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TO HUMAN BURIALS FROM
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HUMAN BURIALS FROM CHACO CANYON



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Number Nine

**A BIOCULTURAL APPROACH
TO HUMAN BURIALS FROM
CHACO CANYON,
NEW MEXICO**

**by
Nancy J. Akins**

**BRANCH OF CULTURAL RESEARCH
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1977 Aerial Remote Sensing Techniques in Archeology. Reports of the Chaco Center, No. 2. National Park Service and University of New Mexico, Albuquerque.

3. POWERS, ROBERT P., WILLIAM B. GILLESPIE, AND STEPHEN H. LEKSON

1983 The Outlier Survey: A Regional View of Settlement in the San Juan Basin. Reports of the Chaco Center, No. 3. Division of Cultural Research, National Park Service, Albuquerque.

4. BRUGGE, DAVID M.

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5. WINDES, THOMAS C.

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6. LEKSON, STEPHEN H., ED.

1983 The Architecture and Dendrochronology of Chetro Ketl, Chaco Canyon, New Mexico. Reports of the Chaco Center, No. 6. Division of Cultural Research, National Park Service, Albuquerque.

7. MCKENNA, PETER J.

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8. JUDGE, W. JAMES, AND JOHN D. SCHELBERG, EDS.

1984 Recent Research on Chaco Prehistory. Reports of the Chaco

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The Branch of Cultural Research, formerly known as the Chaco Center, was established in 1971 to conduct multidisciplinary research in the area of Chaco Canyon, New Mexico. From 1971 through March 1986, this was a joint National Park Service/University of New Mexico facility housed on the university campus in Albuquerque. Effective April 1, 1986, the staff moved to National Park Service facilities in Santa Fe; the collections and all their documentation (archival material) are curated by the Maxwell Museum of Anthropology of the University of New Mexico in Albuquerque.

One of the most important missions of the Branch of Cultural Research is to disseminate the results of its research to the professional community and to the interested public, in addition to Park managers and interpreters. Reports on research projects of the Branch are issued either in the National Park Service Publications in Archeology series or in the Reports of the Chaco Center series. The latter was established in 1976 to provide economical and timely distribution of the more specialized research undertaken during the Chaco project studies. This report is issued as the ninth of that series.

The Branch of Cultural Research maintains an up-to-date listing of all published papers, reports, and monographs that include Chacoan or Chaco-related research carried out under the general auspices of the Chaco project, regardless of where they might be published. This list, entitled "Contributions of the Chaco Center," is available on request. Correspondence should be addressed to the General Editor, Branch of Cultural Research, National Park Service, P.O. Box 728, Santa Fe, New Mexico, 87504-0728.

PREFACE

While the actual assembly of this volume was remarkably fast, the events and research involved go back over ten years. My initial interest in human remains started with a work-study position at the Maxwell Museum Human Osteology Laboratory and has continued. After I began work for the National Park Service (then the Chaco Center), I inventoried the collections at the Maxwell Museum and the NPS office in Albuquerque as a student project. Very little of the research was accomplished in an official capacity, since human research was considered the lowest of priorities--to be pursued only after completion of my responsibilities as a faunal analyst.

In spite of this restriction, some research was started. Cranial measurements were taken over a number of years, mainly because the collections are dispersed from Tempe to New York and had to be done during vacations. Collections at the Field Museum of Natural History, Chicago, Illinois (1977); United States National Museum, Washington, D.C. (1978); American Museum of Natural History, New York, New York (1979); Peabody Museum, Cambridge, Massachusetts (1979); and Arizona State University, Tempe, Arizona (1981) were examined and measured.

H. Wolcott Toll and I reviewed the Maxwell Museum and NPS collections for paleopathologies as part of a class taught by S. Rhine and W. Minear in 1979. Unfortunately, we both had other obligations and were unable to assemble this information at that time.

Slightly later (1980), for a Society for American Archaeology symposium on recent work on Chaco, John Schelberg and I pulled together as much of the information on mortuary practices as possible and to produce a preliminary analysis and paper. Additional data were gathered and reorganized for the 1984 symposium and workshop on mortuary variability in the Southwest organized by John C. Ravesloot and held in Phoenix, Arizona.

Finally, in the summer of 1985 arrangements were made for me to compile all of the information on the Chaco human research into a single volume. The time allowed (four months) was much too short; for this reason more emphasis is placed on presentation of the data.

Many persons contributed to this work and deserve recognition. For the physical remains, Stanley Rhine, William L. Minear, and R. Ted Steinbock gave Wolky Toll and me the benefit of their expertise and examined a number of our specimens. John Schelberg aided in the mortuary data collection and contributed greatly to the direction the research has taken. John Ravesloot deserves credit for some of the analytic framework, which he suggested during the 1984 symposium.

Several institutions allowed us to examine collections and a great deal of appreciation goes to those individuals who made our work considerably easier. These include Stanley Rhine at the Maxwell Museum, James W. VanStone at the Field Museum of Natural History, Douglas H. Ubelaker and Ann Palkovich at the United States National Museum, Eric Trinkaus at the

Peabody Museum, R. S. MacNeish at Phillips-Andover, Barbara Conklin and Anibal Rodriguez at the American Museum of Natural History, and Christy Turner at Arizona State University.

Peter McKenna and Tom Windes (of the Chaco Center) provided identifications for ceramic vessels and examined photographs of vessels for the chronological descriptions. Wolky Toll and John Schelberg listened and discussed many aspects of the research and conclusions.

Several persons waded through the initial draft of this report. Stanley Rhine (University of New Mexico) and George R. Milner (University of Kentucky) reviewed the biological sections; James A. Brown (Northwestern University) and Joseph A. Tainter (USDA Forest Service, Albuquerque) commented on the mortuary practices. Alden Hayes (Portal, Arizona) provided invaluable comments on my interpretation of the history of Chacoan archeology and mortuary practices. George Milnar pointed out Southwestern particulars in need of expansion for a more general audience. F. Joan Mathien, John D. Schelberg, and H. Wolcott Toll made additional comments from the viewpoint of the current Chacoan research. In the final version I have tried to incorporate the comments of the reviewers; I have benefited greatly from their suggestions. Thanks again.

W. James Judge and Larry Nordby (successive "chiefs" of the project--variously known as the Chaco Center, the Division of Cultural Research, and Branch of Cultural Research) and Joan Mathien (series editor) made this volume possible. Jerry Livingston (NPS) took many of the photographs and prepared the illustrations and plates, and Dolores M. Guenzi (NPS) typed the manuscript. John Thomas, as the technical editor, clarified many of the thoughts and provided consistency throughout.

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INTRODUCTION

The study of human remains offers a unique perspective on prehistory. Environmental reconstructions can approximate the constraints of life in a particular area, but the examination of the human remains can measure the success of a population's adaptation to those conditions. Mortuary practices are a part of the cultural system that has seldom been studied by Southwestern archeologists. Too often biological and cultural aspects are treated as independent topics. The biological analyses do not take cultural and environmental aspects into consideration, and the archeologists' interpretations of biological and paleopathological information are superficial. Fortunately, such oversight is dwindling, as we come to realize that adaptation is both biological and cultural. This report uses both perspectives, augmented by the recent research on Chaco Canyon.

Background

To begin with, the district is little better than a desert; many parts of it, indeed, are absolutely barren wastes of sand and rock which do not even support the usual dry country flora of the Southwest. It is almost devoid of springs, has no permanent streams, is subject to severe sandstorms, is blistering hot in summer and bitterly cold in winter. It is hard to see how life in Chaco could have been anything but a continual struggle for bare existence. Yet in this harsh and difficult environment Pueblo Culture reached its highest development. The towns are large, excellently constructed, and lie in close proximity to each other. If all of them had been inhabited at the same time, they might well have housed more than 10,000 people. But how so large a population could have supplied itself with the mere necessities of life, and still had time and energy left for the development of so remarkable a civilization, has puzzled every observer who has visited the Chaco country [Kidder 1924:179].

Not all of Kidder's contemporaries shared his pessimistic view of the environment of prehistoric Chaco Canyon. Most, like Fisher (1934), deemed it impossible that the canyon was occupied under conditions similar to the present; therefore, physiographic conditions must have changed. Fisher's explanation was that the now dry Chaco Wash, terminating in the San Juan River, must have flowed during the greater part of the year, keeping vegetation intact and providing enough water to irrigate 600,000 acres and to support a prehistoric population of 30,000.

Brand (1937) was less radical in his view of the prehistoric environment, assuming a more diversified vegetation in what was still a cold desert. He felt that the considerable use of ponderosa pine and Douglas

fir in construction at the greathouses, or large pueblo sites, implied a nearby source of timber. Judd (1954), who worked in the canyon before Brand, believed that the thousands of logs that went into the construction of roofs at Chaco had to come from within easy carrying distance. Since the tree rings indicated a constant water supply, Chaco must have had a better climate. As late as 1970, Gwinn Vivian considered Chaco an oasis attractive to early farmers within the San Juan Basin; he suggested that a belt of pine stretched through at least the canyon area, providing materials for construction and fuel.

Recent paleoenvironmental research returns us to Kidder's characterization. Although the climate between A.D. 900 and 1130 was relatively warm and wet, it was within historical limits; periods of drought occurred between A.D. 900 and 910, 1030 and 1050, and 1080 and 1100, with a particularly severe one between A.D. 1130 and 1180 (Hogan 1983). Annual precipitation between 1950 and 1980 has averaged 220 mm (8.5 in.), with a range of 85 to 350 mm (3.35 to 13.75 in.). Since 1960 the mean number of frost-free days is just over 100, with more than half of the years below the mean (Gillespie 1985). The different varieties of Hopi corn take between 115 and 130 days to develop, and even a slightly warmer and wetter climatic regime would make Chaco a high-risk area for agriculture.

Packrat midden studies in Chaco Canyon suggest that ponderosa pine and the more montane conifers were rare at best in the centuries before the Anasazi (Gillespie 1985). While some pinyon and juniper continued as late as A.D. 700, they did so only as scattered stands on cliff sides and in sandy outcrops. The disappearance of pinyon and juniper may have been due to human use of these taxa (Betancourt and Van Devender 1981).

Surface water is scarce in the canyon, and the quality of the soil is poor. The presence of sodium carbonate and the impermeability of the soil would have made any agriculture difficult. A modern Soil Conservation Service classification indicates that Chaco has little potential for irrigation agriculture and in fact has some of the poorest soils in the San Juan Basin (Schelberg 1982). This lack of productive land, as well as the insufficient number of local exploitable animal resources (Akins 1985), leaves some doubt that even a relatively low population could maintain local self-sufficiency within a slightly better climatic regime.

Explanations of Chaco

For the early researchers who assumed a better and more productive environment, there was no need to explain the presence of a population in the canyon. Instead their queries were directed toward the occurrence of both large formal greathouse structures and small relatively crude houses in the same area. Explanations offered usually invoked migration (Judd 1954; Kluckhohn and Reiter 1939; Vivian and Mathews 1965--for the McElmo style greathouses only), conservative versus progressive factions (Hawley

1937; Kluckhohn and Reiter 1939), and different groups (Vivian and Mathews 1965).

In 1970, after study of the water control system in the canyon, Gwinn Vivian proposed that the greathouses were associated with hydraulic features. With this "new" perspective and many of the misconceptions perpetuated in the earlier literature, Grebinger (1973) proposed that Chaco represented a ranked society rather than one analogous to the modern egalitarian Pueblos. Ensuing arguments have not all concurred, but the most current researchers, backed by new data, analyses, and social theory, tend toward interpretations involving some degree of complexity (see Judge and Schelberg [1984] for some of the arguments and data).

Current explanations for social development follow two general schools of thought. One, the Mesoamerican argument, notes several parallels in the architecture and material culture between Mexico and the Southwest. Its more extreme version (such as Kelley and Kelley 1975) holds that Chaco was a pochteca trading outpost and that Mesoamerican influence was the principal cause of the emergence of any identifiable Anasazi culture. Mathien (1981, 1986) and McGuire (1980) have effectively demonstrated that few of the traits are strictly Mesoamerican and that many can be explained by long-distance trade connections in place well before and after the supposed Mesoamerican domination of the Southwest.

Proponents of the second view, that of indigenous development, differ widely in all aspects of the account of Chaco development. In addition to views expounded by those less familiar with the data base, investigators involved in recent work and analysis of Chaco materials tend to hold their own beliefs--generally influenced by their particular data base. Much effort has been expended in identifying the characteristics and tracing the extent and form of development of the Chaco system through various artifact analyses. Few analysts have been concerned with why it developed, in part because the analytic studies are prerequisites of causal explanations.

Grebinger (1973) thought that ranking, redistribution, and the outliers (Chacoan greathouses outside of the immediate canyon area) were the result of differential access to more productive farmland and of the consequent need to balance resources between elites and villagers. The outliers were taken to be established by excess population from Chaco.

Schelberg's (1982, 1984) argument is based on ecology. Given the low ecological diversity, environmental extremes, and low productivity throughout the San Juan Basin, increased social complexity would enhance the quality, quantity, and complexity of information processed by the social system. Response to local or regional problems, such as drought, could be coordinated, ameliorating the risk and uncertainty inherent in a sedentary horticultural existence in the San Juan Basin. Chaco's location at the center of the basin is seen as crucial to its development. Such an explanation also pushes the inception of social complexity back into Basketmaker times, associating it with increasing sedentism and agricultural dependence and pre-dating greathouse architecture. The system is

seen as a complex chiefdom operating both through scheduled ceremonies and when the need arose.

Judge's most recent explanation (1983) also accepts the importance of environmental variability and Chaco's central location. According to Judge, Chaco's influence on other areas was minimal until the end of the tenth century; before that time its only special role was as the locus of turquoise and ornament processing and finishing. In his view, turquoise had been integrated into an existing exchange network that by the early A.D. 1000s informally regulated exchange of other materials. The more favorable climate and the focus on southern portions of the basin suggest to him that the dominance was more in the nonmaterial realm--a primary ritual function with turquoise as the durable item of symbolic value. Periodic visits to Chaco became increasingly formalized, as did the networks. Chaco could thus buffer its resource base by a continued exchange of turquoise.

Brown (1981) reviews a number of general conditions under which ranking or social complexity develops; these include (1) resource control--through a vital function in an exchange network, a strategic geographic position, or control of the technical means for producing valued goods, and (2) managerial control--in which local subsistence insecurity and limited subsistence supply are alleviated by allocation of authority, or threat to the security of the food system or safety of the community from outside encougages investment in a decision-making authority. In this framework, Schelberg's explanation would be essentially managerial and Judge's one of control of a resource (in this case, turquoise). Brown's discussion leaves little doubt that Chaco was in a position in which ranking could occur, although not which explanation is more likely. For purposes of this report it is more important that ranking was present.

Population Estimates

Appraisals of the maximum human population in Chaco Canyon have tended to be based on optimistic views of the local environment and productivity. Fisher (1934) claimed that 10,000 could have lived in the greathouses alone. Pierson (1949), basing his analysis on the number of rooms at the sites, estimated 4,400. Drager (1976), working from more recent, complete survey data and using roomblock area, estimated a maximum of 6,000. Hayes's (1981) estimate is more complex: again using survey data, but also considering visibility of site types, average number of rooms, contemporaneity of sites, and functional life of structures, he calculated a total of 2,889 for the small sites and 2,763 for the great-houses. Windes (1984) reduces the figure for the entire canyon to 2,000 by figuring one household unit per firepit. On this basis, Pueblo Bonito, with around 650 rooms, might have housed 100 persons at the maximum. Lekson (1984a), using round rooms (or kivas) to measure population at the

greathouses and Hayes's figure for small sites, estimates 4,100 for the canyon.

Objectives

After a short history of burial removal and a discussion of the problems associated with the data base in Chapter 2, I examine the biological characteristics of a portion of the skeletal population (Chapter 3). Dependence on agriculture in an area of such poor potential should, and did, have its effect on the general health of the populace. Unfortunately the sample is almost entirely of small-site residents, and comparisons cannot be made with the, possibly elite, greathouse dwellers. In contrast to these biological studies, the craniometric and biological distance studies offered here center around one series of crania from Pueblo Bonito. In Chapter 4 I review the numerous studies involving this collection and present a new one. Chapter 5 brings together the available mortuary information. Much of this material is archival and of poor quality. Yet there are quantifiable differences in the treatment of individuals from the small and large sites, as well as slight differences over time. I consider implications of these patterns. Finally, in Chapter 6 I build on the preceding biological and mortuary studies to evaluate current concepts of complexity.

HISTORY OF BURIAL REMOVAL

Reports and Archives

Removal of human remains from Chaco Canyon (Figure 2.1) has a long and often undocumented history. While Jackson is credited with the discovery of a human skull near Pueblo del Arroyo in 1877 (Reed n.d.; Senter 1937), this was probably not the first. The U.S. National Museum catalog lists a number of contributors of Chaco materials preceding a donation by V. and C. Mindeleff, who were there in 1877. J. S. Newberry, G. M. Wheeler, J. W. Powell, T. F. Beckford (probably F. T. Bickford in 1890), L. J. Hatch, C. Rau, and G. S. Orth, as well as the Mindeleffs, all deposited collections before Neil Judd's 1920s work in the canyon. Although most of these donations were one or small numbers of items, they do suggest active collection at an early date.

Table 2.1 gives a chronological listing of the known burials. It is incomplete for the early years, when many of the visits were similar to that of F. T. Bickford, who stopped for eight days in search of burials (McNitt 1966), or of Richard Wetherill, who in 1895 stayed until 40 pieces of pottery had been collected (letter to Talbot Hyde dated December 1895). The Hyde Exploring Expedition, under the direction of George Pepper, is virtually the only excavation from the early period with good documentation. More typical of this era was a group led by Warren K. Moorehead of Ohio State University:

It was not the purpose of Mr. Peabody's expedition to attempt a thorough exploration but simply to make a typical collection in three weeks, and, as a total of about two thousand specimens of various kinds were secured in that time, the object of the visitation was accomplished [Moorehead 1906:33].

That expedition worked in a few rooms at Pueblo Bonito and "a small cemetery" about a mile from Bonito where "a number of skeletons" and 40 to 50 vessels were recovered. "Enroute to Durango several collections were purchased from ranchmen at La Plata, Farmington, and Olio, New Mexico" (Moorehead 1906:53).

Also typical was the Tozzer and Farabee expedition of August and September 1901. Four "burial mounds" and two roomblocks were excavated. The mounds were typically staked out in 10-foot squares, and Mound 1, consisting of 30 squares, was totally excavated in four days. The last of the mounds, Mound 4, had been previously disturbed by treasure hunters (Andrews 1970).

Apparently such excavation activities were not rare, and those prior to 1906 are largely undocumented. How much activity can be attributed to

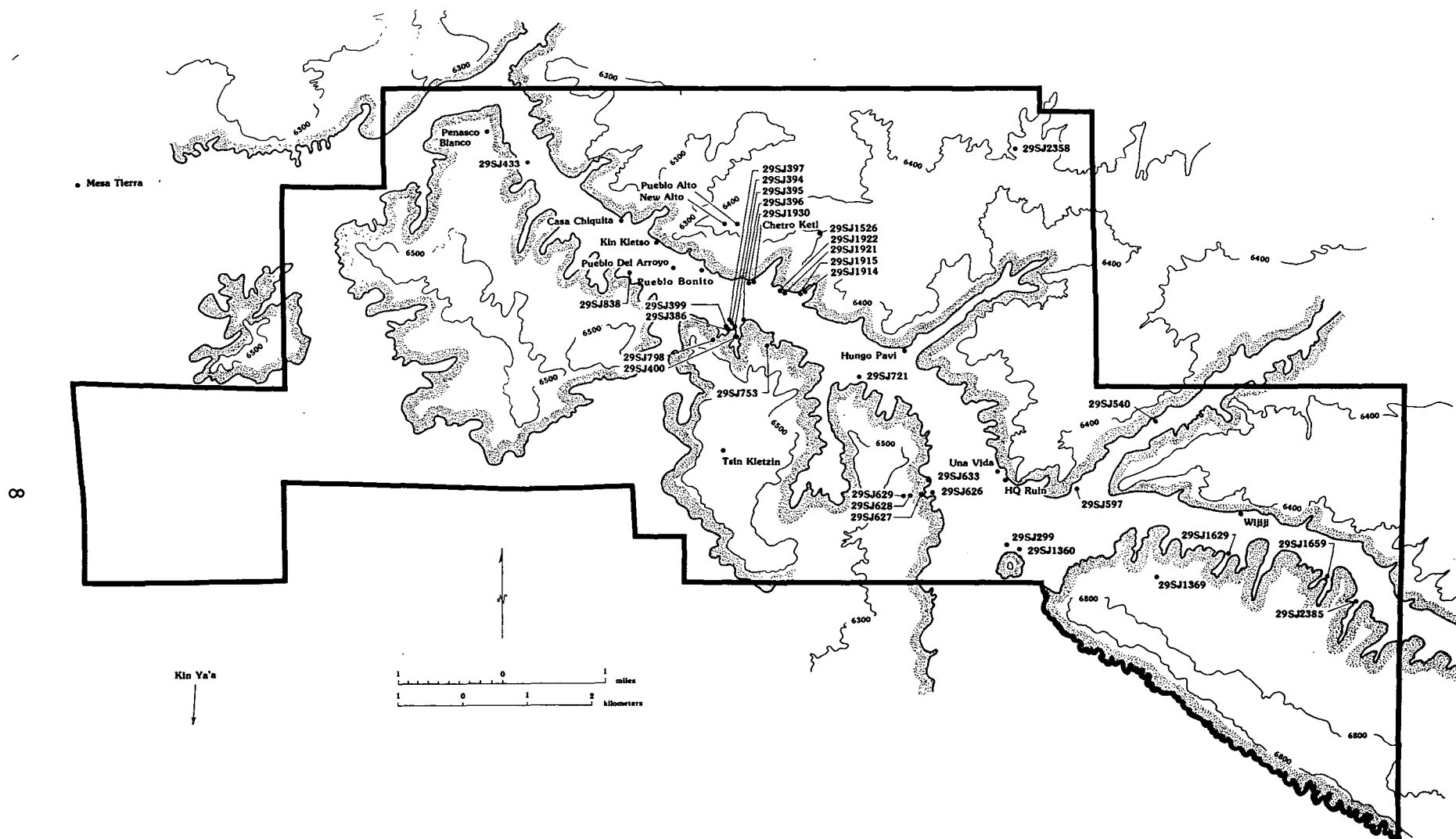


Figure 2.1. Chaco Canyon, New Mexico

Table 2.1. History of Chaco Canyon burial removal

Date	Excavator	Location	Number of burials
1890	F.T. Bickford	Peñasco Blanco	"a few fragments of skulls"
1895	Richard Wetherill	South Gap area	"a number of burials"
1896-1910	Richard Wetherill	"every mound in the canyon"	unknown
1896	George Pepper, AMNH	Mound 1 (Bc 59)	12
	George Pepper, AMNH	Mound 2	19
1896-1899	George Pepper, AMNH	Pueblo Bonito	18 (+15)
1897	W.K. Moorehead	Pueblo Bonito	1 (+4+)
	W.K. Moorehead	cemetery 1 mile E of Pueblo Bonito	"a number of burials" and 40 to 50 pots
late 1890s	Col. D.K.B. Sellers	Pueblo Bonito	1 (mummy)
1899-1900	A. Hrdlička	near Kin Bineola	72
1901	Tozzer and Farabee	Mound 1	5+
	Tozzer and Farabee	Mound 2	4-8+
	Tozzer and Farabee	Mound 3	unknown
	Tozzer and Farabee	Mound 4	10?
	Tozzer and Farabee	Mesa Tierra	1 (+1)
	Tozzer and Farabee	Picture Cliffs	1
1901	S.J. Holsinger	2 miles E of Kin Klizhin	7
		1 mile NW of above	3
1921-1927	Neil Judd, Nat. Geog.	Pueblo Bonito	75-95 (Judd, 73; Hrdlička, 75; Palkovich, 95+)
1923-1926	Neil Judd, Nat. Geog.	Pueblo del Arroyo	6 (+10) (Reed, at least 15)
1925	Neil Judd, Nat. Geog.	near Pueblo Bonito	1
1926-1927	F.H.H. Roberts	Turkey House	7
	F.H.H. Roberts	10 miles E of Pueblo Bonito	9
	F.H.H. Roberts	29SJ 2358	3
	F.H.H. Roberts	near Fajada	21
1927	Neil Judd	near Pueblo Bonito	4
1927	F.H.H. Roberts	Shabik'eshchee	14
1928	Neil Judd	near Pueblo Bonito	9
1930	UNM	behind Wiji1	5
1931	UNM	Casa Rinconada	1
	UNM	near Peñasco Blanco	3 (+1)
	UNM	Chetro Ketl	1 (+3-5+)
1934	UNM	Bc 126	2 (+2)
	UNM	Kin Kletso	1-2
	UNM	Talus Unit	5
1936	UNM	Bc 50	12
	UNM	Bc 51	4
	UNM	Leyit Kin	1 (+1)
1937	UNM	Bc 50	1
	UNM	Bc 51	28
1938	UNM	Bc 51	11
1939	UNM	Bc 51	6
	G. Vivian [CCC]	Three C	16
1940	UNM	Bc 53	5
1941	UNM	Bc 52	1
	UNM	Bc 53	14
	UNM	Bc 54	1
	UNM	Bc 55	1
	UNM	Bc 56	1
1942	UNM	Bc 57	9
1947	UNM	Bc 58	1
	UNM	Bc 59	12
1950	RSU, G. Vivian	Bc 59	42
	RSU, G. Vivian	Kin Kletso	6 (+5+)
	RSU	Pueblo del Arroyo	1
	RSU	Bc 51	4
1950 or 1951	RSU	Talus Unit	1
1956	RSU	Kin Ya'a	1
1958	RSU	Bc 236	2
1960	RSU	Bc 192	1-2 (+2+)
1962	RSU	Bc 362	2
1971	RSU	Talus Unit	1
1972	NPS	29SJ 563	1
	NPS	29SJ 628	0 (+4)
	NPS	29SJ 1396	1
	NPS	29SJ 1526	1
	NPS	29SJ 1629	1
1973	NPS	29SJ 299	4 (+1)
	NPS	29SJ 423	0 (+2)
	NPS	29SJ 721	1
1974	NPS	29SJ 627	3 (+4-11+)
	NPS	29SJ 1360	6 (+2-7)
1975	NPS	29SJ 627	1
1976	NPS	Pueblo Alto (29SJ 389)	1 (+4-19)
	NPS	29SJ 629	2 (+2+)
1978	NPS	29SJ 633	4 (+2)
1979-1980	NPS	Una Vida	0 (+1)
1980	NPS	29SJ 597	1
1981	NPS	29SJ 597	1 (+1-3)
	NPS	29SJ 626	2
Dates unknown			
	AMNH	Gallo Ruin	1
	AMNH	Peñasco Blanco (Waylo's work)	3+
	UNM	Bc 50	2
	UNM	Bc 57 (1942?)	5
Skeletons with no references			
	UNM	Bc 63	1
	UNM	Near Fajada (d 5/1)	1
	Buckingham	Bc 191?	1
	unknown	unknown	2
	unknown	unknown	3 skulls

Note: This does not include many partial burials and isolated bones from early work and non-NPS work.
 () indicates additional individuals represented by partial skeletons or miscellaneous parts.

Richard Wetherill will never be known. Correspondence dated 1904 and 1905 between the Wetherill Mercantile Company and the Field Columbian Museum discusses a collection exhibited by Wetherill at the World's Fair of 1904 in St. Louis. The collection is noted as "especially valuable on account of the number of skulls it contains as well as several interesting baskets and over 200 pieces of pottery (letter to the director of the museum from Geo. A. Dorsey dated January 23, 1905). A letter from the Wetherill Mercantile Company (November 15, 1904) notes that the pottery was from burial mounds in Chaco Canyon and its vicinity and that the few skulls were from the same mounds; the pottery is said to have been dug primarily by Indians. A large number of ceramic vessels (140 to 150) are listed in the Chicago Field Museum catalog as having been acquired from Richard Wetherill. While Richard himself may not have been responsible for the excavations, he and traders purchasing such objects encouraged local Indians to excavate.

Similarly, the American Museum of Natural History catalog includes a number of Pueblo Bonito and Chaco mound items that were purchased from O. C. Buck. This material had been collected during the winter of 1897 and 1898. Buck was hired by the Hyde expedition as a teamster during the work at Pueblo Bonito.

The magnitude of early digging is expressed by Holsinger--"The burial mounds of the canyon are practically exhausted" (1901:91)--and later by Hewett:

Along the important ten miles of the Chaco Canyon with its great central group and a large community house on each mile of the north side of the valley, not a refuse heap is to be seen that has not been dug over, and across the valley to the south where the dead from the great communities were once supposed to have been buried, not a mound can be found that has not been pitted over and over in search for pottery [1936:51-52].

The expedition of the American Museum of Natural History under the direction of George Pepper spent several seasons (1896-1899) excavating approximately 190 rooms at Pueblo Bonito (Pepper 1909, 1920). A number of burials were recovered. Most of these were disturbed, but there is a detailed account of the objects found in the rooms. Some interpretation of associations is necessary.

After the Antiquities Act of 1906 and proclamation of the area as a national monument in 1907, activity slowed. Until around 1928 the work involving burial excavation was done by the National Geographic Society under the direction of Neil Judd. "Scientific excavation" was carried out at Pueblo Bonito and Pueblo del Arroyo and at a number of smaller sites. The latter are generally unpublished and are often represented by little documentation and poor indications of site location, such as "near Pueblo Bonito" or so many miles from Pueblo Bonito. Judd's burials from Pueblo Bonito are the largest single sample of burials from Chaco Canyon. Around ninety-five were recovered from four adjoining rooms. Many of these, like Pepper's burials, were disturbed. Some are well described, but there are

gaps in the information for any given individual and it is not possible to be sure that a description is complete. To add to the confusion, there are three accounts of how many individuals were involved (Judd 1954; Hrdlička n.d.; Palkovich 1984); the reported totals differ by as many as twenty persons.

From 1930 through 1947, excavations in the canyon were largely conducted as joint School of American Research and University of New Mexico or University of New Mexico field school endeavors. The information varies from nonexistent to conflicting, but it is occasionally thorough. Some students had difficulty remembering which room or even which site they were in, and descriptions of even the same burial often do not match.

Little is known about the first series of burials removed by the School of American Research/University of New Mexico (SAR/UNM) explorations of the early 1930s. These were given a "d" designation, in which d 0 indicated Chaco Canyon, exact provenience unknown; d 1.1, the Chetro Ketl refuse heap; d 2.1, just outside the great sanctuary of Casa Rinconada; d 3, Wijiji; d 4, one-eighth mile north of Peñasco Blanco; and d 5, "on fork of arroyos (Chaco and Ch_) near Mesa Fajada." Most were not removed as part of a formal excavation program, and the comments on meager burial forms either do not match the remains now at the museum or provide no information about the individual. For example, Wijiji has burial numbers at the Maxwell Museum (d 3/1-d 3/3) but a burial form for d 3/3 is the only one that could be located. The form reveals almost no information--only that the skeleton was a female and that with it was a child whose remains were not brought in. The bones now stored under this number are parts of a young female and of a slightly older male. By 1934 the "d" system had been abandoned and an assortment of alpha characters were used (If for Chetro Ketl, CK for Talus Unit 1; SWI for Bc 126). Finally the "Bc" system was adopted, eliminating much of the site provenience ambiguity.

The burial removal methodology at Bc 50 and Bc 51 was described by several students who noted that it was desirable to remove the soil in such a way that the skeleton was left untouched on a platform. To accomplish this, a 2-foot-deep trench was excavated around the area where the soil of a partially exposed burial was thought to be. Then the soil directly associated with the skeleton could be gently pulled into the trench and shoveled out. Unfortunately, this practice occasionally left parts of the body or the burial goods outside the trench, and it was then impossible to determine if they were associated.

