably the major factor. In a prehistoric site, placement within a 200-year span is fully adequate in survey data, but when correlation of an archeological sequence with the historic record is important, even survey data should be datable to within a few decades at most. Few cultural changes take place with the suddenness of historic events such as migrations, epidemics, wars, or conquests. A potter who learned certain techniques in her youth is unlikely to change them greatly later in life, when younger potters are adopting new ideas; Thus, the overlap in types may be expected to be long even in a product such as pottery, where durability of a single piece in use is rather limited. In spite of such factors, pottery remains one of our more sensitive temporal indicators for early historic sites, and it is necessary to take into account all the indications that this kind of evidence can supply.

Further work with the types and various individual traits may in time refine our knowledge so that we will be able to use ceramic data with greater precision. Useful as the type concept is, it will probably be separate traits that will permit the development of such refined chronology. It is unfortunate that the ceramic collections from this survey of the Navajo sites of the Chaco region are so sparse. This results in part from

Table 4 Pottery Distributions from Sites with Historic Components

[illegible]

Table 4 Continuation

SITE	NAVAJO SERIES											PUNAME SERIES											ASHIWI SERIES													
	Navajo Type Unk	Dinetah Utility	Dinetah Utility	Transitional Var	Dinetah Utility	Micaceous Var	Navajo Utility	Navajo Utility	Micaceous Var	Gobernador Poly	Navajo Painted	Filler Decoration	Lip Impressed	Jicarilla	Tewa Series	Type Unk	NE Keres Series	Type Unknown	San Pablo Poly	Trios Poly	Ranchitos Poly	St. Ana Poly	Red Rim	Black Rim	Zoned Base	Type Unknown	Acomita Poly	Kiapkwa Poly	McCarthy Poly	Zuni Poly	Acoma Red Rim	Acoma Black Rim	Zuni Red Rim	Zuni Black Rim	Zuni Red Base	Zuni Black Base
29 SJ 2131	-	-	-	-	37	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	X	-	-	-
29 SJ 2132	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	
29 SJ 2141	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2146	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2185	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2190	-	-	-	-	1	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2202	-	-	8	-	-	-	-	4	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2203	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2213	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2219	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2221	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29 SJ 2227	-	-	-	-	57	20	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	-	-	-	X	X	-	-	

1* = Vessel

X = Indicates Presence of individual traits.

() = Indicates sherds transitional between two types.

* = Kiva Poly w/Black Rim

.. = Filler strip, from a flat object, not a vessel

CIM = Cimarron Micaceous

+ = Unknown number of sherds of the type in previous collections from the site.

the fact that some of the sites had already been collected from as many as three times by earlier workers. On sites where the ceramic debris is normally limited, as is true of Navajo sites, very little is left for later collectors. While it is certain that our collections from some sites are thus diminished, it is also quite probable that the selection is far from representative. This is especially true for the earlier sites that normally produce the larger ceramic collections, for these are the sites to which earlier workers have given the most attention.

Dinetah utility, Indented variety

Shows the greatest influence of Puebloan tradition, and is most common in sites well to the north of the Chaco region. It is presumed to be the first utility pottery produced after the arrival of Pueblo refugees from the Reconquest in the 1690's, and to have had a relatively short lifespan. None was found in the Chaco region, and this absence is presumed to indicate that few

or none of the refugees from the eastern pueblos came directly to the region.

Dinetah utility

The classic Dinetah utility developed out of the indented variety very early in the 18th century, and soon replaced it entirely. Throughout the first half of the 1700's it was produced with considerable standardization in the Dinetah proper and perhaps with greater variability in neighboring sections. The fine, well-rounded sand temper so regularly used in the Dinetah may not have been available elsewhere, and more angular sands or even crushed rock seem to have been used in the Chaco region. Just how early the type was first produced here is uncertain, but it probably continued in use at least until the end of the 18th century, and perhaps into the very early 19th century. It is associated with post-1800 pottery at only eight sites. In five cases, the association is with Navajo utility, and in three with black-base Zuni pottery.

Dinetah utility, Micaceous variety

The micaceous variety of Dinetah utility is localized in the Mount Taylor area, Chacra Mesa, and Chaco Canyon, the last marking its northern limits. Dating is rather uncertain, but it probably extends from sometime in the early or mid-18th century until about 1800. Only five sites produced this variety. In two cases, it was associated with Dinetah utility; in four, with Dinetah utility, Transitional variety; and in two, with Navajo utility. There is one case each of association with Gobernador polychrome and Navajo painted. There are two associations with Zuni black-base pottery, one with Acoma black rim, and one with Puname zoned base. The cumulative weight of these associations indicates a timespan of predominantly late 18th to very early 19th century, suggesting that the assumed beginning date may be too early.

Dinetah utility, Transitional variety

This is a late 18th century variety that maintained a rather standardized tradition, resembling Dinetah utility in all respects except for the substitution of sherd temper for sand and some very slight thickening of the walls. It is best represented from sites with tree-ring dates in the 1750's to 1760's, but is believed to extend until about 1800. The popularity of this type (found at 32 sites) in the Chaco region is good evidence of a relatively populous Navajo occupation in the late 18th century. It is most common at sites in the eastern end of the monument, but does appear on a few sites even at the western end.

While this type lacks the fillet decoration of later Navajo pottery, a variant upper neck decoration of a row of vertical applique lugs was noted on one vessel. The use of decorative lugs may have briefly preceded the introduction of the fillet. It is a rare variant, and its only association here is with Puname polychrome and Puname series zoned-base—insufficient evidence to assist in its temporal placement.

Gobernador polychrome

Only seven sites produced sherds of typical Gobernador polychrome. The type probably ceased to be produced shortly after 1750. It is common enough to suggest that there was probably some occupation here prior to 1750, rather than a mere representation of heirloom pieces

brought from elsewhere, but it was probably never produced in the Chaco region, and indicates trade with the Dinetah.

Navajo painted

The highly variable painted varieties that developed from Gobernador polychrome are so scarce that they are for the present best lumped under this catchall designation. Although 18 sites produced sherds that fit the loose definition of the type, the total collection adds little to our knowledge, other than indicating that most occupation in the region postdates 1750.

Navajo utility

Navajo utility differs from earlier types in being thicker, usually having fine sherd temper, having fillet decoration, and being generally of smaller vessel size. Some examples have sand or crushed rock temper, a variation that seems especially common in the Chaco region. Vessel size seems to diminish with time, and examples with somewhat thinner walls and curves indicating moderately large jars are presumed to be early. Time range is from about 1800 to the present, the type appearing less skillfully made in more recent times as interest in pottery declined. By the late 19th century, it is generally rare, and is extremely rare on 20-century sites. It was present on 51 sites, making it the most common type on historic sites. Its frequency indicates a large Navajo population during the 19th century, but does not help greatly in placing sites much more accurately. The extreme variability of the type in the Chaco country does not appear to be susceptible thus far to refinement of dating in other than very general terms. Thus, relating sites to important historic events such as the war of 1804–1805, Mexican Independence, the beginnings of Anglo-American occupation, the final Navajo wars, the return from Fort Sumner, the development of trading posts, and similar phenomena can as yet be made only on the basis of guesswork. It is likely that better temporal control will be possible with further work, however. Two innovations at about the time of the development of Navajo utility were the addition of a decorative fillet and occasional decoration of jar lips with small indentations. The fillet is the most important, and its use is considered to be the most diagnostic trait of Navajo utility. A possible precursor of this trait—the use of small

decorative lugs in a row around the jar necks—has been noted above as of rare occurrence on Transitional variety jars. An even rarer find—fillet decoration broken from some sort of a flat object and having a paste similar to Dineta utility—was collected at one site. This was associated with post-1900 trash, and was undoubtedly no more than a late use of a Dineta-like paste in the production of some unique object. While notched or impressed rims seem to date about the same as fillets, they are too rare to permit more than a guess at present.

Only nine sites produced datable associations with fillets. These associations are generally consistent with a beginning date of about 1800 or a little earlier. The only site that appears too early for this interpretation is 29 SJ 1655, which produced one sherd of a thin-walled, sand-tempered vessel with an elaborate undulating fillet. All other associations at this site seem to be with 18th-century traits—a pueblito; Dineta utility pottery; Gobernador polychrome; and Dineta utility, Transitional variety. Whether this single occurrence is indicative of an early, but perhaps rare, use of the fillet decoration in this area or is merely the result of later deposition is not clear. That the Chaco region, where considerable experimentation in ceramics appears to have prevailed, might be the area where the fillet first appears and where unusually early examples might be found, is a possibility worth considering in further work in the area.

Cimarron micaceous

This Jicarilla Apache type, found on only one site in association with Dineta utility, suggests that the present contacts of the local Navajos with that tribe have significant time depth. The type is easily distinguished from the micaceous varieties of Navajo types by being much more heavily micaceous and having a strongly laminated appearance in cross section.

Tewa series

Although four sites produced sherds of the Tewa series, none of this pottery could be assigned to specific types, and present data do little but indicate some trade contact with the Tewa area.

Northeast Keres series

The very small quantity of trade pottery—

two sherds from two sites—from the northeastern Keres pueblos may be due to limited ceramic production with little used for export by those pueblos. However, Puname types may have been produced by the northeast Keres people (Warren, 1967), and trade with these pueblos might thus be greater than the ceramic data suggest at first glance.

Puname series

Twenty sites produced sherds from this series, which thus ranks as second in popularity among Pueblo trade wares. The earliest type, Puname polychrome, is absent, suggesting that this trade did not begin until after 1760. The latest type in the series, Zia polychrome, was also not identified in the collections, and it is thus probable that trade for pottery in this direction lasted less than a century, ending prior to 1850. San Pablo polychrome, dating from about 1740 to 1800 (Harlow, 1973:53), was the most common type, appearing on seven sites. Good Trios polychrome (Harlow, 1973:53–5) appears to be absent, but two sites yielded sherds that seem to be transitional between San Pablo and Trios. Two occurrences of Ranchitos polychrome (Harlow, 1973:56)—one of sherds intermediate between Ranchitos and Santa Ana polychromes and one of Santa Ana polychrome—suggest continued but diminishing trade into the 19th century. The timespan for this trade seems consistent with the presumed earlier period of intensive occupation.

Two features of temporal significance that appear in the Puname series independently from Harlow's types are the shift from a base slipped in red all over to a base slipped and polished only on the upper portion, which I refer to as red-zoned, about 1700 (Harlow, 1973:52), and a change from red rims to black rims about 1765 (Harlow, 1973:53). Insofar as may be determined in the sherds, most of which are relatively small, only the red-zoned base is present, appearing in three lots. Rims are red in five lots, and black in two. The proportions of rim colors do not correlate well with the proportions of types. If Harlow's dates are correct, the greater part of trade for pottery in this series would have taken place within a 5-year period, from 1760 to 1765. This does not seem a reasonable assumption. It is most probable that the change to black rims is rather gradual, with a significantly long period during

which both rim colors were produced.

Ashiwi series

Ashiwi series sherds were produced by 26 sites, making it by far the most common trade ware.

Neither Ashiwi polychrome, 1700–1760, nor its contemporary Acoma type, Ako polychrome, 1700–1770 (Harlow, 1973:60, 62, 65–6, 86–8) were identified in the collections. The post-1760 types—Acomita polychrome, 1760–1830 (Harlow, 1973:62–3, 86), in six collections, and Kiap-kwa polychrome, 1770–1850 (Harlow, 1973:66, 88), in eight collections—seem to indicate the major period of trade for pottery from the south and southwest. Only one later lot, of Zuni polychrome, 1850–1920 (Harlow, 1973:66–8, 88), was recovered. There were, however, numerous sherds that could not be identified in terms of Harlow's types, including eight lots from sites that did not produce any typable sherds in this series.

Certain changes in specific features can be identified in the Ashiwi Series that do help with temporal placement even when the type is not identifiable. These are the change from red to black on the rim, which according to Harlow (1973: 60, 67) took place about 1740 at Acoma and 1770 at Zuni and the change from a red base to a black one at Zuni, which is dated at about 1800 (Harlow, 1973:63, 66). Rim colors are identifiable in only two lots of Acoma sherds. In one case the color is red and in the other black. In the Zuni sherds, there were three lots with red bases and four with black, one lot with red rims and 12 with black. These figures are again most compatible with a late 18th- and early 19th-century date for the period of greatest trade for Pueblo pottery, but fail to suggest an end date.

Not only were trade contacts strongest to the south and southwest, but Zuni types seemed to predominate. Thus trade contacts, at least insofar as pottery is concerned, were with the more peripheral pueblos under the least rigid white control, and became stronger progressively in accordance with the lessening of white rule, excepting only the more distant Hopi towns, which were long completely independent.

Table 5 presents the number of sites from which sherds of various Pueblo trade wares were collected; the straight-line distance in kilometers from the southeast corner of Chaco Canyon Na-

Table 5 Factors Affecting Navajo Trade at Various Pueblos/ Number of Sites Producing Trade Sherds

	Sites	Distance (km)	Span. Pol. Control	European Goods
NE KERES	2	143	Strong	+
TEWA	4	150	Strong	+
SANTA ANA	9	129	Moderate	+
ACOMA-LAGUNA	12	115	Moderate	+
COCHITI-ZIA	14	115	Moderate	+
ZUNI	14	138	Weak	+
HOPÍ	—	228	None	—

tional Monument; and a rough rating of the degree of Spanish political control exercised during the late colonial period. Only pueblos that produced decorated types for trade are included. Jemez, long a resort for Navajos for trade and visiting, had ceased to manufacture painted pottery (Mera, 1939:4). The northern and southern Tiwa, particularly at Taos and Isleta, are known to have had some Navajo contacts, but also lacked painted wares for trade, and are not considered in this comparison. Trade with any of these pueblos cannot be expected to be reflected in the ceramic collections, but is certainly not ruled out because of this factor. It is unlikely that pottery was a major item of trade for the Navajos, but rather was incidental to trade in foodstuffs, dyes, cloth, and other goods, many of which would not appear in surface collections from open sites, as most of the materials from this survey do. Of the various trade goods available, most except for foodstuffs were of European or southern Mexican origin. If the quantity of pottery from a pueblo or group of pueblos is roughly proportional to the overall quantity of trade, as is assumed here, the effect of other factors in this trade should be apparent by a comparison such as that presented in Table 5.

The first factor listed is the distance from the Chaco region. For purposes of the comparison, the distance has been measured from the southeast corner of Chaco Canyon National Monument, because most of the larger sites of late Spanish colonial times with trade sherds are concentrated in that portion of the Monument and extend to the southeast beyond the limits of the Monument and the survey. It is apparent that distance correlates well with the numbers of collections, even though the differences in distance are not great in many cases. Only Zuni, at a moderately great distance, does not conform to the pattern.

The correlation of exchange with the availability of European trade goods is exact, although this must of necessity be based on a simple presence or absence rating due to our lack of information on internal trade patterns in New Mexico. All of the pueblos under Spanish rule that had at least fair access to European goods did receive trade from the Chaco Navajos, while the Hopi pueblos, having less opportunity than the Navajos themselves, received little or no trade from the Chaco region. It is probable that European goods were most plentiful along the Rio Grande in the vicinity of the larger Spanish towns, but also available in adequate quantities for the rather limited trade that the Navajos might require in the frontier settlements. Thus this factor, while giving an additional reason for the absence of Hopi contacts at Chaco, does nothing to explain the importance of Zuni as a trade center.

The third variable is the degree of political control exercised by Spain over the various pueblos. The Tewa and northeastern Keres towns were close to areas of concentrated Spanish settlement and major routes of travel within the colony. All had missions, and most had resident priests. Santa Ana, Acoma, Laguna, Cochiti, and Zia were a bit out of the way and on the frontier, where Spanish control was much weaker, and Navajos could come and go more freely. Zuni was especially remote, and often had no Spanish residents whatever, not even a priest. This was a period of intermittent warfare and growing distrust between the Navajos and the New Mexicans. It seems likely that Zuni offered an ideal situation, wherein the balance between availability of Euro-American goods and lessened official regulation was readily recognized by the Navajos as providing the safest and most advantageous market, especially in time of actual or threatened war. Obviously, this interpretation is based on a relatively small sample, and should be tested in other areas of Navajo occupation.

While most of the trade for Pueblo pottery seems to have taken place during the late Spanish colonial era, from perhaps 1750 into the early 1800's, the frequent wars that began with Melgares' term as governor of New Mexico in 1818 and lasted into the Fort Sumner exile probably did not halt Pueblo-Navajo trade entirely. However, sites that can be firmly dated within this period of frequent warfare cannot be identified

with any certainty on the basis of these survey data.

Minor Artifacts

Introduction

A very high proportion of the Navajo sites also include prehistoric components, or are so close to prehistoric occupations that any attempt to separate Navajo lithic artifacts from similar items of Anasazi and Archaic origin on the basis of surface collections would be futile. Navajo reuse of prehistoric stone implements is so well documented (Kluckhohn, Hill, and Kluckhohn, 1971:120-1, 173-6) that recycling presents additional complications. As a result, chipped tools of glass are the only artifacts produced by this technique that are described as definitely Navajo (See Appendix A).

Artifacts of wood and other perishable materials were often distinctively Navajo in character and frequently produced from sawed lumber, so that doubts as to their associations were few.

Cradles

Portions of two cradle boards were found, both made of commercial lumber. A lath-like piece of wood with two notches in the end and several on the sides may have been broken from the end of the canopy for a cradle board. These usually are supplied with holes for lashing to the cradle (Kluckhohn, Hill, and Kluckhohn, 1971:198-200), but the use of notches for such a purpose is a logical solution.

Weaving Tools

One half of a wooden spindle whorl made of commercial lumber was collected. It has a diameter of 10.0 cm. and a thickness of 1.3 cm. and was drilled in the center. A second spindle whorl made of sawn pine was about two-thirds complete. The edge was beveled. Dimensions are 8.3 cm. in diameter and 1.2 cm. in thickness, and the central hole is about 1.0 cm. in diameter. A cache of six peeled twigs with cut ends, ranging in length from 34.6 to 98.4 cm., was found together with a small broken batten showing little wear and a wooden object resembling a handle, perhaps of commercial origin. The small size of

the twigs and batten suggests that they may have been for use with a belt loom.

Beater

A stick 117 cm. long with a forked end wrapped with miscellaneous scraps of wire to produce a sort of network between the forks was found. Its use is uncertain. The collectors suggested that it was a pinyon beater, probably for beating the nuts from the cones. Navajo opinions should be sought regarding this object. The artifact type described by Kluckhohn, Hill, and Kluckhohn (1971:258-9) under this name is that used to knock cones from the trees, quite a different tool.

Sticks

One digging stick, 48.4 cm. in length and 2.6 cm. in diameter, was pointed at one end and had concave sides at the other end. Two worked sticks from another site may have been intended either as digging sticks or fire pokers. Miscellaneous worked sticks were found at two other sites.

Games

A piece of cottonwood root, roughly rectangular with roundish ends, black on one side, and measuring $10.8 \times 2.5 \times 1.1$ cm., seems almost certainly to have been made for one of the dice games formerly played by the Navajos, probably either the game called "seven cards" or the women's stick dice game (Kluckhohn, Hill, and Kluckhohn, 1971:395-402). An elongated oblan-ceolate wooden object with pointed ends and measuring 12.0×2.0 cm. may be a variant form for a similar purpose, but it lacks any coloring. A small wooden peg, $15.5 \times 1.7 \times 0.9$ cm., tapered to a blunt tip at one end, is too small to have been the pointer in the moccasin game unless used by children in copying adult play, and may well have had a more utilitarian function. It is included here for lack of better identification. A small hand-carved wooden sword is an obvious child's toy.

Religious

Three objects suggest religious use. The most enigmatic was a porcupine tail found at one site, the possibility of its having been intended for ceremonial use being quite uncertain. Another site produced a gourd of flattened spherical shape that had been used as a rattle. The handle

was missing, but it had two holes, one square for insertion of the handle and another opposite it circular to receive the tip. One half of the rattle was decorated with a painted red design resembling a spider web. This style of gourd rattle is similar to that used by the Ye'i dancers in Nightway (the "Ye'i Bichei"), and it was probably made for that ceremony.

One small wooden doll of cottonwood was found in a very eroded condition on an Anasazi ruin. It was undoubtedly the type used in curing (Kelly, Lang, and Walters, 1972), but is too weathered for any of the diagnostic features to be observed.

In addition, a group of artifacts from one site may, in part at least, be a portion of a medicine bundle. This includes four projectile-points found together as a "cache," a small ceramic insectlike object, two broken projectile-points, a broken stone blade, and a utilized flake. The cache of four points is suggestive of something that might once have been in a pollen bag or otherwise wrapped for inclusion in a set of ceremonial objects. The small effigy is similar to a "medicine turtle" of calcite that is in a bundle now located in the Army Medical Museum, which was obtained by an officer from Fort Wingate in 1878 during the Government's efforts to suppress a witch purge among the Navajos. The other items are not so likely to have been a part of a bundle. It should be noted that only unbroken projectile-points are considered by the Navajos as suitable for such use, although later breakage is entirely possible.

Basketry

Two baskets were found in the course of the survey. Both are early types.

One was a pitch-covered water jug, fig. 63, 38.0 cm. high and 35.0 cm. in circumference. Unlike modern Navajo pitched jugs, which are universally done in coiled weave, this is a twined basket with full unpeeled twig warps and split twig wefts. Both types of elements are probably three-leaved sumac (*Rhus trilobata*). The pitch, where still present, has a reddish color, and seems to have been applied only to the exterior surface. Two handles whittled from bent sticks are woven onto the sides, but no trace remains of any carrying strap that might have been tied to them. The body was globular, the fairly wide neck leading to an unflared rim reinforced with

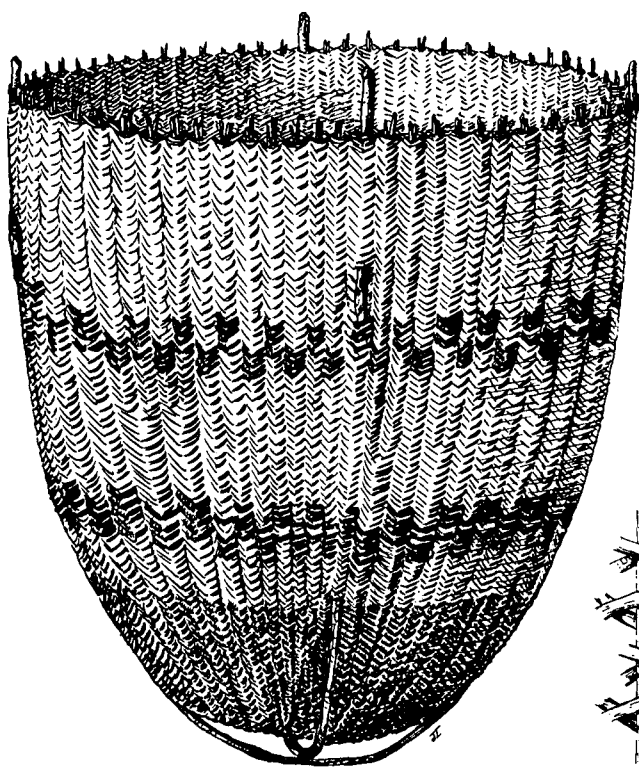


Figure 63. Navajo tosje
or basketry water jug
with detail.