One student paper (Maher 1947) describes a 1947 search by field school students for a "burial ground" located by Paul Reiter and Gordon Vivian "while out on a stroll to avoid evening seminar" in 1931. Three or four burials had been removed at that time and the burial form located these as north of Peñasco Blanco in a broad flat area. The students put in fifteen test pits and three trenches in an area Vivian thought might be the site, but nothing was found. A recent review of student notes in the National Park Service archives revealed a 1931 account that mentions

removal of burials from a quarter of a mile west of Peñasco Blanco on a small flat (Archive 1862). This is unfortunately typical of the earliest SAR/UNM years in the canyon; the location, number of individuals uncovered, and details are in general sketchy. All of the 1930-1931 burial forms appear to have been filled out by Paul Reiter much later. The single burial from the Chetro Ketl dump is described many times, but the information does not match the burial form. Provenience data on the bags in which this skeleton was placed provide yet another contrasting set of information. In addition, entire collections of human bones for some years have been lost, and some series of burials have no documentation.

The next twelve years of work in the canyon was limited to National Park Service Ruin Stabilization Unit (RSU) efforts. These undertakings included the excavation of parts or entire sites. Here again the information is variable and ranges from good to sketchy. In some instances the only records are catalog cards. One of the more amazing examples of an RSU excavation took place at Bc 59. While moving a portion of the refuse to provide diversion for surface runoff, excavators found thirty-five burials (forty-one individuals) in the "thin fringe on the west side, nearest the ruin" (Archive 1449:2). Reed (1962) examined these and provided age and sex determinations, but the results are questionable. Two individuals in the collection identified by Reed as males had been well cleared and photographed. Both H. W. Toll and I concluded after study of the photographs that the innominate bones were female in appearance--one shows a well-developed preauricular sulcus. In addition, when I measured this series, I recorded both as females. Situations such as this tend to cast doubt on the published observations made on this collection. The burial numbers, bones, or photographs may have become mixed over the years.

Beginning in 1972 the National Park Service Chaco project uncovered a small number of burials. Excavation was directed toward definition of architectural features with limited outside testing, a factor that restricted the number of burials recovered. These were well documented and are available for study.

In summation, there is very little high-quality information on burials from Chaco Canyon. The published reports are usually incomplete or even wrong, and the archival accounts are sketchy and often inconsistent. The following analyses have taken this into consideration.

The Question of a Lack of Burials

The earliest excavators in Chaco certainly did not perceive a lack of human burials. The small sites in the canyon were typically referred to as burial mounds even into the University of New Mexico field school era. Typically, big sites in the Southwest produce large numbers of burials, many of which come from midden areas. At Pecos Pueblo, actually at least six superimposed towns that were occupied for several centuries, over

1,200 burials were recovered; trenching a midden in the first season of excavation, Kidder (1924) found 200 burials. Mound 7 at Gran Quivira consisted of three superimposed structures dating from A.D. 1300-1400, from the early 1500s, and from 1545-1672. The maximum size was around 200 rooms. Approximately 550 individuals were recovered, over half of which were intramural (Hayes 1981). Arroyo Hondo, with over 1,000 rooms, had a peak population of more than 1,000 and an occupation of just over 100 years. Four years of excavation uncovered 120 burials and a number of isolated human bones. Most were from plazas, trash areas, or trash-filled structures (Palkovich 1980). At Grasshopper, a Mogollon pueblo with over 500 rooms occupied between A.D. 1275 and 1400, 655 burials were excavated before 1975 (Whittlesey 1978).

George Pepper was one of the first to put a concerted effort into trenching a large-site midden, that of Pueblo Bonito. Because his contemporaries were accustomed to removing burials from refuse mounds at small sites and from other large sites throughout the Southwest, it came as a surprise when no burials were found in the midden. Pepper thought that the number of burials recovered from the rooms at Pueblo Bonito was inconsequential and ultimately concluded that, since most of his investigations were inside the ruin, the cemetery must lie outside to the east or west and could be covered by silt and sand (Pepper 1920). Neil Judd, dismayed at the small number of burials at Pueblo Bonito, also supposed that they must lie in an outside cemetery; he put in "half a dozen" tests and monitored arroyo formation for human remains. He finally suggested that they must be located over a quarter of a mile from Pueblo Bonito (Judd 1954).

Edgar Hewett found a similar situation at Chetro Ketl--although one or two burials were found during trenching of the trash area. He too recognized that much burial prospecting had preceded him and that burial customs were casual and interments often shallow, yet he still concluded that those found in the canyon were insufficient (Hewett 1936). In all fairness, his statement did predate the SAR/UNM work at the Bc sites and he may have been unaware of those recovered by Judd. Hewett appears to have been the first to ask why there were so few Chaco burials instead of asking, with his predecessors, where the burials were. This theme was carried on by Donovan Senter, who claimed that since the first excavations "archeologists have wondered at the amazing dearth of burials" (1937:141). He was himself amazed to find sixteen burials during the 1936 excavations at Bc 50 and 51. A student paper written in 1941 (Palmer 1941) expressed wonder that an area that was the home of thousands of people had so few burials.

McNitt (1966) compiled a list of burials from Chaco that resulted in the much quoted figure of 302 burials. He contrasted the north and south sides of the canyon but erroneously assigned Pepper's mounds to the north side. His numbers include only those of the published accounts and a few of the RSU burials, the existence of which was related to him by Gordon Vivian.

Alden Hayes (1981) revived Judd's and Pepper's perception that perhaps the lack of burials was associated with greathouses rather than with

Table 2.2. Carnivore gnawing on isolated human remains
from recent excavations

Site	Number of elements	% Gnawed
29SJ 299	7	14.3
29SJ 423	15	13.3
29SJ 597	9	22.0
29SJ 627	24	20.8
29SJ 629	40	10.1
29SJ 1360	19	31.6
Bc 192	15	40.0
Pueblo Alto	31	3.2
Una Vida	4	100.0

Chaco in general. More recent work and an evaluation of the problem suggest a number of implications. A much lower human population residing in the canyon and especially in the greathouses reduces the initial expectations as to the number of burials that should be found. While most larger sites in the Southwest are just that, large sites with many occupants, the greathouses in Chaco appear to have housed relatively few persons, possibly elites. Certainly a maximum population of 100 at Pueblo Bonito would leave fewer burials than would the 1,100 suggested by Judd. Shallow interment in midden areas at the small sites encouraged not only relic hunters but also the local carnivore population. Incidence of carnivore-gnawed human bones was recorded for the Chaco project excavations; it is quite high for some sites (Table 2.2). These two types of disturbance, combined with the overall poor preservation of human bone, substantially reduce recovery. Finally, there is excavation bias. Excavation at the small sites has usually concentrated on architectural features and consequently has missed all or most of the midden interments. The burial mounds referred to by early explorers were the trash middens associated with the small sites. The two sites with large burial samples (Bc 50, Bc 51, and Bc 59) had large-scale exterior excavations. The greathouse burials representing the classic or height of system complexity (A.D. 1020-1120) appear to be concentrated in rooms, and these rooms represent only a small portion of the site; 1% of the Pueblo Bonito rooms held nearly all of the burials. Strategies involving less than complete excavation could easily miss these or other formal facilities. A number of burials have been found along the cliff base and talus and cannot be associated with any particular site. Placement of individuals outside of the site area is definitely part of the overall burial program, but this is one aspect that is hard to integrate into an archeological sampling strategy--much less to actually sample for.

In combination, these many factors bring the information at hand closer to our expectations--especially since our assessments of how long sites were occupied and by how many persons still lack precision.

BIOLOGICAL STUDIES

Background

The primary purpose of these biological studies is to generalize from observed patterns to the health of the population. Although it would be ideal to study change through time, the sample is too small and the number of well-dated burials even smaller. Nor are there enough burials from the greathouse sites for comparisons between large and small sites. Instead, it is necessary to focus on the small-site spectrum, regardless of time; when Pueblo Bonito is studied, the two samples can be compared.

This chapter is organized for presentation of the data by the following topics: (1) general characteristics (age, sex, and site distribution), (2) congenital and developmental disorders, (3) dental conditions, (4) arthritis and trauma, (5) hematological conditions, and (6) disorders that are uncommon or of uncertain origin. For each topic, the relevant conditions are defined and their incidence given. Finally, there is a discussion of the general health based on the preceding data.

Detailed biological studies of prehistoric Southwestern populations are rare, making even minimal comparison with groups adapting to similar environmental and subsistence constraints infeasible. Many of those available are vague about where their object population came from (such as "Chaco Basin"), or consist of very small numbers of individuals, or employ such gross time scales as to make their utility very limited.

The collections used in our evaluation are those housed at the Maxwell Museum of Anthropology Osteology Laboratory and those held by the National Park Service Branch of Cultural Research. Other collections of Chaco Canyon human remains are located at Arizona State University, Tempe (Bc 59, Kin Kletso, and other RSU burials); the American Museum of Natural History, New York (Pueblo Bonito, Peñasco Blanco, Bc 59, Pepper's Mound 2, Kin Neole, and others); the Field Museum of Natural History, Chicago (Moorehead's Pueblo Bonito); and the U.S. National Museum, Washington, D.C. (Pueblo Bonito, Pueblo del Arroyo, and some small-site excavations). Those from Pueblo Bonito are the largest collection from one site and offer the best comparative material for assessing differences between the smaller sites (this sample) and the greathouses. The Pueblo Bonito collection has not been reported in detail and only a few observations can be made from published reports.

The Maxwell Museum Collection. The extensive excavations carried out by the SAR/UNM field schools uncovered a large number of burials; however, not many have survived. Of the twelve individuals found at Bc 50 during the 1936 season (Senter 1937), none are extant. A partial burial recov-

ered in 1937, a mandible from Room X, and a partial skull and ulna from an unknown provenience are all that represent that site.

Bc 51 fared slightly better, although the remains are fragmentary and often consist of only a few bones. Fifty-five numbers were assigned, and fifty-seven to fifty-nine burials plus spare parts are suggested by the mortuary information. Of these, nineteen are now in the Maxwell collection.

Although not every burial recorded at Bc 53 can be accounted for, there were twenty individuals indicated by burial records and twenty-four identified in the analysis of the remains. Some confusion is caused by nonconsecutive numbering of burials from the two seasons of excavation.

While some of the burial numbers from Bc 57 appear to have been mixed, thirteen of the fifteen reported individuals are intact. Bc 59 had the largest number of burials removed, around seventy-five. Twelve of these were recovered by SAR/UNM and nine are now in the Maxwell collection.

Other Chaco burials housed at the Maxwell Museum include those from Bc 56, Bc 63, Bc 126, Bc 248 (Kin Kletso), Bc 257 (Talus Unit), Chetro Ketl, and a few for which the site is not known.

The National Park Service Collection. The human remains at the Branch of Cultural Research, consisting of materials recovered in excavations between 1971 and 1980 and some of those from RSU activities, are more complete than many of those at the Maxwell Museum. Included are those from sites with "29SJ" designations and, from RSU work, Bc 191, Bc 192, Bc 236, and Kin Ya'a. A few others have been in the National Park Service collections for many years and presumably the Chaco Canyon proveniences are correct.

In conjunction with a University of New Mexico class in paleopathology taught by Professor Stanley Rhine and W. L. Minear, an orthopedic surgeon, H. W. Toll and I evaluated the Maxwell Museum and National Park Service skeletal series from Chaco Canyon. Dr. Minear supplied the x-rays and was extremely helpful in pointing us in the right direction for many problems and giving his opinion in the more difficult cases. R. Ted Steinbock, a radiologist and paleopathologist, also reviewed a number of burials.

We began by designing a "General Information and Pathlogy" form, which was eventually completed for each burial. More detailed studies of arthritic and degenerative processes, dental pathology, trauma, and hematological conditions were completed as individual topics to help ensure consistency in recording. Other areas such as inflammatory reactions, metabolic disease, neoplasia, and disorders of uncertain origin were not finished and have been left at the descriptive level. The forms for each burial and a complete listing by burial are on file at the Branch of

Cultural Research. Appendix A gives a complete list of the information used as the basis for this discussion.

General Characteristics

The population of 135 individuals ranges from some represented by a few skull fragments to nearly complete individuals. Preservation of human bone is generally poor in the Chaco Canyon small sites. Even the complete individuals are often fragmented, complicating the assessment of age and sex. Only thirty of the eighty-five adults (35%) had a pubic symphysis complete enough for aging. Infants and children were in better condition, their bones were less broken, and they often retained the teeth. It is quite likely that infants and children are underrepresented in the collections from some sites; infant bones are not as easily recognized as human or as a burial, especially when uncovered by inexperienced students or laborers employing shovel excavation.

Table 3.1 gives the age and sex distributions for the population. No single site has a population large enough for study on its own; however, the Anasazi adaptation was similar throughout the occupation and it should be possible to discern general patterns. Demographic evaluations are not feasible with this data base, given the small sample from any one site, the time span involved, and the biases inherent in excavations of this many sites.

Age. Dental development is the most accurate indicator of chronological age in subadults. It is strongly controlled by genetic factors with minimal influence from environmental factors (Ubelaker 1978:46). The chart developed by Ubelaker (1978:47) for American Indians was used to estimate the age for all subadults with dentition. When teeth were not present, long-bone measurements were used. These are not as accurate as analysis of dental development, since growth rates, even within the same racial group, vary. Long bones were aged from a chart (1978:48-89) based on a population of Arikara Indians (Table 3.2 provides ages determined by dental development and long-bone measurement). Long-bone development is generally slower for the Chaco population than for the Arikara; the age estimates from long bones are usually lower than those estimated from dentition.

Dental age is plotted against measurements of the femur, tibia, humerus, and radius in Figures 3.1 and 3.2. Also included in these figures is a curve developed by Weaver (1977) for Grasshopper Pueblo, Arizona. Although different criteria were used to age the dentition, the curve is similar to that from Chaco. The Chaco children do appear to slow down in rate of growth earlier than those from Grasshopper. However, this may be an artifact of the different dental aging criteria. The Chaco long bones without accompanying dentition were reexamined using the Chaco curve to increase the accuracy of the age determination.

Table 3.1. Age and sex distribution of the biological studies population

Site	0-1	1-2.9	3-4.9	5-14	15-25		25-40			40+			Adult unk. age			Total
					M	F	M	F	U	M	F	U	M	F	U	
Bc 50							1				1			1		3
Bc 51		2	1	3				3	3		1		4	2		19
Bc 53	2	2	4	1		3	2	1	1	1	1			3	3	24
Bc 56															1	1
Bc 57	2	2	2	3				1		2	1					13
Bc 59				2		1		2		2			1	1		9
Bc 63											1					1
Bc 126				1			1									2
Bc 191							1									1
Bc 192								1								1
Bc 236	1							1								2
Bc N															1	1
29SJ 299							1	2			1					4
29SJ 389	1															1
29SJ 563											1					1
29SJ 597					1						1					2
29SJ 627	1		1				1	1								4
29SJ 629							1						1			2
29SJ 633	2	1			1											4
29SJ 721						1										1
29SJ 1360	2	1	1					2								6
29SJ 1396				1												1
Unknown							3	1	1		1			1	1	7
Casa Rinconada										1						1
Wijiji		1		2		1	1									5
Near Peñasco Blanco			1			1	2								1	5
Near Mesa Fajada													1			1
Talus Unit	1	1	2	1		1							1			7
Chetro Ketl						1							1			2
Kin Kletso			1	1												2
Kin Ya'a							1									1
Total	12	10	13	15	2	9	15	15	5	6	5	4	9	5	10	135

Table 3.2. Dental age and long-bone measurements (cm)

Site/Number	Dental age	Femur	Tibia	Fibula	Humerus	Radius	Ulna
Bc 51							
RSU	12+4m	11.7	9.4		9.2	7.1	8.1
Bc 53							
60/1	9+3m	9.5	8.0		7.9	6.1	7.1
60/2	3+1y				10.2	8.0	8.9
60/4	3+1y	15.4	13.0			9.1	10.1
60/5	4+1y	17.3	14.1	13.9	13.3	10.4	11.5
60/9	nb+2m	7.5	6.4	6.2	6.4	5.2	5.9
60/12	9+4m	9.9	7.9	7.7	8.0	6.3	7.1
Bc 57							
60/1	9+3m				7.3	5.9	6.7
60/3	2y+8m		10.7	10.2	9.9	8.1	9.1
60/9	nb+2m	7.7	6.8	6.4	6.5	5.3	6.1
60/11	5y+16m					9.0	
60/12	18+6m				8.7		
Bc 59							
60/4	9+2y			25.0			
Bc 236							
#62	nb+2m	7.4	6.2			5.1	5.8
29SJ 633							
1	12+4m	11.2	9.2	9.0	8.6	6.9	8.0
2	2y+8m	13.5	11.5	11.1	10.9	8.6	9.4
4	12+4m	10.8	9.4	8.7	8.6	6.8	7.5
29SJ 1360							
3	3+1y	14.7	12.1	12.0	11.6	8.7	9.7
5	3m+3m	8.1	6.8	6.4	6.9	5.5	6.2
Wijiji							
d 3/1	5y+16m	15.6	16.4				
Talus Unit							
RSU	6+3m	9.1	7.7		7.5	6.2	7.1
60/4	4+1y	16.5	13.6	13.0	12.2	9.6	10.8
60/6	18-24+6m				10.2	8.3	9.3
Chetro Ketl							
#992	3+1y					8.2	9.3
Kin Kletso	7+2y				12.6	10.0	11.0

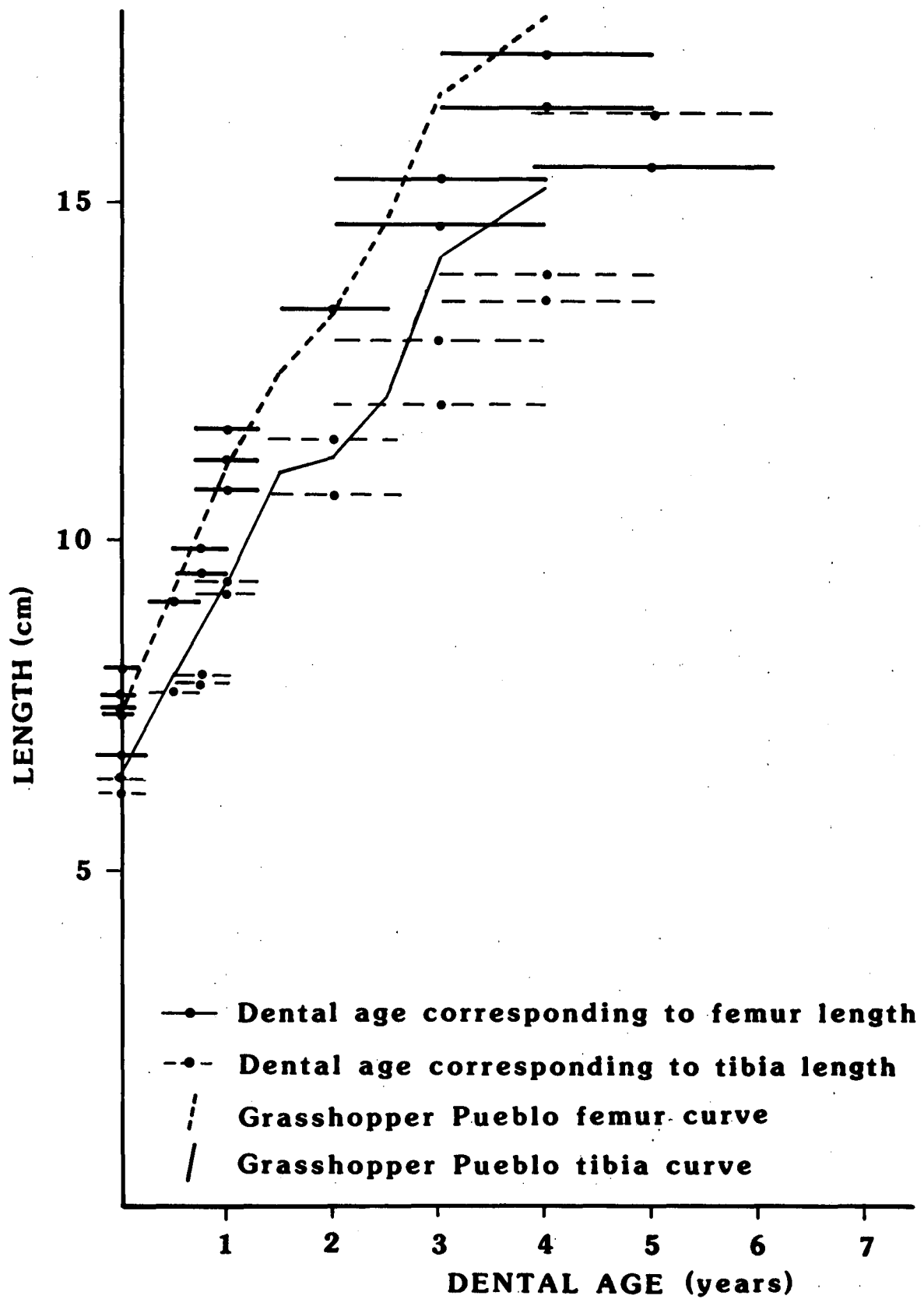


Figure 3.1. Dental age versus femur and tibia lengths

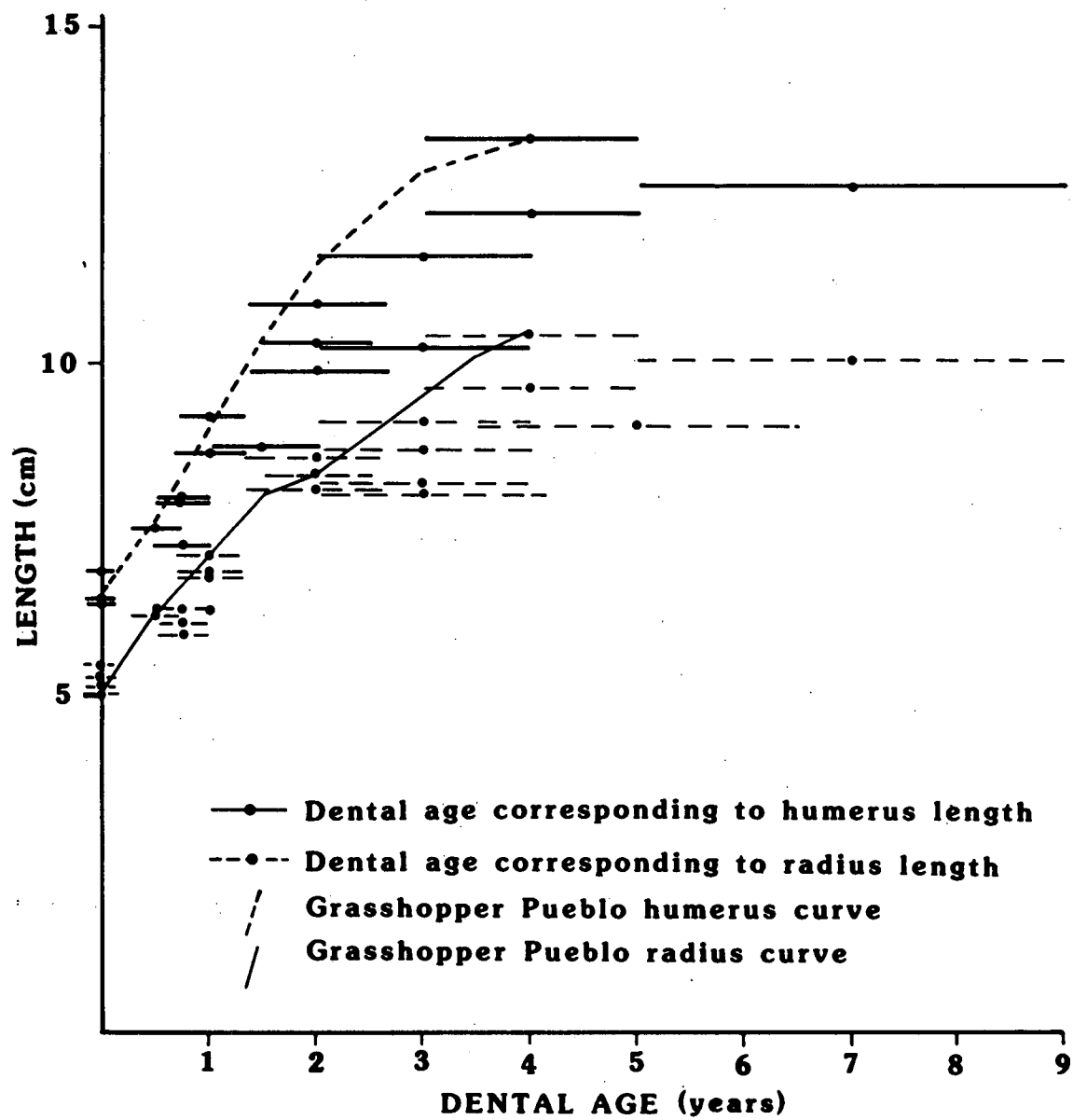


Figure 3.2. Dental age versus humerus and radius lengths

Ages of subadults with neither dentition nor long bones (generally portions of the skull) were estimated by size or were eliminated from the sample. Epiphyseal union was considered for the older individuals.

Adults presented more of a problem. When present, pubic symphysis was evaluated by using the three methods illustrated by Ubelaker (Gilbert and McKern 1973; McKern and Stewart 1957; Todd 1921) and the range or overlap was used for the age. A little over one-third of the adults could be aged by this method. Another third of the population was assigned to broad age groups based on the amount of tooth wear. The stages of tooth wear were based on a working knowledge of the wear present in the well-aged individuals in this collection. In general, wear was apparent by age 25, moderate in ages 30 to 35, and extreme, with tooth loss common, by age 40. Age group assignments were in 10-year increments or were expressed as greater than age x. Two individuals had sufficient arthritis present to suggest that both were at least 25 years of age. The use of broad or minimum ages here and in the following analyses should do no harm. Of the adults, 28.2% could not be evaluated by any means.

Sex. More than half of the adults had innominate bones complete enough to allow assessment of the sex of the individual. The entire pelvic morphology was considered whenever possible. Unfortunately, complete innominate bones were rare, and because portions of the ilium tended to be more complete than the pubic bone, the size of the sciatic notch and the presence or absence and elevation of a preauricular sulcus were often used as criteria. When no other means was possible, the overall robustness was relied on only for the unambiguous cases. Those instances where the stature reconstruction did not agree with the sex determination were rechecked and confirmed. Slightly over 22% of the adults could not be assigned a sex. The overall sex distribution is quite close, with thirty-two males and thirty-four females. Only the 15- to 25-year age group has an uneven distribution, with two males and nine females; this is a frequent finding in prehistoric samples. No attempt was made to sex subadults.

Congenital and Developmental Disorders

Congenital and developmental disorders include those occurring in utero, at birth, or any time during development. These defects are poorly understood, but many appear to be under strong genetic control (Zimmerman and Kelley 1982:19). In addition to the commonly found fusion defects (e.g., spina bifida), conditions such as cranial deformation, wormian bones, septal apertures, and pacchionian pits, as well as evidence of muscle development, are included in this section.

Development of the Deltoid Tuberosity. Habitual use of a certain set of muscles should result in the pronouncement of corresponding features on the long bones. In this respect the deltoid tuberosity of the humerus was

recorded as slight or pronounced for the Chaco adult population. Activities such as corn grinding may have affected the pronouncement of this feature. The deltoid muscle is also involved in abduction, which would reflect such activities as transporting building materials and working with masonry. However, these activities are not continuous and would be less likely than a daily activity such as corn grinding to modify bone structure.

The sample sizes are unfortunately small (Table 3.3), but when slight development is compared to pronounced development of the deltoid tuberosity by age and sex there are some suggestions. Males of any age are more likely to have slight development (70.6%), whereas females, in general, have slight development less often (55.5%)--but the association is not statistically significant ($\chi^2_c = .46$, $p = .49$). The likelihood of slight development decreases with age in females (87.5%, 50%, and 33.3%) but remains about the same in males. While not conclusive evidence, it can be suggested that some differences might exist in the activities routinely performed, such as grinding by females, and that this may account for the distribution.

Squatting Features. Squatting facets were found in only eight cases (4 male, 3 female, 1 unknown); they occurred in all three age groups, though with six in the oldest group. Another distinctive characteristic resulting from habitual squatting is lateral-medial thinning of the tibia and pronounced ridging on the posterior femur (linea aspera). Squatting positions were evidently not sex- or labor-related (Table 3.4). Males exhibited at least one squatting feature to a moderate or extensive degree in all cases. Most females (88.5%) exhibited the same high degree, as did all the unknown cases. Age does not seem to be a determining factor.

Cranial Deformation. In only 22 cases could the location of cranial deformation be assessed. All others were either too fragmentary or were infants. The location of the deformation was equally divided between the parietals and the lambdoid suture. Deformation to the left was observed six times (27.3%), symmetrical twice (9.1%), and to the right most often (12; 54.5%). The only unusual aspect of the distribution is that males exhibited parietal deformation more often (6; 83.3%) than females (11; 34.6%) and unknown cases (5; 40.0%). The small sample size could account for the variation. Reed (1962) reports that of the eleven crania from Bc 59 only one was deformed to the right, two were uncertain, one was symmetrical, and the rest were deformed to the left. Stewart (1937) noted that at least 90% of the crania from Chaco Canyon, especially those from Pueblo Bonito, exhibit lambdoid deformity. According to him, this kind of deformity was primarily limited to Chaco, Zuni, and southwestern Colorado.

Wormian Bones. Single or multiple wormian bones along the lambdoid suture are common in the Chaco collection: half ($n = 30$) of the cases complete enough to exhibit this feature. While most sites had too few observations for patterning, 29SJ 299 is interesting in that all four

Table 3.3 Development of the deltoid tuberosity

	<25	25-35	35+	Unknown	Total
Male					
slight	1	5	4	2	12
pronounced	1	2	2		5
Female					
slight	7	4	3	1	15
pronounced	1	4	6	1	12
Unknown					
slight				3	3
pronounced			3		3
Total	10	15	18	7	50

Note: The lower end of the range is used for the age.

Table 3.4. Squatting features

	<25	25-35	35+	Unknown	Total
Male					
slight	0	0	0	0	0
moderate/extreme	2	7	8	2	19
Female					
slight	1	0	1	1	3
moderate/extreme	8	6	7	2	23
Unknown					
moderate/extreme		1	4	4	9
Total	11	14	20	9	54

Note: The lower end of the range is used for the amount and the age.

individuals exhibited this feature, as did two of three individuals from nearby 29SJ 1360.

Pacchionian Pits: Found on the interior of the cranial vault, pacchionian pits are the result of enlarged normal villi that cause absorption of the bone. They are not found in infancy and are rare until the third year of life; they are common after the seventh year and increase with age, although they are not always found (Gray 1977:642). These pits cannot always be observed in intact crania or accurately counted in fragmentary ones. For the 21 cases in which observations could be made, three had none. The range was from one to six, and the number does not appear to correlate with age. The individual with six pits was aged at 22 to 28 years and an 18- to 19-year-old had four (Appendix A).

Septal Aperture. A foramen through the olecranon fossa of the humerus that allows hyperextension of the elbow is usually more common in females than males (Bass 1971:115; El-Najjar and McWilliams 1978:30). Thirty-eight of the Chaco individuals were complete enough for this observation to be made on at least one humerus (12 males, 21 females, 5 unknown), and twenty had them on both. Virtually the same proportion of males (41.7%) and females (42.8%) exhibited this feature on at least one humerus.