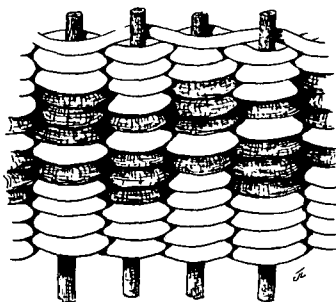
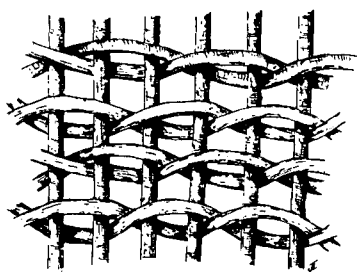
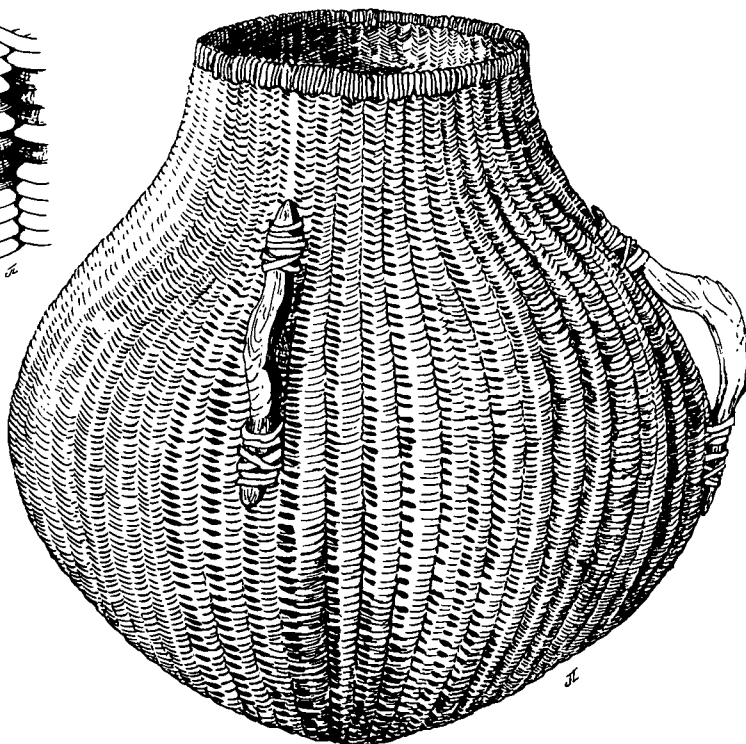


Figure 64. Navajo burden
basket with detail.



a coiled stitching. It differs from the coiled water basket reported by Vivian (1957) not only in weave, but in shape. Although quite warped, the original shape was probably much closer to that of the modern *tosje*, the Navajo pitch-covered water basket, than that reported by Vivian. The weave is a different matter. Done in a simple two-weft twine enclosing two warp elements between each twist, with four warps per inch (two per cm.) and three and one-half weft elements per inch (one and one-half per cm.) and no significant variation in the weave, it is more like the modern Western Apache *tus*, the Apache counterpart of the Navajo *tosje*, than the Navajo *tosje*.

The Vivian basket was associated with a burden basket and six utility jars lacking fillet decoration. Vivian concluded that the coiled example dated from prior to the last quarter of the 18th century. Allowing for some possible overlap in the change in weaving technique for *tosje*, it seems safe to conclude that this specimen was made before 1800. The site which produced the basket had an early Navajo occupation, probably dating no later than 1820.

The second Navajo basket recovered was another burden basket, probably very much like that reported by Vivian (1957), fig. 65A, but less complete. Part of one end of each bow remains, as well as somewhat less than three-fourths of the walls. The bottom is missing, and if the rim had any special finish, it also is no longer present. The evenness of the warp tops suggests that an estimated height of 40 cm. would be close to the original dimension, and the diameter is estimated to have been about the same or just slightly less. Warps vary from two to three in each cluster, but two are more usual. The distance between the centers of warp clusters averages about 1 inch (2.5 cm.). There are eight to ten wefts per inch (3–4 per cm.). The weaving material has some resemblance to rabbit brush (*Chrysothamnus*), although willow (*Salix*) and sumac (*Rhus*) are the only materials mentioned in published descriptions (Kluckhohn, Hill, and Kluckhohn, 1971:60–2). Rabbit brush is used by the Hopis for wickerwork trays (Underhill, 1948), and may well have been used in the very similar burden baskets made by the Pueblos. Like the Vivian specimen, this basket had alternating bands of peeled and unpeeled weft elements for decoration. The lower portion of the basket, some

12 cm., is of unpeeled twigs; next is a narrow band of peeled weft about 2 cm. wide; next a band of two rows of checkerboarded squares about 2.5 cm. wide; next an 8-cm. zone of unpeeled weft; next another checkerboard band about 2.5 cm. wide; and finally unpeeled twigs to the top of the basket.

This style of basket was used into the early 20th century (Franciscan Fathers, 1910:298). The site at which this example was found lacked any good associations for dating.

Arrow

One partial arrow of possible Navajo origin was recovered. It consists of a small portion of the distal end of a cane (*Phragmites communis*) main shaft, most of a wooden foreshaft, and a stone point. The specimen is 36.3 cm. long; the diameter of the main shaft is about 1.0 cm.; the diameter of the foreshaft at its proximal end, where it is broken, is 5.5 mm., tapering to a diameter of about 3.5 mm. at the distal end. The point is of grayish quartzite, is triangular with side and basal notches, and measures $2.2 \times 0.9 \times 0.3$ cm. It is set in a notch and attached by sinew binding which extends down the foreshaft about 2.2 cm. There is also some sinew binding about the main shaft 1.0 cm. from the end.

The arrow was found in a walled natural cavity and has no associations that might identify it as either Navajo or Anasazi. Comparison with Anasazi arrows in the collections of the Chaco Center and as illustrated by Pepper (1920:110) and Judd (1954:253) shows that the Anasazi foreshafts had a narrow tang for insertion into the main shaft, and that the diameter of the two at the junction was the same, resulting in a smooth surface. This arrow, however, has a foreshaft with no inset in the diameter at its junction with the main shaft, producing a sudden increase in arrow diameter. The foreshaft also has six shallow incised "lightening" grooves, five straight and one undulating, similar to those seen on modern Navajo arrows (Kluckhohn, Hill, and Kluckhohn, 1971:33, 36, 37, 39, 41), although the number used is greater than that reported ethnographically.

Reworked Trade Items

A number of examples of mass-produced trade items reworked for secondary use were found. Most interesting, perhaps, are the glass

sherds showing evidence of chipping or use (see Appendix). The amount of reworking varies from simple repairs, such as the use of wire to replace a broken bale handle on a pot or to bind a cracked wooden ax handle through intermediate improvisations, including the use of a piece of iron pipe to replace the broken handle of an ax, to completely new artifacts fashioned from materials no longer needed for their original functions.

Tin cans were frequently reused in new ways. Aside from possible use as simple containers, a use that would leave little trace, only four objects made from cans were collected. One, the top of a can folded four times to produce an elongate trianguloid object 9.8 cm. long and 3.7 cm. wide at the broad end, is of uncertain function, but may have served as a rough improvised tool for some immediate task and been soon discarded.

A complete milk can had a rectangular hole cut in one side and numerous holes punched in the bottom. Use as a candle holder has been suggested.

Another milk can was mounted on a wire handle and had five large holes punched in one end and six in the other. This may have been a noisemaker or missile used to scare sheep in the desired direction, or perhaps a pull-toy.

Two can tops with rims from the body of the can, appearing as though they had been removed with a key, had been fitted together and a nail driven through their centers to produce a toy wheel on an axle.

A heavy iron strap with two holes drilled near the center may originally have been a wagon part. One end had been hammered on the edges to provide a handle; the other end had been hammered on the sides to further flatten and broaden it for a chisel-like tip. Dimensions are 94.2 cm. \times 4.2 cm. \times 1.5 cm. This was probably a digging stick, for the body of the strap is only 5 mm. thick and would not have had the strength required for a crowbar.

A piece of sheet metal very roughly cut into an "X" with a hole in the center measures 8.4 \times 8.9 cm. No apparent function other than a toy can be suggested.

A rectangular piece of sheet metal measuring 11.6 \times 5.4 cm. has a nail hole in each corner, as well as one in the middle of each side. A punched oval hole 2.2 \times 1.8 cm. is in the center. It would appear to have been intended for some

utilitarian purpose, but what this was is uncertain.

Two sites yielded scraps of sheet copper. At one site, this was merely a single piece of moderate thickness with three ragged edges and one side cut rather unevenly as if done with a chisel. At the other site, two very thin pieces of copper were found. Both appear to have been cut with tin snips, and have raised ovals embossed with a pair of dies, as is done on some Navajo silverwork. One side of one piece is also coated with solder. There can be little doubt that these were produced in a silversmith's shop, probably by a child or an apprentice. They are so irregular that it is unlikely they were carried any distance, and the site was quite probably the home of a smith. Copper is often used for teaching an apprentice because it is much cheaper than silver (Adair, 1944:73).

Anglo-American Goods

Introduction

Trade for durable goods of Euro-American origin is not evident in this series until the appearance of materials obtained through Anglo-American sources (Table 6). Trade for metal, glass, and crockery items during Spanish and Mexican times can safely be assumed, but was on such a small scale, and the goods received of such value that they are very rare in surface collections. The present survey failed to recover any objects that can be assigned to this origin.

On the other hand, goods handled by Anglo merchants were present in considerable quantity. A very few of these in the collections might have been available in New Mexico prior to 1850, but none has a terminal date earlier than 1892, and only one that early. Another 12 have terminal dates between 1900 and 1903. The first and only known trading post within the survey area did not begin business until 1897 (McNitt, 1957:173), but other traders had established themselves near the canyon much earlier. Tizna-tzin, some 20 miles northwest of Pueblo Bonito, is said to have been the site of a trading post as early as 1878 (McNitt, 1962:339-40) and a well-known 1887 inscription at Pueblo Bonito advertises a store "10 miles down canyon," probably at the site of the later Tsaya Trading Post.

Thus the scattering of trade items, mostly cartridge cases and varieties of glass that might date as far back as the 1870's, may well be indicative of the beginnings of the Navajo trade or the initial intrusions of white settlers; however, no individual site can be confidently placed in this early period on this basis alone. Seven sites produced Indian sherds dating from earlier times, as well as late trade goods. In six of the cases, the terminal date for the pottery type is about 1800. Of these, five produced trade goods indicative of post-1900 occupation, and the sixth is at least post-1860, so that all seem more likely to be two-component sites than places of long occupancy. The seventh, with Kiapkwa polychrome, a type that ended about 1850 (Harlow, 1973:66), also produced only trade goods post-dating 1900, and the same conclusion appears most reasonable.

Combining the data from the 63 sites that produced datable trade goods with the probable beginnings of trading posts in the region, it seems best to date all such sites as at least post-1880. Many are clearly post-1900. Earlier trade items would not be unexpected, but will require careful identification when found.

A terminal date of 1945 is indicated by the dates obtained from the trade items, there being nothing with a beginning date beyond that year. White grazing activity continued on the eastern portion of the Monument only until 1946, and fencing of the Monument was completed in 1947 (Pierson, 1956). The last Navajo family left the Monument in May 1948 (Pierson, 1956), but most had been moved out about 1936 or 1937 (Robert W. Young, personal communication; Corbett, 1938). Very few items that became available after 1930 were recovered. The correlation of the archeological record with the known dates of removal of residents other than those under National Park Service supervision is remarkably good.

Trade Items

Mass produced or commercial items of Euro-American origin were not collected with sufficient regularity to enable the present sample to be considered entirely representative, but it is large enough to give some idea of the kinds of things the Navajos and their white neighbors imported into the region and the purposes these

served. In addition, many of these artifacts are datable within fairly narrow limits. Only a few sites produced a large enough collection of datable Euro-American trade to be considered well dated by this means (Table 6). The following list, with no effort at interpretation, provides eloquent testimony to the kind of life the people lived:

Dress and Grooming

- Buttons, Levi rivets, etc.—19
- Combs—1
- Boots—1
- Beads—10
- Miscellaneous jewelry—1
- Cosmetic and perfume bottles—4

Household

- Tin cans
 - Sardine—1
 - Canned meat—4
 - Lard—4
 - Coffee—4
 - Condensed milk—3
 - Baking powder—9
 - Other—7
- Bottles
 - Soda—2
 - Other—21
- Cooking Utensils (pots, pans, etc.)—7
- Wash basins—2
- Spoons, forks, and knives—7
- Serving dishes—8
- Mason jar lids—1
- Bottle caps—1
- Grain or coffee mill—1

Storage

- Trunk handle—1
- Water or gas cans—1

Tools

- Jackknives—3
- Axes and ax handles—4
- Hammers—1
- Hoes—1
- Nails—2
- Rivets—2
- Bolts—3
- Flashlight—1

Transportation

- Horseshoes—1
- Horseshoe nails—1
- Bridles and harness—9
- Stirrups and saddles—4

Wagon parts—1
 Axle-grease cans—4
 Weapons
 Rifle cartridges—27
 Shotgun shells—2
 Trap—1
 Housing
 Window glass—2
 Locks—1
 Tent accessories—3

Medicinal
 Pillboxes—2
 Mentholatum bottles—1
 Liniment bottles—1
 Miscellaneous medicine bottles—2
 Eyeglasses—1
 Religious
 Medal—1
 Recreation
 Toys—7

Table 6 Anglo-American Trade Sources

Site	Date	Comments
	1850 1900 1950 1970	
29SJ220	Cartridge Case	
29SJ221	Cartridge Case	
29SJ261	Button	
29SJ278	Comb	Glass and Metal Not Collected.
29SJ349	Glass	
29SJ350	Button Nail Glass Glass Glass Glass Glass Doll Bead	Probably Occupied Between 1900 and 1930. Also Barbed Wire Not Collected.
29SJ373	Frying Pan Enamelware Button Bottle Glass Glass Glass Enamelware	Probably Occupied Between 1900 and 1920.
29SJ422	Bottle 1929 1954	Also Occupation Pre 1800 Ranch House With Windmill.
29SJ433	Bottle Tin Can	
29SJ447	Spoon 1927	
29SJ448	Metal Lid Cartridge Case Glass	
29SJ487	Key Lid Glass Glass Glass Bead	Probably Occupied Between 1890 and 1930.
29SJ495		
29SJ497	Metal Lid	
29SJ506	Button	Glass and Metal Not Collected on the Site.
29SJ533	Tin Can Lid	Also Glass and Metal Not Collected.
29SJ535	Oil Can ca. 1935	Also a Quantity of Undatable Material Collected.
29SJ609	Glazed Iron Ware	Also Metal and Leather Not Collected.
29SJ647	Tin Can	Secondary Use as Noise Maker.
29SJ724	Tin Can	Secondary Use as Candle Holder.
29SJ741	Crackerjack Toy	Found Near. Not on the Site.
29SJ744	Tin Can	Also Glass and Metal Not Collected.

Site	Date	Comments
	1850 1900 1950 1970	
29SJ806	Bottle Plate Nail Switch Bottle Fork Bottle Bottle Bottle Bottle Bottle	Probably Occupied Between 1915 and 1930.
29SJ809	Glass	
29SJ810b	Glass	Secondary Use.
29SJ816	Glass	Also Glass and Metal Not Collected. Pre-1800 Pottery.
29SJ909	Cartridge Case Button Cartridge Case Button	Also Glass on the Site. Probably Dates Between 1900 and 1930.
29SJ916	Glass Tin Can	Also Glass and Metal Not Collected.
29SJ949	Metal Lid	Also Glass and Metal Not Collected.
29SJ965	Cartridge Baking Powder Lid Baking Powder Lid Dutch Oven Lids Spoon Cartridge Lids	Large Amounts of Glass. Metal. Leather. Rubber. Not Collected. Probably Dates Between 1890 and 1940.
29SJ967	Cartridge Case Lock	
29SJ971	Pencil Lid Bead Glass	Also Glass and Metal Not Collected.
29SJ1004		Also Barbed Wire Not Collected.
29SJ1034	Lid Lid	Secondary Use.
29SJ1058	Lid Lid	Also 2 Tin Cans Not Collected.
29SJ1059	Plastic	Also Metal Not Collected.
29SJ1064	Baking Powder Lid Baking Powder Lid	Also Metal and Glass Not Collected.
29SJ1067	Glass	Secondary Use.
29SJ1071	Button	Also "Modern Debris" Not Collected.
29SJ1093	Bottle	

Tobacco cans—3
 Beer bottles—9
 Whiskey bottles—3

Miscellaneous

Clocks and watches—2
 Pencil—1
 Ink bottle—1

Although the Navajos were the majority population and much of the white population was transient, the whites commanded more wealth

than did the Navajos and were more oriented to commercial products. Even on hogan sites, objects left by Spanish herders who later camped at the same place might be expected. An example of this that leaves no doubt, found on a site with four hogans, is an oval aluminum plate such as might have been part of an army messkit, engraved with the name "Jose M. Montoya," "Belgian Camp Spur," and a picture of the American flag. Thus a significant, if undeterminable, pro-

Site	Date	Comments
	1850 1900 1950 1970	
29SJ1109	Enamelware	Also Metal Not Collected
29SJ1169	Tin Can	
29SJ1262	Bottle 1903 1917	Also Metal and Glass Not Collected
29SJ1279	Plastic Ring	
29SJ1329	Baking Powder Lid 1907 Bottle 1929 1954	
29SJ1392	Enamelware Crockery	Also Metal Not Collected.
29SJ1408	Crockery 1875	Also Glass Not Collected.
29SJ1440	Lid 1917	
29SJ1510	Cartridge Case 1867 1902 Glass 1873	Secondary Use of Glass.
29SJ1604	Overall Clasp	Also Glass and Metal Not Collected.
29SJ1612	Enamelware Enamelware	Also Metal Horse Gear.
29SJ1619	Aspen Box 1917	Also Glass Not Collected. Pre-1800 Pottery.
29SJ1622	Cartridge Case 1908	Also Glass on Site.
29SJ1719	Bottle 1873 Cartridge Case 1882	
29SJ1746	Glass 1873	Secondary Use.
29SJ1771	Jack Knife	
29SJ1789	Glass Tin Cans	Also Other Late Trash.
29SJ1856	Rivet Glass 1873	Also Crockery, Tin Cans and Barbed Wire Not Collected
29SJ1862	Button Button Lid 1882 Spoon 1927 Bottle 1915 Glass 1917	Probably Occupied Between 1910 and 1930 Also Tin Cans, Crockery, Rubber and Other Trash Not Collected. Secondary Use of Glass.
29SJ2116	Bead Marble Tin Can Baking Powder Can 1903 Cartridge Case 1906 Button 1908	Other Glass and Metal Items Not Collected. Probably Dates Between 1910 and 1930 Also Pre-1800 Occupation
29SJ2131	Button Tin Cans Lids Jar	Other Glass and Metal Left on the Site. Also Pre-1850 Occupation
29SJ2132	Bottle 1905 1916	Also Pre-1800 Occupation.
29SJ2155	Glass	Secondary Use. Also Glass and Metal Not Collected.

Site	Date	Comments
	1850 1900 1950 1970	
29SJ2185	Cartridge Case	One Tin Can and a Wood-Stove Not Collected. Also Pre-1800 Occupation.
29SJ2190	Bottle 1903 1919 Cartridge Case 1908	Also Glass and Crockery Not Collected
29SJ2191	Bottle 1903	Also Crockery Not Collected
29SJ2197	Tin Can 1856	
29SJ2207	Glass 1873	Also Glass and Metal Not Collected
29SJ2224	Bottle 1917	
29SJ2227	Cartridge Case Tin Can Knife 1927	
29MC122	Bead	
ISOLATED FINDS	Enamelware Glass 1917 Baking Powder Lid 1925 Eye Glasses 1929 Baking Powder Lid Bottle 1903 Bottle 1915 1925 Tea Pot Bottle 1903	

portion of trade objects must have had non-Navajo use. Separation of this material in surface collections without association with individual structures is not possible except in rare instances.

Dating

Introduction

The chronology of the historic period sites is not as good as might be wished. Data regarding dimensions and architectural details were too inconsistently noted to allow for confidence in analysis for temporal variation, so that assignment to time periods must rely on presence or absence of major architectural features, such as pueblitos, *hornos*, and the like, and on artifacts included in surface collections. Of the latter, Indian pottery in the earlier sites and commercially manufactured items in the later sites offer the best evidence. The sites that might date between these two periods, from the middle of the 19th century, are the least susceptible to dating by these methods; their apparent scarcity must be considered in part at least to be a result of the absence of data that might place some of the many undated sites within this period. Documentation of Navajo settlement in contemporary sources is best for Chacra Mesa, and extends from the 1770's to the 1850's, while the journals of various expeditions through the canyon make little or no mention of Navajos. There is no mention of Navajos in the region during the last Navajo wars, but evidence of Navajo resettlement in the region very shortly after the return from Fort Sumner in 1868 is strong. Navajo occupation from that time until the present is well-documented, but again is frequently stronger for the Chacra Mesa country than for the canyon proper in the early post-Fort Sumner period. The great gaps in the historic record, however, leave much to be desired regarding the extent and nature of Navajo use and occupation of the region prior to the beginnings of the present century. A detailed chronicle of the documented history will appear in a later volume.