Spina Bifida Occulta and Sacral Clefts. Spina bifida occulta is an asymptomatic form in which there is no protrusion of underlying tissues. It is a fairly common congenital defect in which the fusion of the posterior neural arch of S1-S3 is incomplete. It is common (about 10%; Zimmerman and Kelley 1982) and appears to be hereditary (El-Najjar and McWilliams 1978; Ortner and Putschar 1981). Sacral spina bifida occulta and sacral clefts were common in the Chaco sample. Of the 33 sacra on which observations could be made, 23 (69.7%) exhibited one of these traits (Table 3.5). Complete spina bifida (S1-S5) was found twice. The cleft occurred most often in the lower portion and was rare for the upper portion. Spina bifida rates of 7.8% for Tijeras, 5.4% for Paa-ko, and 14.3% for San Antonio are given by Ferguson (1980). Compared to these three more southerly Anasazi populations, Chaco Canyon has a high expression (24.3%).

Other Fusion and Vertebral Anomalies. A number of other anomalies that do not appear to be traumatic in origin were observed. There was one example of conjoined second and third cervical vertebrae, one of conjoined fifth and sixth cervical vertebrae, and one in which the first cervical was fused to the skull base. Four individuals had from one to three sets of fused terminal to intermediate foot phalanges (Bc 126, 29SJ 1360, and Talus Unit). A lack of complete fusion in the sacral first and second bodies was observed in three older individuals.

Table 3.5. Occurrence and location of spina bifida occulta, sacral clefts, and other vertebral defects

Site	Sacrum							Absent	Other	No.
	S1	S1-2	S1,4-5	S1-5	S3-5 ^a	S4-5	S5			
Bc 51							2			2
Bc 53		1	1			1	1	1	C2 misaligned	5
Bc 57		1 ^a					2			3
Bc 59			1			1	1		C1	3
Bc 63								1		1
Bc 126					1		1			2
Bc 191								1		1
Bc 192							1			1
29SJ 299				1		1			L5 sacralized	2
29SJ 563								1		1
29SJ 597								1	C2-C3 partial	1
29SJ 629								1		1
29SJ 633								1		1
29SJ 1360	1					1			caudal 1	2
Unknown 99-5								1		1
Casa Rinconada								1		1
Wijiji							1			1
Talus Unit							1	1	C1	2
Chetro Ketl							1		S1, S4 misaligned	1
Kin Ya'a				1						1
Total	1	2	2	2	1	4	11	10		33

^aAt least (damaged).

Apparently nontraumatic exostoses were found on one hand first phalanx and on a fourth metacarpal. One third metacarpal had a process that was a separate bone unfused to the rest of the metacarpal. A patella with two centers of ossification was also noted.

When viewed from the superior surface, anterior-posterior asymmetry of the vertebral bodies was found twice in the thoracic vertebrae. An atlas vertebra and the spinous processes of four sets of cervical vertebrae also were asymmetrical in development. Figure-8-shaped foramina were observed in three individuals' cervical vertebrae; another had two foramina on one side of C8. Extra facets were observed on the odontoid process of an axis vertebra and on a seventh and eighth thoracic vertebrae.

Other Congenital Anomalies. A scaphocephalic skull, probably from Chaco Canyon (Figure 3.3), and an infant skull of unusual proportions suggestive of scaphocephaly (Figure 3.4) were found. This long, narrow form of the cranial vault is thought to be the result of premature closure of the sagittal suture that results in excess growth anterior to posterior and a reduction in width (El-Najjar and McWilliams 1978).

A curved radius (Figure 3.5) appears to have resulted from the radius growing faster than the ulna, which caused some compensatory changes in the shape of both. The radius is more bowed than usual and the semilunar notch of the ulna is angled upward. A number of other observations and anomalies were noted (Appendix A).

Dental Conditions

Several aspects of dentition have been used as nonspecific markers to infer nutritional stress, based primarily on the presence of these traits in members of low socioeconomic groups from underdeveloped parts of the world. Hypoplasia, a developmental arrest of enamel during crown formation, spans the first six to seven years of life as a permanent marker of physiological stress caused by malnutrition and other disease processes (Huss-Ashmore et al. 1982; Wing and Brown 1979). Dental development is less affected by stress than the bone around it, suggesting that tooth crowding may also be an indicator of stress (Huss-Ashmore et al. 1982). Caries and periodontal disease have also been attributed to nutritional stress and to high carbohydrate diets. Nutritional stress results in defects in tooth structure, which makes teeth more susceptible to disease; a high carbohydrate diet promotes dental plaque, which is associated with caries and periodontal disease (Wing and Brown 1979). Similarly, hypoplasia of the deciduous teeth can cause weaknesses that become carious and result in distinctive circular or bar caries (Cook and Buikstra 1979).

The Chacoan sample exhibited a number of dental pathologies that result from a diet high in carbohydrates and nutritional stress. Caries,

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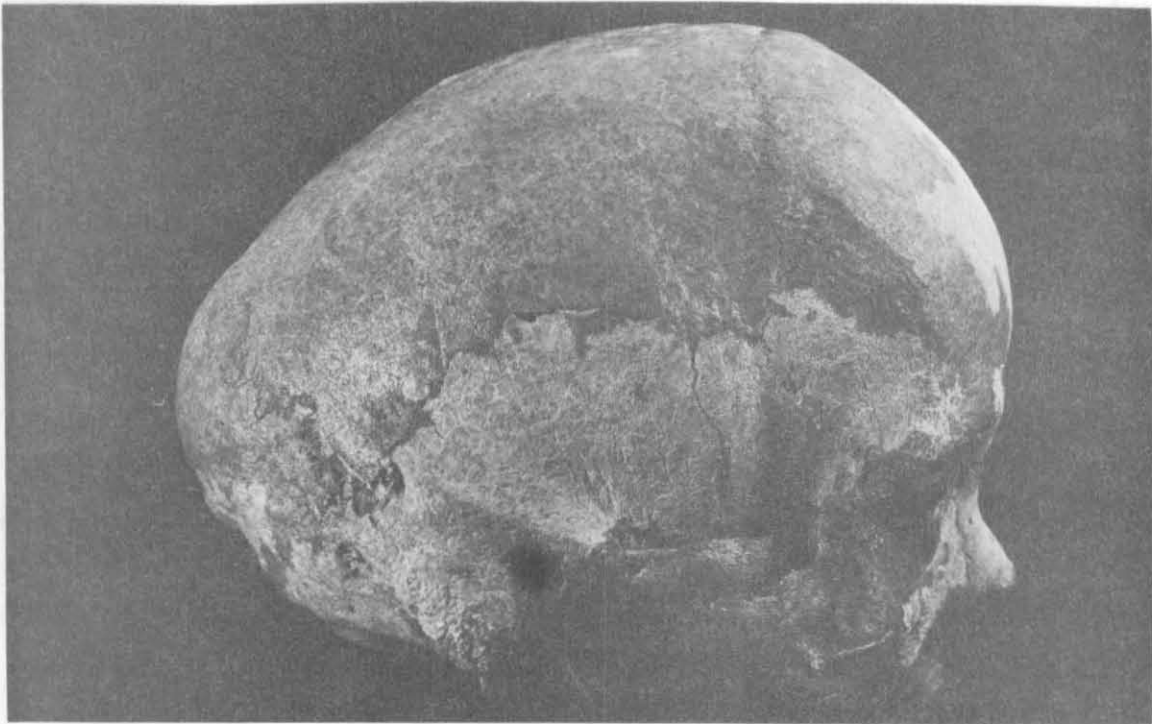
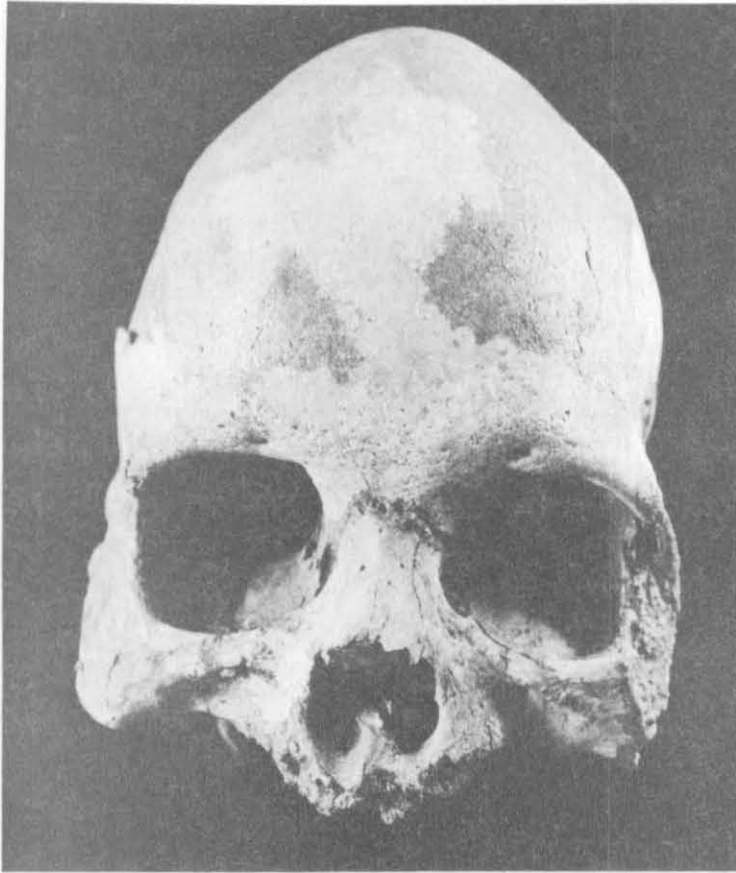


Figure 3.3. Scaphocephalic skull (NPS C26)

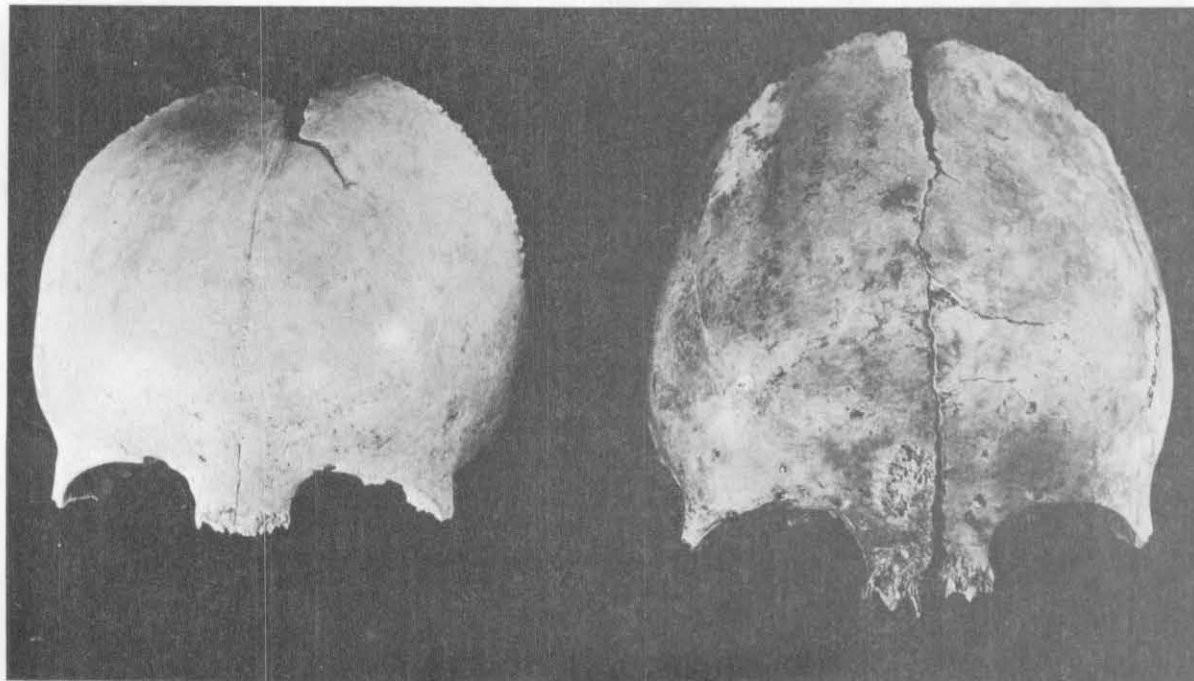
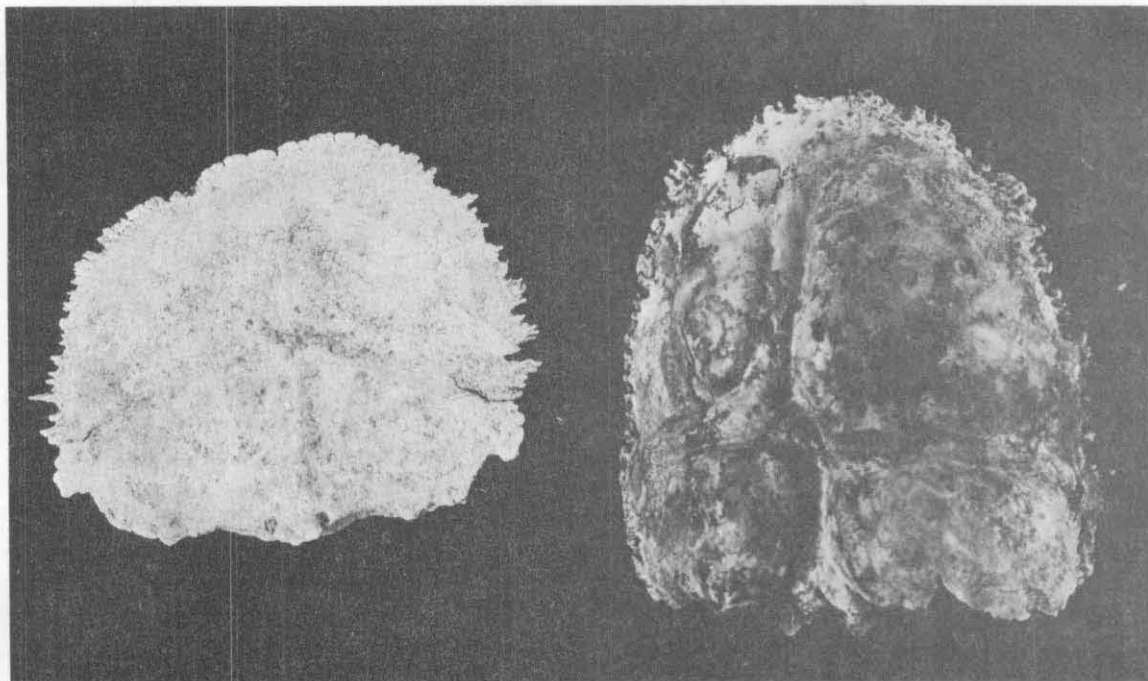


Figure 3.4. Infant skull with unusual proportions (Bc 53 60/5)

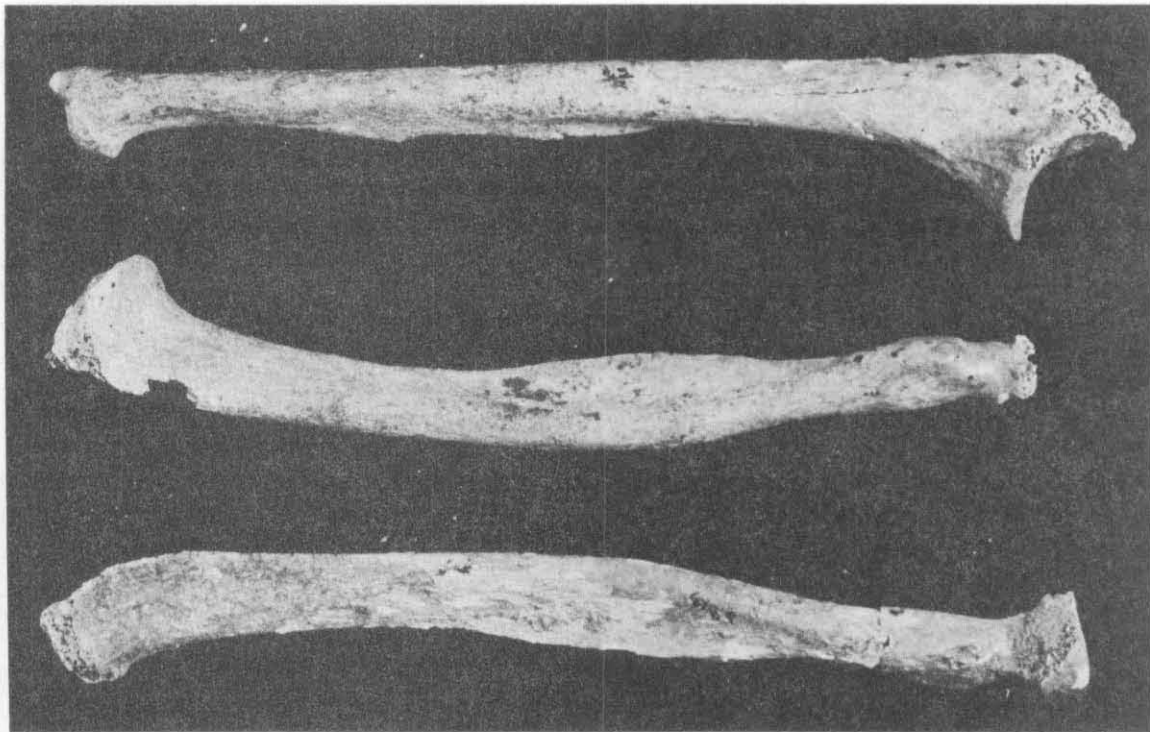


Figure 3.5. Curved radius (Bc 51 60/53)

abscess, and tooth loss were common after age 30, and hypoplasia lines were found in a large proportion of the sample.

Hypoplasia. Hypoplasia lines varying from light to heavy were recorded for a number of the Chacoan individuals. A single line was usual but double lines were found in five individuals. The teeth most often affected were the lower canines (15) and upper canines (15), lateral incisors (9 upper and 8 lower), and central incisors (14 upper and 3 lower). Premolars occasionally exhibited lines (4 upper and 5 lower), molars only rarely (3 M¹ and 2 M²).

Because of the fragmentary condition of most specimens, it was not always possible to make observations on all teeth; severe attrition precluded observations on others. Of the adults with dentition, only three exhibited no lines, and another four had none observable but were missing several teeth. Twenty-two individuals possessed lines on one or more teeth (88.0%). Unerupted teeth were not removed from subadults, but two lines were noted on an unerupted incisor of a 4-year-old child.

Caries. One case of circular caries was observed in a 4-year-old child with other health problems, most likely tuberculosis. Adults had from one to eight caries. Four of the twenty-seven individuals with at least some teeth had no caries, three from age group 10-30 years and another that was over 40. There probably is a tendency for the incidence and number to increase with age, but it is difficult to determine in this small sample and with incomplete dentitions.

Antemortem Loss. Tooth loss was a common feature of the Chacoan skeletal series. Observations were made on parts of forty-six individuals. Loss was quite rare in individuals of less than 30 years (2 of 15, or 13.3%) but increased considerably in the 30- to 40-year range (11 of 15, or 73.3%, averaging 2.9 teeth per individual with loss). By the time individuals reached 40 years of age, each had lost some teeth, ranging from seven to most or all teeth.

Abscess: Abscesses were lacking in only fifteen (38.5%) of the thirty-nine observable cases. Again the incidence increased with age. Only one occurred in the ten individuals under 20 years of age; 28.6% (7, averaging 1 each) of those from 20 to 30 years; 66.7% of the ten (averaging 1.6 each) in the 30- to 40-year group; and 85.7% of the twelve (averaging 2.3 each) individuals 40 years of age had abscesses.

Calculus Formation. Mineralized calculus formation was found thirteen times. One instance occurred in an individual less than 20 years old, four were in the 20- to 30-year age range, seven were from 30 to 40 years, and one was in the over-40 group.

Periodontal Disease. Alveolar resorption indicative of periodontal disease was observed in six individuals. While four of the cases were in individuals 35 years or older, one was 20 to 22 years old.

Congenital anomalies were found, as were unerupted and rotated teeth. These observations are rare and are listed in Appendix A under dental observations.

Arthritis and Trauma

Trauma. Direct evidence of trauma is relatively rare in most skeletal series (Steinbock 1976). The Chaco sample is no exception. The most common areas involved were the extremities and the shoulder area. Two metacarpals, a carpal, one hand phalanx, and three foot phalanges all had signs of some form of trauma, usually healed fractures. A dislocated humerus, a fracture of the proximal end with aseptic necrosis (Figure 3.6), two fractured clavicles (Figure 3.7), one of which was associated with four fractured ribs, and two isolated rib fractures are the most dramatic. Possible fractures of a fragmentary fibula and a twisted humerus that could be developmental or traumatic were also noted. Four small ovoid depressions in the outer table of a parietal may represent healed depression fractures. Three females each had a disruption in the face of the pubic symphysis. In one case this was a nodule on the face; in the others it appears to have resulted from the face having been partially torn away but then healed. Also noted was the slight compression of a lumbar vertebra in a young female. She also had slight lipping on one thoracic vertebra, suggesting, along with her age, traumatic causation. Biconcave collapse was found in a thoracic vertebra of the individual with the fractured humerus and aseptic necrosis; these may have resulted from the same event.

The most unusual example of trauma was found in the ulna of a female from 29SJ 1360, an inclined aperture 0.6 cm in diameter just below the semilunar notch (Figure 3.8). Inside the cylindrical aperture new bone had coalesced, suggesting that the object had remained in place for some time. There were no signs of infection.

One case of myositis ossificans traumatica (ossification into an irregular exostoses for a muscle or tendon that has been pulled from the point of insertion) along the linea aspera of the femur of a male was found (Zimmerman and Kelley 1982). An elderly female had evidence of a pulled cruciate ligament in the right knee (Figure 3.9).

A single osteochondritis dissecans occurred on the lateral condyle of the femur of a 30- to 45-year-old male. This occurs when a fragment of subchondral bone becomes detached and the vascular supply is cut off from the fragment. Although osteochondritis dissecans is probably traumatically induced, there is a genetic disposition. The result is a large crater-

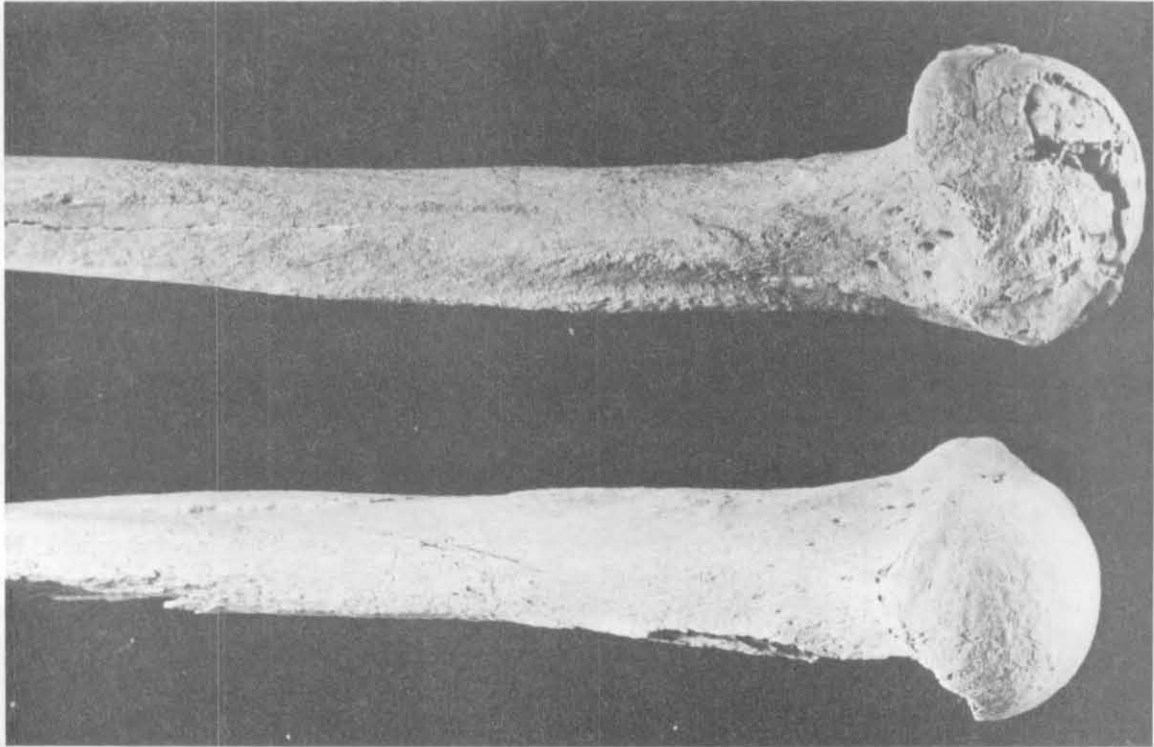


Figure 3.6. Aseptic necrosis (Bc 191)

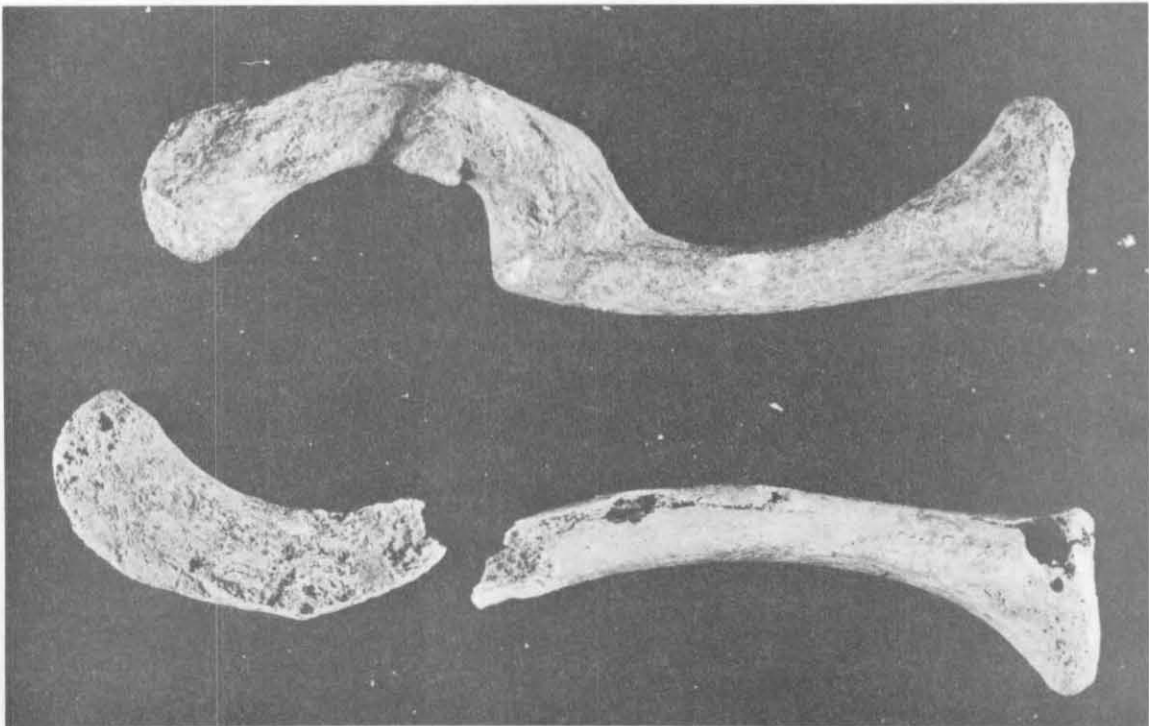


Figure 3.7. Clavical fracture (d 4/1)

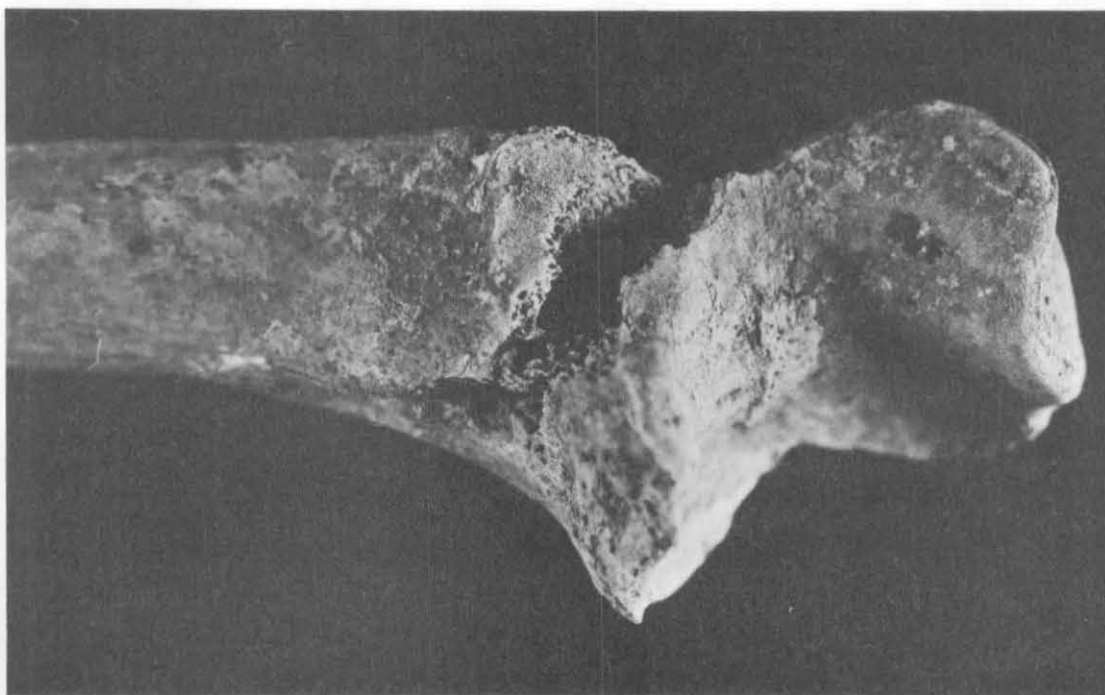
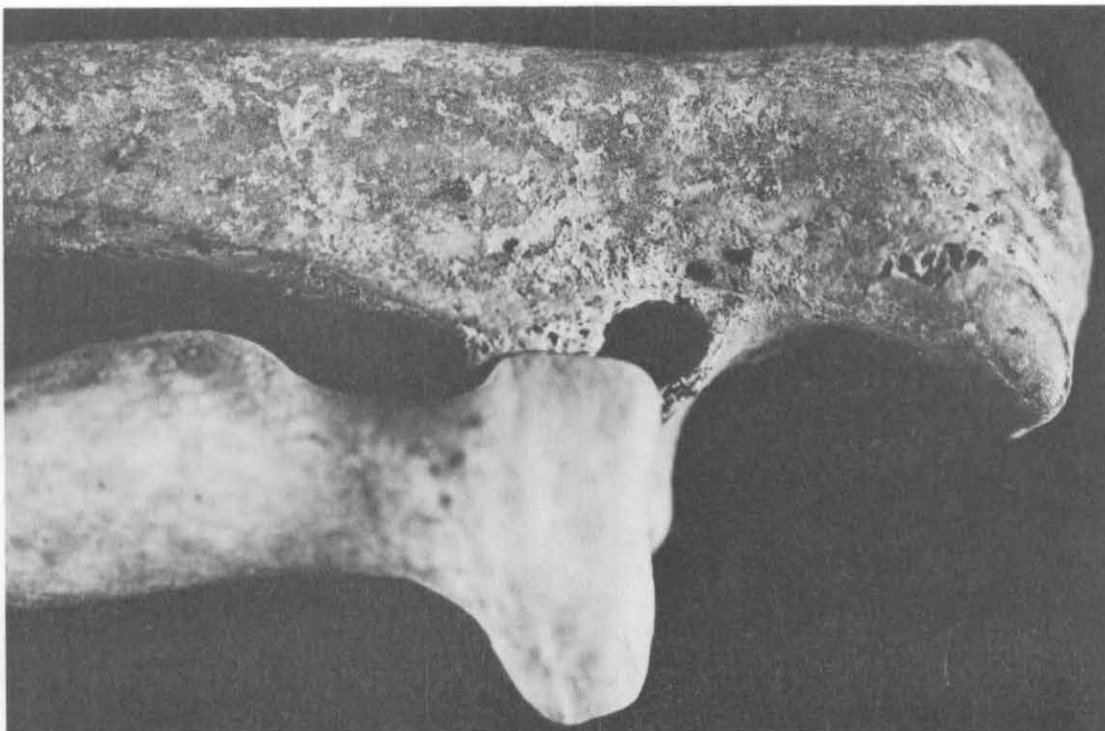


Figure 3.8. Aperture in ulna (29SJ 1360 Burial 2)

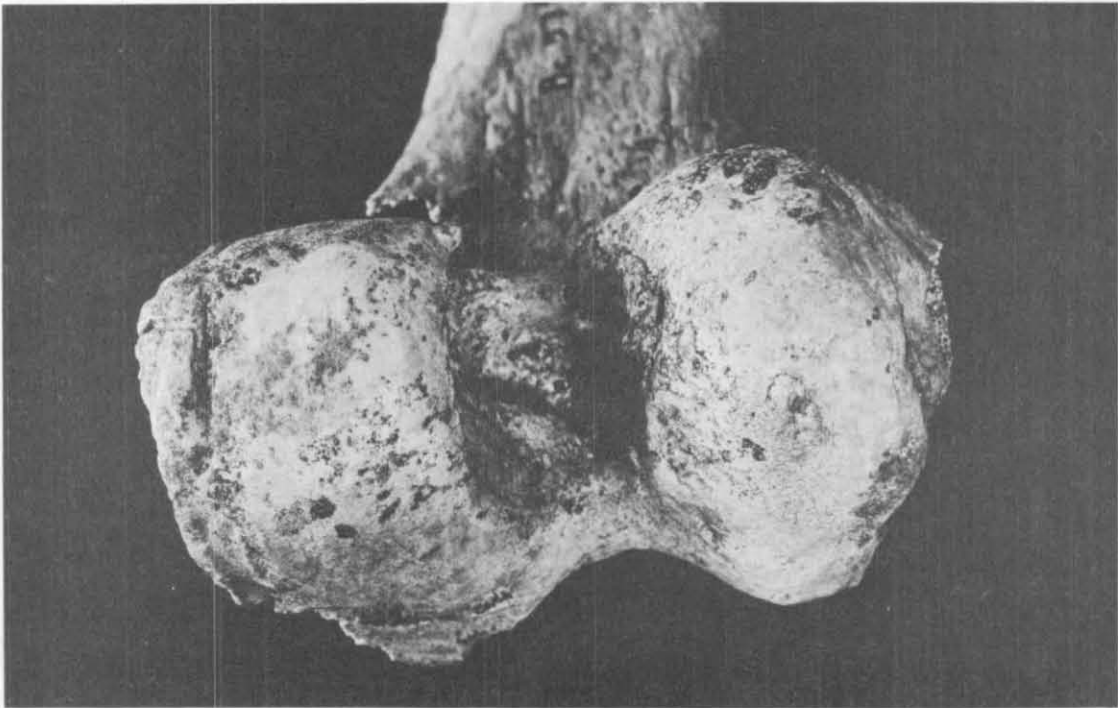


Figure 3.9. Pulled cruciate ligament (Bc 57 60/10)

like defect in the subchondral bone. Ninety percent of all instances occur in the knee (Ortner and Putschar 1981).