A final note on the limitations of our temporal placement of sites regards sites prior to the early 18th century: No Navajo sites that might be confidently assigned dates prior to the Reconquest have yet been reported anywhere, and the

present survey has done nothing to remedy this lack. If Navajo sites dating to the early Spanish or the proto-historic periods exist in the region, we have not yet learned to recognize them.

Temporal Differences

In order to determine some of the changes that came about through time in the Navajo archeology of the survey area, all historic sites that could be assigned to either of the two most easily recognizable time periods—the late Spanish colonial from about 1750 to 1820, and the “recent” from about 1880 to 1945—were selected, and all that had evidence of occupation in both periods or evidence of any Euro-American component were eliminated. This gave samples of 43 sites for the earlier period and 53 for the later. Some sites of dubious ethnic origin were also eliminated in spite of the fair probability that they were Navajo. Sites with Anasazi components were not eliminated.

The selection of these sites was based on ceramic dates and trade items, in the latter case even objects of obvious Euro-American origin that could not be dated but are in all cases obviously much more recent than the Spanish colonial period. Rock art inscriptions were the best evidence for eliminating sites with Spanish or Anglo components, but ranch houses and tent sites were also rejected. The elimination of sites that might have Navajo components from both periods was more difficult. Sites with both early pottery and recent trade goods could easily be identified. The only architectural features considered sufficiently well dated of features present at putatively early sites to force their rejection from the series were wagon roads. Most two-component sites were probably successfully identified, but sites that may have had occupation during the intervening period, 1820–1880, could not be separated.

Differences between these two series are not entirely in accord with the more impressionistic observations given above. The lack of identification of sites dating from about 1818–1868, the period of most intense warfare, leaves a gap in the sequence that would be very useful in attempting to explain the differences and similarities between the sites dating before and after. However, sites of this intermediate period are relatively non-productive of collectable material that may be used for dating, and lacking tree-

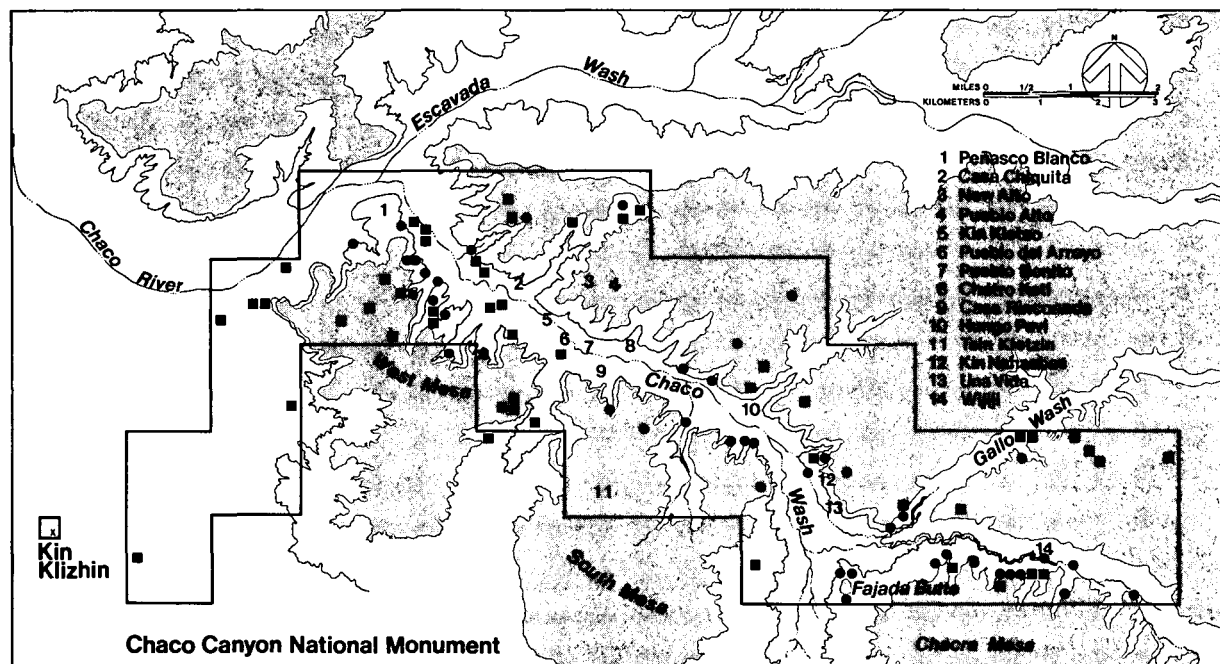
ring dates or very detailed architectural data, they cannot be distinguished with any certainty.

Locations

Early sites tended to cluster more strongly than late sites, and were seldom far from the canyon (Fig. 65). They also tended to be on the south side of the canyon. Twenty-eight sites were on the south side, or in southern tributaries; only two in the canyon bottom; and 13 on the north

may be accounted for by two factors: pressure from white stockmen in the east, and the desire for ready access to employment in the excavations at the major ruins in the Pueblo Bonito area. A sample bias is possible as well, for the greater density of early sites in the east might have led to more two-component sites and caused elimination of more late sites. However, this last factor must have had only a minor effect, and while it might have changed the proportions

Figure 65. Distribution of single component historical sites, dating ca. 1750 to 1820 (circles) and ca. 1880 to 1945 (squares).



side, or in northern tributaries. They also tended to be more common in the eastern (upper) end of the Monument, with 28 in R10W, and 15 in R11W.

The late sites were more scattered. Twenty-five were on the south side of the canyon, in southern tributaries, or on top of mesas south of the canyon. There were seven on the canyon floor. Twenty-one were on the north side of the canyon, in northern tributaries, or on the mesa to the north. Late sites were more common in the western end of the Monument, with 18 in T10W, and 35 in R11W. The strength of this shift to the west was greater than anticipated, but

slightly, it does not appear probable that it would change the overall distribution.

Location with relation to terrain is of interest. The late series includes almost as many sites situated on benches or talus, or both, or in rincos, out of the way with some apparent desire for privacy or concealment, as does the early series: 29, as opposed to 33. Proportionately, however, there was less concern manifested for this type of location in the later series: 23 late sites are in open locations, and only seven of the early sites are so situated. The remainder of the sites are in indeterminate locations.

The cessation of warfare is sufficient to ac-

count for the greater prevalence of sites in exposed locations in the recent series. The fact that a significant proportion of the early sites are in open locales and that a number of the early sites in other locations are not particularly well-situated for either defense or concealment suggests that tactical concerns were not foremost in the selection of homesites, even during the earlier period. Warfare during the first parts of the early periods was limited to Indian enemies (Reeve, 1959), and even in the latter part warfare with the Spaniards was rather sporadic (Brugge, 1968). A few sites of this period appear to have functioned as defensive retreats, and this may have been adequate to meet the demands of protection during this time. Unfortunately, an analysis of the tactical considerations of the period of intensive warfare, from about 1818 to 1868, cannot be made on the basis of present data. However, the effects of this half century of unrest are clearly evident in the recent sites, where over half of the sites continued to be located with reference to terrain features conducive to concealment. Continued suspicion of non-Navajos, kept alive by the competition with Euro-Americans for range in this off-reservation area, survived and influenced to a greater or lesser degree many Navajos' thinking when choosing homesites.

One factor that Navajos still consider important is direction of exposure as determined by slope. A southerly or easterly exposure that provides the greatest reception of the sun's warmth is preferred, and is clearly present in both series, by a ratio of 30 to 13 in the early sites and 34 to 18 in the later series. The lower proportion in the more recent series is easily attributable to the greater number of sites in open locations where no particular exposure was noted. In both series, however, a desire to directly utilize solar warmth and thereby conserve fuel can be considered to have been important. This would have been especially significant in the Chaco region, where firewood is scarce, and where coal, once its use was accepted, required considerable labor to mine and haul.

Purely economic factors appear to have been taken into account in both periods. Access to wage work has already been noted, but more traditional sources of livelihood, in particular agriculture and animal husbandry, should be noted as well.

Almost any location with relation to vege-

tation would give ready access to pasturage. The vast majority of sites were in grassland or a shrub-grass association, but these are the most extensive vegetational types in the Monument. More interesting in this regard is the fact that nearly all sites are close to the borders of vegetation zones. This is probably largely the result of placing sites in less open locales, but it would place two or more plant communities within easy grazing range, and thus perhaps slightly reduce the need for changes of residence. It cannot be viewed so much as a strong factor in site selection as a side effect that was probably beneficial. There was no significant difference between early and late sites in location with regard to plant communities.

There does seem to be a stronger association of early sites with canyon bottomlands suitable for cultivation. The finding of corncobs at a number of the earlier sites is also suggestive of a stronger orientation toward agriculture. However, many late sites are near potential field locations, often the same cultivable areas associated with early sites. Farming must have been important in both periods, but relatively more so in the early period.

Summary

The historic period sites in Chaco Canyon National Monument are indicative of human use and occupancy for a period of about two centuries. The earliest sites are Navajo, and date from at least as early as the mid-portion of the 18th century. During the first part of this early period the Navajos' only enemies were other Indian tribes, but beginning in 1774 there were occasional wars with the Spaniards. While there are some defensive retreats during this period and an obvious effort to build sites on high ground, the concern for defense was not overwhelming, and many sites seem to have been close to cultivable land and relatively exposed. The economy was based on farming, livestock raising, and handcrafts. There was some trade with nearby Pueblo peoples, with the choice of the pueblo seeming to depend as much on availability of Euro-American goods and freedom from official Spanish regulation as on distance.

Beginning in 1818, warfare with the whites became much more intense. This was especially true after Mexican Independence, when trade

over the Santa Fe Trail supplied the New Mexicans with more plentiful firearms and ammunition (Brugge, 1968:147). Sites from this time until the return from Fort Sumner have not been identified, but may well be represented in the survey by some of the less productive hogan groups in well-concealed locations. If Navajos were within the Monument boundaries, they were engaging in far less trade for durable goods.

Navajo return to the Chaco Canyon area shortly after the release from captivity at Fort Sumner seems indicated, but really well-dated sites do not appear until the 1890's. Occupation until the fencing of the Monument is evidenced by the archeological data, as well as by the historic records. Farming and herding remained important means of livelihood, but it is known that wage work also became important. Trade was generally with trading posts established within the area.

The earliest whites to penetrate the canyon area were almost certainly the Spaniards, but the earliest archeological evidence consists of inscriptions left by Anglo-American troops in 1858, 9 years after the first known Anglo expedition through the canyon (McNitt, 1964), and 35 years after the first recorded Mexican passage (Brugge, 1964). Remains of Spanish-American sheep camps and early settlers' cabins are sparse, but the numerous inscriptions on the rocks and canyon walls indicate a constantly increasing white presence.

An integration of more detailed archeological data with a chronicle of recorded events within the Monument and the neighboring region will allow better understanding of the historical and cultural changes and processes. This initial survey suggests some of the problems that must be solved if we are to have a clearer understanding of the historic period, and particularly of Navajo history in the Chaco country. The course of Navajo cultural development must be outlined more fully, and the effects of climate, erosion, intercultural relations in trade, war and competition for resources, and acculturational and adaptive responses need to be determined. The great wealth of data available with regard to archeology, climatic history, geological and ecological changes, tradition, oral history, and documented history make this project one that can carry our knowledge far beyond the results of this beginning effort.

Appendix: The Glass Artifacts

by W. James Judge

Description

A total of 22 glass artifacts was analyzed both macro- and microscopically to determine function and provide an insight to the technological aspect of the Navajo use of glass as an artifact material.

The "Analysis" section of this appendix lists each one of these implements, the attributes exhibited, and an interpretation of function. The following format is used:

Site Number/ FS Number	Description of use attributes
1. Dimensions in millimeters, weight in grams.	
2. Material type, material source, morphology of item.	
3. Presence or absence of modification; technique if present	
4. Visible wear patterns.	
5. Interpreted functional category.	

Table 7 summarizes the frequency of occurrence of the attributes recorded.

Of the 22 items analyzed, four (17%) were neither modified nor utilized. By unutilized, I mean that no wear patterns were visible. It is very possible that some of the glass edges could have been used for cutting that did not leave any visible wear. Unfortunately, there is no way to discern this. Seven artifacts (32%) were not modified (i.e., not retouched), but were used. Thirteen (59%) were both modified and used. In general, this modification was the result of percussion (perhaps soft-hammer) flaking. It was usually limited in extent, frequently employed to produce a concave or "spokeshave" use edge. It is difficult to interpret the exact nature of the technique of modification on glass, since I am not too familiar with glass as a basic material.

With regard to interpreted wear patterns, 14 artifacts (64%) exhibited unidirectional stepfracture; two (9%) had bidirectional stepfracture; three (14%) showed attrition; and six (27%) showed evidence of polish or heavy abrasion. As a result, the following functional categories were interpreted: 13(59%) were used in scraping; nine (41%) were used as "spokeshaves" (i.e., this many had concave scraping surfaces of varying widths); three (14%) were used in cutting; and two (9%)

Table 7 Character of Use-Areas, Navajo Glass

SITE No.	FS No.	Unmodified Unutilized	Unmodified Utilized	Modified Utilized	Unidirectional Step Fracture	Bidirectional Step Fracture	Attrition	Polish/Abrasion	Scraping	"Spokeshave" (Concave Scraper)	Cutting	Piercing/Gouging	Multipurpose	Color
816	259	1	-	-	-	-	-	-	-	-	-	-	-	Brown
1862	1684	-	1	-	1	-	-	-	1	-	-	-	-	Green
1856	1655	-	1	-	1	-	-	-	1	1	-	-	1	Brown
809	823	-	1	1	-	1	1	-	1	-	1	-	1	Green
2207	1883-1	1	-	-	-	-	-	-	-	-	-	-	-	Brown
2207	1883-2	1	-	-	-	-	-	-	-	-	-	-	-	Brown
2207	1883-3	-	1	-	1	-	-	1	1	1	-	-	1	Purple
2155	1817/4	-	-	1	1	-	-	1	1	-	-	-	-	Green
1067	1663/4	-	-	1	-	1	-	-	1	-	-	-	-	Brown
806	182	-	-	1	1	-	-	1	1	1	-	-	1	Green
1034	209	-	-	1	-	-	-	1	-	1	-	1	1	Green
350	1964	-	-	1	1	-	-	1	1	1	-	-	1	Clear
373	1957	-	-	1	1	-	1	-	-	1	1	-	1	Green
1510	557-1	-	-	1	-	-	-	1	1	-	-	-	-	Brown
1510	557-2	1	-	-	-	-	-	-	-	-	-	-	-	Brown
350	1636/4	-	-	1	1	-	-	-	1	-	-	-	-	Brown
433	7	-	-	1	1	-	-	-	1	-	-	-	-	Brown
892	1599/4	-	-	1	1	-	-	-	1	-	-	-	-	Purple
1746	677-1	-	1	1	1	-	-	-	-	1	-	-	-	Brown
1746	677-2	-	1	-	1	-	-	-	-	1	-	-	-	Green
1635	1635/4	-	-	1	1	-	-	-	-	1	-	-	-	Green
810B	963	-	1	-	1	-	1	-	1	-	1	1	1	Brown
TOTALS (N = 22)		4	7	13	14	2	3	6	13	9	3	2	8	
%		.17	.32	.59	.64	.09	.14	.27	.59	.41	.14	.09	.36	

were used in piercing or gouging functions. Of the 22 items, eight (36%) were used as multi-purpose tools; that is, they exhibited more than one edge with different wear patterns.

With regard to material types, I only distinguished the glass by variations in color—brown, green, purple, or clear. Eleven (50%) of the items were of brown glass, eight (36%) were green, two (9%) were purple, and one (5%) was of clear glass. The significance of this distribution is not immediately apparent. There seems to be a slight tendency to select green glass for artifacts which were modified (retouched), but frequencies are too low to determine statistical significance.

Analysis

29SJ 816/FS #259 Unmodified, unutilized

1. L = 80.0, W = 57.0, T = 06.0 mm; Wt = 30.8 gms.
2. Brown glass, curved. Side of bottle. Triangular shape.

3. Unmodified. "Retouch" scars are natural fracture.

4. No visible wear on edges or projection.

29SJ 1862/ Unmodified,
FS #1684/4 utilized (scraping)

1. L = 59 mm, W = 47.5 mm, T = 06.5 mm; Wt. = 025.5 gms.
2. Green glass, flat. (Glass pane?) Triangular.
3. Use-retouch on right portion of convex edge. Use-"retouch" only.
4. Unidirectional step-fracture, probable result of scraping hard material. No polish. Use-edge portion 10 mm long.
5. Probably a scraper.

29SJ 1856/ Unmodified,
FS #1655/4 utilized (scraping)

1. L = 84.0 mm, W = 64.0 mm, T = 04.5 mm; Wt. = 040.5 gms.
2. Brown glass, curved. (Side of bottle w/bottom curve.) Irregular shape.
3. Use-"retouch" only, in three areas.

4. Unidirectional step-fracture. No polish. Two use-areas straight, one concave.
 5. Scraper, and possible spokeshave use.
- 29SJ 809/ Modified, utilized
FS #823 (scraping, cutting)
1. L = 65.0, W = 46.0, T = 06.5 mm; Wt. = 035.1 gms.
 2. Green glass, curved, (Side of bottle right above base.) Irregular shape.
 3. One end modified to convex shape by percussion. Possibly bilaterally modified.
 4. Two use-areas. Modified area shows slight unidirectional step fracture, bidirectional in places. Opposite edge of artifact shows attrition wear on sharp, unmodified edge. No polish.
 5. Modified scraper, unmodified knife.
- 29SJ 2207/FS #1883/4
- #1 Unmodified, unutilized.
1. L = 38.0, W = 37.0, T = 04.0; Wt. = 06.8 gms.
 2. Brown glass, Curved. (Side of bottle?) Triangular.
 3. Unmodified; "retouch" scars are natural fracture.
 4. One edge w/possible wear, but too thin to discount bag attrition.
- #2 Unmodified, unutilized
1. L = 94.0; W = 35.5; T = 04.0; Wt. = 16.2 gms.
 2. Brown glass, curved. (Side of bottle?) Triangular w/projection.
 3. Unmodified; "retouch" scars are natural.
 4. Projection could show bidirectional step-fracture, but too thin to tell.
- #3 Unmodified, utilized (scraping)
1. L = 59.5; W = 29.5; T = 03.0 mm; Wt. = 10.2 gms.
 2. Purple glass, curved. (Side of bottle?) Rectilinear.
 3. Unmodified, except for possible removal of one flake to create spokeshave concavity.
 4. Well-defined, unidirectional step-fracture for 9 mm along one edge. Slight evidence of abrasion (rounding) visible at 30 power. Concave (6.0 mm) "spokeshave" area borders this, with only slight wear.
 5. Scraper w/possibility of use as spokeshave.
- 29SJ 2155/ Modified,
FS #1817/4 utilized (scraping)
1. L = 08.0, W = 12.0, T = 07.0; Wt. = 01.1 gms (broken in use).
 2. Green glass. (Original morphology unknown.)
 3. Unilateral modification by steep edge retouch (probable percussion). Artifact is broken end of a projection (similar to chisel graver) approximately 12.0 mm wide.
 4. Very positive unidirectional step-fracture. Lateral edge shows very heavy wear—step-fracture undercuts edge w/heavy abrasion.
 5. Scraper (chisel/graver morphology).
- 29SJ 1067/ Modified,
FS #1663/4 utilized (scraping)
1. L = 62.5, W = 40.0, T = 11.0; Wt. = 47.5 gms.
 2. Brown glass. Flat bottom of bottle w/turn up at edges. Triangular.
 3. Limited large retouch flakes at "distal" end of tool. Retouch flakes are bilateral. Use was made of curve from base to side of bottle to enhance edge.
 4. Wear is limited to slight bidirectional step-fracture. This occurs on several use edges, in addition to the modified one.
 5. Heavy-duty scraping, but of limited duration.
- 29SJ 806/ Modified,
FS #182 utilized (scraping)
1. L = 45.5, W = 37.0, T = 06.0; Wt. = 13.4 gms.
 2. Light green glass. Flat bottom of bottle w/edge curve. Irregular shape.
 3. Large, percussion-flake retouch of flat bottom to produce concave morphology.
 4. Predominant wear on retouched (concave) edge is polish (rounding of edge). Some slight step-fracture. Use-edge on opposite side of implement has unidirectional step-fracture (uses "lip" of bottle side as sharp edge).
 5. Scraper w/possibility of use as spokeshave (27.0 mm wide).
- 29SJ 1034/ Modified, utilized
FS #209 (scraping, graving)
1. L = 46.5, W = 21.5, T = 06.0; Wt. = 09.0 gms.
 2. Light green glass. (1/4" window pane?) Triangular w/modified projection.

3. Percussion-flake retouch along one edge to form projection. Opposite edge has concavity modification.
4. Very heavy abrasion and rounding on projection w/heavy abrasion continuing along right lateral edge. Some light "polish" on "spokeshave" concavity.
5. Graver/abrader w/some spokeshave use.

29SJ 350/ Modified,
FS #1964 utilized (scraping)

1. L = 42.0; W = 37.5; T = 05.0; Wt. = 16.4 gms.
2. Plate glass. (Window pane?) Rectilinear shape.
3. Large flake retouch along one edge. Many other edges used.
4. Very heavy abrasion and rounding along modified edge. Lighter abrasion and "nibbling" (unidirectional) along other edges. One small (05.0) spokeshave area.
5. Scraper (roughly equivalent to side scraper) with heavy use.

29SJ 373/ Modified,
FS #1957 utilized (scraping)

1. L = 55.5; W = 38.5; T = 07.0; Wt. = 24.3 gms.
2. Light green glass, curved. (Side of bottle.) Irregular shape.
3. Large flake retouch to form spokeshave concavity on one edge.
4. Unidirectional step-fracture in modified concavity. No polish. Several other edges exhibit nibbling (usually unidirectional).
5. Primarily a spokeshave (width 13.0) w/some possible attrition.

29SJ 1510/FS #557

#1 Modified, utilized (scraping)

1. L = 60.0, W = 36.0; T = 07.0; Wt. = 19.6 gms.
2. Brown glass, curved. (Side of bottle) Basically triangular.
3. Edge retouch along sharp distal break to form convex morphology.
4. Very light abrasion along modified edge. Concavity (08.0 wide) worked into modified edge shows no difference in use.
5. Scraper with limited, light use.

#2 Unmodified, unutilized

1. L = 37.0, W = 38.0, T = 07.0; Wt. = 24.1 gms.

2. Brown glass, Curved. Side and base of bottle. Irregular.
3. No modification.
4. No evidence of use (some bag attrition).

29SJ 350/ Modified,
FS #1636/4 utilized (scraping)

1. L = 20.5, W = 18.5; T = 05.0; Wt. = 01.8 gms.
2. Brown glass, curved. (Side of bottle.) Triangular (possibly broken in use).
3. Well-executed, unilateral modification of scraping edges (two sides).
4. Small, unidirectional step-fracture wear on modified edges. Three very prominent, sharp projections show little use.
5. Scraper, possibly broken during use.

29SJ 433/ Modified,
FS #7 utilized (scraping)

1. L = 47.0, W = 56.0, T = 05.5; Wt. = 27.4 gms.
2. Brown glass, curved. (Side of bottle.) Rectilinear.
3. Limited retouch along one edge.
4. Slight unidirectional step-fracture on modified edge. Very little evidence of wear.
5. Scraper with little use. Possibility that modification retouch is actually a function of scraping hard material.

29SJ 892/ Modified,
FS #1599/4 utilized (scraping)

1. L = 17.0, W = 12.0, T = 04.0; Wt. = 00.6 gms.
2. Purple glass, curved. Irregular outline.
3. Systematic retouch (possible pressure) along one edge. Unilateral.
4. Unidirectional step-fracture on modified edge.
5. Scraper. Probably a broken tip-fragment from larger implement.

29SJ 1746/FS #677

#1 Modified, utilized (spokeshave).

1. L = 44.5, W = 17.0; T = 04.5; Wt. = 04.7 gms.
2. Brown glass, curved. Irregular outline.
3. Three well-defined spokeshave concavities along one edge. Two of these may result from use-modification alone, but one was definitely shaped by unilateral retouch. Latter measures 12.0 wide. Others too shallow to measure.

4. All concavities show unidirectional step-fracture, some undercutting, but little or no polish.

5. Spokeshave.

#2 Unmodified, utilized (scraping).

1. L = 42.5, W = 30.5, T = 06.5; Wt. = 13.3 gms.
2. Green glass, curved. (Bottle side?) Rectilinear.
3. One spokeshave concavity possibly modified, but probably results from scraping use on hard material (10.5 wide).
4. See 3 above. Slight unidirectional step-fracture in concavity.
5. Scraper (spokeshave) use.

29SJ 350/

FS #1635/4

Modified,
utilized (scraping)

1. L = 44.0, W = 30.5, T = 05.0; Wt. = 12.4 gms.
2. Dark green glass, curved. Irregular shape.
3. Two "spokeshave" concavities flaked by retouch along opposite lateral edges. One is shallow and 21.0 wide. The other is double (15.5 and 08.0).
4. Slight unidirectional step-fracture in concavities. No polish or abrasion.
5. Concave scraper.

29SJ 810B/

FS #963

Unmodified,
utilized (scraping, cutting)

1. L = 62.5; W = 46.0, T = 05.5; Wt. = 27.6 gms.
2. Brown glass, curved. (Side of bottle w/basal lip.) Triangular.
3. Little or no modification. "Retouch" scars are probably use-derived.
4. Heavy fracture scars (some bidirectional) on dorsal side of one lateral edge. Limited unidirectional step-fracture on basal lip. Prominent projection shows limited attrition and unidirectional (not rotary) step-fracture.
5. Scraper/knife/punch.

Conclusions

In general, it is obvious that the primary use to which glass artifacts were put by the Navajos was that of scraping. Scraping functions varied considerably, but the majority indicate use of a concave scraping surface, which has been termed "spokeshave" here. Whether or not they actually

functioned as spokeshaves is unknown. A concave scraping surface can be used to smooth a variety of surfaces.

The degree of use is difficult to interpret, due to my unfamiliarity with the durability of glass edges used in scraping. A total of 27 percent of the artifacts used as scrapers showed heavy wear (polish/abrasion), and thus indicated heavy usage. Others showed only minimal wear, and some none at all. In general, I would say that the degree of usage of individual artifacts was probably less than that shown by Anasazi tools, but this is a subjective feeling.

With regard to technology, the modification or retouch technique is difficult to interpret on glass, but in general it seems unrefined, and directed toward the immediate task at hand. I did not pick up any evidence of the production of a "curated" tool—that is, one which was carefully made to be carried around and used for either specific or general tasks. Frequent use was made of the natural morphology of the broken glass, such as using the "lip" formed by the base/edge junction of a bottle to form a ready scraping surface. In all probability the tools were expedient and directed toward an immediate task, and then discarded because they were worn out. I doubt if any were resharpened.

Comparing Navajo use with that exhibited by Anasazi implements, two distinctions emerge. First, there is a tendency for the Navajo to select either surface (dorsal or ventral) of a scraping edge to use in their work. Prehistorically, the wear patterns on such a surface are almost always directed toward the dorsal side. The Navajos did not indicate any preference for dorsal over ventral. This could possibly be due to the lack of a true flake morphology in glass fragments, or it could possibly have something to do with motor habits. Second, the use of glass—specifically, natural glass or obsidian—for scraping purposes is very rare in prehistoric assemblages. There are two possible explanations for this: 1) obsidian was a poor material for such use; or 2) obsidian was such an excellent pressure-flaking material that it was quarried and used primarily for projectile-point production. Other more readily available materials were used for such utilitarian purposes as scraping.

The predominant use of glass (analogous to obsidian) for scraping purposes is therefore interesting. I would guess that for the kind of scrap-

ing that the Navajos were doing (and I don't know what that would be) glass was perfectly satisfactory, and that it functioned as a readily available raw material for artifact production. It was evidently selected over other lithic resources for scraping purposes. I would guess also that its use for cutting purposes (which is a secondary use of obsidian in prehistoric times) was mitigated considerably by the availability of metal knives, etc., which could be resharpened, and had a much longer life expectancy.

Part Three

Transect Sampling in Chaco Canyon— Evaluation of a Survey Technique

Probably no two surveys have collected exactly the same kinds of information or have recorded it in precisely the same way. Different geography and various kinds of archeological manifestations often call for different approaches, and, more important, the objectives of the surveys and the prejudices of the surveyors determine the character of the results.

Alden C. Hayes

Introduction

Two distinct archeological surveys have been carried out in Chaco Canyon under the auspices of the Chaco Center: the intensive "inventory" survey reported by Hayes (this volume); and an extensive sampling survey reported by Judge (1972). The former was designed to cover the entire 32 square-mile area of Chaco Canyon National Monument, while the latter was designed to cover only a portion thereof. As will be seen, the two surveys differ qualitatively in their purpose, in the kinds of information recorded, and in the methods of recording the information. However, they were both carried out on the same data-base, and thus offer an opportunity to compare the results of different survey orientations, as well as the chance to evaluate the effectiveness of a specific sampling technique in estimating the parameters of a population of archeological sites.

For purposes of comparison, the survey conducted in the summer of 1971 is referred to hereafter as the "transect survey," since that was the fundamental nature of the sampling technique involved. The other survey is termed "inventory survey," a term that has gained popularity in the rapidly expanding field of cultural resources

management. The word "inventory" itself derives from legislative requisites imposed by Executive Order 11593, instructing Federal agencies to "locate, inventory, and nominate" cultural properties within their jurisdictions that appear to qualify for inclusion on the National Register of Historic Places. The archeological interpretation of this is that *all* sites would have to be examined in order to distinguish those that are significant and thus merit nomination. For this reason, the term "inventory survey" has become equivalent with "100 percent sample," or, in effect, an attempt to determine the true population of archeological sites in a given area. I discuss the origin of the term at this point because I feel the evaluation which follows is relevant to Federal agencies in their attempt to meet the requisites of the Executive Order.

Plans for the transect survey were initiated in the late fall of 1970. At that time the Chaco Project was in its infancy (Thomas Lyons was acting Director, pending the arrival of Chaco Center Chief Robert Lister), and as a member of the University of New Mexico Anthropology Department, I was aware of the research potential in Chaco Canyon. After consultation with Dr. Lyons, in which we reviewed the project and its formal research plan as outlined in the *Pro-*

spectus: Chaco Canyon Studies, I decided to write a proposal for an initial archeological survey of the Chaco Canyon area. This proposal was submitted early in 1971, and was approved and the contract awarded on March 17, 1971, for the amount of \$7,600. Fieldwork was carried out during an 8-week period from June 14 to August 6, 1971. Further supplements to the contract were required to analyze the results of the fieldwork, and these were awarded during the fall of 1971. The final report (Judge, 1972) was submitted to the National Park Service on March 31, 1972, and is now on file in the archives of the Chaco Center.

In the spring of 1972, when Lister assumed the position of Chief of the Chaco Center, it was learned that Alden Hayes would complete a sufficient amount of work on his Pecos studies to permit his transfer to the Chaco Center as research archeologist. The opportunity to acquire Hayes was indeed fortunate for the Center, because not only did he bring a long history of personal interest and familiarity with the Chaco data, but also a great deal of experience in archeological survey and excavation (Hayes, 1964, 1974; Hayes and Lancaster, 1975; Hayes and Windes, 1975). In addition, long-range funding prospects were clarified at this time, and it was decided that an inventory survey of the Monument was both feasible and desirable. Under the direction of Hayes, plans were made for the comprehensive survey, and it was carried out during the following four field seasons. The results of that survey are reported herein (Hayes, this volume; Brugge, this volume), and all of the survey data (including those from the transect survey) are accessioned in the collections of the Chaco Center.

In June 1974, I joined the National Park Service as a full-time research archeologist on the staff of the Chaco Center. At that time, my duties were to assist Hayes in the direction of the fieldwork, primarily in the excavation phase of the research program. I was, however, familiar with the survey that Hayes was conducting, as well as with the field crews carrying it out. Due to the fact that I had written the research proposal for the transect survey, had acted as principal investigator on that contract, and was also familiar with the purpose, methods, and implementation of the inventory survey, it seemed appropriate that I prepare a comparison and

evaluation of the two surveys for this volume.

I envision this paper serving three primary functions. First, it offers an opportunity to evaluate the effectiveness of a specific transect sampling design as an estimator of a population of archeological sites. Such an evaluation is timely, although perhaps less so now than in 1971 when the proposal was submitted. Recently, archeologists have become increasingly aware of both the value and necessity of formal sampling procedures in archeological research. With this awareness, or perhaps as a result thereof, has come an increasing number of publications on sampling, including Ragir (1967), Redman (1974), Redman and Watson (1970), Gumerman (1971), Mueller (1974, 1975), De Bloois (1975), Judge (1975), Plog (1976), and Thomas (1976). Given what may seem to be a wealth of information on sampling in archeology, and the fact that some of the publications (Mueller, 1975; Plog, 1976; De Bloois, 1975) deal expressly with measuring the effectiveness of specific sampling designs, it might seem redundant to offer yet another evaluation at this point. However, most of the literature deals with the determination of variation in estimation due to sampling error. Few, if any, archeologists have had the opportunity to investigate discrepancies that could be attributed to disparate research orientations. The reason for this is quite obvious: because of funding restrictions, once an area is surveyed, it is rarely resurveyed. Thus, we are offered a unique opportunity here to present a survey comparison rarely encountered.

The second function of this paper is to attempt to relate the discrepancy in survey results to the variation in research orientations, recording methods, and interpretative techniques employed by the two surveys. This is the most difficult aspect of the project, since comparisons at this level require more qualitative than quantitative treatment. It must, of course, follow adequate demonstration that the discrepancy between the transect survey estimation and the population parameters is not the result of sampling error alone. Thomas (1976:444-446), in his discussion of sampling in anthropology, notes three categories of random error in anthropological research: sampling error, errors of content, and errors of analysis. A sampling error, of course, occurs when the sample chosen does not accurately represent the population in ques-

tion. Errors of content and analysis have received less attention. The former involves errors which occur during the acquisition of data (e.g., field work), and the latter occurs during the analysis of those data (e.g., laboratory work). Thomas notes further that "the archeological laboratory is a chamber of horrors where random errors arise as if by orthogenesis" (1976:445). Perhaps the same comment could be made for archeological field survey. At any rate, since we have the opportunity to evaluate qualitatively distinct research efforts, it seems reasonable that we do so. It may be that some of the "randomness" of errors of content and analysis can be explained by differences in research orientation or methods. If so, the results will be profitable to those who wish to engage in sampling as an archeological survey technique and generalize from the findings.

Finally, the third function of this paper is to comment on the relevance of the results to the general field of cultural resources management. As mentioned earlier, existing Federal legislation requires that land managing agencies inventory the cultural resources in their jurisdiction, and nominate those that are significant to the National Register of Historic Places. The largest agencies, such as the Forest Service, the Bureau of Land Management, and the National Park Service, control literally millions of acres of land that must be examined for cultural resources. Obviously, this must be done initially by sampling, although eventually perhaps a large percentage will be covered by inventory survey. As an example, at this writing, a survey is being anticipated by the Bureau of Land Management of roughly 80 sections of land immediately to the north of Chaco Canyon. This represents an approximate 10 percent sample of some 800 square miles considered to be directly or indirectly impacted as a result of anticipated coal strip-mining. Totally apart from questions of the adequacy of the sampling design for the estimation of the site population (i.e., questions involving potential sampling error) are questions about possible errors in content. Such things are generally considered unapproachable in archeology because we lack adequate data to evaluate them. It is hoped that the results presented in the following pages can offer insight into these kinds of problems and suggestions as to how to best avoid them.

The Two Surveys

A recent attempt to achieve standardization in archeological survey at the regional (Southwestern) level has met with only limited success (Euler and Gumerman, 1978). Members of the Southwestern Anthropological Research Group (SARG) have attempted to standardize data collection with reference to a research problem that had been agreed upon in advance. Even in this kind of cooperative venture, data equivalency between survey projects is difficult to achieve. Standards for archeological survey simply do not exist, and if the SARG experience can be taken as an example, they will be difficult to achieve. Thus, we can evaluate project results simply as different, rather than better or worse. It is not the purpose of this paper to attempt a quantitative evaluation of this difference with respect to the two surveys considered herein, although that would be a good experimental project for someone with the time and inclination. Instead, the purpose is to compare two surveys whose research orientations differed qualitatively, and to determine if the differences in results can be attributed to this qualitative distinction. In order to do this, we must examine the research orientation and associated method of each survey in some detail.

Transect Survey

Purpose

The transect survey was not intended to accomplish an inventory of the archeological sites in Chaco Canyon National Monument. Instead, it was directed toward obtaining as much information as possible, within the time allotted, about the archeological sites in Chaco Canyon and the environmental context in which they were located. It was therefore planned from its inception as a sampling design to be conducted specifically as an inductive search to generate research problems relevant to future survey and excavation. At the same time, provisions were made to fully record those sites located during survey.

Implicit in the research orientation and explicit in the research proposal submitted (Judge, 1971) was the adoption of a multistaged approach. Each stage of this kind of approach builds on the preceding one by deductively exploring

the problems generated (see also Redman, 1973; Judge et al., 1975). This assumes either a given set of initial research problems or a basically inductively oriented first stage. The latter approach was adopted here. Of course no data can be collected in the absence of some research orientation, and the transect survey, albeit primarily inductive, was strongly oriented toward the determination of correlations between site locations and specific environmental variables. This orientation, derived largely from my participation at the time in the newly formed Southwestern Anthropological Research Group, considerably conditioned the nature of the variables recorded and the methods employed by the transect survey crew. In point of fact, the data were recorded in a manner compatible with the SARG data format at that time (Plog and Hill, 1971, 1972; Green, 1972) and were reported as such at the SARG meetings in Tucson in March 1972. However, in late 1973 and early 1974, the members of SARG completely revised the data format, and for that reason the Chaco transect survey data were never stored in the SARG data bank.

In any event, a primary purpose of the transect survey was to record site loci in their environmental context not only to satisfy the SARG objectives, but also to provide environmental criteria for use in stratifying the survey area ecologically in anticipation of the next research stage. At the level of research orientation, it was this emphasis that distinguished the transect survey from the inventory survey. Within that general theoretical framework, the goals of the transect survey were expressed as follows (Judge, 1972):

1. To estimate, through the use of a reliable sampling technique, the number and distribution of the various types of archeological sites in the Chaco Canyon area.
2. To record and/or collect sufficient cultural material from each site to fulfill research goals.
3. To accurately record all those environmental variables considered to be of possible relevance to the selection of a particular site location by its original occupants.
4. To assess, through the analysis of survey data, those environmental variables or clusters of environmental features that were significant to determining the location of sites for each specific cultural phase represented by the survey data.

represented by the survey data.

5. To define, if possible, those natural resources considered "critical" (in the SARG research design sense) by the prehistoric occupants of the Chaco area.
6. To generate, on the basis of information derived by the survey, research problems deemed important for further investigation through: a) additional analysis of the survey data, b) additional archeological survey, or c) specific, problem oriented excavation of selected sites.

Methods

Area Considered: At the time the transect survey was originally conceived, the nature and number of additional archeological surveys to be carried out under the auspices of the Chaco Project were unknown. For that reason, it was decided to survey an area considerably larger than the Monument itself so that generalizations about man/land relationships of the past could be made apart from the arbitrary boundaries delineating Federal ownership. The area selected, shown in Figure 66, was a rectangle 16 miles (east-west) by 8 miles (north-south), centered on Chaco Canyon National Monument. Outlying areas, such as Kin Ya'a, Pueblo Pintado, and Kin Bineola were not included, but due to its proximity to the Monument, Kin Klizhin was. Although the 8 by 16-mile rectangle boundaries were arbitrarily imposed to facilitate the implementation of transect samples, it was felt that the area included full representation of the range of ecological variation.

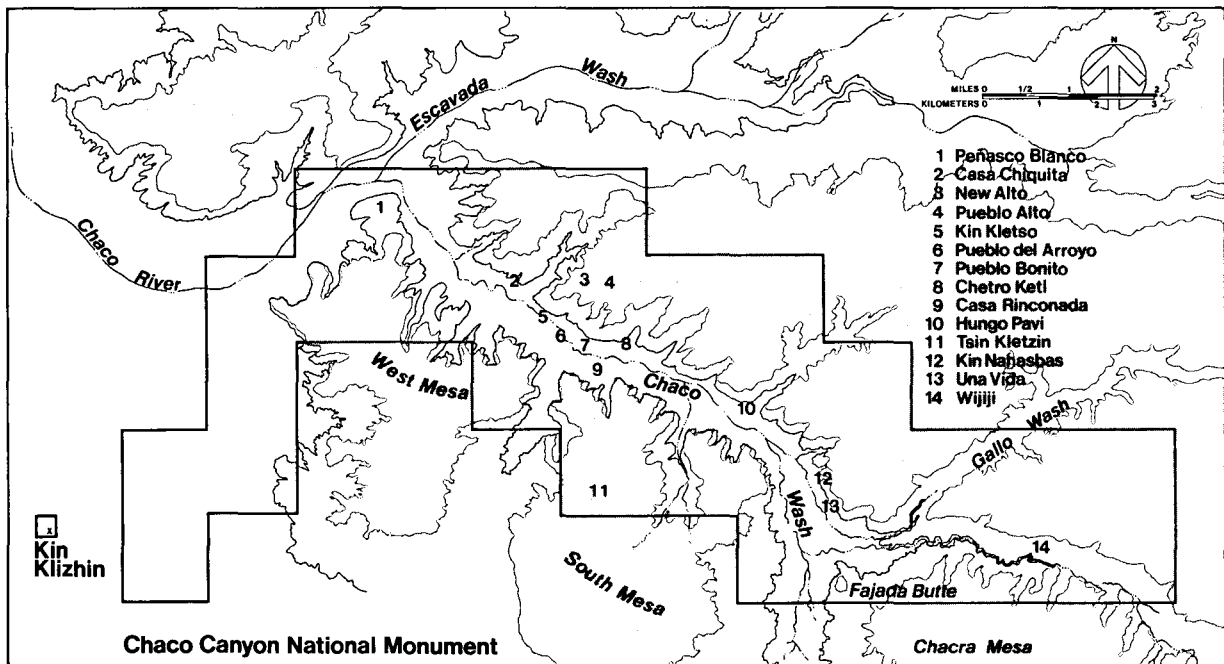
Sampling Technique: At the time the survey was being planned in early 1971, a total inventory of the Chaco area was not considered feasible; it was thus decided to employ some sort of probabilistic sampling design. Submitted with the initial research proposal was a design of the type termed "nested sampling" (Haggett, 1965), which involved the random selection of 160 quadrats, each $\frac{1}{2}$ mile square. As selected, the quadrats managed to miss all of the major Bonito Phase ruins in Chaco, a fact which was pointed out to us on several occasions. However, the purpose of the design was to serve as an example of random sampling only. As it turned out, in selecting the quadrats we had neglected to randomize the north-south lineal axes, which resulted in a sample with a definite east-west bias. I mention this

only to caution those who wish to use the technique in the future, and to point out that it was human, not sampling error that resulted in missing the Bonito Phase sites. The outcome was that the efficacy of sampling in general was challenged, and perhaps even viewed with distrust in the actual survey.

Actually, the nested sampling design, which caused the misunderstanding, was never seriously considered as the design to be implemented

placement, according to the desired sampling fraction. The transects used in this survey were each 1,056 feet wide (or $\frac{1}{8}$ of a section) and 8 miles long. Each transect, then, covered the entire north-south dimension of the survey area, and there were a total of 80 transects in the 16-mile, east-west dimension. The north-south orientation for transect length was selected in order to crosscut the general direction of topographic diversity in Chaco Canyon, since the canyon itself,

Figure 66. The survey area with monument boundaries in bold outline.



in the field. As a result of lengthy discussions at the 1971 SARG meetings, as well as decisions regarding the field implementation of sampling techniques, it was decided to use a strip transect rather than quadrat design. The transect technique permits the randomized and thus unbiased selection of sampling units, while at the same time effectively monitors the total range of ecological and physiographic variation in the survey area. Transects have since been shown to be quite effective as the first stage of a multistage research design (Judge et al., 1975).