Arthritis. Degenerative joint disease is characterized by deterioration and abrasion of articular cartilage and formation of new bone at the joint surfaces due to repeated minor trauma or wear and tear on the joints. Degeneration of articular cartilage gradually leads to small depressions with rims of sclerotic new bone, especially in weight-bearing areas. Marginal lippling replaces cartilage spurs, and in advanced cases the cartilage erodes completely and friction leads to eburnation or polished compact-looking areas (Steinbock 1976).

Since stress is the most significant factor in the development of degenerative arthritis, it has been suggested that the distribution and severity vary with different roles in and between cultures (Cockburn et al. 1979; Goodman et al. 1984; Ortner and Putschar 1981). The Chaco collection was examined in detail to determine if age- and sex-related patterns of degeneration were present (Appendix A).

The joint involvement for each area or joint was recorded using grades (Stewart 1957) that include (1) absent; (2) slight, indicating slight lippling; (3) moderate, for more pronounced lippling at the margins; and (4) heavy, when extensive lippling and modification were present. Also recorded for vertebrae were biconcave collapse, wedging, presence of Schmorl's nodes, ankylosis, eburnation, porosities, and actual destruction of bone. Schmorl's nodes (Figure 3.10) are probably caused by extrusion of nucleus pulposus material into the vertebral body (Ortner and Putschar 1981). Porosities, large bubbly looking pores (Figure 3.11), are characteristic of advanced states of arthritis, particularly in the cervical vertebrae.

Small areas of degenerative change in the articular cartilage that lead to bone reaction characterized by lytic cavities or porous depressions (Figure 3.12) were common. They occurred in every major joint area, including the mandibular condyle, but were particularly common in the knee, elbow, and shoulder joints. The term porosity is used for scattered porous openings indicative of deterioration of a joint surface, rather than for the small isolated areas that generally rim the joint surface. Eburnation was extremely rare.

Table 3.6 lists the age and sexual distribution of vertebral arthritis. The sample is far too small for more than broad generalizations. It appears that individuals of either sex had little or no involvement through the second decade of life. Females in the 20- to 30-year range did tend to have more "slight" observations than males in the thoracic and lumbar areas--perhaps an indication of some labor differential. In the 30- to 40-year range, cervical vertebra involvement remains absent to slight and generally similar for the sexes. The thoracic involvement appears to be greater for females but the sample size for males is small. Individuals of both sexes had Schmorl's nodes. The frequency of defects in the lumbar region is similar in both sexes. Wedged vertebrae begin to

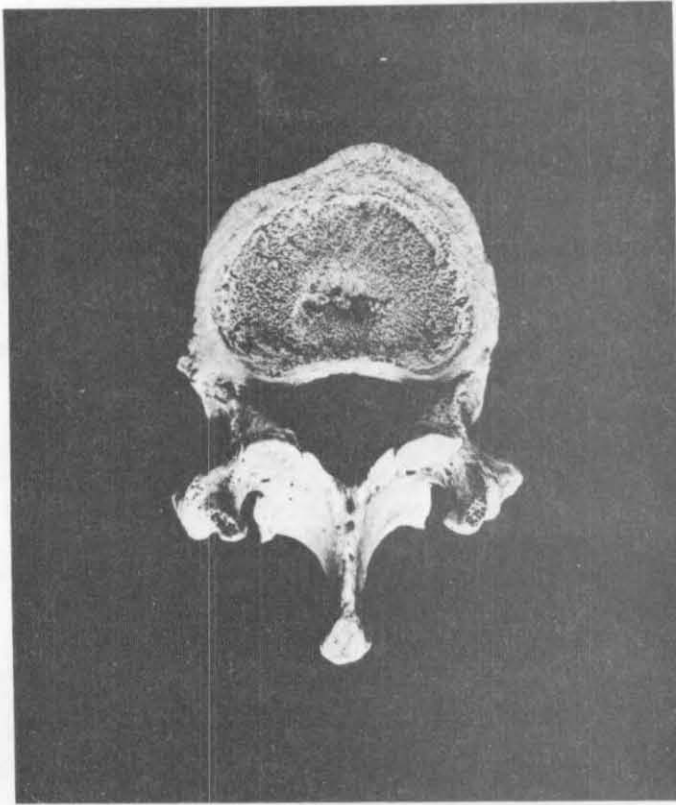


Figure 3.10. Schmorl's node (Kin Ya'a)

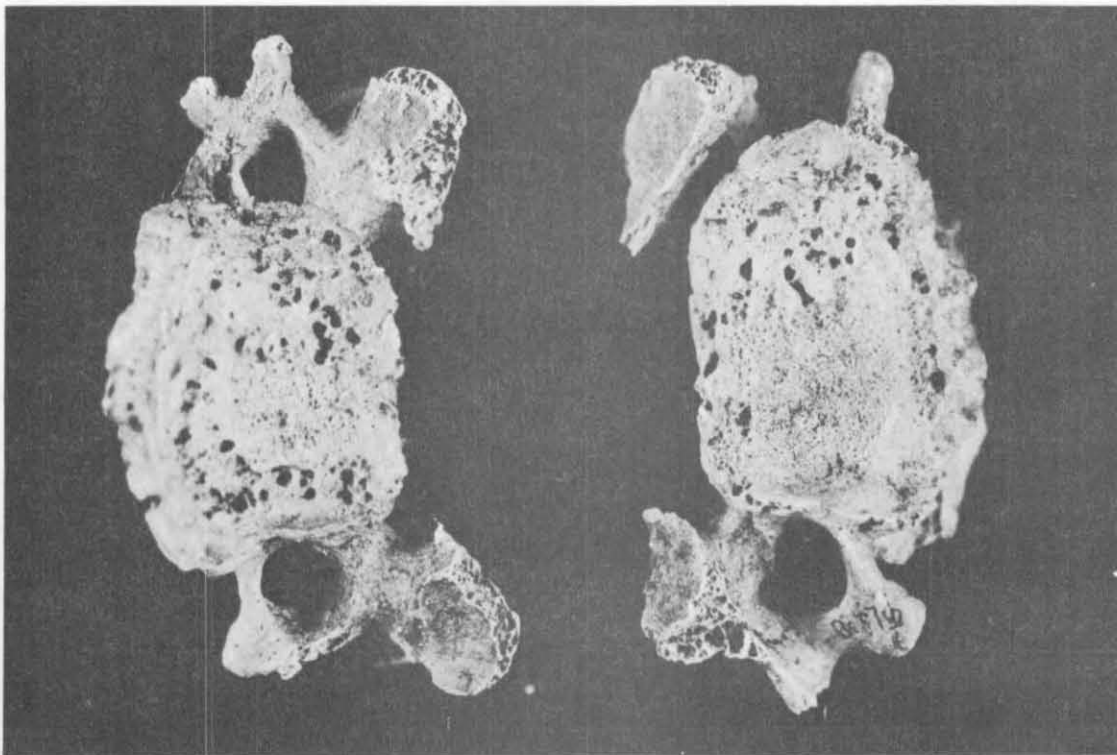


Figure 3.11. Porosities in cervical vertebrae (Bc 57 60/?)

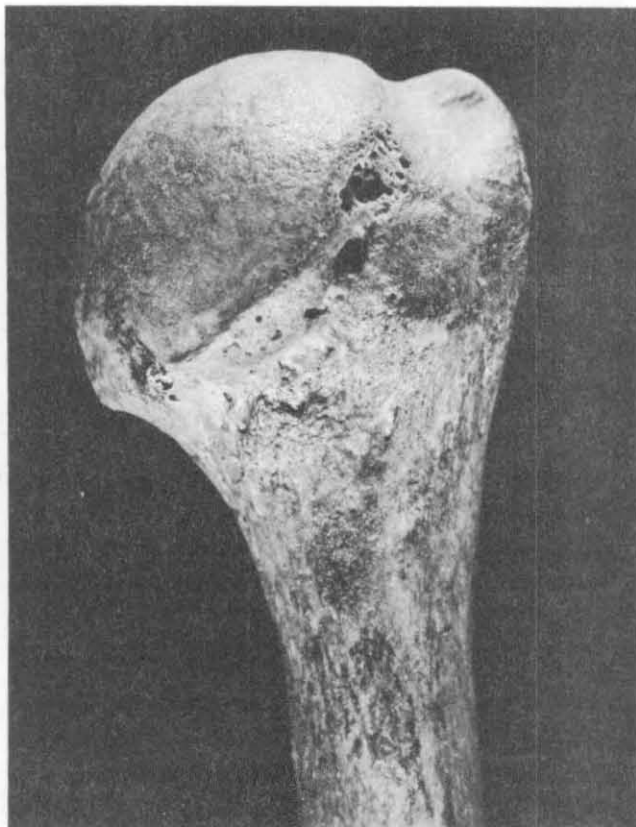


Figure 3.12. Degenerative changes (d 2/4)



Table 3.6. Vertebral arthritis and trauma

		Cervical						Thoracic								Lumbar								Sacral						
	n	0	L	M	E	P	S	0	L	M	E	A	P	S	W	C	0	L	M	E	A	P	S	W	C	0	L	M	E	P
<20																														
male	1	1						1									1									1				
female	6	4	1					3	2	1							6							1		4				
20-30																														
male	6	4						4									3									2	1			
female	5	4	1					2	3					1			3									3	1			
30-40																														
male	9	1	1	1		1		2	1	1				3	1		2	1	3							1	1			
female	9	5	4			1		5	2	1				2			2	2	3	2		1		2		2	3	2	2	
40+																														
male	5	1	1	1	1	2		3		1	1	1	1					2	2	1			1	1		1	2	1	1	
female	8	1	3	2	2	1	1	2	2	2				3	5		1	3	3				1	1		3	1	1		
Total	49 ^a	21	11	4	3	5	1	12	16	6	4	1	1	10	5	1	14	7	11	7	1	1	2	4	1	13	10	5	2	3

Note: Aged and sexed individuals only included in this table. The greatest extent and earliest age or greatest overlap of age ranges was used for group selection.

Codes: 0 = absent, L = slight, M = moderate, E = extensive, P = porous, S = Schmorl's node, W = wedging, C = collapse, A = ankylosed.

^aObservations could not always be made on some individuals.

appear after age 30. The final age group, over 40, shows increases in the number and intensity of involvement for both sexes. Schmorl's nodes and wedging increase, especially in women, probably reflecting postmenopausal osteoporosis.

The main joints (Table 3.7) do not exhibit lipping in the first two decades of life, and when found in the third decade it is generally slight. The fourth decade shows an increase with some moderate lipping. Extreme lipping occurs only in the older group, with one exception--a 20- to 30-year-old male with extensive modification of the mandible that was probably traumatically induced.

Males appear to have more involvement in the shoulder area; females more in the elbow and knee. Degenerative changes occur in all age groups but increase with age. Females may have a greater incidence. Few individuals have moderate or extensive lipping of the hand or foot bones.

Hematological Conditions: Cribra Orbitalia and Porotic Hyperostosis

Cribra orbitalia, lesions of the superior portion of the orbits (Figure 3.13), and porotic hyperostosis, lesions of the cranial vault (Figure 3.14), are characterized by a sieve-like or coral-like porosity of the outer bone table. One widely hypothesized cause is iron-deficiency anemia, in which bone alteration is caused by a widening of marrow cavities to accommodate increased production of red blood cells. This is more pronounced in thin bones such as the skull (Goodman et al. 1984; Mensforth et al. 1978; Steinbock 1976).

Rapid growth in infants and children is accompanied by an increased need for iron. Epidemiological studies demonstrate that the most common age for iron-deficiency anemia is between 6 and 24 months, and that prolonged milk feeding and weaning diets of maize gruels are often associated with high frequencies of anemia in infants. Children with iron-deficiency anemia are more likely to develop respiratory and gastrointestinal infections (Mensforth et al. 1978; Steinbock 1976).

Not only is maize low in iron content; the two chelating agents present further inhibit the absorption of iron. Beans are also low in absorbable food iron. Ascorbic acid, which facilitates the absorption of iron, is totally lacking in maize and beans. Treating maize with alkaline substances can enhance its nutritional quality by reducing the imbalance of amino acids (Katz et al. 1974), but we have no evidence this was done at Chaco. Meat products contain more absorbable iron and enhance absorption from vegetable foods (El-Najjar et al. 1976; Huss-Ashmore et al. 1982; Mensforth et al. 1978; Steinbock 1976).

The prevalence of porotic hyperostosis and cribra orbitalia is high for Chacoan infants and children (Tables 3.8-3.11). Porotic hyperostosis percentages peak in the 6- to 12-month age group and remain high through

Table 3.7. Degenerative joint disease

	<20		20-30		30-40		40+	
	male	female	male	female	male	female	male	female
<u>Jaw</u>								
n	1	2	5	2	2	6	1	4
absent	1	2	3	2	1	6		4
extensive			1					
porosities			1		1			
degenerative changes			1				1	
<u>Shoulder</u>								
n	1	6	4	5	7	9	4	7
absent	1	6	3	4		3		1
slight				1	5	2	1	3
moderate					2	1	1	
extensive								1
porosities						1	1	
degenerative changes		1	1	1	1	4	3	5
<u>Elbow</u>								
n	1	5	5	5	7	8	4	7
absent	1	5	4	3	2	3	2	1
slight			1	2	3	4		3
moderate					2	1	2	1
extensive								2
porosities								1
degenerative changes					1		1	3
eburnation								1
<u>Knee</u>								
n	1	2	4	4	7	8	3	7
absent	1	2	3	3	6	5	2	3
slight			1	1		2	1	
moderate								3
extensive								1
degenerative changes								
eburnation						1		1
<u>Hand/foot</u>								
n	1	4	5	5	5	9	4	7
absent		3	4	3	2	6	1	3
slight			1	2		2	2	2
moderate					2		1	
extensive						1		2
trauma	1	1			2	2	1	1

Note: Aged and sexed individuals only included in this table. The greatest extent and earliest age or greatest overlap of ranges was used for group selection.

Codes: slight = slight lipping at edges, moderate = notable lipping, extensive = extensive lipping, degenerative changes = small depressions with rims of sclerotic new bone.

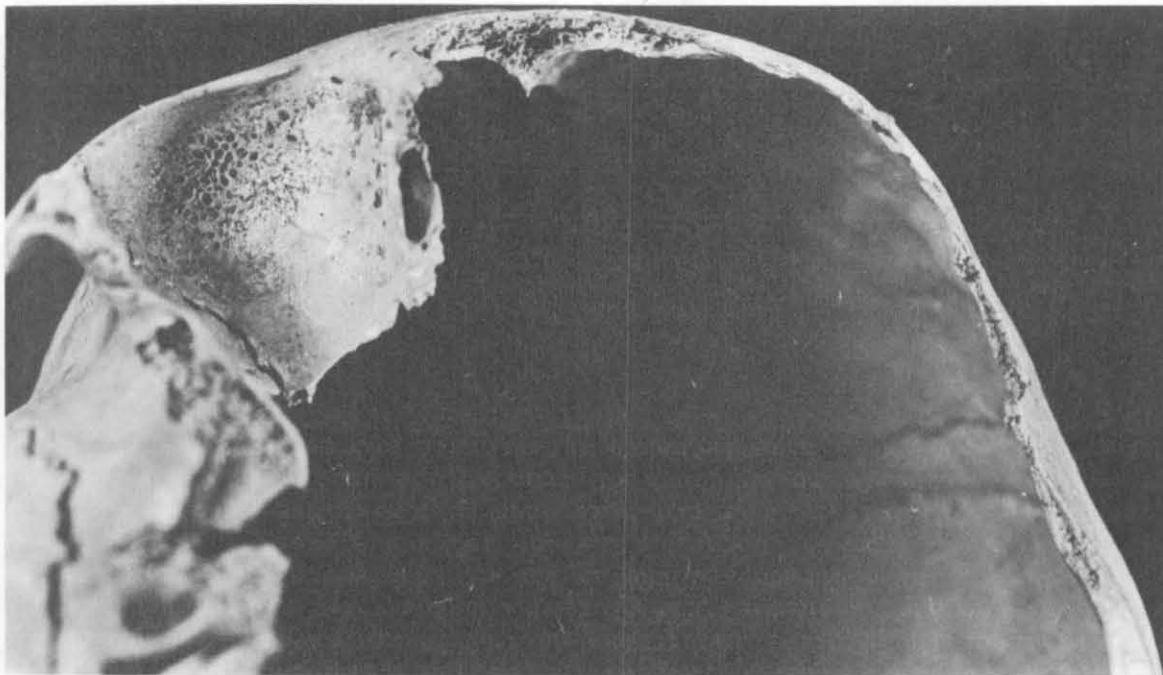


Figure 3.13. Cribra orbitalia (Bc 126, SWI 2, #993)

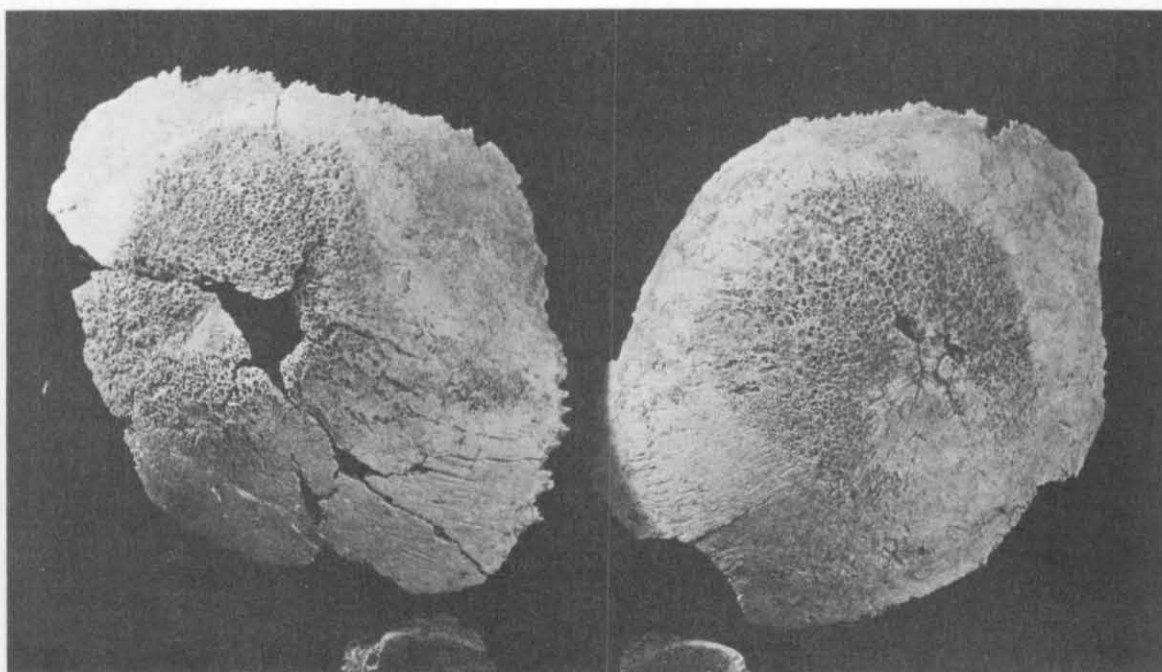


Figure 3.14. Porotic hyperostosis (29SJ 389 FS 470)

Table 3.8. Incidence of porotic hyperostosis

Age	Present						Total		
	Remodeled		Unremodeled		Unknown			Absent	
	No.	%	No.	%	No.	%		No.	%
<6 m	1	20.0	1	20.0			3	60.0	5
7-12 m	4	50.0	1	12.5	3	37.5			8
1-2.9 y	7	70.0	2	20.0			1	10.0	10
3-4.9 y	3	42.9					4	57.1	7
5-10 y							6	100.0	6
Total	15		4		3		14		36

Fisher's Exact Probabilities

	<6 months	7-12 months	1-2.9 years	3-4.9 years
7-12 m	.035			
1-2.9 y		.555		
3-4.9 y			.059	
5-10 y				.122

Note: Remodeled refers to those that appear to be healing, indicated by rounding of lesion edges and thinning of the diploe.

Table 3.9. Degree of involvement of porotic hyperostosis

Age	Absent		Slight		Moderate		Extensive		Total
	No.	%	No.	%	No.	%	No.	%	
<6 m	3	60.0	1	20.0	1	20.0			5
7-12 m			3	37.5	1	12.5	4	50.0	8
1-2.9 y	1	10.0	3	30.0	4	40.0	2	20.0	10
3-4.9 y	4	57.1	1	14.3	2	28.6			7
5-10 y	6	100.0							6
Total	14		8		8		6		36

Note: slight = scattered small pores, moderate = moderate amount of lesions, little or no hypertrophy, extensive = large areas of lesions and hypertrophy of the diploe.

Table 3.10. Incidence of cribra orbitalia

Age	Present								Total
	Remodeled		Unremodeled		Unknown		Absent		
	No.	%	No.	%	No.	%	No.	%	
<6 m	1	25.0	1	25.0			2	50.0	4
7-12 m	4	71.4			1	14.3	2	28.6	7
1-2.9 y	4	57.1	2	28.6			1	14.3	7
3-4.9 y	6	75.0			1	12.5	1	12.5	8
5-10 y	3	60.0			1	20.0	1	20.0	5
Total	18		3		3		7		31

Fisher's Exact Probabilities

	<6 months	7-12 months	1-2.9 years	3-4.9 years
7-12 m	.469			
1-2.9 y		.733		
3-4.9 y			.733	
5-10 y				.641

Table 3.11. Degree of involvement of cribra orbitalia

Age	Absent		Slight		Moderate		Extensive		Total
	No.	%	No.	%	No.	%	No.	%	
<6 m	2	50.0	1	25.0	1	25.0			4
7-12 m	2	28.6	4	57.1	1	14.3			7
1-2.9 y	1	14.3	3	42.8	3	42.8			7
3-4.9 y	1	12.5	4	50.0	3	37.5			8
5-10 y	1	20.0	3	60.0			1	20.0	5
Total	7		15		8		1		31

Note: slight = scattered pores, moderate = more concentrated lesions but little or no expansion of diploe, extensive = concentrated lesions with expansion of diploe.

the third year; by the fifth year no cases were found (Figure 3.15). This agrees fairly well with other findings that the peak should fall between 1 and 2 years of age (Buikstra and Cook 1980; Mensforth et al. 1978). Porotic hyperostosis appears to start slightly earlier in the Chaco population, which may suggest that the Woodland population studied by Mensforth et al. and Buikstra and Cook had better fetal stores of iron, a greater variety of vegetal foods, or more animal protein in the early diet. The amount of involvement in the Chaco sample peaks at the same time as the incidence. It is greatest in the 7- to 12-month and the 1- to 2.9-year groups.

Cribra orbitalia has a different pattern. High percentages are found from 6 months through the final age group, with moderate or extensive involvement very common in those from 1 to 5 years old. Mensforth et al. (1978) found the greatest frequency in their 6- to 12-month group (60.0%), with a steady decline into the 5- to 10-year group (10.7%). The dissimilarity between the porotic hyperostosis and cribra orbitalia curves (Figure 3.15) may suggest some other factor than anemia.

El-Najjar et al. (1976) looked at twelve Chaco Canyon (probably from Bc 59) children (less than 10 years old) as part of a study comparing several Southwestern populations. The reported instance for cribra orbitalia was 90% and 40% for porotic hyperostosis as compared to 77.4% and 61.1% in our sample.

Two cases from Pueblo Bonito have been reported in the literature. Von Endt and Ortner (1982) studied three infants from Pueblo Bonito. One had well-developed porotic hyperostosis and two others had no sign of it. These three, modern controls, and an adult were tested for amino acids that might be deficient in children suffering from iron-deficiency anemia. The affected infant was found to have less of the amino acids containing the hydroxyl group and acidic side chains, and this is compatible with a dietary iron-deficiency anemia. Ortner and Putschar (1981) provide detailed descriptions of two infants from Pueblo Bonito, both with extensive involvement. X-rays demonstrated enlarged marrow cavities and diminished cortical thickness. Ortner and Putschar thought a diagnosis of anemia for these two was a strong possibility. Palkovich (1984) studied the U.S. National Museum Pueblo Bonito collection and reported incidence of 25% for porotic hyperostosis and 20% for cribra orbitalia. The population was lumped into one group consisting of all individuals less than 10 years of age ($n = 20$). Much of the slight incidence for porotic hyperostosis may be accounted for by the age distribution: one was less than 1 year old, eight were from 1 to 4 years, and eleven were over 5 years old. Nevertheless, the small-site population appears to have a greater incidence of cribra orbitalia.

When found in adults, causes suggested for iron-deficiency anemia include an increased need for iron from menstrual blood loss, fetal demand during pregnancy, or intestinal parasites (El-Najjar et al. 1976). One and possibly two helminth parasites have been found in a sample of 19 coprolites from Chaco Canyon (Reinhard and Clary, Appendix E, this volume). A more recent study (Stuart-Macadam 1985) indicates that when found in

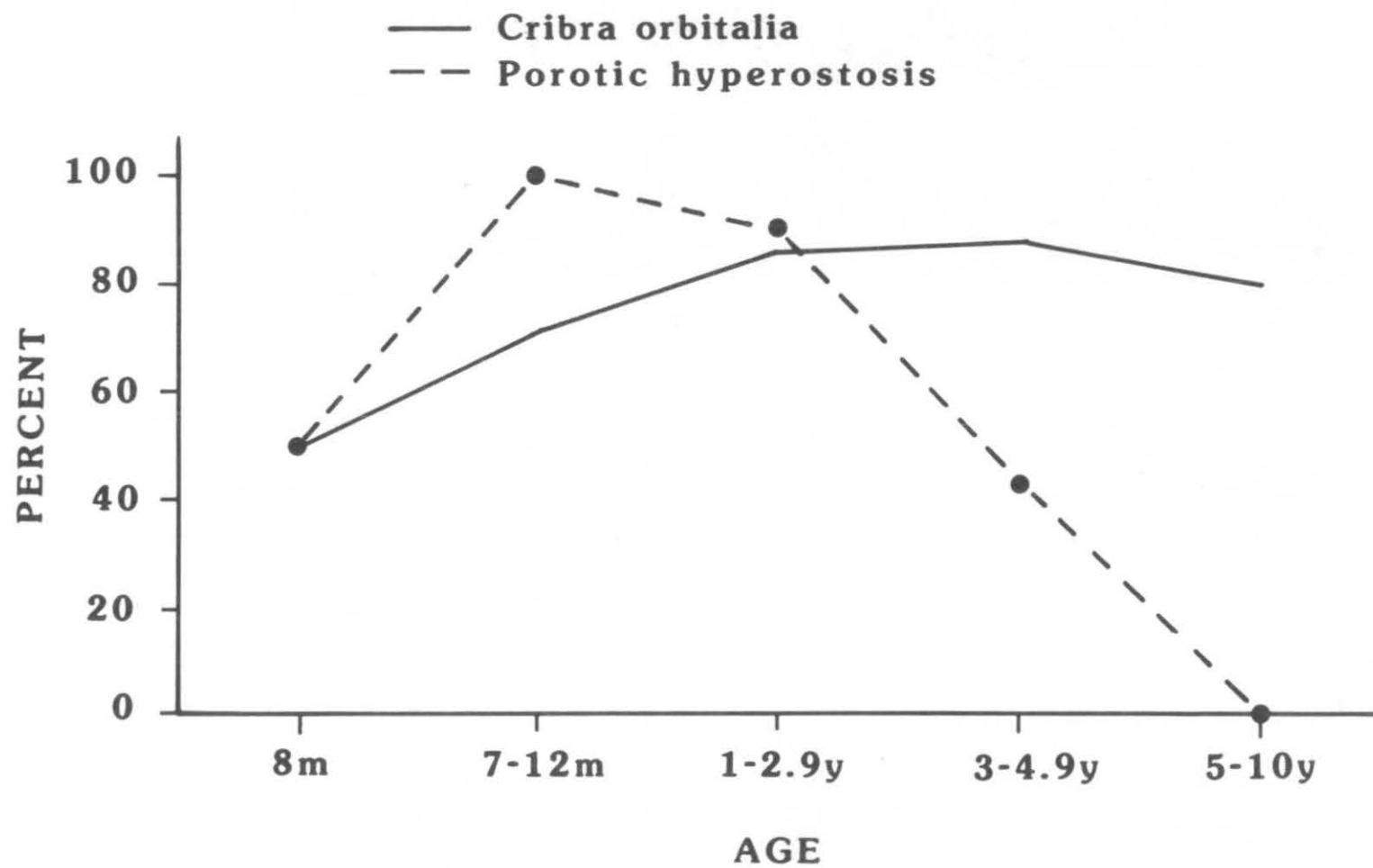


Figure 3.15. Incidence of porotic hyperostosis and cribra orbitalia by age

adults, porotic hyperostosis is the result of a condition that developed in childhood. Adults are able to compensate for the anemia without expanding the marrow space.