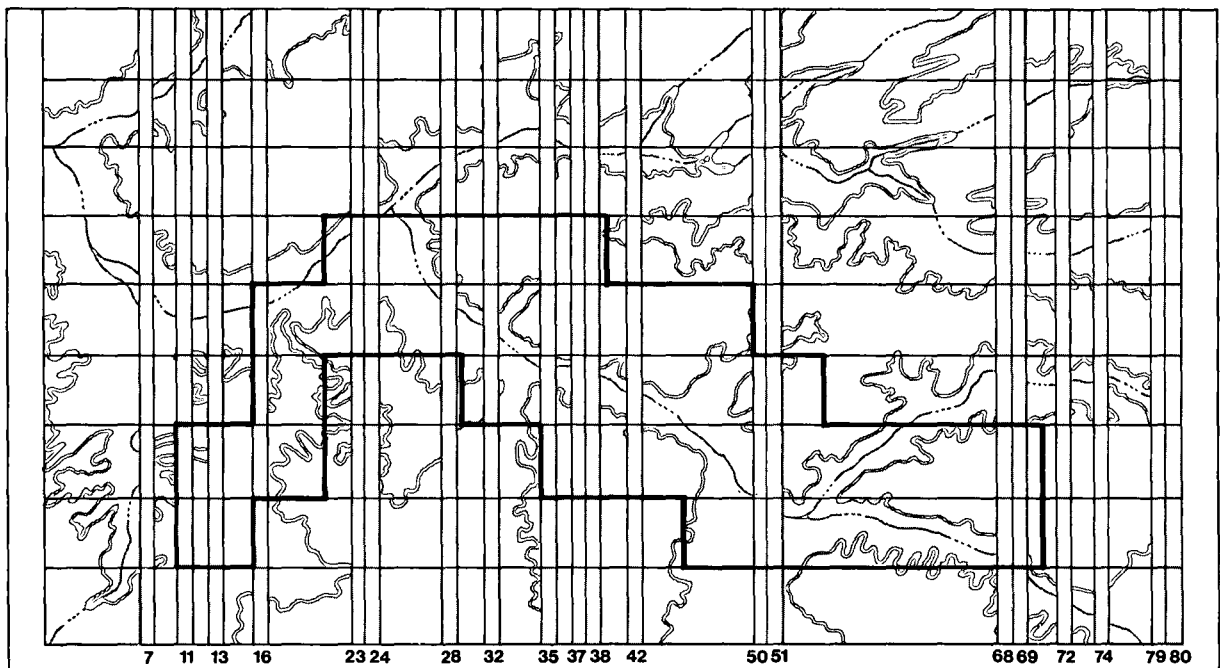
Strip transects are, in effect, elongated quadrats which are randomly selected without re-

placement, generally run east-west. Each of the 80 transects was numbered, and four sets of samples of 20 transects each were selected (without replacement), using a random number table. The four sets were then visually inspected, and the one that appeared to encompass the highest degree of topographic diversity (and thus, presumably, the most ecological diversity) was selected for field implementation. Thus, the sample actually selected for survey consisted of twenty strip transects representing a total area of 32 square miles, or 25 percent of the total survey region. The location of these transects is presented in Figure 67.

Unfortunately, we were unable to survey the entire 8-mile length of each of the transects, due primarily to a lack of time in the field. In fact, at the end of the field season, we had completed only 15.5 percent, rather than the anticipated 25 percent, of the total 128 square mile area. When it became apparent that we would not complete as much as we anticipated, we adjusted our field methods to complete two basic objectives. First, we reduced the transect lengths to one mile seg-

As can be seen in Figure 68, a total of 99 of the 1 by 0.2-mile transect segments were actually surveyed, arranged linearly along the transects initially selected. This constitutes a total of 19.8 square miles surveyed, or 15.5 percent of the total area. Due to the location of the 99 segments selected (cf. Figure 68), it is obvious that they do not constitute an unbiased sample of the original 8 by 16-mile area. Nevertheless, the argument is made here that the 41 1-mile

Figure 67. Location of transects selected.



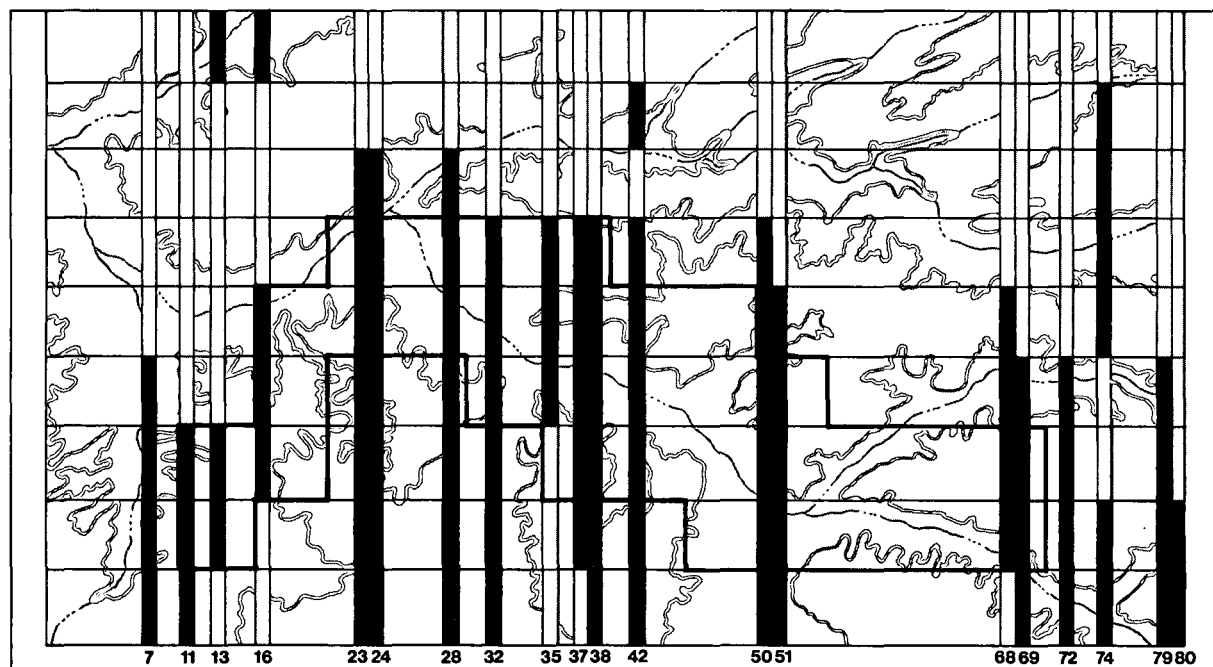
ments of the 8-mile lengths initially selected. This was to permit accurate calculation of the reduced sampling fraction and, most importantly, to facilitate continuing the transect survey in another field season. Second, we insured that *all* of the 1-mile transect segments lying within the boundaries of Chaco Canyon National Monument were surveyed. At the time, we did this to permit accurate estimation of the total site frequency within Park Service boundaries. As it turned out it was a wise decision, since the 32 square mile Monument area itself was the *only* area conterminous between the two surveys, enabling the comparative analysis which follows.

transect segments located within the Monument boundaries do constitute a representative sample of that 32-square-mile area. Technically, however, they cannot be considered a truly random sample of the Monument area. To achieve such a random sample, we would have had to reselect 41 transects from the 160 total contained in the Monument. Had we done this, some of the transect segments would have been offset linearly and we would have lost the integrity of the original transect design for the larger, 8 by 16-mile area. Again, I would point out that we fully intended to complete the original survey in another field season.

Though technically not random, the 41 transects are considered representative of the Monument area. Since the original transects were purposely run north-south to accommodate ecological diversity, and since their full lengths were surveyed within the Monument area, the only bias that could have affected transect selection would be in east-west placement. Since, as pointed out previously, the 20 east-west transects were randomly selected in the initial de-

the Smithsonian Institution, was selected to direct operations as field supervisor. In addition to a number of years of both excavation and survey experience, Stanford brought with him extensive knowledge of the presedentary cultures of the Southwest. Reflecting, perhaps, my own bias in addition to Stanford's, instructions were given the crew to specifically search for evidence of pre-Anasazi occupation of the Chaco area (but not at the expense of Anasazi sites, of course),

Figure 68. Final transect sample. Solid areas indicate segments actually surveyed.



sign, there was no *known* bias involved in the selection of those transects lying within the Monument boundaries. Thus we may conclude that the 41 transects do constitute a representative sample of the Monument area. Indeed, this claim is verified in the analytic section which follows (see Test of the Transect Survey Sampling Design, pp. 235–238 below).

Field Methods: Since I was directing the University of New Mexico field school in archaeology in Tijeras Canyon during the summer of 1971, I was unable to physically participate in the Chaco Canyon survey. Dennis Stanford, now Curator of North American Archeology at

since this aspect of prehistory had been largely ignored in the past (Vivian and Mathews, 1965:28).

The remaining members of the crew consisted of John Beardsley, Leo Flynn, and Dan Witter. Beardsley, now a Bureau of Land Management archeologist in Colorado, had considerable archeological experience, much of it in survey, and a good working knowledge of Pueblo ceramics. Flynn, now State Archeologist for the BLM in New Mexico, was experienced in mapping, recording, and photo interpretation. Witter, now working as an archeologist for the Australian National Government, had extensive

training in biological ecology as well as experience in recording vegetational and geological data.

Each transect was surveyed by the four-man crew walking 130 feet apart. The procedure involved first locating the transect boundary on the ground—at times quite difficult to do, especially in relatively unbroken terrain. A sighting was taken on some object on the horizon, and one member of the crew was assigned the task of keeping the whole crew on the transect line. One half the width of the transect (i.e., 528 feet) was then surveyed until one half the allotted time was consumed; then the crew doubled back to survey the remaining half of the transect and return to the vehicle. Either the distance from the vehicle, or a topographic barrier (e.g., sandstone cliff) conditioned the actual length of the transect surveyed each day.

Whenever any member of the crew found a site, the remaining members converged on the location to assist in the recording. It was found that the most efficient method was for each crew member to specialize in a given aspect of the recording procedure. As in all archeological surveys, there was some problem with the interpretation of the degree of artifact concentration necessary to constitute a "site." As a rule of thumb, the SARG-accepted density figure of five artifacts per square meter (Plog and Hill, 1971:25) was adopted, although this could be altered by discussion and agreement among crew members while on the site.

Site numbers were assigned in sequence as the sites were found, beginning with the number 29 SJ 101. We started with "101" rather than "001" to avoid possible redundancy with sites numbered by previous surveys using the Smithsonian system. Sites were marked by a wooden stake with the site number on it. Navajo hogans outside the Monument boundary were not so marked, however, since some still had evidence of occasional use.

Due to the extreme variety of exposure and erosional history occurring at sites in the Chaco area, it was decided not to undertake systematic random surface sampling of artifacts for site collections. Such surface sampling techniques are very time consuming, and, at least in the Chaco area, the reliability of the generalizations made on the basis of such samples can be questioned. As an example, site 29 SJ 627, situated near the

southern entrance of the Monument, was recorded by the 1972 inventory crew as a 3-room, 1-kiva site dated as Pueblo I/Early Pueblo II. Subsequent excavation revealed it to have 25 rooms, 3 kivas, and 2 pithouses, dating from Basketmaker III through Late Pueblo III. Although some cautious statements could be made on the basis of systematic surface collections, it was decided that the nature of these would not be worth the time spent in ensuring the unbiased collection of the artifacts. Thus, "grab" samples that were felt to adequately represent the range of variation of surface material visible at the site were collected. At the same time, an initial field classification of the ceramics was made to assist in temporal placement.

Based on the information recorded, an estimate was made at the site itself as to the cultural period or periods represented. If more than one period were manifest, the "primary" occupation was assessed. This on-the-spot evaluation proved important to the final classification of sites in a number of instances. However, in no case was a site assigned a temporal category for the final report until the laboratory analysis of the artifacts and other data had been completed.

During the early part of the survey, a relatively long period of time was spent recording data at each site—perhaps as much as an hour per site. However, after the crew gained confidence and increased knowledge of the survey area, as well as familiarity with their recording specialties, the time was reduced to approximately 20 minutes per site. A total of 231 man-days was expended during the 8-week field survey in 1971, and a total of 19.8 square miles was surveyed. This equals a total of 11.67 man-days per square mile for the transect survey—a figure that offers a very interesting comparison with the inventory survey.

Data Recorded: Two basic types of data were recorded at each site on the transect survey: cultural attributes of the site itself, and environmental attributes of the immediate site location and general site setting. These variables, along with the frequency of their occurrence in the survey area, are listed in detail in the survey report (Judge, 1972, Tables 1–7) and are only mentioned here.

The cultural variables recorded included: 1) primary occupation of the site (e.g., Pueblo II, Navajo), and the secondary and tertiary com-

ponents as well, if these could be discerned; 2) general occupational category (habitation, limited activity); 3) estimated primary activity (herding, farming, storage, etc.); 4) north-south and east-west site dimensions; 5) amount of chipped stone debitage (common, rare, absent, etc.); 6) types of projectile points observed; 7) types of lithic materials observed; 8) presence or absence of ground-stone artifacts (manos, metates, etc.); 9) ceramic types observed (Lino Gray, Red Mesa, Wingate, etc.); 10) estimated number of pithouses, kivas, and/or surface rooms; 11) type of masonry; 12) presence of architectural rubble; 13) presence of trash midden; 14) number of hearths and/or cists; and 15) presence or absence of rock art and/or water-control systems, and the distance and direction to these features when present.

As mentioned, the transect survey involved a strong emphasis on the relationship between site location and environmental features; thus a variety of environmental variables was recorded. Included were: 1) basic site location, in township, range, and section, and latitude and longitude calculated to the nearest tenth of a second; 2) site elevation in feet above sea level; 3) the basic geological formation on which the site was located, and the rock type associated with that formation; 4) the character of the immediate topography at the site, as well as topographic features nearby; 5) the general physiographic setting of the site location, including the distance and direction to the surrounding physiographic features; 6) the slope direction at the site and the slope angle, measured in degrees; 7) the distance to the nearest stream, as well as the length of that stream, both measured in meters; 8) the rank of the nearest stream and that of the second-nearest stream (see also Plog and Hill, 1971; SARG data format); 9) the topsoil color, texture, and occasionally depth, at the site; 10) the general vegetational structure of the site location (i.e., relative abundance of grasses, shrubs, forbs, etc.); and 11) the relative abundance of specific plants in the site vicinity.

In addition to keeping records of environmental data at each site location, a running record was kept of the vegetative changes occurring along the length of each transect (Witter, 1972). This provided a general environmental context, apart from that obtained through the analysis of the sites themselves. Such informa-

tion is extremely important to the interpretation of prehistoric site locating behavior in that it is essential to know the types of vegetation occurring where sites are *not* located as well as where they are (see also Euler and Chandler, 1978).

Analytic Methods: In order to analyze and interpret the transect survey data, a total of 209 attributes was named for each site. These variables included the recorded data noted in the previous section, as well as such things as date of survey, topographic quadrat, and transect number. This material was coded for computer processing, keypunched, and stored on disk.

The original version of the SPSS system (Nie, Bent, and Hull, 1970) was used to analyze the data. Sub-programs CONDESCRIPTIVE AND CODEBOOK were used for continuous and discrete variables, respectively. Although some crosstabulation was done involving the use of Chi-square, generally the analysis was limited to basic descriptive statistics available in the two subprograms noted above. Very little was done with respect to the formal use of inferential statistics. Population parameters of the various attributes recorded were not estimated, nor were confidence intervals established. At the time, it was felt that the sample was insufficient for such estimation, and in addition, the primary goal of the survey was to examine the relationships between the sites and their environmental settings rather than estimate parameters at arbitrarily selected levels of probability.

To analyze sites in their environmental loci, they were divided into nine mutually exclusive cultural categories, six of which were chronological in nature. The categories were Preceramic (Jay, Archaic, Basketmaker II); Basketmaker III; Pueblo I; Pueblo II; Pueblo III; Navajo (Refugee, Modern); Unclassified Lithic; Unclassified Anasazi; and Unclassified Storage. Sites in each of these categories were examined quantitatively with respect to the cultural and environmental attributes, and interpretations were derived based on the ratios existing between the several categories. Thus, the differences in environmental loci (and, theoretically, the differences in adaptations, site functions, etc.) between cultural periods were compared without making precise inferences about population parameters.

Reporting Format: On March 31, 1972, the results of the transect survey were transmitted to the Chaco Center in two basic forms: a com-

puter-generated report on each individual site, and a final narrative report and data summary of the project results.

Rather than fill out final versions of site-survey forms, as is the custom in archeological survey, it was decided to computer-generate permanent survey records. Basically, this involved writing a program (COBOL was used in this case) to produce a permanent format of "headings" (major categories of data) that included the locational attributes, cultural attributes, and environmental features recorded for the survey. Within the general headings were preset sub-headings, such as architectural data, and general environmental components. Once the structure of the headings was set, the program moved the data specific to each site into the appropriate category and printed it. In brief, we had the computer print the survey form, then fill in the blanks for each site. An example of the completed form is shown in Figure 69.

Although a considerable amount of time was spent in designing the format and writing the program, there are numerous advantages to this type of survey record. It is very legible and serves well as a permanent record, either as printout or stored permanently on tape. Any number of copies can be generated easily by simply running the program, as opposed to reproducing the site forms. Once the program is written, it is a simple matter to add sites to the file, in order to report on additional survey. Most important, the site report can be ordered in any fashion one might wish to facilitate retrieval of information. For example, as part of the final report, we turned in survey forms for all sites surveyed in three separate units. One was arranged by site number, one by site type (chronological), and one by site location. This, we felt, would be helpful to both the Monument manager, who might wish to gain rapid access to the sites in a specific location of proposed construction, and to the researcher who might wish to know the location of all sites of a given time period (e.g., Basket-maker III).

With several copies of the site-survey forms, the final narrative report was turned in (Judge, 1972). This report consisted of a narrative description of the goals of the survey, the methods (sampling, field, analytic) employed, and the results. Included in the last were the summary frequencies of all sites located in the survey, the

range of variation in the site assemblage, and an interpretative summary of the cultural and environmental attributes for each time period. Much of the material was presented in tabular form to facilitate use by other researchers. Tables included frequencies of ceramic, lithic, and environmental attributes by cultural period, as well as by the survey as a whole, and frequency data on plant species and physiographic settings of sites. A concluding section summarized the results, and defined problems to be addressed through further research, including further analysis of existing data, further survey, and controlled excavation of certain kinds of sites.

Inventory Survey

Hayes (this volume) has prepared a comprehensive report on the results of the inventory survey carried out under his direction in 1972. To discuss it in detail here would be redundant. However, a review of some of the points is presented to facilitate comparison with the transect survey. In addition, discussion of several field and analytical methods not covered by Hayes is included here, again for purposes of comparison.

Purpose

In addition to seeking as comprehensive a survey as possible, Hayes defines three specific goals of the inventory survey: 1) to gain a complete inventory of the sites within the boundaries of the Monument, in order to provide a management tool; 2) to obtain information about the distribution of populations and cultures through time and space, and to determine why people located where they did; and 3) to pose questions for further investigations.

Three distinct differences between the goals of this survey and the transect survey should be noted here: First, the need for a complete inventory of sites in the Monument was defined. This was specifically not the intention of the transect survey, although the desirability of such a goal was recognized. Second, information on the distribution of *populations* was desired. Certainly the most appropriate method of obtaining such information is through inventory survey, as only limited information on population changes through time can be gained on the basis of an unstratified sample. As such, the transect survey was not oriented toward population reconstruc-

SITE TYPE: PUEBLO II SURVEY DATE: 14 JUN 1971 SITE NUMBER: 29SJ104
 ADDITIONAL OCCUPATIONS (IF ANY): 1)PUEBLO III 2)UNKNOWN ELEVATION: 6160 FT
 LATITUDE NORTH: 36 DEG. 2 MIN. 59.0 SEC. USGS 7.5 TOPO QUAD: PUEBLO BONITO TOWNSHIP NORTH: 21 RANGE WEST: 10
 LONGITUDE WEST: 107 DEG. 56 MIN. 37.4 SEC. UNM SURVEY TRANSECT NO: 42 SECTION: 18

CULTURAL ATTRIBUTES

I. OCCUPATIONAL DATA:
 A. GENERAL OCCUPATIONAL CATEGORY: HABITATION SITE B. ESTIMATED PRIMARY ACTIVITY: FARMING
 C. SITE DIMENSIONS (IN METERS): 1)NORTH-SOUTH: 091 2)EAST-WEST: 030 3)TOTAL SITE AREA (IN SQUARE METERS): 2.730

II. ARTIFACTS ENCOUNTERED ON SURFACE:
 A. CHIPPED STONE: 1)AMOUNT OF DEBITAGE: COMMON 2)POINT TYPES: CORNER-NOTCHED
 3)LITHIC MATERIALS REPRESENTED: CHALCEDONY, CHERT, QUARTZITE, OBSIDIAN, SILICIFIED WOOD
 B. GROUND STONE: 1)METATES/MILLING STONES: ABSENT 2)MANOS/HANDSTONES: ABSENT 3)OTHER GROUND STONE: ABSENT
 C. CERAMIC TYPES REPRESENTED:
 PLAIN UTILITY WARE, CORRUGATED, CHACO B/W, CITADEL POLYCHROME, ESCAVADA B/W, GALLUP B/W, KIATUTHLANA B/W,
 LA PLATA B/W, LIND B/G, LIND GRAY, MANCOS B/W, MC ELMO B/W, RED MESA B/W, TUSAYAN B/R, WINGATE B/R

III. ARCHITECTURAL DATA:
 A. MASONRY TYPE: STONE B. ESTIMATED NO. OF SURFACE ROOMS: 12 C. ESTIMATED NO. OF PITHOUSES: 00
 D. NO. OF KIVA DEPRESSIONS: 1 E. ARCHITECTURAL RUBBLE: ABSENT F. TRASH MIDDEN: PRESENT G. GREAT KIVA: ABSENT

IV. OTHER CULTURAL FEATURES OBSERVED:
 A. NO. OF HEARTHS: 0 C. PETROGLYPHS/PICTOGRAPHS: NOT OBSERVED DISTANCE(FT): N/A DIRECTION: N/A
 B. NO. OF CISTS: 0 D. WATER CONTROL SYSTEM: NOT OBSERVED DISTANCE(FT): N/A DIRECTION: N/A

ENVIRONMENTAL FEATURES

I. GENERAL ENVIRONMENTAL COMPONENTS:
 A. GEOLOGICAL FORMATION: MENEFEE B. ROCK TYPE: CHANNEL SANDSTONE/SHALE
 C. VEGETATIONAL STRUCTURE: 1)TREES: ABSENT 2)SHRUBS: RARE 3)BUSHES: FEW
 4)GRASSES: NUMEROUS 5)FORBS: RARE 6)SUCCULENTS: RARE

II. SPECIFIC ENVIRONMENTAL ATTRIBUTES:
 A. PLANT SPECIES COMPOSITION: (PLANT TYPE IS LISTED, FOLLOWED BY OCCURRENCE IN PARENTHESES)
 GREASEWOOD (RARE), WOLFBERRY (LOCALLY NUMEROUS), SPINY SALTBUSH (FEW), SNAKEWEED (RARE), SMALL LEAF SAGE (LOCALLY FEW),
 DESERT GRASS (NUMEROUS), SAND DROPSIED (NUMEROUS), GALLETIA (LOCALLY COMMON), RED HEDGEHOG (RARE)

B. TOPOGRAPHIC SITUATION: 1)TOPOGRAPHY AT SITE: KNOLL 2)N/A 3)N/A
 C. EXPOSURE AND DRAINAGE: 1)SLOPE DIRECTION AT SITE (IN COMPASS DEGREES): 025 2)SLOPE ANGLE AT SITE (IN DEGREES): 03
 3)RANK OF NEAREST STREAM: 4 4)RANK OF 2ND NEAREST STREAM: 4
 5)DISTANCE TO NEAREST STREAM(METERS): 100 6)LENGTH OF NEAREST STREAM (METERS): 2092
 D. PHYSIOGRAPHIC SETTING OF SITE (PHYSIOGRAPHIC FEATURE IS LISTED, FOLLOWED BY DIRECTION TO FEATURE IN PARENTHESES):
 RINCCN (SOUTHWEST), ARROYO,1ST (WEST), ARROYO,2ND (EAST), ARROYO,3RD (NORTH), MESA,1ST (SOUTHWEST),
 MESA,2ND (NORTHEAST), CANYON BOTTOM (NORTHEAST)

F. SOIL DATA (SAMPLED AT SITE): 1) TOPSOIL DEPTH (IN INCHES): UNKNOWN
 2)TOPSOIL COLOR: LIGHT BROWN 3)TEXTURE (PRIM. COMPONENT): ROCKS, SAND (2ND COMPONENT): UNKNOWN
 4)SUBSOIL COLOR: UNKNOWN 5)TEXTURE (PRIM. COMPONENT): UNKNOWN (2ND COMPONENT): UNKNOWN

tion. Third, the specific concern about the relationship between sites and environment, detailed in the transect survey, was not emphasized explicitly as an inventory survey goal.