While El-Najjar et al. found high incidences of cribra orbitalia (50%) and porotic hyperostosis in adults (30%; n = 20), their definition--"thinned outer tables suggestive of expanded diploid space" (1976:480)--was more liberal than ours. Few instances were noted in our sample--three cases of cribra orbitalia (10.7%; n = 28) one of which also had the only indications of adult porotic hyperostosis (3.4%; n = 29). Two of these were females and the sex of the other is unknown.

Other Conditions and Disorders of Uncertain Origin

Osteolysis (localized bone destruction). Several kinds of lytic lesions or areas of localized bone destruction were noted in the collection. Lesions with some indication of inflammatory reaction (possibly osteomyelitis) but usually healed were noted for a proximal femur, a patella, a proximal humerus, a first metatarsal, a hand phalanx, a foot phalanx, and a carpal. Two cases of osteomyelitis (Figures 3.16 and 3.17) in which pyogenic bacteria had entered the bone were identified. Unfortunately, both are isolated humeri, presumably from Kin Kletso. Minear (n.d.) studied one of these (CC-KK) macroscopically, microscopically, and with x-rays and noted multiple sinus tracts and woven bone. The other is enlarged at the distal end, where infection has followed a fracture.

A number of problematic lesions were found. Endocranial striae--probably hypervascular bone of rapidly growing infants (2)--and pitting (1) were noted for three infants. Others include a large lesion above the right orbit of an older adult (Figure 3.18); lumbar vertebral bodies of a 12- to 16-month-old infant with formation defects or lesions (large rounded pores anterior and posterior); a small smooth-walled lesion that resembles a subperiosteal cortical defect (Zimmerman and Kelley 1982:70) in the metaphysis of a proximal femur of a 9-month-old infant; a small lytic lesion in the lower portion of the right orbit of an adult female; "lacy" or rounded porous areas on the bodies of two thoracic vertebrae (T-11 and T-12) of a 16- to 18-year-old female; a lytic lesion and thinning of the occipital in a 9-year-old child (Figure 3.19); a series of pits with cortical bone and a punched-in look in the metatarsal of a female 22-28 years old (possibly postmortem); a small healed depression in the parietal of an adult; and lytic lesions and a thinned table of the parietal of a 6-month-old infant.

A granulomous lesion (Figure 3.20) was found in the seventh cervical vertebra of a 5-year-old child. No other vertebrae or body parts appear to be affected, but the burial also included parts of one other child (3-4 years old) and an adult, and it was difficult to determine whether all elements belonged to the 5-year-old.

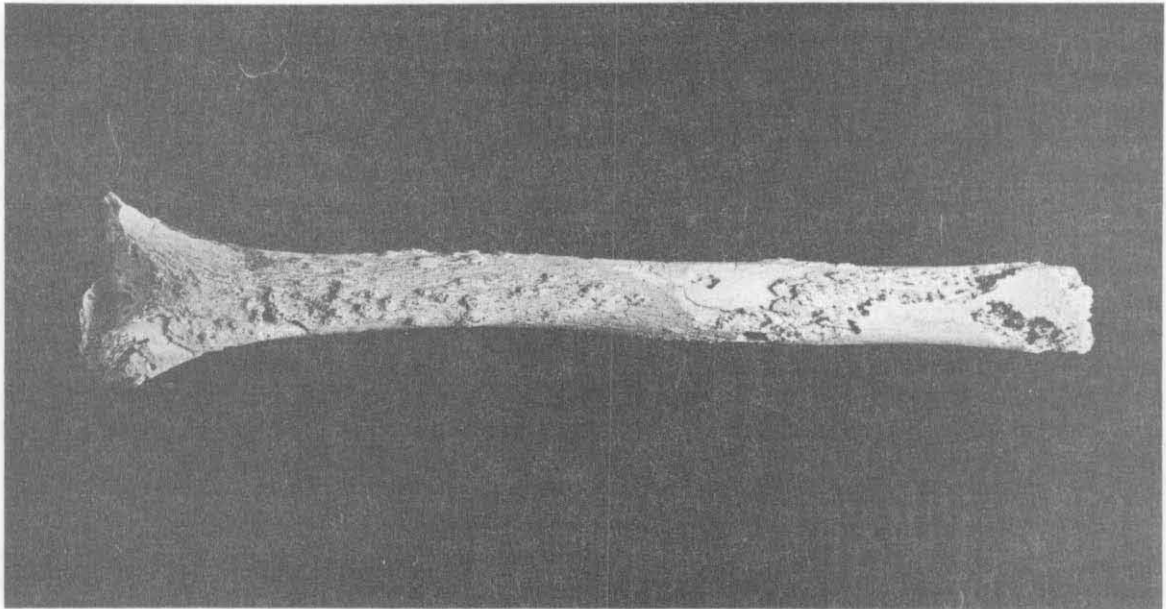


Figure 3.16. Kin Kletso osteomyelitis (CC-KK)

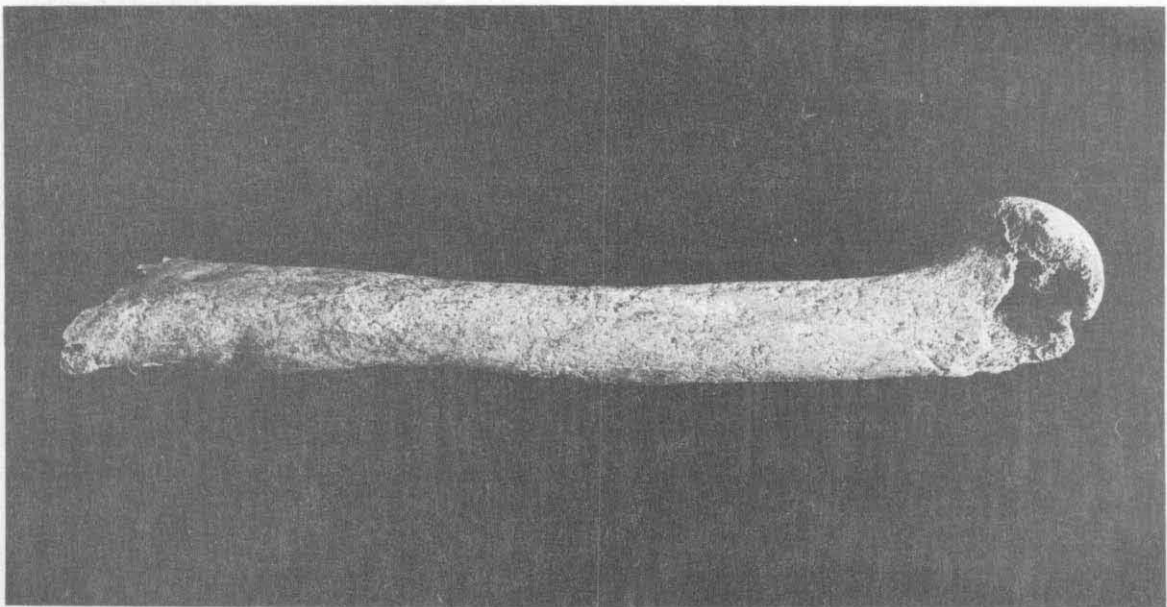


Figure 3.17. Kin Kletso osteomyelitis (no number)

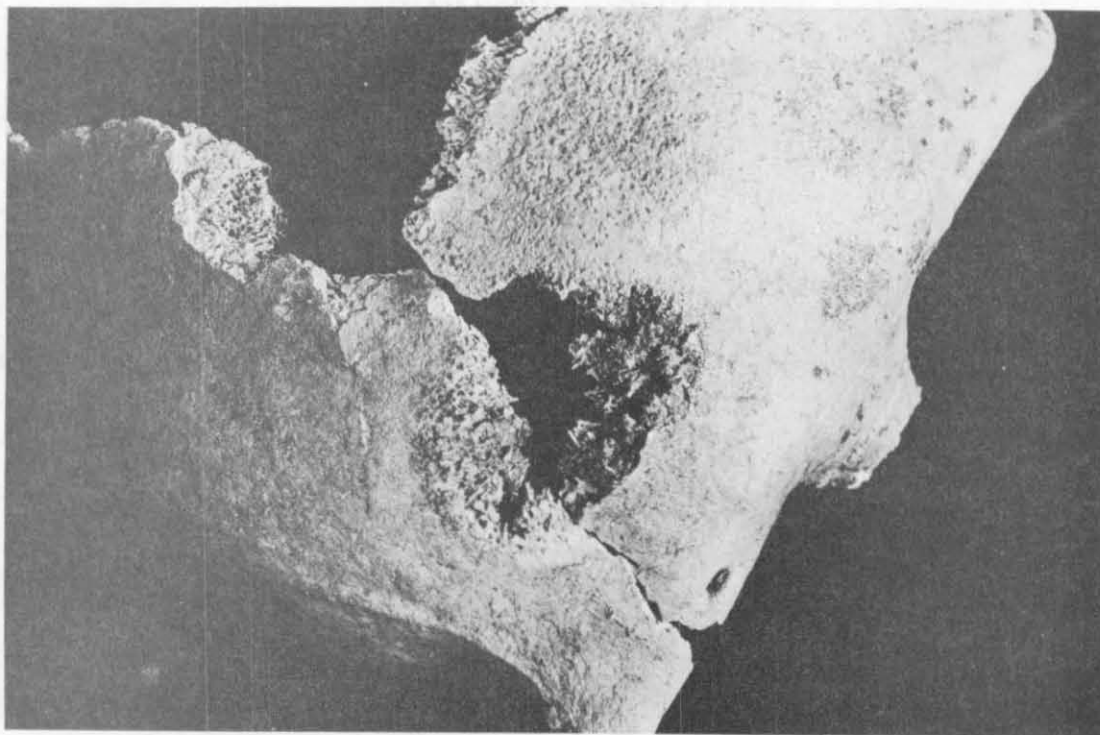


Figure 3.18. Lesion above orbit (Bc 50 60/?)



Figure 3.19. Lesion in occipital (Bc 126, SWI 2, #993)

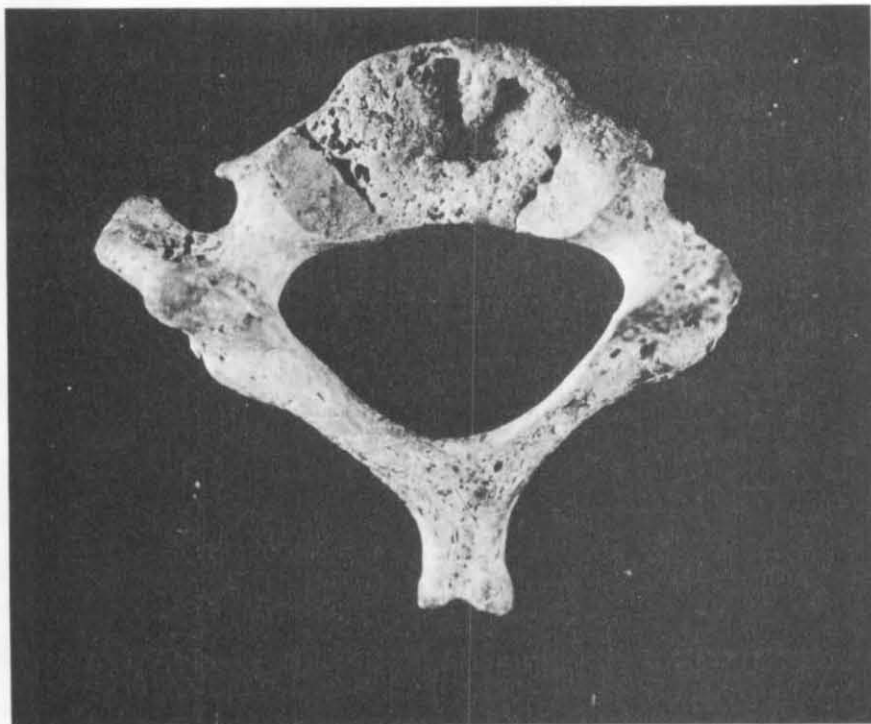


Figure 3.20. Granulomous lesion (d 3/1)

Nonspecific Periosteal Infection. Inflammatory reactions with no obvious causation were noted twice. Both instances were in femora of adults.

Osteoporosis. Thin bones were not uncommon but generally accompanied other conditions such as porotic hyperostosis. Bc 57 60/4 was unusual in that only the cortex of the hand bones was thin; all other bones had normal cortical thickness. All the bones of Bc 63 60/6 were very thin and light, and the tibiae were slightly bulbous, but no obvious causation could be discerned.

Minear and Rhine (1985) undertook an intensive study of the skeleton from 29SJ 563, a female older than 40 years. Through x-ray and macroscopic examination of cortical thickness they determined that she exhibited postmenopausal osteoporosis. Remodeling of most joint areas, anterior wedging of two vertebrae, a number of Schmorl's nodes, and pitting of the cranial case were all present.

Neoplasia. Button osteomas, slow-growing benign tumors no more than 2 cm in diameter composed of dense lamellar bone, usually found in individuals from 20 to 40 years of age (Zimmerman and Kelley 1982), were noted on seven individuals. These were generally multiple: four individuals had three, two had two, and one had one. The most common locations were the frontal (12) or parietal (4) bones of the skull. One of these also occurred on a rib. Ortner and Putschar (1981:368) note that the most frequent locations are the frontal and parietal bones.

Unexplained Origin. Conditions that may represent developmental anomalies or have other causes were also noted. These include asymmetrical vertebrae (smaller anterior-posterior on one side), a facet on the medial side of a femoral shaft two-thirds down, enlarged nutrient foramina, and bowing of the lower arm bones. These deserve study.

Outstanding Conditions and Problems. The following individuals had conditions that merit description and discussion:

29SJ 597, an older female, had an unusual mechanical disturbance of the knees--the right more affected than the left (Figure 3.21). The proximal articular surface of the tibiae are set back posteriorly; the articular facets are at 40° and 20° angles to the shaft (normal is around 13°). Development of the gluteal insertions on the femora suggest muscular compensation. As a consequence, the gluteal tuberosities are rotated medially from the normal position and the angles of the femoral condyles are inclined about 10° from the normal. The one calcaneus present is shortened. Areas of radiolucency at the proximal ends of the tibiae can be seen in the x-rays. There is no evidence of traumatic causation. The articular surfaces of both knees have begun to deteriorate and exhibit heavy lipping

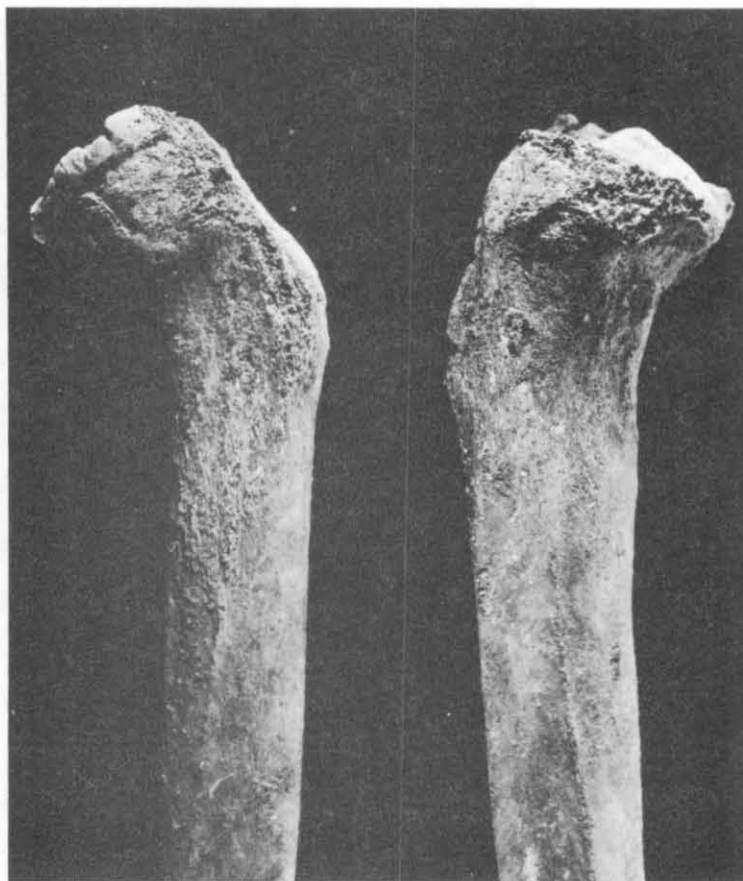


Figure 3.21. Mechanical disturbance of the knees (29SJ 597 Burial 1)

on the proximal fibulae and tibiae and the distal femora. Muscular and bony compensatory evidence suggest that this was a long-term and probably developmental condition.

Bc 53 60/12, a 9-month-old infant, exhibits cranial lesions quite different from the porotic hyperostosis found in other Chacoan infants. The involvement includes a thin brown porous layer of bone that covers large areas of the frontals (Figure 3.22), almost all of the parietals and occipital (Figure 3.23), and all of the temporals. The condition is similar to a periosteal reaction: new layers of bone over the normal cortex. Mensforth et al. (1978) suggest that periosteal reactions are a fundamental response to infectious disease.

Other abnormalities in this individual include destruction of areas of the occipital along the lambdoid suture, apparently from the interior, and a dark brown discoloration of all teeth that are present (Figure 3.24). Small porosities on the ribs are the only anomalies noted for the postcranial skeleton. No Harris lines were present on the tibiae or femora.

Talus Unit 60/4, a 4-year-old child, is the most problematic (Figure 3.25). Four of the thoracic vertebrae have large lytic lesions that have destroyed parts or all of the sides of the arches. Moderate cribra orbitalia was developing rather than healing, and large porosities were noted near the ends of several long bones, on arches of vertebrae, on some ribs, and along the lambdoid suture of both parietals. All bones are very thin and light. Sternal development was irregular, lesions were noted in the petrous portion of the temporal bone, the ribs are twisted and flat, and there is a congenital absence of both lower lateral incisors. This individual also has circular caries, one each at the base of the lower central incisors. The x-ray clearly shows at least five Harris lines on the distal femur and tibia (Figure 3.26). The circular caries and Harris lines suggest that this child had been subjected to repeated episodes of illness.

Minear has "best-guessed" that this individual suffered from malnutrition and in a weakened condition acquired tuberculosis. This would not be the first case of tuberculosis reported for Chaco Canyon. A case from Pueblo Bonito has been described by Ortner and Putscher (1981:170-173). The age of that individual is estimated at about 9 years from femur measurements and dental eruption. Only the vertebrae appear to have been affected--T11, T12, and L1. The L1 body is completely destroyed and the pedicle is fused with the L2 body. The anterior portion of the T12 body is destroyed and an enlarged canal is present on T11. Most researchers note that tuberculosis usually affects the vertebral bodies and rarely invades the arch (Allison et al. 1981; Morse 1967; Ortner and Putscher 1981; Steinbock 1976), but arch involvement has been described when there is extensive destruction of the vertebral body (Buikstra 1976).

Talus Unit 60/4 does not fit the lesion patterning or age profile (Buikstra 1976) for other conditions such as fungal or bacterial infections, and tuberculosis remains a possibility. Coccidioidomycosis in-

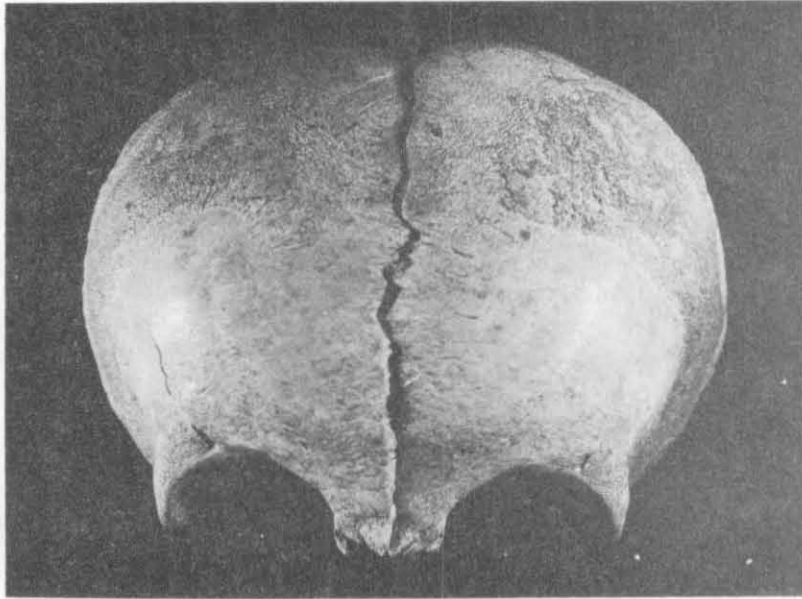


Figure 3.22. Periosteal reaction: frontals (Bc 53 60/12)

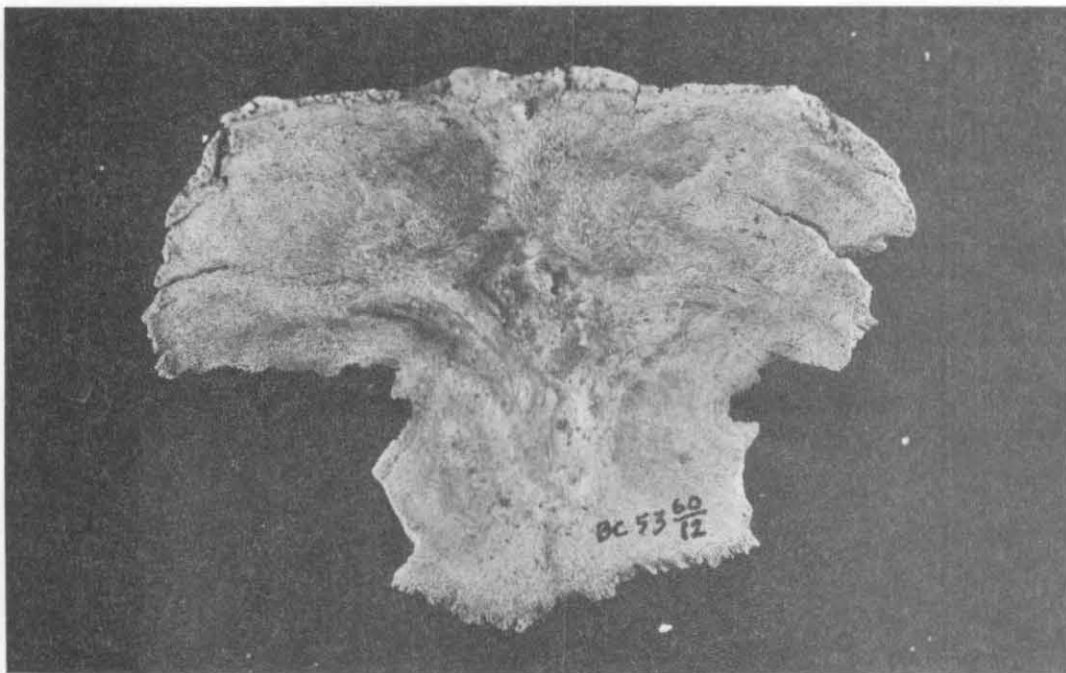


Figure 3.23. Periosteal reaction: occipital (Bc 53 60/12)

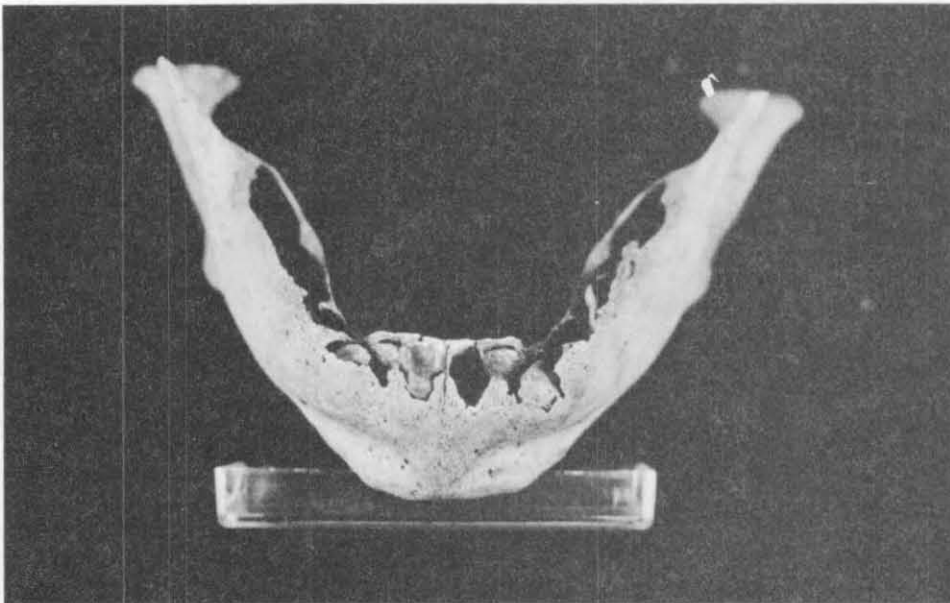


Figure 3.24. Discolored teeth (Bc 53 60/12)

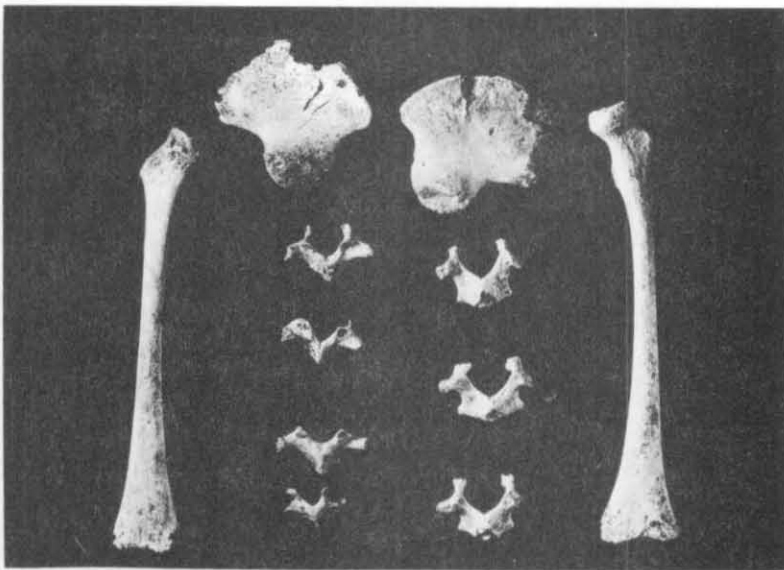


Figure 3.25. Possible tubercular Talus Unit child (Bc 257 60/4)

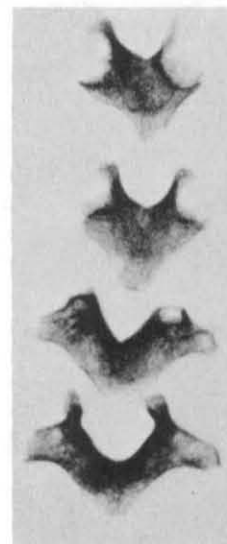


Figure 3.26. Harris lines: Talus Unit child x-ray (Bc 257 60/4)

volves the neural arch and is restricted to arid regions of the Southwest. However, it is caused by a soil-born fungus and the general pattern is for adults to be most affected and for risk to increase with age (Buikstra 1976; Long and Merbs 1981). Relatively large sedentary populations and intensified agricultural activities provide a favorable situation for tuberculosis or a tuberculosis-like pathology to develop (Buikstra 1981). Fink (1985) describes the remains of a 4- to 5-year-old child from near Tocito, New Mexico, with very similar lesions that have also been attributed to tuberculosis.

The final case is a child from Kin Kletso. Unfortunately, the bones of a 7-year-old and a 3- to 5-year-old child are mixed, and it is not always possible to determine which individual is represented. The most unusual aspects are large nutrient foramina in both tibiae and very large rounded lesions in the ilia and the ribs (Figure 3.27). The occipital is thickened with hypertrophic fine spongy bone and the fibulae are bowed. All bones are very light. The older child has a large resorbed area below the deciduous second premolar. Although it is completely healed, it may have released bacteria into the blood system and contributed to the condition.

Discussion

The climate and general surroundings of Chaco Canyon are not ideal for sedentary human occupation, yet the number and size of archeological sites found suggest a relatively successful adaptation. The most direct means of assessing the success of this adaptation is through the study of human remains.

Although environmental stress cannot be directly observed, its impact can be determined (Huss-Ashmore et al. 1982). Sedentary populations dependent on agriculture have been shown to suffer from malnutrition and disease, due in part to an emphasis on single staple crops low in most nutrients and to the instability of the agricultural system (Cohen and Armelagos, eds. 1984; Huss-Ashmore 1982). For this reason alone we would not expect to find a completely healthy population from Chaco Canyon. As previously noted, maize is deficient in iron, and a diet consisting largely of maize and beans should lead to some signs of stress regardless of the local success of the population.

Epidemiological studies of crude death rates indicate that infant mortality is a measure of a population's fitness (Mensforth et al. 1978). Because environmental influence is greatest during periods of rapid growth and development (Huss-Ashmore et al. 1982), much attention has been focused on infants and children. Mensforth et al. (1978:12) have identified the most likely causes of death for infants and children by age group. The leading causes of death from birth to 1 month include prematurity, birth injury, congenital anomalies, asphyxia, lung collapse, and acquired infections; from 1 to 12 months, infectious diseases are the leading

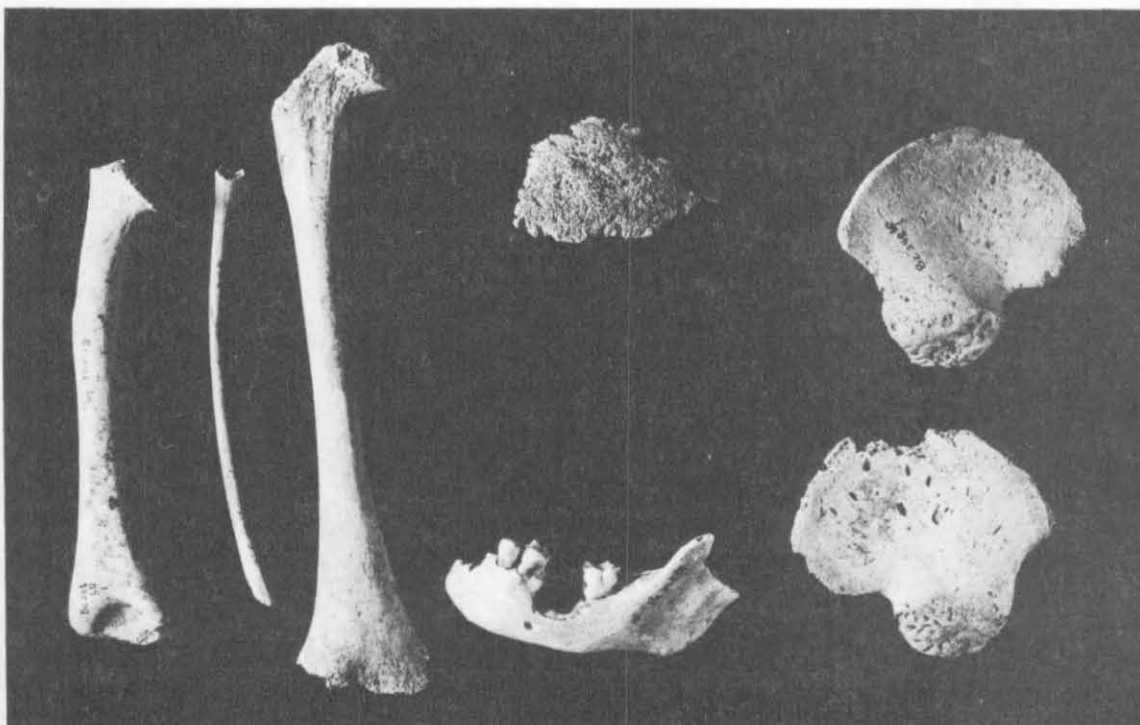


Figure 3.27. Pathological Kin Kletso child (Bc 248 60/4)

cause; from 1 to 4 years, malnutrition is most significant, with a decrease in infectious disease. Children with iron-deficiency anemia are more likely to acquire gastrointestinal and respiratory infections.

Given that the Chacoan sample of infants comes from a number of sites, that the removal was somewhat unsystematic, and that the burials cover a time span of up to 500 years, it is difficult to argue that the age distribution is representative; however, it is the only sample available. The number of individuals in each age group increases with age: four less than 6 months old, eight from 6 to 12 months, ten from 1 to 2.9 years, thirteen from 3 to 4.9 years, and fifteen from 5 to 14 years. The largest increase is between the under-6-month and the 6- to 12-month groups, when the greatest cause of death is from infectious disease and problems associated with weaning. Direct evidence of infectious disease, periosteal infection, was uncommon, with only one possible example found. This in itself contrasts with the findings of studies from different areas. Periosteal infections tend to increase under conditions of sedentism and population aggregation--and the consequent malnutrition. The incidence may level off or decrease with more successful adjustments to the new living conditions (Cohen and Armelagos 1984).

The number of infants in the Chaco sample is low compared to most other Southwestern populations. For Arroyo Hondo 45.3% of the burial population ($n = 108$) were under 5 years of age (Palkovich 1984). Similarly, Grasshopper, Arizona, ($n = 614$) had 55% under age 5 years (Berry 1985), compared to 25.9% for the Chaco sample. The percentage of the Gran Quivira ($n = 206$) population under 3 years of age was 25.8 (Turner 1981) compared to 25.0% ($n = 28$) for those from San Antonio, 29.7% from Tijeras Pueblo, 31.6% from Paa-ko (Ferguson 1980), 28.3% ($n = 152$) from Forked Lightning, 33.7% ($n = 86$) from Pindi, 9.8% ($n = 124$) from the Glaze I period at Pecos (Palkovich 1980), and 16.3% of the Chaco sample. Yet excavation bias may account for much of the difference, especially in the sites excavated before 1970.

Cribra orbitalia and porotic hyperostosis, which are measures of iron-deficiency anemia in maize-dependent societies, were relatively common, especially if El-Najjar et al.'s (1976) figures are used. Chaco children (less than 10 years of age) exhibited these conditions 83.3% of the time, compared with 72.0% for the Canyon de Chelly Basketmakers, 88.0% for the Canyon de Chelly Pueblos, 63.6% for Inscription House, 15.9% for the Navajo Reservoir area, and 18.2% for Gran Quivira. Palkovich (1980) reports incidence from Arroyo Hondo of 29.1% (0-1 year) and 15.0% (1-4 years) for porotic hyperostosis, and 12.5% and 10.0% for cribra orbitalia. Children in the 5- to 9-year group exhibited neither. These are much lower than the rates found in the Chaco sample. While observer bias may influence the recording of these conditions, both studies do suggest that Anasazi populations in areas of more diverse vegetation and greater animal resources were less likely to suffer from this condition.

It should be emphasized that, in general, "the anemia itself appears to operate as a homeostatic mechanism which functions to balance iron metabolism. Such a physiological mechanism has a strong selective value

for a rapidly growing organism" (Mensforth et al. 1978:21). It is often the increased susceptibility to infectious disease, gastrointestinal disorders, and respiratory disorders that cause the mortality. Given the lack of characteristic periosteal reactions, it is unlikely that infectious disease was the primary cause of mortality in the Chaco children.

Hypoplasia lines in the teeth can also give a general picture of health for those individuals surviving into adulthood. Unless severe attrition has worn away the teeth, these lines are permanent markers unaffected by events later in life. The central maxillary incisor is the one most likely to exhibit hypoplasia from an event occurring before 3 years, and the canine teeth for events between 3 and 7 years (Huss-Ashmore et al. 1982). The Chacoan sample contained an extremely high (88% of the individuals for which observations could be made) incidence of hypoplasia, suggesting that malnutrition or disease did indeed affect the majority of the population. Populations from Black Mesa, Arizona, had much lower frequencies (a maximum of around 20%), but the criteria employed were slightly different (Martin et al. 1985). A line had to be present on at least two teeth to be considered stressful. Approximately half of the Chacoan sample would be categorized as stressed under this criterion. Goodman et al. (1984) found that 80% of the individuals from Dickson Mounds in Illinois (Middle Mississippian) had one or more hypoplasia lines, and a maximum of 60.3% was reported by Perzigan et al. (1984) for a Fort Ancient population from the Turpin site in Ohio. The instances from Chaco may be high for a Southwestern group, but there are other areas that are similar.

Harris lines or radiographic transverse lines visible in the x-rays of long bones can reflect states lasting as few as four days (Buikstra and Cook 1980); these form when the bone resumes growth but may resorb for unknown reasons. For such a line to form, it is necessary that the individual recover from the condition. An individual who exhibits lines has experienced seasonal periods of starvation and good nutrition rather than chronic malnutrition (Steinbock 1976) or has recovered from the disease episode. Populations with chronic malnutrition should exhibit fewer lines than those undergoing seasonal shortages. The Chacoan sample was not systematically x-rayed for Harris lines. In general, the nine adults tested had from one to four lines that clustered near the epiphyseal plates, suggesting some arrest in growth near the completion of the growth cycle. The four infants examined usually had some other disease complications and exhibited up to five lines.

Adult stature may also be an indicator of general health, but because the population from any one site or time period is insufficient, these comparisons have not been made. Stature of the small-site residents is compared with that of the Pueblo Bonito population in Chapter 6.

There are numerous indications that life in Chaco Canyon was not easy. Evidence of iron-deficiency anemia and hypoplasia are the strongest arguments for less than optimal living conditions. Yet much of this may reflect general cultural practices (age of weaning, low-protein weaning

foods, and dependence on maize) rather than the poor productivity of the area.

CRANIOMETRIC STUDIES

Background

The first extensive study of Southwestern crania was done by Hooton (1930) on materials from Pecos Pueblo. Numerous measurements and observations were made; however, the resulting definition of a number of types was entirely subjective:

All male crania ... were spread out in the laboratory. These were then grouped according to their mutual resemblances. The criteria of differentiation were mostly facial features. ... After a number of days of sorting and resorting, the series of 129 male skulls was finally divided into eight types [1930:185].

These "types" were then quantified by presenting average measurements for each.

Hrdlička's Catalogue of Human Crania in the United States National Museum Collections (1931) included a number of Southwestern groups, and the measurements in this report were used as the basic data for a number of later studies. By examining mean figures, Hrdlička concluded that there were no physical subdivisions that correlated with cultural differences, mainly because of the intrusion of extraneous persons. He thought that the Pueblo were a racially heterogeneous group (Corruccini 1972).

Seltzer (1944) relied on Hrdlička's (1931) data for his assessment of the racial prehistory of the Hawikuh Zuni. Eliminating measurements that he thought were affected by cranial deformation and using primarily face and cranial-base measurements, he was able to suggest that Southwestern Basketmaker and Pueblo populations were of the same racial stock and that there were no "sweeping changes" in physical type until late Pueblo IV.

Spuhler (1954) was probably the first to approach the problem in a nontypological manner. Again using Hrdlička's (1931) measurements, he calculated coefficients of divergence as measures of relationship on 13 measurements of 13 Southwestern cranial series. His approach was criticized at the time by Stewart, who thought that, because some skulls were deformed, the relationships were accidental rather than biological, and by Krus, because the data used were neither reliable nor valid since the cranial sample was not temporally or spatially uniform (Spuhler:1954).

With the increasing emphasis on statistical analysis, attention was next directed toward the validation of measures of biological distance and the determination of which traits or measures were the most appropriate. Corruccini (1972) used chi-squares, F tests, and t tests on minor discon-

tinuous traits, postcranial measures and cranial measures, and Penrose's distance measure to assess distance. Howells's (1973) multivariate analysis of crania on a worldwide basis demonstrated that, as a methodology, discriminant analysis could be used with great efficiency to classify crania. Multivariate analysis allows an individual skull, rather than population means, to be the unit of analysis.

Carpenter (1976) used multivariate analysis on metric and discrete cranial traits to conclude that metric traits were significantly related to the sex and race of an individual. The same method was used by Corruccini (1976) to synthesize patterns of variation within six regions of the skull (mandible, palate and maxilla, face, calotte, basicranium, and infracranial fossa), and it was determined that nonmetric and metric traits were not completely independent. Finally, Falk and Corruccini (1982) compared the use of cranial versus dental measurements and traditional versus cranial-base measures using F tests and Wilk's lambda variance ratios to determine that both traditional (e.g., maximum length and breadth) and nontraditional (small measurements that do not span more than one bone) cranial measures were better than dental measures and that the traditional cranial measures were by far the best.

Among the latter studies on methodology have been a number concerned with biological and cultural relationships between and among skeletal populations (Droessler 1981; Jantz, Owsley, and Willey 1981; Mackey 1977, 1980; Owsley, Bennett, and Jantz 1982).

The Pueblo Bonito Series

The Pueblo Bonito skulls recovered by Judd's excavations have been part of several of the studies mentioned above. Hrdlička concluded that the population of Puye was distinct from those of Pueblo Bonito and Jemez, and that the average Pueblo stature indicated a "weakened" group with "unfavorable cranial capacity" (Corruccini 1972). Seltzer's (1944) interest was in the biological relationships with the old Zunis. His comparison of these with the Pueblo Bonito sample found the Hawikuh series to be somewhat smaller, but his measurements and indices were practically identical in 10 of 12 measurements. It was concluded that "there is a fundamental physical relationship between them, even though this inference is based on a limited series" (Seltzer 1944:17).

Spuhler (1954) also included Chaco crania in his study. Of the other series used--Pecos, Salt River, Hawikuh, Utah Basketmaker, Arizona Basketmaker, Chavez Pass, Puye, Petrified Forest, Ventana Cave, Swartz Ruin, San Simon, and Chama (Figure 4.1)--the two with the lowest coefficient of divergence or closest relationship to Chaco were Utah Basketmakers (1.03) and Salt River (1.11). The most distant or least relationship were with Chama (2.44) and Swartz Ruin (2.60). Spuhler was able to conclude that there was a biological separation of the Mogollon group (Swartz Ruin) from

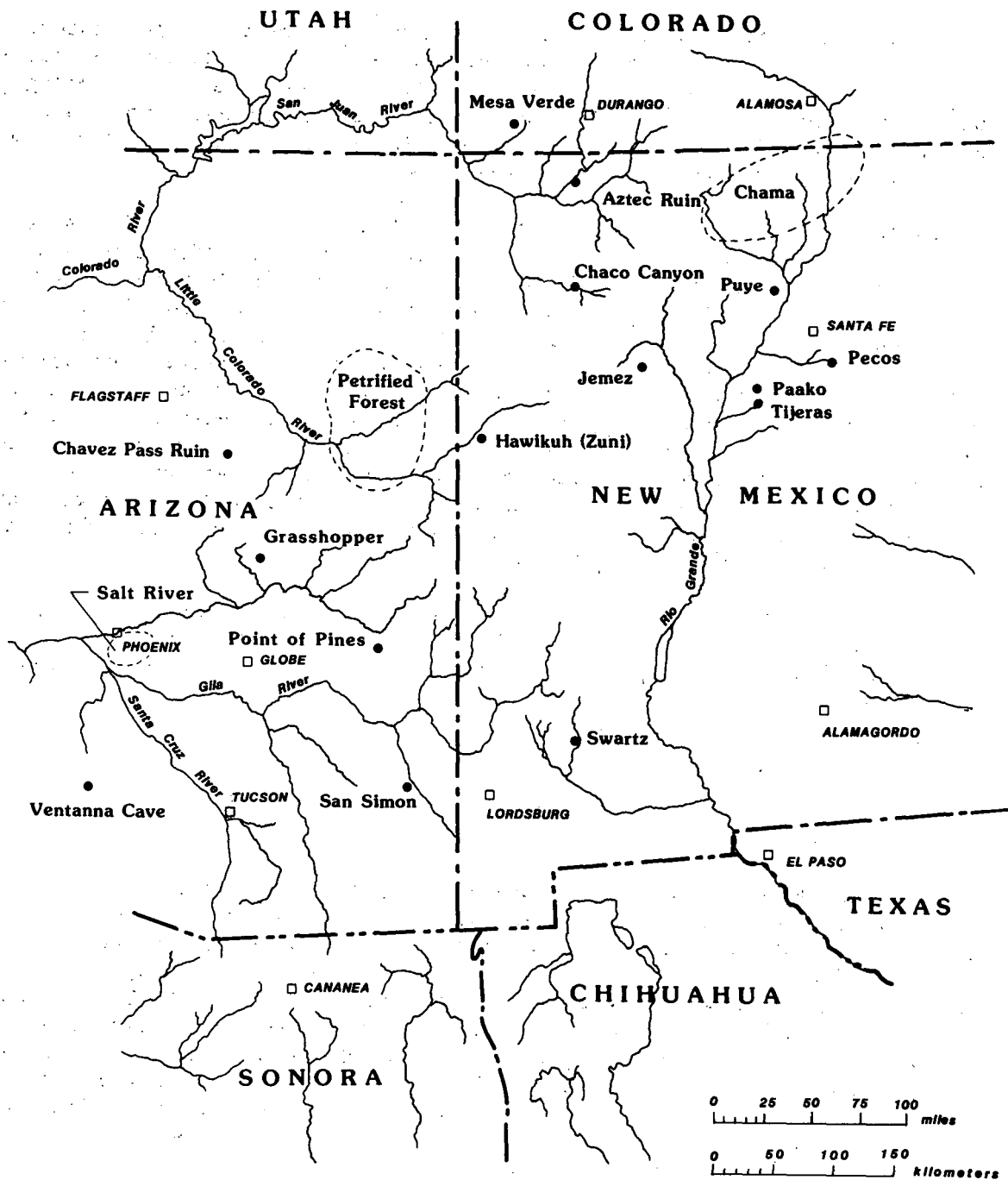


Figure 4.1. Sites referred to in the cranial studies

the Pueblo groups and that the Basketmaker groups could be grouped with the Pueblos.

Corruccini (1972), working with Hawikuh, Pueblo Bonito, and Puye, found no important racial differences between the three and concluded that although significant genetic variability existed between each pair, they formed a unified group compared to non-Southwestern groups. Comparing results of only males and females from each group, he noted that interpopulation distances were smaller, shape differences larger, and intrapopulation cohesiveness more complete for females than for males. This was attributed to the presence of exogamous matrilineal clans. Shape and, to a lesser extent, size differed within a Pueblo village less than between Pueblo villages. In terms of Penrose's distance measures, Pueblo Bonito was the most isolated in size for both sexes and in shape for males.

The next work to include crania from Pueblo Bonito was that of Lumpkin (1976). The purpose of his study was to test the reliability of craniometry for archeological problems employing multivariate techniques, specifically discriminant and principal-components analyses. He also added a number of new measures based on curvatures of the orbits and face. His sample consisted of crania from Mesa Verde (A.D. 1000-1200), Aztec Ruin (A.D. 1150+), Pecos Pueblo (A.D. 1100-1200), Pueblo Bonito (A.D. 950-1150--Judd's rooms only), Grasshopper Pueblo (A.D. 1280-1340), and Point of Pines (A.D. 1000-1450) (dates from Lumpkin 1976). When all groups were included, discriminant analysis found that the Pueblo Bonito series was closer to the Mesa Verde sample ($D^2 = 14.804$) than it was to any other and that it was the furthest statistical outlier of the Anasazi groups studied. It was furthest from Grasshopper ($D^2 = 28.529$) and closer to Point of Pines ($D^2 = 18.503$) than it was to either Aztec ($D^2 = 19.460$) or Pecos ($D^2 = 19.628$). The closest relationship found in the samples was between Mesa Verde and Aztec ($D^2 = 7.496$), which are also the two closest spatially (Figure 4.1).

Contrasting each pair gave Mesa Verde and Pueblo Bonito the largest D^2 of any combination, and there was no overlap between the populations. This is not inconsistent with the total sample comparisons, since the discrimination in each run is based on differences seen in the pairings while those for the total group distinguish a number of populations. Only 4 of the top 10 variables for the Pueblo Bonito-Mesa Verde pairing are the same as those for the total group analysis. Thus, while the Pueblo Bonito is closer to the Mesa Verde population than to any other, the two are still distinct with respect to each other.

This analysis supports Spuhler's finding that the Mogollon (Grasshopper) are biologically distinct from the northern Anasazi. It also suggests a close biological connection between Aztec, Mesa Verde, and Pecos. The founding of Pecos by people from Mesa Verde has been suggested on the basis of ceramic evidence (Kidder and Amsden 1931). The relative isolation of the Pueblo Bonito series from other northern Anasazi groups is interesting, but it may be explained by sampling procedures. This series probably represents a single kin group, while Mesa Verde is repre-

sented by several sites, Pecos by several superimposed sites, and Aztec (at minimum) by a number of kin units.

A final study (Ferguson 1980) appears to have used Lumpkin's (1976) data to demonstrate that the middle Rio Grande Tijeras and Paa-ko Pueblo populations formed a unit compared to the northern Anasazi groups from Pueblo Bonito, Aztec, and Pecos. But as Ferguson states regarding the curvature measurements, "tracing of the face, the choice of end points for the curvatures, and the fitting of circles to curvatures all depend to some extent on the judgments of a particular investigator, so that data collected by one person may vary slightly from data taken by another" (1980:126); investigative variability may be the primary cause of so complete a separation.

The importance of the later studies is in demonstrating that discriminant analysis does an excellent job of distinguishing between Southwestern populations. Also significant may be the suggestion that Pueblo Bonito is more isolated (distinct) than the other populations (Corruccini 1972; Lumpkin 1976) and that its individuals presumably are genetically closer to those of Mesa Verde than to those of Aztec (Lumpkin 1976).

Comparisons within Chaco

Judd considered both burial clusters found at Pueblo Bonito to represent the "Old Bonitians," a Pueblo II people living in a Pueblo III age who as a group "clung to its ancestral home after the Late Bonitians had migrated" from Pueblo Bonito (1954:340). Yet even the Old Bonitians were not considered native to Chaco Canyon; because they built mainly with stone, Judd thought that their most likely origin was from beyond the San Juan River. The New Bonitians were also from the north, southeastern Utah, and southwestern Colorado. For Judd, the presence of late pottery with burials in the older portion of the structures suggested that the Old Bonitians inhabited the structure longer than the New Bonitians. The absence of New Bonitian burials was quite simply explained--Pueblo III people tended to have isolated and concealed communal burial grounds (1954:341).

Another point of view is that of Reyman (1978), who suggests that Pepper's status burials at Pueblo Bonito might actually represent pochteca personnel. Reyman and others (Frisbie 1978, 1980; Hayes 1981; Kelley and Kelley 1975; Lister and Lister 1981) suggest that developments at Chaco were not indigenous but rather directed and conditioned by Mesoamerican influence. Certainly, if Mesoamerican traders were present in the Chaco burial population, they should stand out physically from the local Anasazi population.

Finally, Judge (1983) has suggested that Chaco served as a basin-wide ceremonial center, with a small core population joined by people from all corners of the basin on ceremonial occasions.

These three views have implications that can be addressed through studies of biological distance. Judd would be quite pleased that the Pueblo Bonitians were closer to the Mesa Verde population than to any other, but he would be bothered that Aztec was only slightly closer than Pecos. Reyman and others' postulated pochteca among Pepper's burials can easily be addressed with a simple comparison of these with others in that cluster and with Judd's burials. Judge's (1983) thoughts are more difficult to address, except on very general grounds. Basin-wide gatherings might be expected to generate a very heterogeneous "core" population in the canyon itself--yet Corruccini (1972) and Lumpkin (1976) suggest a relatively closed population. Another possibility is that the population of the San Juan Basin was relatively homogeneous and that the residents of the outlying sites were closely related to the Chaco population. If the economic relations operated on the basis of kinship ties, Aztec Ruin (a Chacoan outlier) should then be more closely related to Chaco than was Mesa Verde. Presumably the Aztec sample, which postdates the Chaco system, were the descendants of the original inhabitants. Lumpkin's findings also conflict with this alternative.

With these kinds of problems in mind, a series of craniometric studies are discussed here. Again a long-term interest and study, Chaco crania housed at the Field Museum of Natural History in Chicago (Moorehead's Pueblo Bonito collection), the U.S. National Museum (Judd's collection), the Museum of Natural History (Pepper's collection), Arizona State University, the Maxwell Museum, and those at the Branch of Cultural Research were measured over a number of years (and well-planned vacations). Eighteen basic measurements (Bass 1971) were made on each specimen (Table 4.1). It is encouraging that, although some time had elapsed between sessions and a variety of instruments were used, the Moorehead sample clusters with Pepper's, the one to which it belongs spatially.

Discriminant analysis was chosen as the means of analysis for a number of reasons. As mentioned previously, the unit of analysis is the individual--essential for picking out pochteca and other outliers. It maximizes separation, which is desirable when dealing with biological populations, and can be used with relatively small sample sizes (Lumpkin 1976). The analysis is used to find classification functions or linear combinations of the variables that best separate the groups. BMDP stepwise discriminant analysis (Dixon 1975) was used on the Chaco Canyon cranial data. No substitutions were made for missing data.

The original sample of crania consisted of 74 cases from over 24 sites. Most site samples consisted of one or two individuals, some poorly dated, and a fair number for which the site was unknown. This collection was eventually narrowed down to samples from a few sites. Pueblo Bonito had the largest sample, with twenty-one measurable individuals (13 females and 8 males) from the western cluster of burial rooms and eighteen (9 of each sex) from the northern cluster of burial rooms. Also included were a male and a female from Pueblo del Arroyo (a greathouse site very close to Pueblo Bonito), six individuals (5 females and 1 male) from two small sites near Fajada Butte (29SJ 299 and 29SJ 1360), and five females from Bc 59 (see Table 4.1 for the catalog numbers of these crania).

Table 4.1. Cranial measurements and crania used in the analyses

maximum length	right orbit height
maximum breadth	left orbit height
^a basion - bregma height	right orbit breadth
^a menton - nasion height	left orbit breadth
alveolar - nasion height	nasal height
maximum bizygomatic diameter	maximum nasal breadth
^a basion - alveolar point	maximum palatal length
^a basion - subnasal point	maximum palatal breadth
^a basion - nasion	^a mandible height at symphysis

Pueblo Bonito north:	AMNH: 3659-3666; 3669-3672; 9167
	Peabody/Cambridge: 3075
	Chicago Field Museum: 42520; 42533-42535
Pueblo Bonito west:	USNM: 327052; 327058-327060; 327062; 327063;
	327065; 327070; 327071; 327077; 327081;
	327084; 327088; 327101; 327106; 327112;
	327113; 327115; 327116; 327125; 327126
Pueblo del Arroyo:	USNM: 327139; 327140
Fajada:	NPS: 29SJ 299 Burials 1-4; 29SJ 1360 Burials 1-2
Bc 59:	ASU: C1891; C1892; C1894; C1924; C1927

^aEliminated from the final analyses because more than 10% of the cases had missing values.

Table 4.2. F and classification matrices for Chaco Canyon cranial discriminant analyses

Male and female combined

	Pueblo Bonito north	Pueblo Bonito west	Pueblo del Arroyo	Fajada
F matrix				
P. Bonito north	21.44			
P. del Arroyo	12.15	6.00		
Fajada	5.87	20.43	12.95	
Classification matrix (74.5% correctly classified)				
P. Bonito north	13	4	0	1
P. Bonito west	1	19	1	0
P. del Arroyo	0	1	1	0
Fajada	4	0	0	2

Male and female separate

	Pueblo Bonito north		Pueblo Bonito west		Fajada	Bc 59
	M	F	M	F	F	F
F matrix:						
P. Bonito north female	0.99					
P. Bonito west male	5.43	3.16				
P. Bonito west female	7.91	4.65	0.13			
Fajada female	5.91	9.29	17.10	20.64		
Bc 59 female	12.79	10.45	6.55	6.18	16.22	
Classification matrix (53.1% correctly classified)						
P. Bonito north male	6	2	0	0	0	1
P. Bonito north female	2	4	1	2	0	0
P. Bonito west male	0	0	5	3	0	0
P. Bonito west female	0	0	6	7	0	0
Fajada female	3	0	0	0	2	0
Bc 59 female	0	0	0	3	0	2

Male only (100.0% correctly classified)

	Pueblo Bonito north
F matrix	
P. Bonito west	33.42

Female only

	Pueblo Bonito north	Pueblo Bonito west	Fajada	Bc 59
F matrix				
P. Bonito west	16.16			
Fajada	9.55	18.41		
Bc 59	13.76	1.28	13.07	
Classification matrix (71.9% correctly classified)				
P. Bonito north	7	2	0	0
P. Bonito west	0	12	0	1
Fajada	2	0	3	0
Bc 59	0	4	0	1

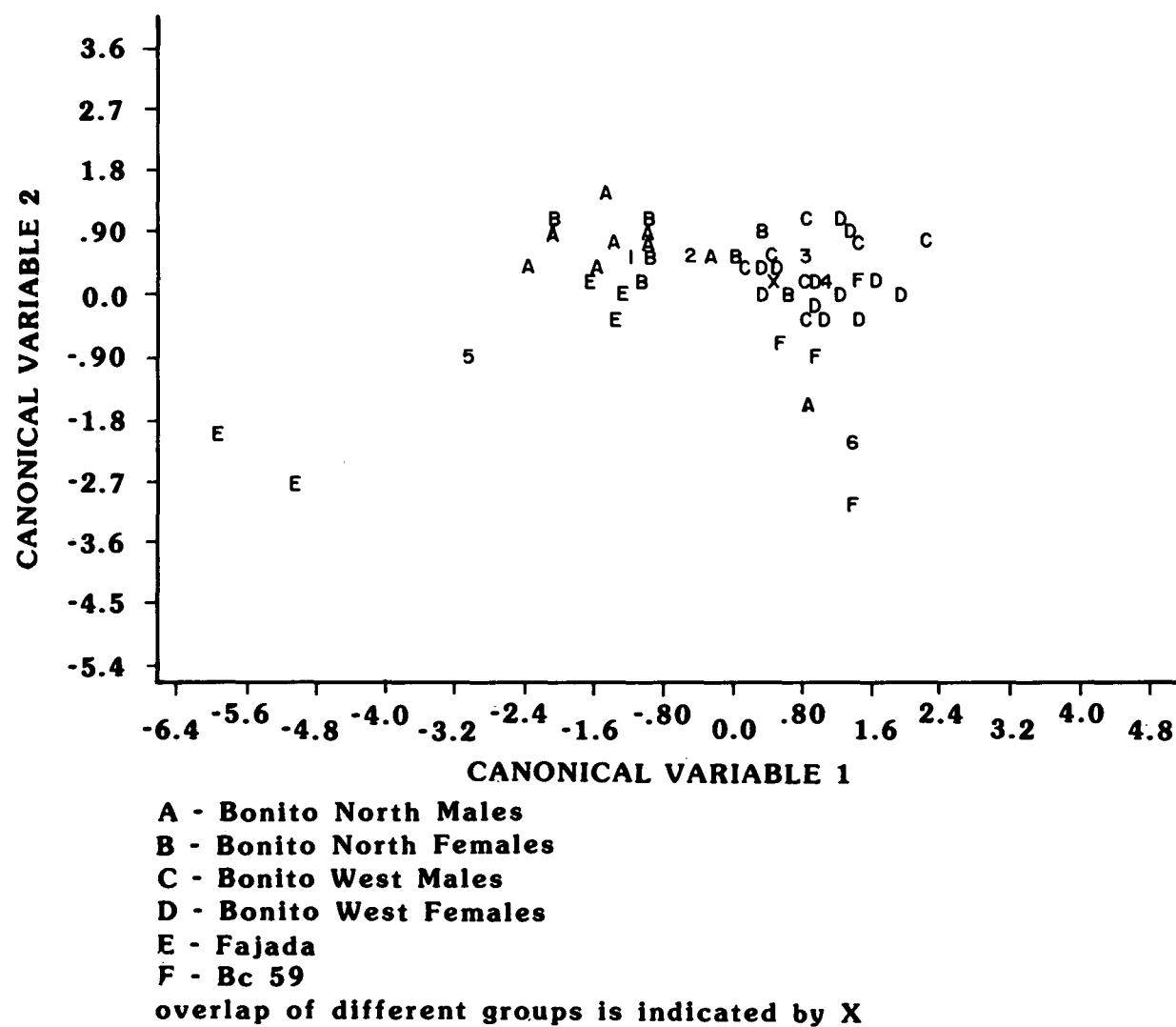


Figure 4.2. Chaco Canyon cranial discriminant plot.

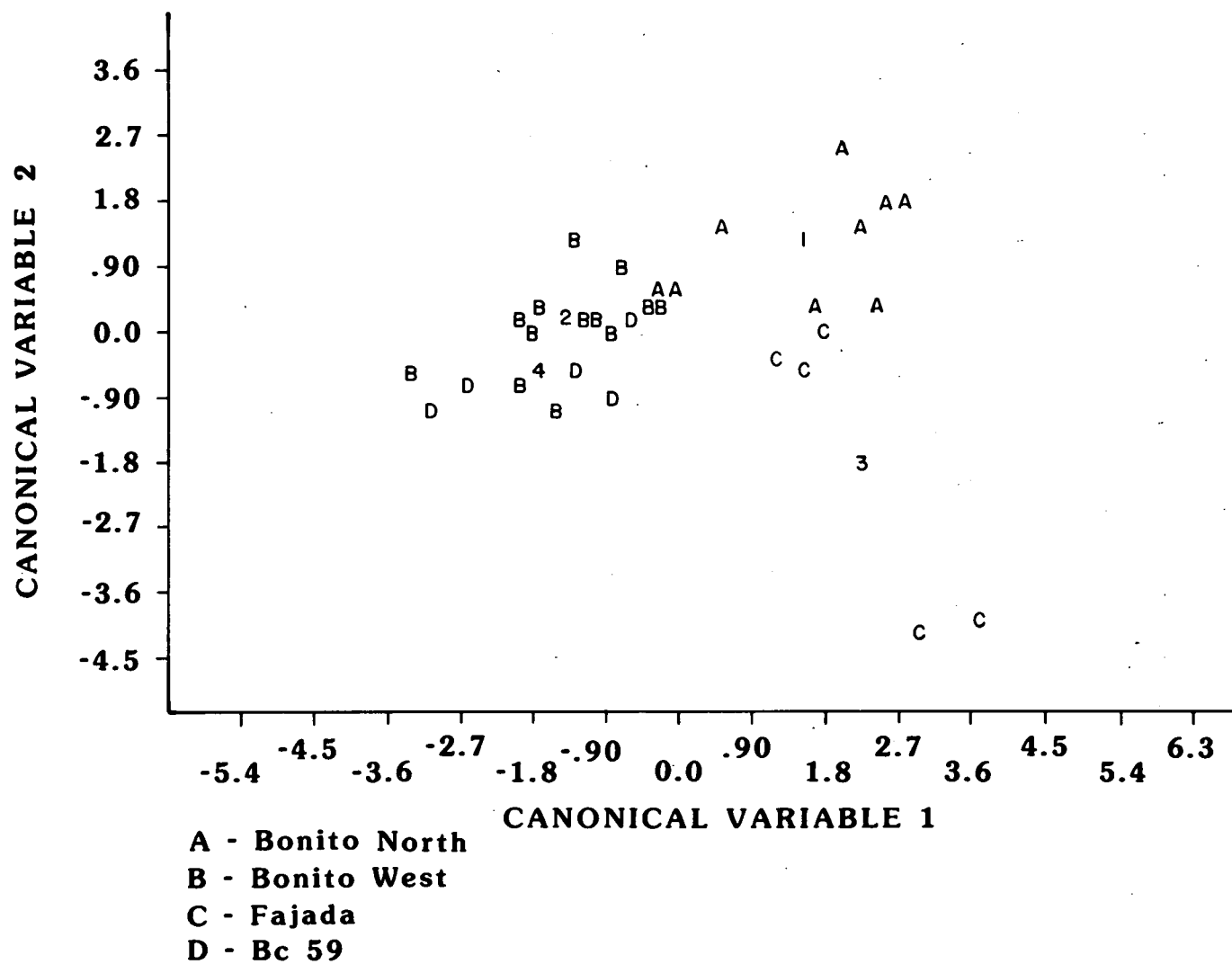


Figure 4.3. Chaco Canyon cranial discriminant plot, females only.