Although Hayes does not discuss the theoretical framework underlying the inventory survey specifically, it is implicit in the statement of goals above. He does, however, make specific reference to the fact that the SARG system was not followed, due in large part to the time consuming nature of the variable recording and the fact that many of the data required were considered irrelevant (an observation since confirmed by several SARG members; see also Judge, 1978). Since the transect survey adopted the SARG theoretical posture as basic, this also is a difference between the two surveys.

Methods

Area Considered: The inventory survey of Chaco Canyon National Monument was carried out during the 1972 field season by three four-man survey crews. Approximately 36 square miles were surveyed then, including the 32 sections within the main portion of the Monument, the outlying areas, and various areas immediately adjacent to the Monument boundaries. For purposes of comparing the intensity of the two surveys (i.e., number of man-days per section) the 36-section information is used, since the Chaco Center has records on actual crew-days for that summer. However, to compare the data recorded by the transect sample with that of the inventory, only the 32 square mile main portion of the Monument is used, since that is the only area which the two surveys share completely.

Sampling Technique: Since the inventory survey is here viewed as a "100 percent sample," formalized probabilistic sampling techniques were, in effect, not employed. However, some clarification is required about the terms "inventory" and "100 percent sample."

The 100 percent sample gained by the inventory survey refers to 100 percent of the transects in the 32 square mile portion of the Monument. The basic unit being sampled is the transect—i.e., a segment of geographical space. Forty-one of these were surveyed by the transect survey, and all of them (a total of 160) were surveyed by the inventory survey. It is important to remember that archeological sites were not

sampled—transects were. Sites are elements, or more technically *variates*, of the transects. Thus, the "population" gained by the inventory survey refers to a population of transects, and the total number of sites discovered becomes a parameter of that population. Technically, then, the term population refers only to the 160 transects comprising the Monument, not to the population of sites, nor to the population of people who inhabited those sites. Further, as all archeologists with survey experience realize, the total number of sites discovered (herein termed a population parameter) is in itself only a sample of the true number of sites once occupied, since an unknown number lie still buried, while others are simply missed, or have disappeared as a result of erosion or weathering. The fact that the inventory "population" only represents a sample of unknown fraction may be troublesome, but there is nothing one can do about it, and thus the inventory site-frequency must be considered a population parameter.

Field Methods: Crew leaders for the inventory survey were Tom Windes, Dave Bardé, and John Beardsley, all of whom had had prior survey experience. In addition, Beardsley had been a member of Stanford's crew on the transect survey. The remaining nine crew members varied considerably in survey experience. In order to standardize as much as possible between crews, Hayes spent a week of actual survey in Chaco Canyon with the crew leaders before the field season began, and, thereafter, at least one day a week with each crew.

Whereas the transect crew members walked a set distance apart in order to complete one-half a transect at a time, the inventory crews walked from 25 to 100 feet apart, depending on the nature of the terrain. This points to one of the major differences in field techniques between the two: the transects were laid out purposely to bisect the general topography and thus the ecological diversity. The inventory crew, on the other hand, paralleled major topographic features such as cliffs, benches, and talus slopes, working most frequently in a direction perpendicular to the transects. Thus, the inventory survey followed natural features, as opposed to the arbitrary transect lines. This, of course, makes survey areas much easier to follow, and virtually ensures complete coverage of the area intended. By the same token, in the absence of areal strati-

fication it can only be applied when 100 percent coverage of the area is anticipated.

As with the transect survey, when a site was found, all crew members converged to do the recording. Specific artifact density as a criterion for the definition of "site" was not used by the inventory survey. Instead, as Hayes states, "a 'site' was a geographical area in which archeological evidence existed that was separated from another 'site' by a recognizable stretch of sterile surface." As noted earlier, the definition of an archeological site has been, and will continue to be, a problem for the survey archeologist. In the final analysis, the judgment must be somewhat subjective, and thus will vary from crew to crew.

Inventory site numbers were assigned in the same manner as were transect survey numbers. One difference, however, was that the inventory survey marked the site locations (within the Monument boundaries) with rebar stakes, rather than wooden ones. This is one of the reasons why the sites discovered by the transect survey were revisited by the later crews: to replace the wooden stakes with rebar.

Surface collecting of artifacts was quite similar for the two surveys. Both employed grab sampling of ground and chipped stone, but the inventory survey biased the sherds collected toward rim sherds and decorated sherds. No on-site assessment of the probable cultural affiliation was made by the inventory survey crews, although in the "remarks" section of the survey form occasional reference is made to the possible time period represented.

The actual time spent on recording each site varied too much to permit generalization, although Windes (personal communication) felt that the maximum number of sites that could be recorded on an average survey day was around eight or nine. With respect to the amount of time spent per square mile, however, accurate information is available, and it points to the single most striking difference between the two surveys: The field season in 1972 lasted from May 3 to September 28, but not all 12 crew members were there the entire time. Records show that a total of 1,100 man-days were spent on actual survey during the field season. During this time, a total of 36 sections were surveyed, yielding a figure of 30.56 man-days per square mile for the inventory survey. This contrasts with the 11.67 man-day figure from the transect survey, and

points to the variation in intensity between the two.

Data Recorded: As with the transect survey, the inventory survey crews recorded both cultural and environmental data at each site. Here, however, the emphasis was on cultural rather than environmental features. With respect to the cultural attributes, the inventory survey defined 16 "functional" types of sites, including such things as field-houses, pueblos, hogans, rock art, and sherd areas. Site size was recorded in two dimensions, and the number of rooms, kivas, pithouses, or other architectural features was estimated on the basis of surface evidence. Additional cultural attributes were noted in the "remarks" section of the survey form, when necessary.

Regarding the environmental features, site elevation was recorded, as well as the location as to township, range, and section. In addition, a minimum of two azimuth readings was taken to prominent natural or cultural features to obtain the precise site location. Slope at the site was recorded in terms of cardinal direction and percent, and the general drainage (e.g., Chaco, Gallo wash) was noted. Soil type (e.g., residual, alluvium) and vegetative cover (e.g., grass, brush) were recorded in general terms at the site location.

Perhaps the most detailed of the environmental attributes recorded by the inventory survey was the landform feature, in which both primary and secondary categories were considered. Primary landform referred to either "plains," "mesa," or "bottom." Secondary landforms were features of these categories, and consisted of bench, cliff-edge, talus, ridge, etc.—comprising eight features in all. However, this contrasts with a total of 28 general and specific landform categories recorded by the transect survey, again pointing to the difference in emphases on environmental variables between the two.

Analytic Methods: To analyze the inventory survey data, the architectural data and landform categories recorded for each site were reviewed, and this information was combined with the results of the analysis of ceramics collected from the site. Once these classifications had been finalized, the information was transferred to edge-punch cards for compilation. No computer analyses were carried out on the inventory survey data.

Based on architectural and ceramic information, each site was assigned one or more chronological divisions or components. These divisions were: Archaic/Basketmaker II; Basketmaker III; Pueblo I; Early Pueblo II; Late Pueblo II; Early Pueblo III; Late Pueblo III; and Historic (predominantly Navajo). The criteria used for assigning sites to these categories are presented in detail in Hayes' report.

The edge-punch card prepared for each site contained information as to the functional category (pueblo, hogan, rock art, sherd area, etc.); the landform at the site (plains, mesa, talus, etc.); the ceramic types present; and the interpreted temporal component(s). It is important to point out that the majority of the sites were assigned more than one temporal component, since this is a major difference between the inventory and transect surveys. In the case of the latter, each site was assigned a "primary" temporal component, and others noted if present. In the inventory survey, no weight was given each component on the edge-punch cards. I mention this here because this difference was the primary source of problems encountered in attempting to compare the results of the two surveys. As will be seen, in order to achieve comparability, "primary" categories had to be assigned the inventory sites, perhaps somewhat arbitrarily in some cases.

Reporting Format: Results of the inventory survey are presented in the form of the final report (Hayes, this volume); the site survey forms, edge-punch cards, photos, and artifact catalog worksheets are all on file at the Chaco Center. In his report, Hayes includes a descriptive section on the cultural and environmental characteristics of each of the major chronological divisions, as well as the functional categories. The frequency tabulations given for the chronological divisions are given as component frequencies. In addition, Hayes analyzes in detail the probable human population of Chaco Canyon for the various time periods represented. Given the nature and intensity of the inventory survey, this reconstruction is probably as accurate as one can derive on the basis of archeological survey evidence.

Summary

The foregoing discussion of the transect and

inventory surveys has been presented in an effort to delineate aspects of similarity between the two so that effective comparisons could be made. Should it turn out that results of the two differ considerably, it will be important to be able to determine whether the difference is a function of variation in basic goals, survey techniques, or analysis, or whether it is due to some other factor, such as sampling error. For this reason, the differences as well as similarities have been discussed above and are summarized briefly here.

Purpose

Transect: Sample the general Chaco area to determine site distribution by type and location with respect to environmental features. Fundamental emphasis on environment.

Inventory: Obtain inventory of all sites within and near the Monument to determine distribution of population through time and space. Fundamental emphasis on culture.

Area Considered

Transect: An 8- by 16-mile area, with the Monument roughly in the center. Focus on the total range of physiographic variation within the Chaco area.

Inventory: Area within the Monument proper, including the outliers, with some selected areas on the periphery of the Monument boundaries. Thirty-six sections in all.

Sampling Techniques

Transect: Random selection of north-south transects ($\frac{1}{2}$ mile by 1 mile), cross-cutting the ecological diversity of the area. 15.5 percent of total area sampled, 25.6 percent of area within the main portion of the Monument.

Inventory: General east-west orientation of survey, paralleling ecological diversity. 100 percent coverage of area within Monument boundaries.

Field Methods

Transect: One four-man crew for 8 weeks, averaging 11.67 man-days per square mile.

Inventory: Three four-man crews for 21 weeks, averaging 30.56 man-days per square mile.

Data Recorded

Transect: Strong emphasis on recording en-

vironmental features, although not to the exclusion of cultural attributes.

Inventory: Cultural attributes emphasized, although landform features recorded in some detail (categories recorded differ from transect categories, making comparison difficult).

Analytic Methods

Transect: Six general chronological and three functional categories analyzed by computer with respect to associated environmental attributes.

Inventory: Eight chronological and six generally functional categories analyzed by edge-punch cards, with emphasis on population reconstruction.

Reporting Format

Transect: Emphasis on quantitative (tabular) treatment of data with narrative supplement. *Site* is basic unit of quantitative analysis.

Inventory: Emphasis on narrative reporting of results with some quantitative supplement. *Component* is basic unit of quantitative analysis.

Comparison of Survey Results

Basic Statistical Comparison

In the following discussion, the transect sample is dealt with initially as if the population parameters were unknown—in other words, as if the inventory survey had not been done. The sample statistics (mean, variance, standard deviation, standard error) are calculated, then the population parameters are estimated and confidence limits established at the 80 percent and 95 percent levels. Following this, the inventory survey data are analyzed to establish the true population parameters, which are then compared to the sample statistics and estimated parameters. The probability of obtaining the transect sample mean from the population is calculated. This, then, establishes the *accuracy* of the transect sample estimate in terms of its deviation from the true population mean (Cochran, 1963).

It should be recalled at this point that the basic unit being sampled is not the site, but the transect. The 32 square mile main portion of Chaco Canyon National Monument was divided into 160 such transects, each $\frac{1}{2}$ mile by 1 mile in

area. As discussed previously, 41 of these were surveyed. The sites recorded within each transect are the element variates being compared; thus, the sample mean consists of the mean number of sites per transects surveyed. Only site frequencies are considered here. Ratio comparisons of site *attributes* are made later.

Transect Survey Sample

The data from the transect survey are presented in Appendix A. Site frequencies ranged from a low of zero to a high of 13 per transect, with a median of 6.5 and a mode of 2. A total of 162 sites was recorded in the 41 transects surveyed, yielding a sample mean (\bar{x}) of 3.95 sites.

The variance of the sample mean is computed from the common formula:

$$S^2 = \frac{\sum_{i=1}^k x_i^2 f_i - ((\sum_{i=1}^k x_i f_i)^2/n)}{n - 1} \quad (1.1)$$

The standard deviation (S) of the sample is taken as the square root of the variance. Thus for the transect sample,

$$S^2 = 9.248 \quad \text{and} \quad S = 3.041$$

For the sample, the standard error of the mean is arrived at by the following (Cochran, 1963:25)

$$s_{\bar{x}} = s/\sqrt{n} (\sqrt{1-f}) \quad (1.2)$$

where f is the sampling fraction (n/N). Thus for the transect sample, the standard error of the mean is:

$$s_{\bar{x}} = .4096$$

The population site frequency (\hat{X}) is estimated as follows:

$$\hat{X} = ((\sum x_i f_i)/n) N = \bar{x} N \quad (1.3)$$

where N is the total number of transects. Thus, for the transect survey, the estimated total population of sites is:

$$\hat{X} = (3.95) (160) = 632.2 \text{ sites.}$$

Confidence limits for this estimate can be established at various levels as follows:

$$\hat{X}_{UL} = N\bar{x} \pm (tNs/\sqrt{n}) \sqrt{1-f} \quad (1.4)$$

where "t" is derived from Student's *t* distribution at *n* - 1 degrees of freedom. It can be seen from (1.2) that the confidence interval is a function of the *t* value and the standard error of the estimate. Here, confidence limits at the 80 percent and 95 percent levels are figured ($\alpha = .20, .05$ and $Q = .10, .025$ respectively). At *n* - 1 (40) degrees of freedom, *t* = 1.303 at the 80 percent level, and 2.021 at the 95 percent level. Thus for the transect survey:

80 percent confidence interval:

$$\hat{X}_U = 632.2 + 85.39 = 717.59 \text{ sites}$$

$$\hat{X}_L = 632.2 - 85.39 = 546.81 \text{ sites}$$

95 percent confidence interval:

$$\hat{X}_U = 632.2 + 132.44 = 764.64 \text{ sites}$$

$$\hat{X}_L = 632.2 - 132.44 = 499.76 \text{ sites}$$

These data, representing the basic descriptive statistics and population estimates from the transect survey, are summarized in Table 8. Briefly, they indicate a mean of 3.95 sites per transect, and predict a 95 percent probability that between 500 and 765 sites will be found in the 32 square mile portion of Chaco Canyon National Monument.

Table 8 Summary of Statistical Comparison of Sample and Inventory Surveys

	Transect	Inventory	Transect Test
Mean	3.95	10.56	11.73
Variance	9.248	36.76	42.20
Standard Deviation	3.041	6.063	6.496
Standard Error of Estimate	0.4096	—	0.8749
Site Frequency	632.2	1689	1876.8
Confidence Interval at 95% Level	±132.44	—	± 282.92

Inventory Survey

As mentioned previously in this paper, the inventory survey itself only yielded a sample of the archeological sites that existed in Chaco Canyon, since some were probably missed and others lie buried at this time. Nevertheless, for purposes of comparison, the inventory sample is here considered a 100 percent sample of the 160 transects comprising the total transect population, and the

sites recorded by the inventory survey are considered a population parameter. This permits comparison with the population estimates from the transect sample.

The data from the inventory survey are presented in Appendix B. Frequencies ranged from a low of one to a high of 27 sites per transect. The median value was 13.5 and modes occurred at 4 and 12. A total of 1,689 sites was found in the 160 transects surveyed, yielding a mean (μ) of 10.56 sites per transect. The variance of the population is arrived at by:

$$\sigma^2 = \frac{\sum_{i=1}^k x_i^2 f_i - ((\sum_{i=1}^k x_i f_i)^2 / N)}{N} \quad (1.5)$$

and the standard deviation is taken as the square root of the variance. Thus for the population:

$$\sigma^2 = 36.76 \quad \text{and} \quad \sigma = 6.063$$

These data, representing the parameters of the population as established by the inventory survey, are summarized in Table 8 with the sample statistics. It can be seen immediately that there is a large discrepancy between the estimated values derived from the transect sample, and the true population figures revealed by the inventory. The sample yielded a mean site frequency of 3.95 per transect, compared with the inventory value of 10.56, and estimated a total population of 632 sites, when the inventory value was 1,689.

Knowing the population parameters, it is possible to calculate the probability that a sample mean of 3.95 be drawn from the inventory population. Converting to a standardized score:

$$z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} \quad (1.6)$$

where $\sigma_{\bar{x}}$ is the standard error of the sample mean, based on the population variance. We have, for the transect sample:

$$z = (3.95 - 10.56)/.9469 = -6.981$$

A "z" value of this magnitude indicates a probability of less than 0.001. Thus the chances that the transect sample mean was drawn from the inventory population mean are virtually nil. This is discouraging to say the least, since we know that the transect sample was indeed drawn

from the inventory population, and it raises an issue that must be resolved.

There are two possible explanations for this discrepancy. First, it is possible that the transect sample design does not represent an unbiased sample of the survey area and that the discrepancy is thus due to sampling error. Alternatively, the error is not due to sampling bias, but instead to incomplete data collection within the sampling units themselves. These two possibilities are dealt with in order.

Test of Transect Survey Sampling Design

A number of tests of sampling designs for archeological surveys have been made recently, as archeologists become increasingly aware of the need to undertake probabilistic sampling in their research (Mueller, 1975; Plog, 1976). Most of these tests have dealt with the *precision* (Cochran, 1963) of the various designs in deviating from a mean, and demonstrate that transect or quadrat sampling (i.e., some form of unbiased cluster sampling), when properly applied, can provide a reliable method of estimating population parameters. Here, however, a somewhat different situation is presented, in that we are able to compare two independent field trials of the same sampling design with known population parameters, thus measuring accuracy rather than precision.

To test the accuracy of the transect design, we can select exactly the same transects actually surveyed by the transect survey crew, but use the data (i.e., site frequencies) recovered by the inventory survey to estimate the population parameters. In other words, we can experimentally reconstruct the situation as if the inventory survey crews were undertaking the transect sample as originally carried out, and then determine the degree to which the results estimate the population data. In this way, possible biases existing between the two surveys can be eliminated, and the accuracy of the transect design itself can be assessed. If the results of the test show that the estimate is close to the known parameters, then the efficacy of this particular sampling design will have been demonstrated, and we can conclude that the discrepancy noted in the prior section between the transect and inventory surveys was probably not the result of sampling error. It should be added, however, that this would not

reflect on the accuracy of transect sampling designs in general—merely this particular one. Again, precision of measurement is not being considered here.

The data used in this test are presented in Appendix C. Site frequencies ranged from a low of 2 to a high of 27 per transect, with a median value of 14.5 and modes at 4 and 11. A total of 481 sites was found by the inventory survey in the 41 transects selected by the initial sampling design. This yields a sample mean of 11.73 sites per transect.

The variance of the sample mean, computed by formula (1.1), is 42.20, and the standard deviation is 6.496. The standard error of the mean is 0.8749 from formula (1.2). Using formula (1.3), we find that estimating population site frequency yields a value of 1876.8 sites. Confidence limits, established from formula (1.4), are as follows:

80 Percent Confidence Level

$$\hat{X}_U = 1876.8 + 182.40 = 2059.2 \text{ sites}$$

$$\hat{X}_L = 1876.8 - 182.40 = 1694.4 \text{ sites}$$

95 Percent Confidence Level

$$\hat{X}_U = 1876.8 + 282.92 = 2159.72 \text{ sites}$$

$$\hat{X}_L = 1876.8 - 282.92 = 1593.88 \text{ sites}$$

These data, representing the descriptive statistics and population estimates of the test of the transect sample, are summarized in comparison with the transect and inventory surveys in Table 8.