A number of different analyses were performed on all or combinations of these individuals. Table 4.2 summarizes the F statistics, which are proportional to Mahalanobus's D^2 and give an indication of the biological distance between the groups based on the functions defined (Dixon 1975). The classification matrix is also provided.

The variables contributing to the functions in the site and both sex analyses are those measuring the breadth of the face and facial features and the palatal length. The functions in the females-only analyses were again defined by the maximum breadth, the nasal breadth, the palatal breadth, and orbit heights. The males from the two Pueblo Bonito clusters were differentiated on the right orbit height and the maximum bizygomatic diameter.

While the classification results for some of the analyses were not especially good, there are several implications in the F and classification matrices. Pueblo Bonito consists of two distinct populations, and each of these have smaller biological distances with other groups in the canyon than with each other. Both clusters appear to represent the same time span; the differences cannot be related to chronology. The western burial cluster is more closely related to the sample from Bc 59 than to any other and the northern is closest to the Fajada site group. Within Pueblo Bonito the males and females from within each cluster of rooms are closer to each other than they are to any other group (Figures 4.2 and 4.3).

Unfortunately, there are no other series of Chaco crania that can be compared. It would be interesting to analyze both Pueblo Bonito clusters with those from Aztec and Mesa Verde as a measure of how these are related to each other relative to outside groups that are close in terms of biological and geographic distance. Eventually, series from some of the other outlier communities could be included to help determine whether the Chaco system operated on the basis of kinship or through biologically autonomous groups.

MORTUARY PRACTICES

The systematic study of mortuary practices is relatively recent. The common pattern in Southwestern site reporting is strictly description; interpretations, if any, are drawn from ethnographic descriptions of modern or near-modern Pueblo groups. Only recently have Southwestern archaeologists begun to question the applicability of the egalitarian Pueblo model to prehistory (Adams 1981; Schelberg 1984; Upham 1982) and for that matter to the protohistoric period. The ethnographic Pueblos represent the earlier groups exposed to European influence; their egalitarian principles may be an adaptation to historic conditions (Wilcox and Masse 1981).

One of the best cases for a complex social organization among the Anasazi can be made for Chaco. Most overt is the distinction in house types: large formal structures characterized by core-veneer masonry, large rooms with high ceilings, and distinctive Chaco kivas; and small sites that are essentially typical Anasazi dwellings that housed nuclear or extended family groups and grew by accretion. The Chacoan outliers (as many as 70; Judge 1983) exhibit greathouse construction and are linked to the canyon and each other by a system of engineered roadways.

At least superficially, there is cause to examine the mortuary practices at Chaco for evidence of organization beyond that previously assumed. The following section briefly reviews some of the development of the general theory behind mortuary study. This is followed by a descriptive analysis of the Chaco Canyon burials and, finally, a discussion of the Chaco materials and their interpretation.

General Mortuary Theory

Much of the work on mortuary variability has sought to demonstrate that there are cross-cultural regularities between the level of social complexity of living communities and the differentiation shown in mortuary treatment. Binford (1971) offered three propositions based on an examination of ethnographic cases. First, that the social persona recognized in mortuary ritual depends on the complexity of the status structure, which in his study was measured by the form of subsistence practice. Second, that among simpler societies status distinctions are based on general characteristics such as age, sex, and achievement, while in the more complex societies they are abstract and independent of age, sex, and subgroup affiliation; it follows that the number of dimensions varies with the organizational complexity. Third, that the form of ritual varies with the dimensions of the social persona. The size of the mourning group or amount of disturbance that death causes in the community reflects the relative rank of the buried individual.

Saxe (1970) also proposed a number of regularities that underlie mortuary behavior and are applicable beyond specific contexts. These were tested against ethnographic accounts of three groups; some received support, while others could not be confirmed. Other researchers have expanded on and worked toward clarification or confirmation of these two early works. Using thirty ethnographic cases, Goldstein (1981) tested one of Saxe's proposals to conclude that a corporate group seeking to legitimize its use or control over scarce resources may have as one means of rationalizing this relationship a permanent, specialized, and bounded disposal area. She also concluded that in an egalitarian system the burial mode is controlled by age/sex and normal/deviant distinctions, while in a ranked society it is determined by culturally defined social roles and kinship position.

Tainter (1975, 1977, 1982) expanded on Binford's third proposal, observing that as social status increases, so does the amount of energy expended in mortuary treatment. When a hierarchy increases, it appears to be more important to clearly signify functional roles, levels of authority, and lines of descent in crucial personnel. These are emphasized through physical symbols and mortuary ritual.

Chaco Mortuary Data and Methodology

As mentioned, Chaco burials have a long history of removal and a rather poor history of documentation. Problems inherent in the use of archival data are compounded by the diversity of sources from which the information is derived. Some of the entries require a fair amount of interpretation and evaluation for accuracy. Appendix B provides a summary list of human burials or remains for which some record exists. A more detailed compilation, from which Appendix B was derived, is on file at the Branch of Cultural Research, National Park Service, Santa Fe.

The bulk of the information on Chaco Canyon burials comes from work done by the School of American Research/University of New Mexico (SAR/UNM), the American Museum of Natural History, the National Geographic Society, the National Park Service Ruin Stabilization (RSU), and the Chaco project.

Of these, the SAR/UNM records are the most troublesome. The burial form itself, used throughout SAR/UNM work, resulted in a number of ambiguities. For example, the type of burial gave the following choices: simple excavation, stone protection, cist, under floor, or sealed. Rarely was it noted whether a pit was dug or a body placed on the ground and then covered. The almost universal answer was "simple excavation," a choice most did not understand. While the form asked for a sketch of the burial and of designs on the pottery, this was rarely supplied. Another problem-plagued variable was that of flexion. Given the choices of complete, right-angle, and extended, many of those shown in photographs or sketches

as semiflexed (right-angle) were recorded as completely flexed. There was no attempt to distinguish disturbed from secondary burial.

The age and sex of an individual were often recorded, but these frequently do not match the current assessments made for those remains that have survived. This results, in part, from inexperienced students making the determination or from interpretations based more on interpretation of the burial goods than on the remains. For example, this account concerns an individual (female) from the Talus Unit:

The burial itself was an adult man, as far as could be judged from the character of the bones and of the skull, and also from the fact of his having been buried with such care with food jars to carry his spirit, as we presume, to the spirit world. Such care does not commonly seem to be taken of the Soul of Pueblo women at burial [Southwestern Monuments 1934].

Terms for age groups were not standardized; observers frequently differed in the age ranges they used to define the terms infant, children, baby, youth, and adolescent. (In this report an infant is considered to be less than 3 years of age, a child from 3 to 10 years.

Ceramic vessels accompanying a burial are one of the few, and usually the only, means of even roughly dating a burial. Not many of the vessels excavated are still available. The few remaining at the Maxwell Museum were examined by T. Windes (National Park Service), and enough discrepancies were found between the field identifications of vessel types and our current typological concepts to cast doubt on most field identifications. Red Mesa was labeled Gallup, and Red Mesa and Mesa Verde were confused. In other cases the vessel is missing, it has no field identification, and there is no photograph of the burial.

Preceding and supplying the basis for this study, information on Chaco mortuary practices was collected for a number of years and a preliminary analysis was done in 1981 (Akins and Schelberg 1984). Before compiling the final data, the National Park Service archives and published accounts were again reviewed. All of the information pertaining to burials was copied and filed by site so that all of the references to a single burial could be examined at one time. The accounts were compared and the excavators' notes, photographs, and mortuary forms were used in the final descriptions. Information from the skeletons themselves was integrated with the mortuary data and Park Service personnel were subjected to sketches of ceramic designs and photographs and asked for identifications to establish a chronology. Those sites for which vessels were not identified or were feared to be unreliable but which had some sort of sherds counts (Bc 50, Bc 51, Bc 57, and Bc 59) were checked to at least bracket the time span. Individual burials with no time-diagnostic accompanying objects were checked by context (i.e., compared with other interments in that room or with sherds counts), and some could be assigned dates. Many of those in Appendix B are from multicomponent sites and could not be given even a rough date or lacked information essential to the analysis.

Approximately 130 individuals for which information considered to be essential was lacking were eliminated from the small-site analysis. There was no information on the age of twenty-one individuals, and ten others were not associated with a site. Forty burials were noted as disturbed, and many of these consisted of only a few elements or appeared to have been secondary. Of the nineteen from midden areas, five definitely had vessels in association. Eleven others apparently had no vessels, but given the disturbance this remains questionable. For three others there was no information on associations. The twenty-one disturbed room or kiva burials included three with vessels, six recorded as without vessels, and twelve for which the associations were unknown.

A total of thirty-nine undisturbed midden burials could not be used in the analysis. Of these, twenty-one were associated with vessels, but the information on the vessel type was missing and no ceramic association group could be assigned. Seven did not have associated vessels and for eleven others there was no information on associations. Of the ten undisturbed room burials, four had vessels, four did not, and in two cases the associations were unknown. There were ten additional cases for which no provenience information was available; in one of these cases, the burial was found in the plaza. One burial had vessels and one had no vessels; for the remainder, no associations could be determined.

The individuals included forty-one infants or children, fifty-six adults, and two adolescents. Proportionately more midden than room burials were eliminated from the sample. Slightly more individuals were known to have vessels than to probably not have vessels.

Simple significance tests were used to identify possible correlations in the data. It is assumed that a statistically significant result in the observed patterning is less likely to result from random variation. The specific statistical methods include chi square (X^2), chi square corrected for continuity (X^2_c), and Fisher's exact test. Criteria followed the guidelines for application of these tests given by Thomas (1976: 298). A probability (p) of less than .05 was considered to indicate a potentially meaningful correlation.

Chronological Analysis

As noted, ceramic vessels are virtually the only means to evaluate the time framework for most Chaco burials. In order to provide a description of mortuary practices, five basic groups were used. These are based on ceramic associations, and since many of the vessel types cooccur, there is some overlap in the groups (Figure 5.1). Curation of some vessels is not seen as a major problem, especially since some chronological overlap is recognized. The five groups based on ceramic associations are referred to by the predominant or characteristic black-on-white ceramic design; these are Basketmaker III through Early Red Mesa, Red Mesa, Gallup, McElmo (actually Chaco-McElmo), and Mesa Verde. The ceramic types used to define

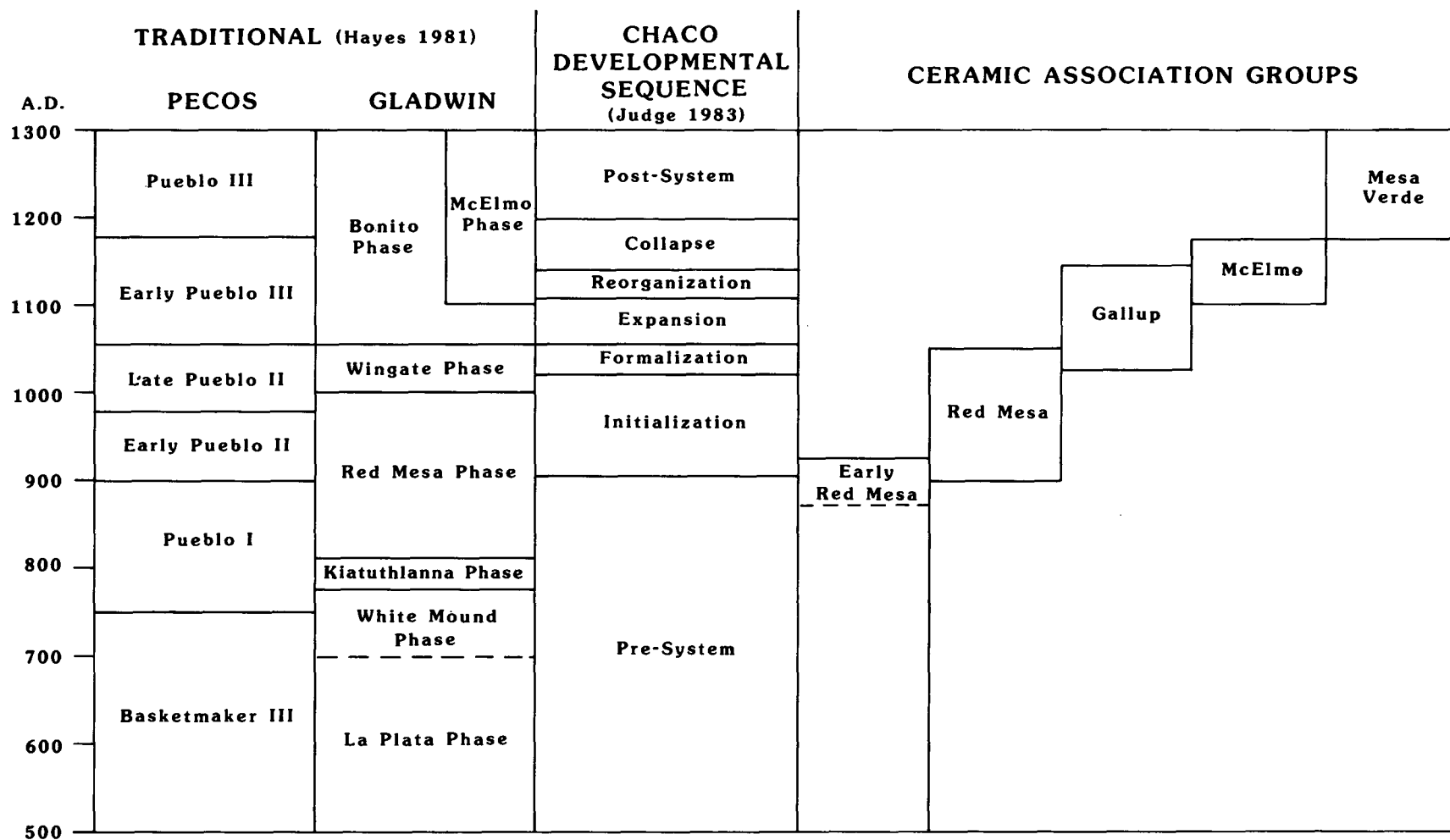


Figure 5.1. Relationship between ceramic association groups and other chronologies

each of these and dating of these wares can be found in the following discussion. The latest dated vessel was used to assign a burial to a group. Table 5.1 summarizes the sites found in each period.

This section gives a roughly chronological account and brief comparisons both between the groups and between the larger pueblos or greathouse samples and those from the small sites. Since so many of the burials from virtually our only greathouse sample, Pueblo Bonito, were disturbed, a separate section is devoted to a room-by-room description of Pueblo Bonito.

Basketmaker III - Early Red Mesa

Burials dating from Basketmaker III through early Pueblo II, or pre-A.D. 900-925, are relatively rare. Senter (1937) refers to several from Bc 50 and Bc 51 as Pueblo I, but the ceramic assemblages from the rooms or accompanying vessels suggest later dates. A large block of time was chosen for this study in order to keep the Three C site as one unit, and in doing so others with early Red Mesa vessels were included for consistency. Ceramic types in this sample are Lino Gray, White Mound Black-on-white, La Plata Black-on-white, and Early Red Mesa Black-on-white. Those burials identified include one from Bc 50, two each from Bc 51 and Bc 59, fifteen from the Three C Site, and fourteen from Shabik'eshchee Village.

From this meager data base (Table 5.2) it appears that refuse of midden areas was by far the most common burial location (88.2%). These tended to be scattered, shallow excavations that contained few accompanying objects. Shabik'eshchee Village is the earliest in the sample and tended to be highly regular in burial plan when compared to the other sites. Thirteen (92.9%) were semiflexed and twelve (85.7%) were on the left side with their heads to the west. Eleven had no burial goods, but Roberts (1929) suggests that they were buried with perishable items such as baskets. Those with accompanying vessels (3, or 21.4%) were higher in the fill and probably some of the latest. Significance tests suggest that only the orientation at Shabik'eshchee differs statistically ($p = .005$) from the other sites. This site has one of the two Chaco Canyon great kivas that definitely date to this period.

Many of the burials from the Three C site were disturbed. Otherwise, positioning was variable--five flexed, five semiflexed, and three extended; burial on the back was most common (8) with two face down and one each on the right and left sides. Children were more likely to be extended than adults ($p = .04$). The orientation includes equal numbers (3) for south, west, northwest, and southwest and two to the north. None were east or easterly (one from Shabik'eshchee was to the east).

Burial goods other than ceramic vessels were absent. Nine of the fifteen burials from the Three C site (60%) had no accompaniments. Since inclusion in this group was dependent on vessels associated with the

Table 5.1. Ceramic association groups and sites

Ceramic association and dates	Greathouse site	Small site
Basketmaker- Early Red Mesa pre A.D. 925		Shabik'eshchee Village Three C site Bc 50 Bc 51 Bc 59
Red Mesa A.D. 900-1050	Pueblo Bonito	Bc 51 29SJ 627 29SJ 629
Gallup A.D. 1030-1150	Pueblo Bonito	Casa Rinconada Pepper's Mound 2 Three C site Turkey House Bc 50 Bc 51 Bc 52 Bc 53 Bc 59 Bc 192 Bc 362 29SJ 597 29SJ 626 29SJ 627 29SJ 1629
McElmo A.D. 1100-1175	Kin Kletso	Bc 50 Bc 51 Bc 53 Bc 57 Bc 59 29SJ 721
Mesa Verde A. D. 1175-1300		Leyit Kin Robert's small site Bc 236 29SJ 633

Table 5.2. Basketmaker III-Early Red Mesa burial practices

Variable	Shabik'eshchee	All others					Total
	All	Child	Youth	Male	Female	Adult	
Number	14	5	1	1	1	12	34
Location							
room	1			1		2	4
midden	13	5	1		1	10	30
Position							
extended		2				1	3
semiflexed	13		1		1	3	18
flexed				1		4	5
back	1	2	1		1	4	9
face		1				1	2
left side	12					1	13
right side	1			1			2
Orientation							
north	1	1				1	3
south		1			1	1	3
east	1						1
west	12			1		2	15
northwest		1	1			1	3
southwest		1				2	3
north-south		1					1
Number of vessels							
zero	11	2	1			5	19
sherds only				1		2	3
one	3	3			1	3	10
three						1	1
Number of bowls							
zero	11	4	1	1		7	24
one	3	1			a	3	7
two						1	1
Number of pitchers							
zero	14	4	1	1	a	11	32
one		1					1
Culinary wares		1			a	2	3

^avessel form unknown

burials from multicomponent sites, it follows that all those from Bc 50, Bc 51, and Bc 59 had ceramics. Burials dating to this period in these three sites but lacking vessels could not be identified. Two burials from Bc 51 and eight burials from Bc 59 had no ceramic offerings.

Not including Shabik'eshchee Village, for which the age and sex of the individuals with accompanying vessels is not known, nine individuals had vessels buried with them. Three children were buried with an Early Red Mesa pitcher, an Early Red Mesa bowl, and a small culinary jar. One adult burial included three vessels, while five others had single vessels. Since the sex of the individual is known in only one case, it is not possible to assess whether vessel form or number is related to either age or sex; this seems unlikely since the children had different vessel forms. Six individuals only had sherds or bowl fragments. Seven of those from the Three C site had no offerings--four adults, one child, and one "youth."

Summary

Shabik'eshchee Village appears to have had a more organized plan for burial position than the other sites sampled. West or westerly orientation was the most common at both Shabik'eshchee (85.7%) and the Three C site (72.7%). Burial in structures was rare and appears to be unrelated to the age, sex, or number of items buried with the individual. The usual accompaniment is no offerings, a single vessel, or a vessel fragment. Only one individual had more than one, and offerings other than ceramics have not been reported.

Red Mesa

Burials associated with classic Red Mesa ceramics, dating from approximately A.D. 900-1050, are extremely rare. Seven were identified from the small sites and another seven from Pueblo Bonito (Table 5.3). Several factors may account for this paucity. Many of the sites with Late Red Mesa components also have long occupations postdating this period (Bc 50, Bc 51, Bc 53, Bc 57, and Bc 59); this could have resulted in disturbance of earlier burials. In the preceding period burials often had no offerings (60% at the Three C site), and unless they do, temporal assignment in midden areas is not possible. Furthermore, trash or exterior were still the most common burial locations, and many burials were probably missed by sampling procedures.

Small-Site Sample

The sample from small sites includes three from Bc 51 and two each from 29SJ 627 and 29SJ 629; it consists of two females, three males, and

Table 5.3. Red Mesa burial practices

Variable	Small site				Pueblo Bonito			
	Child	Male	Female	Total	Child	Male	Female	Total
Number	2	3	2	7	1	4	2	7
Location								
room			1	1	1	4	2	7
midden	2	3	1	6				
Position								
extended			1	1	1	2	2	5
semiflexed		3	1	4		2		2
back		3	2	5		2	2	4
right side						2		2
Orientation								
north						1		1
south	1		1	2				
east		1		1		1	2	3
west		1	1	2				
northeast						1		1
northwest		1		1				
Stone/slab	1	2	1	4				
Mat/feather cloth/textile							2	2
Number of vessels								
zero		2		2	1			1
sherds only		1		1			1	1
one	1			1		3	1	4
two						1		1
three	1		1	2				
four			1	1				
Number of bowls								
zero	1	3		4	1		2	3
one	1		1	2		4		4
two			1	1				
Number of pitchers								
zero	2	3	0	5	1	3	1	5
one			2	2		1	1	2
Miniatures	1			1				
Culinary ware			1	1				
Ornaments						3		3
Projectile points			1	1		1		1

two children. Only one was found in a structure. Burial position was remarkably standard given the preceding period and the number of sites--four of the five recorded were semiflexed, one was extended, and all five were on the back. Orientation was still variable, with two each west and south, one east, and one northwest. Four had stones or slabs over the body or parts of the body.

Burial goods were not equally distributed, but given the small sample the differences are probably not meaningful. Two of the males had no offerings and the third had only a quarter of a bowl. One child had a single small bowl; the other had two miniature bowls and a miniature pitcher as well as two ground stone items. The two females had the most objects. That from Bc 51 (60/29) had four vessels--a Red Mesa bowl and pitcher, a corrugated jar, and a neck-banded jar; 29SJ 627 Burial 1 was accompanied by two Red Mesa bowls, a pitcher, an olla fragment, and 10 well-made projectile points. The latter was also the only room burial, which may suggest that more care was given to her interment than to that of others in the sample.

Pueblo Bonito

Seven Pueblo Bonito burials had late Red Mesa ceramics in association. Other similar vessels were found with later burials and with the disturbed burials in both Judd's and Pepper's burial rooms. Curation of this vessel type is more likely here than at smaller sites, and any or all may be more typical of the following Gallup period, especially given that several Gallup individuals had both Red Mesa and Gallup vessels. Pepper's two burials have a late version of Red Mesa dating to about A.D. 975-1025 (Peter McKenna, personal communication 1985). Given that this vessel type is often found with Gallup Black-on-white, and Pepper's were a late version, it is unlikely that the sample is as representative of late Red Mesa as that from the small sites. Five were from Judd's western burial rooms and two from Pepper's northern rooms: two females, four males, and a child. The latter was buried in a small adobe bin that had been constructed for the interment (Judd 1954). The two females from Room 320 were side by side, extended, on their backs, with heads to the east. Both were accompanied by reed mats, feather robes, and textiles. Between them was a joint offering of a Red Mesa pitcher, half of a bowl, and two baskets. One of the males (USNM 327088) was in the same position as the females and was accompanied by a Red Mesa bowl, 25 well-made projectile points arranged in a triangle between his knees, and a bundle of arrow shafts that included 16 additional projectile points. In the same room beneath the floor was another male on his back with the knees up. With him was a Red Mesa bowl and a black-on-white pitcher, and resting on his chest were an olivella, a worked-shell necklace, and a pair of zoomorphic shell pendants or earrings (Judd 1954).

The other two burials were in Room 33. Two males were found beneath a plank floor on a layer of clean sand with a large number of ornaments and other objects, including a Red Mesa bowl and a black bowl. These are by far the most lavishly accompanied burials found at Chaco Canyon to date and are described in detail in the section on Pueblo Bonito. It is surprising that neither occupied the relatively standard Pueblo Bonito burial position: AMNH 3671 (Burial 13) was extended on the right side with his head northeast and AMNH 3672 (Burial 14) was semiflexed, probably on his back with his head north (Pepper 1909).

Comparison

The only statistically significant contrast between the small sites and Pueblo Bonito was the presence of ornaments ($p = .03$). Three individuals from Pueblo Bonito had some ornamentation; none from the small sites did. There were few differences in the Red Mesa and pre-Red Mesa samples. None were significant, although the presence of pitcher forms came close ($p = .07$).

Summary

The few small-site burials from this period continue to be located primarily in midden areas, often with stones or slabs over the body. The positioning is more regular than in the preceding period, generally semiflexed and on the back with varying orientations (westerly is slightly favored). Most had some accompaniments, but this may be influenced by the inability to assign vessel-less midden interment to a period. Vessels numbered from one to four in this small sample and were restricted to females and children. One female also had a collection of 10 well-made projectile points. The Pueblo Bonito burials with Red Mesa vessels may or may not belong with this period; these include the two most elaborately prepared and furnished individuals recovered.

Gallup

Burials with vessels made no later than Gallup Black-on-white (A.D. 1030-1150, but possibly continuing until 1200) were more common than for any other group. The primary wares include Gallup, Escavada, and Puerco Black-on-white.

Small-Site Sample

Sixty-six small-site burials were assigned to the Gallup period. Fourteen of these were from Bc 51, ten from Bc 53, twenty-two from Bc 59,

six from Turkey House, two each from Bc 50, Bc 362, and 29SJ 627, and one each from Bc 52, Bc 192, 29SJ 597, 29SJ 626, 29SJ 1629, the Three C site, Pepper's Mound 2, and Casa Rinconada.

The sample from any one site is fairly small and in some cases (e.g., Bc 53) is not representative of the available locations in which burials are found (e.g., midden deposits were not sampled). There are intersite differences in some practices, particularly position and orientation; however, they have been lumped into one sample. Rather than looking at differences between sites, each variable was evaluated with respect to the age and sex of the individual and whether the burial was within a structure or from a midden location (Tables 5.4-5.6). The age and sex distributions were examined for changes that would imply differential treatment (i.e., between infants and children, children and adolescents, males and females, and children and adults). Males and females were also examined by age group (less than 25 years, 25-45 years, and over 45 years) but the sample of aged individuals was much too small to reach any firm conclusions. When sample size permitted, significance tests were done for each variable with respect to these factors. Very few of the distributions were statistically significant, implying that there were few or no patterns of disposal related to the age and sex of the individual and that burial within a structure or in a midden did not condition what was interred with these individuals.

The distribution of burial locations depends as much on where the archeologist has sampled as it does on mortuary practices. Comparison at this level is possible only when the archeological sample includes all possible locations, and that was not true of the Chaco sample. Middens at some sites were well sampled (Bc 51 and Bc 59), but others were completely ignored. Subfloor excavations were not always done.

Thirty-four burials were found in rooms, twenty-nine in middens, and three in miscellaneous areas--one isolated, one in a plaza, and one just outside the great kiva wall at Casa Rinconada. The only significant age-related difference was found between infants and children ($\chi^2 = 3.92$; $p = .047$); infants (less than 3 years old) were buried in rooms most often (76.9%), whereas children (3-10 years) were usually in midden areas (80.0%). Males were found in rooms (70.0%) more often than females (47.6%) and adults (53.3%) more often than children (52.2%).

Extended burials were rare in the small-site sample (2, or 3.7%). Body position was almost equally divided, except that more were on the left than the right side. When divided by age and sex groups, the numbers were too small for significance tests or were not significant (male-female and adult-child). The only possible trend observed was for females to be buried on the side (14, or 73.7%: 47.4% on the left side). While burial on the side was similar for both rooms and trash, those on the back or face down were reversed in frequency; room burials tended to be on the back (26.5%), whereas those in midden areas were face down (31.0%).