It is immediately apparent that the transect test is quite close to the inventory survey parameters, and quite distant from the transect sample. The transect test tended to overestimate the true population of sites, but this value was still well within the limits established at the 95 percent confidence level.

Viewed another way, one could examine the transect test mean at the 0.5 level of significance, which seems to be commonly accepted among archeologists at present. Thus:

$$H_0: \mu \leq 10.56 \text{ (the inventory mean)}$$

$$H_1: \mu > 10.56$$

$$\alpha = .05, \text{ thus } z = 1.64 \text{ (one-tailed)}$$

$$X = \mu + z\sigma_{\bar{x}} = 10.56 + 1.64(1.0145)$$

$$X = 12.22$$

Therefore, again assuming a normal distribution, since the transect test mean value of 11.73 does not fall within the region of rejection, the null hypothesis is not rejected and a value equivalent to that of the test mean can be expected. In fact, it would require a mean value as high as 12.22 sites per transect to permit rejection of the null hypothesis at this level of significance.

It is thus quite apparent that a sample drawn by using precisely the same design as that used by the transect survey, yet using the data derived by the inventory survey, would have resulted in an acceptable estimation of the true population parameters. In other words, it is highly unlikely that the variation noted in the estimate by the transect survey is a result of sampling error, and we must look for other causes.

Possible Origins of the Discrepancy

There is a fundamental assumption underlying the application of sampling techniques to archeological survey—one that is rarely articulated. This assumption can be termed "accuracy of measurement." In challenging the validity of sampling in archeological research, reference is frequently made to the accuracy, precision, and cost, and at times to the relevance, of specific designs. Yet the adequacy of data collection as it might affect the estimate from the sample is usually not discussed. Here it has been demonstrated that, in all probability, the sampling design employed was quite adequate, yet the results attained in terms of estimated site frequencies were wrong. There thus seems to have been an error of measurement. Since this is an aspect of survey not normally considered, it merits pursuing.

At least two sources of variability in measurement come to mind immediately: recording techniques, and time spent in survey. Here, as has been pointed out earlier, there was a great deal of difference in the problem orientations of the two surveys, and therefore in the techniques of recording data in the field. It may prove useful, therefore, to attempt to isolate the degree to which the discrepancy might be a function of the different goals and orientations of the individual surveys. Such information is extremely important to the rapidly growing field of cultural resources management, since much of the data col-

lection is being done through the use of sampling in survey, frequently by a variety of contract research organizations, each with distinct research goals and problem orientations.

Comparison of recording techniques at other than the subjective level is usually difficult for archeologists, if not impossible, since areas are rarely resurveyed due to prohibitive costs. We are fortunate here, for comparative purposes, in that many of the sites located by the transect survey within the Monument boundaries were resurveyed the following year by the inventory crew. This was done primarily for two reasons: first, the inventory crew surveyed parallel to the topographical diversity, not perpendicular to it, and thus crossed sites found by the transect crew; and second, sites had to be revisited in order to mark them with rebar, a decision made after the 1971 season. Furthermore, a portion of the area surveyed by the inventory crew in 1972 was resurveyed by another crew under Hayes' direction in 1974. Therefore, the Chaco Project has records of variability in recording techniques, at both the intrasite and intersite levels, between the transect and inventory surveys, which differed in problem orientations, as well as between two crews of the inventory survey, which had identical goals. Data on the intrasite variability is examined first.

Intrasite Differences

The manner in which an archeological site is recorded after it has been located might seem to be unrelated to the total number of sites actually found, and indeed this may be the case. However, potential influence of the former on the latter is suggested in two variables recorded by the Chaco surveys, which can be examined in more detail here: the attributes of temporal component, and site size. For instance, consistent failure to record certain components at multi-component sites might indicate that these components would have a greater chance of being missed when they exist as single component sites elsewhere, thereby affecting site frequency. With regard to site size, if it is found that the transect survey generally recorded larger sites than the inventory survey, then the possibility exists that the latter would result in a higher frequency of smaller sites simply as a function of differences in site definition.

Data on the recording of temporal compo-

nents were compiled on 131 sites initially recorded by the transect survey, and later revisited by the inventory crews. On these 131 sites, the transect survey assigned a total of 155 temporal components, and the inventory survey assigned a total of 205. Thus, the former averaged 1.18 components per site and the latter averaged 1.56. This suggests a tendency on the part of the transect survey to "miss," or perhaps more accurately to not assign, an average of 0.38 temporal components on each site recorded. A comparative analysis of the 155 components recorded by the transect survey follows:

1. **Exact Agreement:** Of the 155 transect components, there was exact agreement with the inventory assessment in 86 cases, or 55.5 percent of the total.
2. **Range Agreement:** In 38 cases (24.5 percent), there was "range agreement" between the two surveys. This means that the component assessment of the transect survey was within the range later established by the inventory. As an example, a P-II site from the transect survey might be recorded as a P-I/P-II site in the inventory, and this was considered a range agreement.
3. **Transect Component "Misses":** There were ten cases (6.5 percent) in which the transect survey failed to record a temporal component, either exactly or within range, which was later recorded by the inventory survey. An example might be failure to record a Navajo component at an Anasazi site.
4. **Transect "Additions":** In eight cases (5.1 percent), the transect survey recorded components which were later dropped by the inventory survey. In some (not all) instances, this was a result of the inventory survey's redefinition of the "extra" component into a separate site.
5. **Disagreement:** There were 13 cases (8.3 percent) in which there was no agreement at all between the transect and inventory survey assessments of temporal components. These are examined in more detail shortly.

In reviewing this information, several points should be made. With regard to the range of agreement, it was noted in the previous section describing the two survey techniques that the policy of the transect survey was to assign a primary temporal component to each site to facilitate computer reporting, and thus, all else being equal, that a site assessed as a given component

(e.g., P-II) might well subsume prior temporal components even though they were not indicated. This assignment of a primary component differed considerably from the inventory survey analysis, where the emphasis was on the component rather than the site. It is thus important to observe that of the 38 cases of "range agreement," 27 (71 percent) of the transect assessments agree with the highest (most recent) component of the range assigned by the inventory; e.g., a transect P-III agrees with an inventory P-II/P-III, a P-I with a BM-III/P-I. This information becomes important when we attempt to achieve comparability between surveys in examining component ratios.

With respect to the ten components "missed" by the transect survey, two were P-I, two were P-II, and six were Navajo. This may have some bearing on the outcome of the transect survey, as will be seen. The components "added" by the transect survey are distributed throughout the temporal continuum, except that none were P-I.

For the 13 cases in which there was no agreement, the transect survey recorded one as Archaic, four as BM-III, two as P-I, one as P-II, one as Navajo, and four as other categories (e.g., "unclassified lithic"). Of the 13, seven cases were recorded as only one Anasazi temporal component apart from the inventory assessment—for example, a transect P-II site recorded as P-III by the inventory. Further, in six of these seven cases, the transect assessment was one component earlier than the inventory.

Of the remaining six cases of no agreement, two were judged as "unknown" by either the transect or inventory surveys, and four showed no similarity in assessment. Of these four, three are mitigated somewhat by the site situation. One, classified as "unknown lithic" by the transect, was termed "historic?" by the inventory. Another, consisting of two storage rooms and a cist, was termed "P-I" by the transect and "Navajo" by the inventory. The third, classified as an "Anasazi hearth" by the transect survey, was called a "Navajo hearth and trail" by the inventory. This leaves one site for which there is unmitigated disagreement. It was called "Late Archaic" by the transect survey, and "BM-III/P-I" by the inventory.

Turning to the attribute of site size, we find a great deal of difference between the two surveys. Here, rather than comparing area, which

was not calculated for the inventory survey, comparison was made by adding length-width measurements and comparing lineal totals for each site. When the lineal totals were within 5 meters of each other, it was considered agreement. Disagreement was anything over the 5-meter variation. Results of this analysis indicate that of the 131 sites revisited, there was agreement in only 29 cases, or 22 percent. Of the 102 cases of disagreement, by far the majority (77 in all) were recorded as smaller by the transect survey. Of these 77 sites, the range of disagreement was from 6 to 374 meters, with a modal frequency of 24 sites in the 6- to-25-meter range. Site frequency dropped considerably beyond the 100-meter value, comprising only 19 of the 77 sites.

Twenty-five of the sites were recorded as larger by the transect survey than by the inventory records. These differences ranged from 7 to 220 meters, with the mode at the 7-to-15-meter range. Thus, although there is a good deal of disagreement in the recording of site size between the two surveys, the modal values tend to cluster around the smaller ranges, and relatively large cases of disagreement (100 lineal meters or more) are not common.

My personal opinion is that site size is one of the most difficult, and at the same time most arbitrary, attributes to record. Criteria for determining site perimeters are hard to define during excavation, and even more frustrating for survey. Questions of whether to include relatively isolated hearths, cists, etc., are subject to arbitrary field judgment. In brief, one would expect this to be a highly variable attribute under the best of conditions. That the discrepancy noted here between the two surveys is not isolated can be seen by comparing the site-size records of 96 sites recorded by one 1972 inventory crew which were resurveyed the following year by a crew with the same goals and problem orientation. Of the 96 sites, there was agreement on only 30, or 31 percent of the total, using the same comparative criterion as before (e.g., 5 lineal meters). Of the 66 cases of disagreement, 57 were classified as smaller by the 1972 crew. This suggests a tendency, by no means verified here, to reclassify sites as larger when they are revisited and more time is spent in attempting to locate and record features.

It is apparent, then, that site size is a highly subjective attribute, regardless of the predispo-

sition of the survey crew. Its variability is not necessarily a function of its being measured on a ratio or interval scale. As an example, information was compiled on the differences of measurement of slope direction and degree at each site by the two surveys (transect and inventory). In 122 cases reviewed, agreement was found 76 percent of the time for slope direction, and 77 percent for slope degree—exactly the opposite situation from the measurement of site size. Thus, apparently some interval scale measurements can be taken with considerable objectivity, although size is not one of them.

To summarize the results of the comparison of the recording techniques of the two surveys for the attributes of site component and site size, it was seen that the transect survey generally recorded fewer components than did the inventory survey (1.18 per site *vs.* 1.56). However, in 80 percent of the cases, there was general agreement on the components recorded—that is, either exact agreement, or agreement within a range interval within the BM-III to P-III continuum. The transect survey “missed” components 6.5 percent of the time, but recorded additional ones almost as frequently (5.1 percent). Of the 13 cases where there was no agreement between the two survey assessments (8.3 percent), the majority are either separated by only one temporal component, or the disagreement seems more understandable in light of a special use or limited activity site situation. In only one case of the 131 sites examined was there “unmitigated” disagreement. Thus, what seemed at the outset as considerable disagreement (i.e., about 20 percent) between the two surveys in actuality is much less than that, regardless of the differences in goals and problem orientations acknowledged between the two.

There was noted considerable disagreement (77 percent) between the transect and inventory surveys with respect to the attribute of site size, but an almost equal amount (70 percent) was noted between the 1972 and 1974 inventory survey crews for 96 sites that were resurveyed. Thus, the discrepancy between the transect and inventory surveys seems less probably a function of the variation in survey techniques than a result of attempting to deal with an inherently subjective attribute. In any case, in both instances of comparison, a tendency to rerecord the sites as larger was noted, probably resulting from

the inclusion of more associated features (trails, cairns, cists, etc.) in the site area. This phenomenon that is, the large size of resurveyed sites—is just the opposite of that necessary to explain the discrepancy in site frequency between the transect and inventory surveys, and thus cannot be considered causal. If there are causal factors involved in recording techniques, then they must lie with the component assessments.

When one compares the discrepancy in the site-frequency estimates made by the transect sample, which are off by 167 percent, with the disagreements in component recording, which vary at the most in only 20 percent of the cases (less than that when mitigating factors are considered), it is difficult to conclude that the latter is responsible for the former. This is further supported by the fact that, with two exceptions, the 20-percent variation in component assessment noted seems distributed without regard to specific time components, and is thus probably unrelated to recording differences which might result from differences in goals and problem orientation between the two surveys. The two exceptions are: (1) the relatively high frequency (5 of 10 cases) in which the transect survey missed recording the Navajo components of sites; and (2) the tendency (4 of 7 cases of Anasazi disagreement) of the transect survey to classify sites as BM-III rather than P-I. These exceptions may help explain the variation in component ratios, to be dealt with later. Nevertheless, neither these nor the magnitude of disagreement in intrasite recording methods is large enough to explain the variation in site frequency noted between the transect sample and inventory surveys.

Intersite Differences

The second type of variation between the two surveys to be analyzed is at the intersite level. Here, sites within the transect sample that were missed by the transect survey and found later by the inventory survey are examined. The purpose of this analysis is to determine if there is any patterning to the types of sites missed that might be attributable to the differences in research goals between the two surveys.

Since a total of 319 sites were found by the inventory survey that were not recorded by the transect survey, it was decided to sample them for review rather than attempt to examine them

all. This sample was not selected randomly, but instead systematically, in an interval fashion, to ensure adequate coverage of the range of physiographic variation in the transect survey. To do this, 12 transects were chosen at regular intervals, comprising roughly 30 percent of the 41 original transects. In addition, the three transects in which the transect survey recorded no sites were included, primarily to see if they contained any patterned information specific to themselves. (They did not.) Thus, a total of 15 transects were examined to compile information on the nature of the sites missed by the transect survey and located by the inventory survey. Of the 319 sites missed, 102 were located on the 15 chosen transects.

The results of the analysis indicate that 55 percent of the sites missed were special use or limited activity sites, while 45 percent were habitation sites. Of the latter (46 total), 22 were Anasazi and 24 were Navajo. Three of the Anasazi sites were pithouse sites, and possibly not readily visible from the surface, but 19 were later sites with masonry presumably visible on the surface. These 19 averaged 2.3 rooms per site, although 15 of the 19 (79 percent) had 2 rooms or less. The 24 Navajo sites averaged 2.3 rooms (hogans) per site also, and, as in the Anasazi case, 79 percent of these (19 of the 24) had fewer than 2 hogans. Thus, by far the majority of the habitation sites missed contained 2 rooms or less.

The distribution of the 56 special use or limited activity sites missed by the transect survey was as follows: baking pits (8), cairns (8), hearths (6), sherd areas (6), storage rooms (6), lithic areas (5), stairways (4), rock art (3), water control (3), corrals (2), stone circles (2), ovens (1), walls (1), and unknown (1). As can be seen, the first three categories, which are usually very small sites, comprise 39 percent of the total.

It might be beneficial to examine the habitation sites in more detail, due to the impact that missing these would have on such things as demographic analyses based on survey data. The question is, why were these sites, portions of which were visible from the surface, missed at all? One suggestion might be that the survey crew, in the course of walking and repeatedly converging for site recording, might have drifted off of the transect line. This is a definite possibility, since such imaginary lines are difficult, at best, to follow.

Another suggestion, made earlier, to explain the missed sites, was that there might be a bias toward one component over another—perhaps as a function of the research design. To examine this, information on the component status of the missed habitation sites was compiled. Of these 46 sites, only nine, or 20 percent of the total, could be considered multicomponent. Thus, there seems to be a general bias toward missing single component sites. The missed Anasazi habitation sites were fairly evenly distributed temporally; no particular component was consistently missed. However, it will be recalled that slightly more Navajo habitation sites were missed than Anasazi (24 vs. 22). The latter represents several components, and the former only one, since all but one of the Navajo sites missed were single component. Thus, when viewed as components, relatively more Navajo habitation sites were missed than Anasazi. Nevertheless, since 80 percent of all missed habitation sites were single component, and since 55 percent of all missed sites were special use or limited activity, it is highly likely that they were missed because of size rather than specific cultural component.

This information on sites missed by the transect survey yields little, if any, patterning which would explain the discrepancy in site frequency as a function of variation in research design. Certainly there was no intention on the part of the transect survey to ignore special use sites, since these were specifically part of the SARG research design, and might well have revealed association with environmental features—a very important research goal. In all probability, the missed sites were not overlooked because of some inherent bias in the research design, but because they were more easily bypassed due to their small size. It is possible that the bias toward missing single component sites might have resulted in underestimating Navajo site frequencies due to the fact that they tend to be single component in nature. However, this bias, although not precisely quantifiable, is simply inadequate to explain the discrepancy in site frequency between the two surveys.

Having reviewed the intersite and intrasite differences between the surveys, one can only conclude that the magnitude of the discrepancy is not the result of differences in recording techniques due to variation in the research designs or goals specific to each survey. Therefore, we

will examine variations in intensity of survey—that is, in the amount of time actually spent in the field.

Intensity Differences

The proposition underlying this review of intensity of survey is a simple one: the more time spent in the field looking for sites, the more sites will be found. Theoretically, this would hold true only up to a certain point, which might be termed the “saturation point,” at which *all* surface evidence of prior human activity would have been recorded. It is doubtful that a saturation survey of this nature has ever been or ever will be undertaken. For one thing, the cost of such an endeavor would be prohibitive; for another, natural processes of erosion alter the surface continually, revealing evidence in some areas while concealing it in others. It would thus seem to be an impossible task. The point is that since saturation survey is virtually impossible, *all* archeological surveys in reality exhibit relative degrees of intensity with respect to the saturation point. There is no such thing as “100-percent coverage” or a “complete inventory,” and a survey which attempts such a goal can only be evaluated by the degree to which it approaches the unattainable point of saturation. This is important to remember when dealing with surveys in which the assumption of “no error of measurement” is implicit. There are two questions here. Is the intensity of archeological survey directly related to the number of sites discovered (a logical, but unproved proposition)? And if so, how does one decide what degree of intensity to attempt? These questions are dealt with in order.

There are undoubtedly numerous ways to measure intensity of archeological survey, but here the actual amount of time spent in the field searching and recording per unit area of land covered (measured in man-days per square mile) will be considered most effective. One person working one 8-hour day will be considered 1 man-day. As noted previously, during the 1971 field season the transect survey spent a total of 231 man-days in the actual survey of 99 transects (19.8 square miles), for an “intensity factor” of 11.67 man-days/square mile. In contrast, the inventory survey, in 1972, spent a total of 1,100 man-days in the survey of 36 sections, yielding an intensity factor of 30.56 man-days/square mile.

To determine the relationship between the intensity factors and site frequencies, we can suggest that the ratio of the inventory intensity factor (I_i) to that of the transect survey (I_t) will be directly proportional to the ratio of the inventory site population (P) to the estimated population based on the transect sample (\hat{X}). Deriving from this a formula to permit testing, we have:

$$\frac{I_i}{I_t} = \frac{P}{x} \text{ or } x = \frac{I_t P}{I_i} \quad (2.1)$$

Where x is site population predicted by the sample, adjusted for the relative reduction in intensity.

Employing (2.1) with our data, we have:

$$x = (11.67)(1689)/30.56 = 644.9 \text{ sites.}$$

Note how closely this corresponds to the actual value (\hat{X}) estimated from the transect survey of 632.2 sites. It would seem then that we have empirical support for our proposition that the intensity of survey as measured by man-days per square mile is directly related to the frequency of sites found. It is important to point out that although a causal relationship between intensity and site frequency may be implied by the proposition, it is by no means demonstrated by the correlation. Numerous other factors not considered here, such as efficiency in recording, methods of covering terrain, and general field logistics, may influence the relationship. To verify causality would require data that can be attained only by repetitive and carefully controlled field experimentation.

The exact character of the relationship between sites discovered and the intensity factor is also unspecified by the correlation, although it is doubtful that it is lineal in nature. In fact, it may well be exponentially related to a point of diminishing returns. Figure 68 suggests how such a relationship might exist hypothetically.

Here it can be seen that as intensity of survey increases, so does the frequency of sites discovered. However, the exponential nature of the curve permits us to define upper and lower limits of productive survey. The lower limit, defined by the area of the curve to the left of I_1 , simply indicates that a certain minimum intensity is necessary to achieve adequate representation of

the total site frequency. This limit would be set by the research design of the survey, in which the goals and the sampling design were specified. The lower the limit, the less time spent per unit sampled, and the more area covered. The upper limit is represented by the area of the curve to the right of I_2 , and corresponds to the phenomenon of diminishing returns noted previously. Even though survey intensity can be increased beyond this point, the information return becomes increasingly less productive due to the limitation on sites visible from the surface. The I_2 limit is flexible also, and its position becomes a function of the research goals with respect to the desire for a "complete" inventory. By way of caution, it should be recalled at this point that the proposed exponential nature of this curve is hypothetical, and must remain so until verified through further experimentation with actual survey. It does, however, present an alternative view to the assumption frequently required in archeological survey that no error of measurement exists within the units sampled.

The point of this rather detailed discussion is that intensity of archeological survey is a variable that can and should be reckoned with, since it influences the survey results. There should be no stigma attached to a survey that is undertaken with an intensity less than the "maximum possible," since the latter may well be nonproductive, and thus wasteful. Instead, the intensity of the survey should be calculated carefully as part of the research design to provide the most return for the time (and thus money) spent in the field.

As an example, if 100 percent coverage of the area surveyed is desired (even though this may be a sample), intensity of a degree toward the I_2 value in Figure 68 should be planned. Depending on the time and funding available, the sample size may have to be reduced in order to achieve this degree of intensity, but it is of benefit to know this in advance and plan for it. Assume, for instance, that in the case of the Chaco inventory survey, 100 percent coverage was desired, but it was not deemed necessary to know the location of each site in the Monument. In other words, assume that relative densities of population were sought as a research goal rather than absolute population figures. Given this, the same intensity of survey could have been undertaken, but the sample reduced to that of the

transect survey. As demonstrated by the statistics in the section on testing the transect sampling design above, the population (and thus density) estimates would have been slightly higher than the true parameters, but would have been well within acceptable confidence limits. The important point is that it could have been done in a total of 605 man-days or, roughly, two crews in 15 weeks at about one-half the cost.

On the other hand, if 100 percent coverage is not deemed necessary by the research goals of the survey, it would be more productive to adjust the intensity factor toward I_1 in Figure 70, which would permit sampling of a larger area at the same cost. As shown by the results of the transect survey herein, the population estimates would be low, but assuming an unbiased sample of those sites that were recorded, specific research objectives could easily be attained.

To summarize, it is suggested here that the number of sites recorded in the process of archeological survey is directly related to the intensity of that survey, as measured by man-days per unit of area sampled. This relationship might be expressed as a sigmoid curve such as that shown in Figure 70. There are nonproductive areas on both ends of this curve, and therefore there is no such thing as "complete" survey, in which *all* manifestations of prehistoric behavior are located and recorded. Further, it is unrealistic to assume that there is no error of measurement in the sample units as surveyed. Instead, the degree of intensity with which archeological survey is carried out is held here to be a function of the information desired by the survey, and it can be made explicit in the research design. In the Chaco case, I feel there is little doubt that the variation in intensity of survey between the transect and inventory surveys is fully responsible for the discrepancy noted between the estimated and true site frequencies within the Monument. Further, I think that the different intensity factors are adequately accounted for by the explicit differences in research goals between the two surveys.

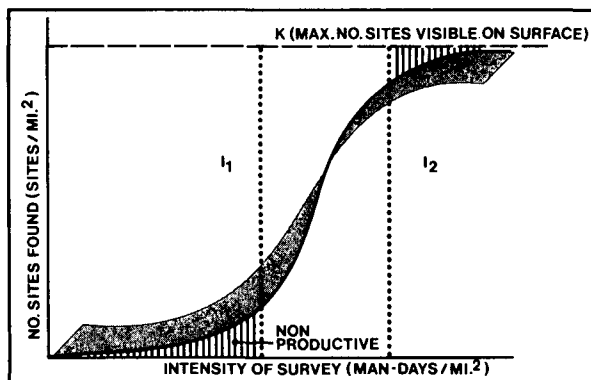
Comparison of Chronological Ratios

Up to this point, the two surveys have been compared on the basis of analyzing element frequency within each sampling unit, rather than focusing on characteristics of those elements.

Now the time periods as variates of the sites themselves are of analytic interest.

The basic hypothesis underlying the analysis is this: If the transect sample were unbiased with respect to any specific time period, the ratios between the time periods in the transect sample should not differ significantly from those of the population (as indicated by the inventory survey), even though a certain error of measurement occurred due to variations in in-

Figure 70. Hypothetical relationship between sites discovered and intensity of survey.



tensity. It is important to test this, since, if verified, it would indicate that comparable data can be derived from surveys that differ in intensity, and that sampled data can yield adequate ratio information. This testing is carried out by first ensuring comparability of data being analyzed, then assuming that the inventory temporal ratios are the correct population values, the chi-square statistical model will be used to determine if there is significant departure of the transect survey values (observed) from the inventory survey values (expected). For purposes of this test, all sites from both surveys which were classified according to time period will be used.

Achieving comparability between the two surveys with respect to assigning time periods to sites is very difficult, due to the variations in analytic and reporting techniques noted in the first section of this report. For example, in the transect survey, the site was the basic unit of analysis and reporting; a primary temporal component was assigned each site. Thus, there are 234 sites in the final report that were classified

according to major time periods (Archaic/BM-II, BM-III, P-I, P-II, P-III, Navajo).

In contrast, in the inventory survey the component is the basic unit of analysis. Each site may have one or more of eight different temporal components (Archaic/BM-II, BM-III, P-I, Early P-II, Late P-II, Early P-III, Late P-III, Historic). Thus, in the report by Hayes (this volume), although there were 2,220 sites recorded by the survey, in the section on site description a total of 2,942 sites are reported by component.

To assign some 3,000 components to over 2,000 sites and make them comparable to another system of classification is difficult at best.

To achieve comparability, it was decided to attempt to "collapse" the inventory components into sites with primary temporal assignments, rather than to attempt to expand the transect survey sites into components. For one thing, the transect components were not specified in the same detail nor by the same criteria as were the inventory components. For another, I wished to retain the site as a principal unit of analysis since the site, not the component, was the basic element within the sampling units.

To derive the population temporal ratios from the results of the inventory survey, the edge-punch cards were used as a data base rather than the data presented in the report. Frequencies may thus vary somewhat from those reported, since sites rather than components are being analyzed. All sites classified temporally on the edge-punch cards were used, regardless of site function (e.g., storage vs. habitation). With few exceptions (see below), it was decided to use only single-component sites reported by the inventory survey. This was done because it would have been impossible to assign multi-component sites from the inventory survey a single temporal component in retrospect as if the transect survey crew were making the assignment.

All single-component sites, as recorded on the edge-punch cards, were isolated and ordered into the six temporal categories used by the transect survey. Early and Late Pueblo II, and Early and Late Pueblo III were combined into P-II and P-III, respectively. This yielded the bulk of the sites considered. Next, multi-component sites which had Early/Late P-II and Early/Late P-III as the only components were isolated and added. These "pure" sites (from the transect standpoint) would have been missed otherwise. Then, multi-

component sites which consisted of a single Anasazi component with an additional Navajo component were added. These are comparable to a transect survey Anasazi site with Navajo as a secondary occupation, and would have been missed otherwise. Finally, all single-component Navajo structural sites were added, resulting in a grand total of 947 sites.

The addition of the Navajo sites caused a problem, in that the majority of Navajo sites in the inventory survey were single-component, while the majority of the Anasazi sites were multi-component. Since multi-component sites were excluded from the analysis, the single-component Navajo sites were over-represented. The same problem occurred, incidentally, with the Archaic, since they too were predominantly single-component, but the problem could be ignored because of low site frequencies. This could not be ignored with the Navajo data. When the 323 single-component Navajo sites were added to the single-component Anasazi sites, they comprised 34 percent of the site totals—a much higher proportion than we would suspect actually exists. For instance, if we refer to the site frequencies used by Hayes (this volume) to reconstruct Anasazi population, and add to them the Navajo dwelling sites, we find that the Navajo proportion is quite close to that of Pueblo I—certainly nowhere near 34 percent of the total:

BM-III	135	8 percent
P-I	373	21 percent
P-II	417	24 percent
P-III	438	25 percent
Navajo	377	22 percent

Thus, the Navajo single-component sites had to be reduced somehow to make them comparable to the Anasazi single-component frequencies. This was done by determining the ratio of single component Anasazi sites to all Anasazi sites (452:1220 or 0.37), and then reducing the total number of single-component Navajo structural sites to correspond to that ratio. This resulted in adding 120 Navajo sites, a frequency which is much closer to the anticipated value corresponding to the P-I site frequency. The final data base, then, comprising a total of 744 single-component sites from the inventory survey, and divided into six distinct time periods, is presented in Table 9.

Using the data from Table 9 as expected values, under the assumption that the inventory survey results represent the correct population parameters, we can test the transect survey ratios by employing the chi-square statistic. The statistical assumptions are that the chi-square sampling distribution is relevant in this instance, and that the assumptions of nonparametric nominal level tests apply (see Thomas, 1976: 340–341). The testing format suggested by Thomas is used here. Although tedious, it has the virtue of clarity:

1. Data:	Inventory True Ratio "p _i "	Sample "n"	Expected Value	Sample Observed Value	(O _i - E _i) ² /E _i
Time Period					
Archaic/BM-II	.11	234	26	20	1.3846
BM-III	.16	234	37	43	0.9730
P-I	.12	234	28	19	2.8929
P-II	.23	234	54	59	0.4630
P-III	.22	234	52	58	0.6923
Navajo	.16	234	37	35	0.1081
	1.00	234	234		$\Sigma = 6.5138$

Note: In the above chart, the sample "n" and sample-observed frequencies are derived from Judge (1972:30).

2. Statistical Hypotheses:

H₀: The expected values (E₁ - E₆) equal their associated values as shown in the chart (i.e., E_i = np_i).

H₁: One or more of the values (E₁ - E₆) is false.

3. Statistical Formula:

Since all cell values are high (above 5), the uncorrected chi-square formula is applied:

$$X^2 = \frac{\sum_i^k = 1 (O_i - E_i)^2}{E_i} \quad (3.1)$$

4. Significance Level:

$\alpha = 0.05$, df = 5. Region of rejection: $X_{.05}^2 \geq 11.0705$

Table 9 Single Component Site Frequencies from Inventory Survey

Time Period	Frequency	Ratio	Ratio (Anasazi Only)
Archaic/BM-II	84	11%	—
BM-III	120	16%	22%
P-I	90	12%	17%
P-II	170	23%	31%
P-III	160	22%	30%
Navajo	120*	16%	—
Totals	744	100%	100%

* Frequency adjusted to correspond to Anasazi single-component site ratio.

5. Conclusions:

a) Statistical: The observed chi-square value of 6.5138 does not exceed the critical value, therefore H₀ is not rejected.

b) Non-statistical: The transect values do not represent a significant departure from the population ratios at $\alpha = 0.05$.

As noted, both the Archaic and the Navajo ratios from the inventory survey are somewhat biased when viewed in relation to Anasazi site frequencies in which the single component sites have been isolated. For this reason, it was decided to test Anasazi site ratios only, to ensure goodness-of-fit between the transect and inventory survey data. To do this, the same test as before was run on the comparative data; however, this time the site frequencies from Table 9 for Anasazi only were used as expected ratios. The resultant chi-square value was 4.9006, and was still well within the significance range at 3 degrees of freedom ($X_{.05}^2 \geq 7.8147$).

In conclusion, it is apparent that even though the transect survey did not estimate site frequencies accurately, due probably to a reduction in intensity of survey, the transect survey ratios of sites ordered chronologically do not depart significantly from the population ratios as measured by the inventory survey. It is highly doubtful that there was any direct temporal bias in the sites recorded by the transect survey. If there were an indirect bias present, due to the possibility of missing single-component sites as a result of a low intensity factor, then this bias did not significantly affect the temporal ratios established by the sample. This is important information since it means that in cluster sampling in archeological survey, even if element frequency is not estimated accurately, characteristics of the elements may be, assuming unbiased

selection. Thus, in this example, data on the relationships of sites with environmental variables through time can be examined from the sample with confidence. Such knowledge is of value to survey archeologists who are constrained by time and money to the use of sampling, as is generally the case in the field of cultural resources management.

One final note on the results of the transect sample: it can be seen from the above tests that, based on the ratio of single-component sites through time, the frequency of sites increased somewhat from Archaic through BM-III times, then stabilized or decreased, then increased to a P-II peak, and decreased to approximate the prior levels during Navajo times. Note how different these values are from those based on the component analyses (including multi-component sites) used by Hayes in his population reconstruction (this volume). In the latter, population climbs steadily through Early P-III, then drops drastically. Though Navajo figures are not included, as noted earlier, they would correspond to the P-I percentage if added. These two curves, the former based on sites which have been assigned a primary time period, and the latter based on single- and multi-component sites with the component as the unit of analysis, vary significantly both in general slope and where the peak occurs. In all probability, the best population estimate is based on the inventory component analysis, but I would point out that most such estimates in archeological survey are derived from data similar to the former (site-based) analysis.

Summary

The results of two archeological surveys, carried out independently on the same data base in Chaco Canyon National Monument, have been compared. One, termed the "transect survey," was initiated in 1971 to sample a portion of an 8- by 16-mile area centered in the Chaco region. The other, termed "inventory survey," was undertaken in 1972 as a complete and intensive survey of the Monument and its immediate environs. The overlap of the sample and intensive surveys within the boundaries of the Monument has permitted comparison between the two. It has, in addition, afforded a unique opportunity

for such comparison, since the two surveys differed qualitatively in both research goals and approaches even though they were completed only a year apart. The extent to which research design, field techniques, and analytic methods condition the results of surveys can thus be evaluated.

Three primary functions of the analysis were identified at the outset of this report. The first was to evaluate the transect sample as an estimator of the population parameters by determining the degree of discrepancy between the predicted and true values. Second, the source of the discrepancy was to be isolated if possible, to determine if the cause lay in error of sampling or error of content. Third, the relevance of the investigation to both archeological (cultural resources) research and cultural resources management was to be discussed.

To provide an effective framework for comparison, the research orientation and methods of each of the two surveys were reviewed in detail. Although there were some general similarities, the two were found to differ considerably in goals, survey areas considered, field methods, kinds of data recorded, analytic techniques, and reporting formats.

Following this review, a more objective comparison was undertaken in the form of a statistical analysis. The basic assumption was that the data resulting from the inventory survey would be taken to represent the true population parameters to which the transect survey results could be compared. Analysis was initiated by first calculating the sample statistics from the results of the 41 transects surveyed. Then parameters for the entire 160-transect population were estimated and confidence intervals established at the 80 percent and 95 percent levels. Next, the inventory data were analyzed to establish what was assumed to be an accurate approximation of the true population parameters, permitting the accuracy of the transect sample estimate to be evaluated. The results showed the transect survey to be a very inaccurate estimator. The predicted total site frequency of 632 did not approach the population value of 1,689, even at the 95 percent confidence level. The probability of a deviation of this extent was calculated at less than 0.001.

Given a deviation of this magnitude, the problem was to determine its cause. The first

issue dealt with was the possibility of sampling error. To analyze this, site frequencies were compiled from the same 41 transects sampled, but using the data recorded by the inventory survey. This tested the sampling design itself, since data used for estimation were comparable to those used in establishing parameters. Such tests are frequently conducted in a repetitive fashion to measure the precision of sampling designs (see also Mueller, 1975). In this case it was found that the sample transects estimated the frequency at 1,878 sites, a value which did not deviate significantly from the parameter, and which was well within the 95 percent confidence limits. It was thus concluded that the discrepancy between the two surveys was not due to sampling error, but to an error of measurement.

The next step was to determine whether the source of the error was related to variations in survey methods that might stem from differences in research orientation. As such, variations in both field recording techniques and intensity of survey were examined. The comparative analysis of field recording methods was possible since many of the transect survey sites had been resurveyed by the inventory crews. Two variables were selected for analysis: temporal component and site size. The two surveys were found to be very similar in their assessments of the time periods represented at sites. There was general agreement in 80 percent of the cases. Total disagreement occurred in only 8.3 percent, and even these were mitigated somewhat by the site situations. There was, in contrast, very little agreement (only 22 percent) between the two surveys with respect to their assessment of site size. However, a discrepancy of almost equal magnitude was found between site size recorded in 1972 by an inventory survey crew and in 1974 by another inventory crew doing selected resurveying. Thus, the variable of site size seems to be an arbitrary one; and it was concluded that variations in recording techniques, as manifested by the variables of component and size, were not responsible for the error of measurement.

Finally, in an effort to isolate the source of the error, the variation between the two surveys as to the actual amount of time spent in the field was examined. An "intensity factor," measured by the number of man-days of survey per square mile, was calculated for each survey. Results of the analysis showed that the ratio of the two

intensity factors correlated almost precisely with the variation in site frequency noted between the two surveys, and it was therefore concluded that this was a probable explanation for the error of measurement. Additionally, the suggestion was made that the relationship between survey intensity and the number of sites discovered varies exponentially as a sigmoid curve, although this was not verified.

An evaluation was next made of the degree to which the discrepancy in site frequency permeated the reliability of other information. A comparison was made of the component ratios from each survey, i.e., the relative frequencies of sites classified according to time periods. Single-component sites were isolated from the inventory data base and adjustments made to conform to transect survey categories. The results of a chi-square test comparing the transect ratio estimates with those established by the inventory survey showed no significant departure from the expected values. It was thus concluded that for this particular case, even though an error of measurement existed between the two surveys, this did not affect the relative site frequencies estimated by time period. This suggests that under certain conditions an unbiased estimate of a variate of an element can be derived from a sample, even though the estimate of the element itself might be biased.

Conclusions

In writing about sampling in survey archeology, several years ago I concluded that "formalized probability sampling designs must become an integral part" of archeological field techniques (Judge et al., 1975:121). I still believe this—although my confidence was shaken somewhat when confronted with an error in the estimate of the magnitude dealt with herein. Yet as it turns out, the analysis of the error merely reconfirms my faith in sampling as an effective research tool. As with any such tool, it is subject to handling error, indicating the need for a more thorough understanding of its limitations as well as applications. Sampling is and will continue to be a fact of life for archeologists (necessitated by inflation if nothing else). Since this is the case, it is patently obvious that we need much more research in the domain of sampling theory and

sampling techniques and their relationship to archeological investigations. A good start has been made recently (Mueller, 1975; Plog, 1976), but this is just the beginning. Most of the work done to date has been in the realm of laboratory experiments measuring the precision of various sampling methods, and suggestions as to how to avoid or at least minimize sampling error. We need much more in the way of controlled work actually done in the field, as well as research in the general realm of error of content.

With respect to the latter, I feel the results of this report point to the need for controlled investigations directed toward the description and analysis of errors of measurement in archeological survey. We need to accept the fact that such errors are bound to occur, and to view them realistically rather than ignore them. We need to determine how such errors can be most accurately predicted, then how to accomodate research designs to most effectively deal with them. I have suggested herein that where it is necessary to economize, controlled variation in intensity of survey could be used selectively in survey research (e.g., in a multistage design), assuming that the errors of measurement that might result could be accurately predicted, and that the research design could accomodate them. However, much more work needs to be done to enable the accurate prediction of such error and thereby permit its use in controlled situations. A starting point, as suggested, would be to more clearly delineate the relationship between site discovery and intensity of survey. As survey sampling technology improves and survey archeologists become more knowledgeable about ways of minimizing errors of all types, they will become increasingly adept at obtaining the maximum potential from various kinds of surveys adjusted to meet the needs of specific research designs. For example, I suggested here that a bias that results in an error of estimate in the frequency of sample elements does not necessarily mean that the same bias is reflected in other characteristics of those elements. Employed with caution and sufficient experimental precedent, this could prove a valuable tool for the survey archeologist. For instance, one could employ a low intensity survey (i.e., reduced man-days per unit area) to cover a large area, thereby gaining valuable data on environmental diversity, yet still be sufficiently confident of variation in site

frequency ratios to permit the definition of refined research questions for an ensuing, more intensive, stage of research. I believe this has been demonstrated by the present study.

Although such information is, and will continue to be, of fundamental interest to the professional archeologist, it is of primary relevance at this point to the cultural resources manager, and to scientists interested in serving the manager. As unexploited archeological resources dwindle in number, the judicious management of those that remain becomes increasingly important. Yet even for the most proficient administrator, effective management is virtually impossible unless he knows the nature of the beast he is trying to protect. The only method of achieving this knowledge in the area of cultural resources in through field survey. Federal agencies are becoming increasingly aware of this, and many are planning archeological surveys as part of long range programs to acquire knowledge about the resources for management purposes, quite apart from public laws, orders, environmental legislation, and other legal mandates. In brief, we are entering a period when more and better information about cultural resources is being demanded of professional archeologists who are sophisticated in the techniques of survey. We can envision this demand as increasing for some time to come, until the backlog of data requisite to the management of cultural resources in a wide variety of geographical locations is acquired.

An even heavier burden placed on the manager at present is the need to acquire as much information as possible, over as wide an area as possible, in the shortest time possible. This generally must be accomplished with minimal funds, since cultural resources management does not yet enjoy high budgeting priorities in many federal or state agencies. Some managers are given the legal responsibility for conserving cultural resources contained on hundreds of thousands of acres of land, without knowing either the nature or the number of the resources they are supposed to protect. If ever a situation were "tailor-made" for expertise in survey sampling techniques, it is the one at present.

Unfortunately, this need for expertise comes at a time when the discipline of archeology is just awakening to the value and necessity of sampling and is thus caught somewhat short handed. Until recently, students have not had adequate

training in survey sampling, and very little research has been done on the application of different sampling techniques to varying field situations. We cannot go to the literature, for instance, to find out whether to stratify a particular type of survey area in the Southwest by topographic features or by soil or vegetative associations, or whether to use transects, quadrats, or some other unit when operating in a thick pinyon-juniper zone, or whether the same guidelines would apply when dealing with a different time period in a different section of the United States. What confidence limits should we strive for in a sample estimate—99 percent? 95 percent? 80 percent? How should we decide? Should we attempt a $\frac{1}{10}$ sampling fraction and assume no error of measurement, or should we increase the intensity of survey to ensure adequate measurement and thereby require a reduction of sample size? Such questions are critical to performing efficiently in the field of cultural resources management, and not many archeologists have adequate information to deal with them. We are being thrust into situations where we are forced to make educated guesses with insufficient education.

There is no immediate cure for this dilemma, as I see it. To acquire the amount of knowledge we need to learn to sample efficiently and effectively in archeology will take time. However, it will take less time if we realize the need for research that will answer the questions about sampling that confront us, and then take an active interest in pursuing that research. As someone once said, "We didn't know we was poor until we went to town." Hopefully, this report might help us get on the road to town.

Appendices

A: Data from Transect Sample

x_i	f_i	$f_i x_i$
13	1	13
12	0	0
11	1	11
10	1	10
9	1	9
8	2	16
7	2	14
6	0	0
5	6	30
4	3	12
3	8	24
2	10	20
1	3	3
0	3	0

$$\Sigma f_i = 41$$

$$\Sigma f_i x_i = 162$$

x_i = Frequency of sites per transect

$$n = \Sigma f_i = 41$$

$$x = \Sigma f_i x_i = 162 \text{ (total sites)}$$

$$\bar{x} = \frac{x}{n} = 3.95 \text{ sites/transect}$$

B: Data From Inventory Survey

x_i	f_i	$f_i x_i$
27	1	27
26	0	0
25	3	75
24	1	24
23	4	92
22	1	22
21	4	84
20	2	40
19	6	114
18	3	54
17	3	51
16	5	80
15	3	45
14	7	98
13	9	117
12	13	156
11	7	77
10	11	110
9	6	54
8	12	96
7	11	77
6	10	60
5	10	50
4	13	52
3	7	21
2	5	10
1	3	3

$$\Sigma f_i = 160 \quad \Sigma f_i x_i = 1689$$

x_i = site frequency per transect

$n = 160$

$x = 1689$

$\bar{x} = 10.56$

C: Data from Test of Sampling Design

x_i	f_i	$f_i x_i$
27	1	27
26	0	0
25	1	25
24	0	0
23	0	0
22	0	0
21	2	42
20	2	40
19	2	38
18	2	36
17	1	17
16	2	32
15	1	15
14	0	0
13	3	39
12	0	0
11	4	44
10	3	30
9	1	9
8	3	24
7	3	21
6	1	6
5	3	15
4	4	16
3	1	3
2	1	2

$$\Sigma f_i = 41 \quad \Sigma f_i x_i = 481$$

x_i = site frequency per transect

$n = 41$

$x = 481$

$\bar{x} = 11.73$

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