Table 5.4. Gallup small-site burial location and preparation

Site/Age	Location					Preparation							
	Room	Subfloor	Floor	Trash	Misc.	Pit	Stones/ slabs	Mats			Feather cloth	Tex- tile	Pillow
	Fill							1	2	+			
Bc 50													
infant	1	1				1		2					
Bc 51													
infant		1	2	1		2	1	1				1	
child				1				1					
adolescent		1		2		1							
adult female		2		1					1	1(4)	1	1	1
adult unk.		1	1	1		1		1			1		
summary		5	3	6		4	1	3	1	1	2	2	1
Bc 52													
adult unk.	1							1					
Bc 53													
infant	1	2					1						
child			1				2						
adult male	1	1						2				1	1
adult female	1	2					1	1			2		
summary	3	5	2				4	3			2	1	1
Bc 59													
child		1		5									
adolescent				2									
adult male	3							2	1				
adult female	4			6		1		4		1(3)			
adult unk.	1						1						
summary	8	1		13		1	1	6	1	1			
Bc 192													
adult female		1											
Bc 362													
infant		1						1				1	
adult female					1			1					
summary		1			1			2				1	
29SJ 597													
adult female				1			1						
29SJ 626													
adult unk.				1									
29SJ 627													
infant	1							1					
adult male			1										
summary	1		1					1					
29SJ 1629													
adult female					1			1			1	1	
Three C													
child				1									
Pepper's Mound 2													
adult unk.				1									
Turkey House													
infant				2			2						
child				1									
adult male				2			2						
adult female				1			1						
summary				6			5						
Casa Rinconada													
adult male					1								
Totals (n=66)	14	14	6	29	3	6	12	19	2	2	5	5	2
Summary													
infant	3	5	2	3		3	4	5				1	
child		1	1	8			2	1				1	
adolescent		1		4		1							
adult male	4	1	2	2	1		2	4	1			1	1
adult female	5	5		9	2	1	3	7	1	2	4	2	1
adult unk.	2	1	1	3		1	1	2			1		
Rooms (n=34)						3	6	14	2	1	3	2	2
% of room burials						9	18	41	6	3	9	6	6
Midden (n=29)						3	6	3	0	1	2	2	0
% of midden burials						10	21	10	0	3	7	7	0

Table 5.5. Gallup small-site burial position and orientation

Site/Age	Position							Orientation							
	Extended	Semi-flexed	Flexed	Back	Face	Left	Right	N	S	E	W	SW	SE	NW	NE
Bc 50 infant		1		1					1						
Bc 51 infant			2		1	1				2					
child			1		1					1					
adolescent		1	1		1	1					1	1			
adult female		3			1	1	1		1	1	1				
adult unk.			2	1					1		1				
summary		4	6	1	4	3	1		2	4	3	1			
Bc 52 adult unk.		1		1						1					
Bc 53 infant	1	2		2	1			1	1		1				
child		1									1				
adult male		3		1			2		1	1	1				
adult female	1		3	1	1	1			2		1				
summary	2	6	3	4	2	1	2	1	4	1	4				
Bc 59 child		4	2	1	2	2	1		1	1			1	1	
adolescent			1	1		1									
adult male			2			2					1				
adult female		2	7			6	3	1	2	2	1		1	2	
adult unk.			1	1				1							
summary		6	13	3	2	11	4	2	3	3	2		2	3	
Bc 192 adult female		1					1		1						
Bc 362 infant		1		1				1							
adult female			1	1				1							
summary		1	1	2				2							
29SJ 597 adult female		1		1				1							
29SJ 626 adult unk.		1													
29SJ 627 infant		1			1									1	
adult male		1		1						1					
summary		2		1	1					1				1	
29SJ 1629 adult female			1			1				1					
Three C child								1							
Pepper's Mound 2 adult unk.		1			1									1	
Turkey House infant						2					2				
child			1				1			1					
adult male			1		2					1					1
summary			2		2	2	1			2	2				1
Casa Rinconada adult male		1									1				
Total (n = 66)	2	26	26	14	12	18	9	7	11	13	12	1	4	3	1
Summary															
infant	1	5	2	4	3	3		2	2	2	3				
child		5	4	1	3	2	2	1	1	3	1		2	1	
adolescent		1	2	1	1	2					1	1			
adult male		5	3	2	2	2	2		1	3	3				1
adult female	1	7	12	3	2	9	5	3	6	4	3		1	2	
adult unk.		3	3	3	1			1	1	1	1		1		
Rooms (n = 34)	2	16	11	9	3	10	4	3	9	6	6	1	1	1	0
% of room burials	6	47	32	26	9	29	12	9	26	18	18	3	3	3	0
Midden (n = 29)		9	13	4	9	7	5	3	2	6	5	0	3	2	1
% of midden burials		31	45	14	31	24	17	10	7	21	17	0	10	7	3

Table 5.6. Gallup small-site ceramics accompaniments

Site/Age	No. of vessels					Mini- ature	Effigy	No. of bowls ^a					No. of pitchers ^b			Culinary			Ladles				
	0	Sherds	1	2	3			4	5	0	1	2	3	B/R	Smudged	0	1	2	Sherds	Min.	Ves.	1	2
Bc 50																							
infant			2				1	1	1	1				2									
Bc 51																							
infant	1	1		1	1		1			2	1	1		1	3	1		1					
child	1									1					1								
adolescent		1	1	1				1		1	2		1		3								
adult female		1		1		1		1		1	1	1		1	1	2						1	
adult unk.		2			1					3					2	1		2			1		
summary	2	5	1	3	1	1	1	3		8	4	2	1	2	10	3	1	3				2	
Bc 52																							
adult unk.						1	1				1		1		1			1					
Bc 53																							
infant	1	1		1						3					2	1				1			
child	1									1					1								
adult male		1				2	1			1		2	1	2(1w/2)	1	2		1	1				
adult female		1	1		1					1	1	1	1	1	2	1							
summary	2	3	1	1		1	2	1		6	1	1	2	2	3	6	3	1	1	2			
Bc 59																							
child		1	2	1	2		1			3	2	1			4	2				1	2		
adolescent				2						1	1				2				2		1		
adult male			2		1					2		1		1	1	2					1		
adult female		1	3	2	3		1			5	4	1			6	4		1			1	1	
adult unk.		1								1					1								
summary	2	4	6	6	3		1	1		12	7	3		1	14	8		1		3	5	1	
Bc 192																							
adult female	1									1					1								
Bc 362																							
infant					1		1				1				1			1	1				
adult female			1							1					1								
summary			1		1		1			1	1				1	1		1	1				
29SJ 597																							
adult female			1				1			1					1			1					
29SJ 626																							
adult unk.			1					1		1					1								
29SJ 627																							
infant				1			1			1					1			1			1		
adult male				1							1				1			1					
summary				2			1			1	1				2			1	1		1		
29SJ 1629																							
adult female				1						1					1							1	
Three C																							
child			1								1					1							
Pepper's Mound 2																							
adult unk.					1		1				1				1			1					
Turkey House																							
infant				1	1					1	1				1	1				1			
child				1			1			1					1								
adult male				1	1					1	1				1	1					1		
adult female			1							1					1								
summary			1	3	2		1			4	2				4	2			1	1			
Casa Rinconada																							
adult male			1							1					1								
Total (n = 66)	7	14	17	15	6	2	5	10	4	39	17	7	3	3	7	45	19	2	5	6	7	10	1
Rooms (n = 34)	6	7	6	6	3	2	4	7	0	20	7	4	3	3	6	22	11	1	1	4	3	4	0
X room burials	18	21	18	18	9	6	12	21		59	21	12	9	9	18	65	32	3	3	12	9	12	
Midden (n = 29)	1	6	10	8	3	0	1	3	4	16	10	3	0	0	1	21	7	1	4	2	4	5	1
X midden burials	3	21	34	28	10		3	10	14	55	34	10			3	72	24	3	14	7	14	17	3
Summary																							
infant	2	2	3	4	1	1		4	1	8	4	1			1	10	3		1	2	3	1	
child	2	1	4	1	2			2		7	2	1				7	3				1	2	
adolescent		1	1	3					1	2	3		1			5					2	1	
adult male		2	3	2	1		2	1		5	2	1	2	1	3	5	5		1	1	1	2	
adult female	2	6	5	5		1	2	1	1	12	6	3		1	2	13	7	1	1	1		3	1
adult unk.	1	2	1		2	1	2	2	1	5		1	1		1	5	1	1	2	2		1	

^aIncludes black-on-red and smudged bowls; does not include miniature bowls.^bDoes not include effigy vessels.

Orientation was not patterned when adults and children were compared using only the north, south, east, and west distributions. Collapsing this into a north-south versus east-west dichotomy still did not produce significant results, although the male versus female distribution is suggestive ($p = .077$); males were usually oriented east-west (85.7%), whereas females were more equally divided (east-west, 43.7%). Room burials were equally divided between the two directions and east-west was favored in the midden interments.

Few age- or sex-related trends were observed in the presence or absence of stones, mats, or textiles. Older females did have an unusually high proportion of mats (3 of the 5, or 60.0%) and females had all but one of the feather cloths. The burial location made little or no difference in regard to stones, feather cloth, or textiles. Mats, however, were much more likely ($\chi^2_c = 7.67$, $p = .006$) to be found with room burials (50.0%) than with those in middens (13.8%). While preservation might be a factor, the almost equivalent distributions of feather cloth and textiles in room and midden locations suggest that more than preservation is involved.

The number of vessels interred with an individual ranged from none to five. When the number of vessels was grouped into four choices (0, 1, 2-3, and 4-5) the adult and child distributions were very similar and the difference between male and female groups was not significant. The individuals with four or five vessels included all age and sex groups except the adolescents. On the basis of presence or absence, males were more likely to have vessels (80.0% had vessels) than were females (61.9%). All three females in the younger group (less than 25 years) had one vessel each whereas those in the middle age group had none (3) or four to five (2). The older ones (5) had none (3), one, or five.

The room versus midden distribution was not significant, although those buried in rooms had vessels less often (61.8% had vessels) than those in midden areas (75.9% had vessels).

Miniature vessels were more often found with infants and children (26.1% had miniatures) than with adults (10.5% had miniatures) and in rooms (20.6% had miniatures) more than middens (10.3% had miniatures). Effigy or animal form vessels were rare and found in most age groups. These were always with midden burials, but this sample is sufficiently small that the distribution may be random.

Up to three bowls were found with an individual. Two males and an adult of unknown sex had the maximum, whereas individuals of all ages except adolescents had two. The group most likely to have bowls was the males (50.0% had bowls); children were the least likely (30.0% had bowls). All individuals with three bowls were found in rooms, as were four of the seven with two bowls.

Only one of twenty-three children had a smudged bowl (4.3% of the children), whereas six adults had at least one (15.8% of the adults). Males were more likely (30.0% of the males) than females (9.5% of the

females) to have smudged wares, but not significantly so. All but one smudged bowl and all three black-on-red bowls were associated with room burials.

No more than two pitcher forms were found in a grave, and both individuals with two were females. They occurred with all age groups except the adolescents--possibly due to the small sample of that age group. Males, again, were slightly more likely to have pitchers (50.0% of the males) than females (38.1% of the females), and adults (39.5% of the adults) more likely than children (26.1% of the children). Pitchers were only slightly less common in midden burials (27.5% of the midden burials) than in rooms (35.3% of the room burials).

All groups had ladles, males and females in almost equal numbers and adults slightly more often (18.4% of the adults) than children (13.0% of the children). These were found in middens (20.7% of midden burials) more frequently than in rooms (11.8% of the room burials).

Small corrugated or neck-banded vessels occurred at least six times and full-size vessels up to seven times. The burial forms did not always distinguish between the small or miniature and the full-size vessels. Miniatures were reported for the infants and adult age groups and full-size vessels for all groups except adult females. Miniature corrugated vessels were found more often in rooms (4 of the 6, or 66.7%) and the full-size vessels were almost equally divided.

Few ornaments were found, but in contrast to the Late Red Mesa sample they were present at small sites. Turquoise was found as pendants, beads, and a nodule; shell as pendants and a bracelet fragment; hematite as a pendant and small cylinders; jet as a pendant; three projectile points were recovered at the neck of a Bc 59 female, suggesting that they were part of a necklace; an infant had 12 tubular bone beads and five nut beads.

Turquoise ornaments occurred four times--three with females and once with an infant. The chip of turquoise was also with a female. Shell was found with an infant, an adolescent, a female, and an adult of unknown sex. Hematite or black cylinders were the only form found with males (2). Ornaments in general were more often found with adults (26.7% of the adults) than with children (13.0% of the children).

Four of the five turquoise objects came from room burials, as did one of the four shell objects. All ornaments were more common in rooms (26.5% of the room burials) than in middens (10.3% of the midden burials).

A variety of other objects, some probably incidental, were reported in low frequencies. Corn cobs or possible food in vessels were noted seven times, bone tools four times, chipped or ground stone nine times, wooden objects six times, red pigment twice, malachite twice, and selenite once; a basket and a possible sandal were also reported.

Greathouse Burials

Greathouse burials from this period occurred at two sites, Pueblo Bonito and Chetro Ketl. That from Chetro Ketl was found deep in the trash midden. It was an adult male (Archive 1857) accompanied by four pots (one a pitcher), a projectile point found among the ribs, and a turquoise bead. He was reportedly flexed with the head west (Archives 1857 and 1859), or halfway between semiflexed and extended with the head north (Archive 1910), or extended on the left side with head north (bag with skeleton). Most sources agree that there were three or four pots and a turquoise bead (which is actually a pendant), and one (Archive 1949) reports that there were also awls. To further compound the inconsistency, the bones now cataloged for this burial (d 1.1/1) consist of parts of a male and a female skeleton.

Because of the ambiguities associated with the Chetro Ketl burial, our description of practices during this time are based on the sample from Pueblo Bonito (Table 5.7). This consisted of thirteen individuals: one infant, three children, two adolescents, and seven females. All but one were from Judd's burial cluster in the western rooms (Rooms 326 and 329). The other was from Pepper's Room 33. While many of the disturbed Pueblo Bonito burials probably date to this time, basic practices can only be documented from those that are undisturbed.

The burial location was always in rooms and was quite standardized in position and orientation. Four individuals deviated from the characteristic Pueblo Bonito burial--extended, on the back, head oriented east. These were an adolescent with the head to the west, the infant, who was semiflexed, a child semiflexed on the right side with head northeast, and another child with the head to the south.

Judd was not consistent in noting the presence of burial mats, but he did state that each burial was placed on one or more mats and that all in Room 326 were accompanied by pottery offerings (Judd 1954:330-331). Both adolescents and all adults except Pepper's female were on mats, whereas none of the three children were.

Only two of the Pueblo Bonito burials were without vessels (the infant and a child); the number of vessels range from two to 14. Three of the adult females had five or more, and for one adult female the associations are not known. Bowls had a similar distribution. Two children, both adolescents, and all of the adult females had bowls. Only one child had a pitcher, whereas all adults had at least one pitcher (adult versus child, $p = .03$).

The three individuals with turquoise were all adult females, and only one child had ornaments of any kind (two shell pendants). One female also had two hematite cylinders.

Other materials associated with these individuals included cylindrical and bifurcate basket parts just above the infant; oval baskets with

Table 5.7. Gallup Pueblo Bonito burial practices

Variable	Infant	Child	Adolescent	Adult female	Total
Location					
Room	1	3	2	7	13
Position					
extended	1	1	1	7	10
semiflexed		1			1
back	1	1	2	7	11
right side		1			1
Number of vessels					
zero	1	1			2
two			1		1
three		1		1	2
four		1	1	2	4
five				1	1
six				1	1
fourteen				1	1
Effigy vessel		1			1
Number of bowls					
zero	1	1			2
one		1	2		3
two				2	2
three		1		2	3
four				1	1
eleven				1	1
Number of pitchers					
zero	1	2			3
one			1	4	5
two		1		2	3
three			1		1
Turquoise					
pendant				3	3
bracelet				1	1
Shell pendant		1			1
Jet pendant				1	1

humerus scrapers with four of the adult females; two digging sticks with another adult female; and a bifurcated and two cylindrical baskets as a joint offering for two adult females.

Comparison

Whereas the distinctions within both the small sites and Pueblo Bonito are relatively unimportant, there are significant differences between the two. Even though the Pueblo Bonito sample has no males, there are no statistically significant differences between adult and child, infant and child, or child and adolescent distributions. The site types are compared on the assumption that resulting differences are not a function of age or sex distribution.

It is possible that even though the room and midden distributions at the small sites were not demonstrably different for any variable other than matting, it might be more appropriate to compare room burials with room burials. The greathouse distribution was thus compared with the total site, the room distribution, and the midden distribution of the small-site sample.

Differences in the burial position (extended and flexed) were highly significant in all three cases ($\chi^2_c = 40.55$, $p = 1.91 \cdot 10^{-10}$ for the total sample; $\chi^2_c = 22.95$, $p = 1.66 \cdot 10^{-6}$ for the rooms; $\chi^2_c = 30.47$, $p = 3.39 \cdot 10^{-8}$ for the midden). The distribution of back, face, and side could not be evaluated without combining back and face and was not done. North-south versus east-west orientation was significantly different for the rooms ($p = .0468$), almost so for the entire sample ($p = .082$), and less for the midden sample ($p = .267$).

While fewer of the Pueblo Bonito burials were without ceramic vessels (16.7% had no vessels) than those in the small-site sample (total sample, 31.8% had none; rooms, 38.2% had none; midden, 24.1% had none), the differences were not statistically significant. The Pueblo Bonito burials with vessels tended to have more vessels (90.0% had three or more) than those of the small sites (28.8%, 42.9%, and 18.2% had three or more). The presence or absence of bowls was statistically different ($\chi^2_c = 4.99$, $p = .02$; $\chi^2_c = 3.71$, $p = .05$; and $\chi^2_c = 3.66$, $p = .05$) as was that for pitchers ($\chi^2_c = 6.27$, $p = .01$; $\chi^2_c = 4.15$, $p = .04$; and $\chi^2_c = 6.03$, $p = .007$).

The presence or absence of turquoise and ornaments was also significant, more so for the entire sample (turquoise $p = .03$; ornaments $p = .03$) and midden (turquoise $p = .02$; ornaments $p = .10$) than for the room sample (turquoise $p = .11$; ornaments $p = .46$). One quarter of the Pueblo Bonito burials contained turquoise; fewer from the small sites did (total sample, 7.6%; rooms, 11.8%; and trash, 3.4%). Shell ornaments were rare and the distributions were similar (greathouses, 8.3%, compared to total, 6.1%; rooms, 2.9%; and midden, 10.3%).

When the Red Mesa and Gallup small-site distributions were compared, the only nearly significant trend was in the presence of stones or slabs covering a burial ($\chi^2_c = 3.57$, $p = .06$). While common in the Red Mesa sample (57.1% had stone covering), fewer were found in the following period (18.2% had stone covering).

The greathouse distributions for Red Mesa and Gallup were fairly similar, differing only in pitcher forms ($p = .07$), which were more common in the later sample.

Summary

Small-site burial practices are variable, with very few statistically significant distributions that would suggest differentiation among individuals by age or sex. While the sample is relatively small, it should have picked up any strong trends. There is a greater variety of materials than in the previous periods, including mats, feather cloth, textiles, ornaments, and other objects that may represent personal possessions or achievement.

The Pueblo Bonito burials appear to follow a standardized plan that was slightly deviated from on occasion for infants and children. Most interments tend to have accompanying vessels and most adults have at least mats and ceramics. Turquoise was found only with adults.

The most important differences between the greathouse and small-site mortuary practices were in the organization of the interment (i.e., body placement) and in the greater quantities of bowls, pitchers, turquoise, and ornaments at the greathouse sites.

McElmo

Burials with late carbon wares such as McElmo Black-on-white have been included in this group. While there is some overlap with the preceding Gallup sample, these date slightly later overall, A.D. 1100-1175.

Small-Site Sample

Thirty-five burials could be assigned to this group: six from Bc 50, sixteen from Bc 51, one from Bc 53, seven from Bc 57, four from Bc 59, and one from 29SJ 721 (Tables 5.8-5.10). Almost all (85.7%) were found in rooms, probably due in part to excavation bias.

Table 5.8. McElmo small-site burial location and preparation

Site/Age	Location			Preparation					
	Room								
	Fill	Subfloor	Trash	Pit	Stones/ slabs	Mat	Feather cloth	Tex- tile	Pillow
Bc 50									
infant	2					2			
adult male	2				1	1			
adult female	1					1			
adult unk.	1								
summary	6				1	4			
Bc 51									
child	3		1			2			1
adolescent	2					1			
adult male	5					2	1	1	1
adult female	2	1		1		3	1	1	
adult unk.		1	1			1			
summary	12	2	2	1		9	2	2	2
Bc 53									
adult male			1						
Bc 57									
infant	2	1				1		1	
adult male	1	2		1 ^a	2	2	1		
adult female	1								
summary	4	3		1	2	3		2	
Bc 59									
infant			1						
child			1						
adult female	1								
adult unk.		1							
summary	1	1	2						
29SJ 721									
adult female	1								
Total	24	6	5	2	3	16	2	4	2
Summary									
infant	4	1	1			3		1	
child	3		2			2			1
adolescent	2					1	1	2	
adult male	8	2	1	1	3	5	1	1	1
adult female	6	1		1		4			
adult unk.	1	2	1			1			

^aStone-lined

Table 5.9. McElmo small-site burial position and orientation

Site/Age	Position							Orientation					
	Extended	Semi-flexed	Flexed	Back	Face	Left	Right	N	S	E	W	NW	E-W
Bc 50													
infant	1				1						1		
adult male		1	1			1	1	1	1				
adult female		1		1						1			
adult unk.													1
summary	1	2	1	1	1	1	1	1	1	1	1		1
Bc 51													
child	3			3						3			
adolescent		1				1				1			
adult male		3	1		2		2			3	1		
adult female		2	1		2		1		1	1	1		
adult unk.		2	2	1	1				1				
summary	3	6	4	4	4	1	3		2	8	2		
Bc 53													
adult male		1			1						1		
Bc 57													
infant	1	1		2				1			1	1	
adult male	1	2					3			1	2		
adult female		1					1						1
summary	2	4		2			4	1		1	3	1	1
Bc 59													
infant													
child			1	1					1				
adult female													
adult unk.			1			1			1				
summary			2	1		1			2				
29SJ 721													
adult female		1		1						1			
Total	6	14	7	9	6	3	8	2	5	11	7	1	2
Summary													
infant	2	1		2	1			1			2		
child	3		1	4					1	3		1	
adolescent		1				1				1			
adult male	1	7	2		2	1	6	1	1	4	4		
adult female		5	1	2	2	1	2		1	3	1		1
adult unk.			3	1	1				2				1

Table 5.10. McElmo small-site ceramic accompaniments

Site/Age	No. of Vessels								Mini- ature	Effigy	No. of bowls ^a					Smudged		No. of pitchers ^b			Culinary		
	0	Sherds	1	2	3	4	5	0			1	2	3	B/R	1	2	0	1	2	Min.	Vessel	Ladle	
Bc 50																							
infant	1		1							1	1		1				2						
adult male			1			1					1		1	1			1	1					
adult female				1							1						1						
adult unk.			1							1							1						
summary	1		3	1		1				2	3		1	2			3	3					
Bc 51																							
child	1		1	1	1			1		2		1	1				4		1				
adolescent			2							1	1						2					1	
adult male	1		1	1		1	1			1	1	2	1	2		1	4		1			1	
adult female		1		2						1	1	1				1	2	1					
adult unk.		1				1		1	1	1	1						2						
summary	2	2	4	4	1	2	1	2	1	6	3	5	2	2	2		14	1	1	1		2	
Bc 53																							
adult male			1							1							1						
Bc 57																							
infant	1	1	1					1	1	3							3			1			
adult male		1	1			1				2	1						1	2				1	
adult female		1								1							1						
summary	1	3	2			1		1	1	6	1						5	2		1		1	
Bc 59																							
infant						1					1					1	1						
child					1						1				1		1						
adult female			1							1							1						
adult unk.				1							1						1						
summary			1	1	1	1				1	3				2	1	1	3					
29SJ 721																							
adult female		1								1							1						
Total	4	6	11	6	2	5	1	3	2	17	6	9	3	4	4	1	24	10	1	1		3	
Summary																							
infant	2	1	2			1		1	1	4	1	1		1		1	6			1			
child	1		1	1	2			1		2	2	1			1		4	1					
adolescent			2							1	1						2					1	
adult male	1	1	4	1		3	1			4	2	3	2	3	1		6	4	1			2	
adult female		3	1	3						4	2	1			1		4	3					
adult unk.		1	1	1		1		1	1	2	2				1		2	2					

^aIncludes black-on-red and smudged bowls; does not include miniature bowls.^bDoes not include effigy vessels.

Burial position was varied, with a significant ($p = .0017$) tendency for infants and children to be buried extended when compared to adults. Five children (71.4%) were extended, whereas only one adult (5.3%) was. Placement of the body on the back, face, or side occurred in almost equal frequencies at Bc 50 and Bc 51; there was a tendency toward either the back or the right side at Bc 57. Infants and children were always on the face or back, whereas adults were most often on the side (55.5%). Orientation was more often east or west (71.4%) and varied little between the age groups.

Matting was equally likely to be found with males, females, adults, or children. Significant differences in the presence or absence of ceramic vessels or forms of vessels were rare. Children were more likely to be buried with vessels than were infants (80.0% and 50.0%, respectively) and children had more vessels. Males had up to five vessels, and more (81.8%) had vessels than did females (57.1%), who were never associated with more than two. Adults were slightly more likely (72.7%) than children (63.6%) to be buried with vessels. One to three bowls were found in a third of the infant graves and in 60% of those of children. Males were more likely to have bowls than females (63.6% and 42.8%), and men had more bowls. They also had three of the four red ware bowls. Children were almost as likely to have bowls as were adults (45.5% and 54.5%, respectively). Smudged vessels occurred mainly with adults (3 of 4). Miniature vessels (3) and effigy vessels (2) were quite rare. While differences in the distribution of pitcher forms was slight between infants and children and between males and females, that between adults and children was significant ($p = .04$). Only one child (9.1%) was buried with a pitcher form, compared to nearly half (45.4%) of the adults.

Ornaments were relatively rare and males were the most likely (27.3% of the males) group to have them. Turquoise was found only once in this sample, a male (?) from Bc 53 who, according to the burial form, had both a pendant and an earring. Shell was found in three burials and bone beads in three. The individual with the most ornamentation for this period (Bc 59 B2) is probably a female. With this individual a necklace of 103 jet beads, 52 shell beads, and a jet bird effigy, as well as two quartz crystals, four steatite cylinders, a bone tube, and two small smoothed-stone objects were all found. Adults (27.3%) were more likely to be buried with ornaments than children (18.2%), but not significantly so.

A wide variety of other materials occurred with McElmo burials. These included ground stone (7), bone tools (7), food items (5), baskets (2), cordage (1), a wooden object (1), a hammerstone, a flake, and a projectile point.

Greathouse Burials

The only reliable group of McElmo greathouse burials comes from Kin Kletso (Table 5.11). The disturbed burial rooms at Pueblo Bonito do have

Table 5.11. Kin Kletso (McElmo) burial practices

Variable	Infant	Child	Female	Total
Number	4	1	1	6
Location				
room	4		1	5
subfloor		1		1
Position				
flexed	2			2
semiflexed	1			1
back	1			1
left	3			3
Orientation				
east	3			3
west	1	1		2
Matting	1			1
Number of vessels				
zero	1			1
sherds only		1		1
one	1		1	2
two	1			1
three	1			1
Number of bowls				
zero	2	1		3
one	1		1	2
three	1			1
Number of pitchers				
zero	3	1	1	5
one	1			1
Culinary/corrugated	1			1

carbon ware vessels, but individuals and their associated objects could not be isolated for analysis. A disturbed burial of a male found at Kin Ya'a is also from this period, but the burial had apparently fallen from an upper story, and so positioning and artifact association could not be determined. Another burial that may represent greathouse mortuary practice at this time was found high in the fill of a room at the Talus Unit just behind Chetro Ketl. This individual was a female over 30 years of age, semiflexed, on her back, with head to the east. She was associated with a woven garment and covered by a slab. With her were two bowls, a triangular vessel, one pitcher, a corrugated pot, a ladle, and three unidentified vessel forms. Flakes and two projectile points were also found. This individual was not included in either sample because of uncertainty as to appropriate group placement.

The six Kin Kletso burials include four infants, a child (9-12 years), and a young adult female (17-18 years)--hardly an adequate sample. Three of these were at least partially disturbed. None of those in place were extended, burial was usually on the left side (3 of 4) and oriented east (3) or west (2). Matting was found with one infant. One infant and the child lacked vessels; the other infants had a variety of ceramic material: one had a culinary jar and half of a McElmo bowl; one had two Chuska bowls, a Black Mesa bowl, half of a Tusayan Black-on-red bowl, and half of a McElmo bowl; the other may have had a McElmo bowl (in Vivian and Mathews 1965 but not in the catalog; it could not be located). The adult female was associated with one black-on-white bowl. No ornaments were found. One infant may have had an associated projectile point and squash seeds.

Comparison

There are undoubtedly some biases introduced by the age and sex distributions of the small-site and Kin Kletso samples. The male and female distributions are not statistically different, but those for adults and children are ($p = .03$). No significant differences were found in orientation or presence or absence of vessels, bowls, or ornaments.

More productive is the comparison of Gallup and McElmo small-site samples. There is a significant increase in the number of extended burials from Gallup to McElmo ($\chi^2_c = 5.01$, $p = .02$) but not in orientation (east-west versus north-south) ($\chi^2_c = 1.46$, $p = .23$). There are no significant differences in the presence or absence of vessels, bowls, pitchers, or ornaments, even when just the adult or child distributions are compared. Shell ornaments were slightly more common in McElmo associations (8.6% of the burials) than in Gallup rooms (2.9%) or in Gallup as a whole (6.1%), whereas turquoise was more often found with Gallup (7.6% of the total, 11.8% of the room burials) than with McElmo (2.8%) burials.

Comparison of Pueblo Bonito and Kin Kletso produced significant differences in extended versus flexed burials ($p = .004$) and presence of pitcher forms ($p = .03$).

There are no significant differences, and in fact the distributions are quite similar, for Kin Kletso and the Gallup small-site sample.

Summary

McElmo burial practices were very similar to those from Gallup small sites. No clear-cut distinctions can be seen between individuals on the basis of age or sex. Infants do tend toward extended burials, and three children from the same room at Bc 51 were the only ones to have the Pueblo Bonito combination of extended, back, and east orientation. Males continued to have slightly more vessels than females.

Mesa Verde

The late occupation of the canyon (post-A.D. 1175) left few burials. Only eleven could be identified as Mesa Verdean, one each from Bc 236 and Leyit Kin, four from 29SJ 633, and five from F. H. H. Roberts' excavations at a small site 16 km east of Pueblo Bonito (Table 5.12). No greathouse burials could be positively identified from this period; although some of those from Pueblo del Arroyo are possible, the available information leaves doubt as to whether these are associated with earlier carbon wares or with the Mesa Verde series.

The age and sex distribution is unusual: six infants, three males, a female, and an adult. Burial tended to be semiflexed (4, or 66.7% of those recorded) and fairly equally distributed between back, face, and side. Orientation was generally west for infants (80.0%) and most often north for adults (60.0%, $p = .04$). Stones were found over three infants (50.0%) and matting and textiles were noted only once, at Leyit Kin.

Up to three vessels were found, although one was most frequent (6), and all individuals had at least a sherd accompanying them. The three with only sherds were infants; one male had two vessels and the female had three. Only four individuals were associated with bowls--all but one of the adults--and one infant had a bowl. Pitcher or mug forms were found twice--both times with adult males. The female did have a corrugated vessel referred to as a pitcher. Ladles were found with two infants and an adult male.

The only possible suggestions of ornamentation were a turquoise chip with one infant and a quartz crystal with a male--both from 29SJ 633. Other materials accompanying the individuals in this sample include a

Table 5.12. Mesa Verde burial practices

Practice	Infant	Male	Female	Adult	Total
Number	6	3	1	1	11
Location					
room		1	1	1	3
floor	2	1			3
subfloor	4	1			5
Position					
extended	1				1
semiflexed	3	1			4
flexed		1			1
back	2	2			4
face	2	1			3
left	1		1		2
right				1	1
Orientation					
north		2		1	3
south		1			1
east			1		1
west	4				4
southeast	1				1
Stones/slabs	3	2			5
Matting/textile	1				1
Number of vessels					
sherds only	3				3
one	3	2		1	6
two		1			1
three			1		1
Number of bowls					
zero	5	2			7
one	1	1	1	1	4
Number of pitchers or mugs					
zero	6	1	1	1	9
one		2			2
Corrugated pitcher			1		1
Ladle	2	1			3
Turquoise chip	1				1

lithic with one infant and seeds and a turkey carcass with another infant.

Comparison

McElmo comparisons were done within infant and adult groups to help compensate for the differences in the age and sex distributions. Even so, samples were so small that most are probably not meaningful. There was a significant difference ($p = .014$) in orientation of adult burials. Whereas the McElmo adults tended to be oriented east-west (73.7%), all four of the Mesa Verde adults were north-south. The vessel and bowl distributions were fairly similar.

Burials from Aztec Ruin, to the north near the San Juan River, date to this same period. Although technically a greathouse, it does have a good sample of burials to contrast with these: 186, of which at least 149 are Mesa Verdean (Morris 1924). Like the Chaco Canyon sample, a fair number of subfloor burials were found and extended burials were rare (3). Dissimilar is the position, which was generally on the side (around 85%), compared to a third of the Chaco sample. Orientation was fairly well divided between north-south and east-west. Pottery occurred with only 78 individuals (42%) and beads with 32 (17%) (Morris 1924).

Summary

The small sample of Mesa Verde burials precludes many statements about practices. Interment does appear to be largely in rooms and often subfloor, although this may be influenced by excavation strategy and reflected in the large proportion of infants in the sample. Ornamentation is essentially absent in the sample and the main differences from the preceding period are in orientation; adult orientation shifted from largely east-west to north-south.

Chronological Summary

Table 5.13 summarizes the burial practices and age and sex distribution in percentages. It shows that there are some fairly great differences in the proportion of children (infant and child) throughout the distribution, ranging from 14.3 to 83.4%. Much of this can be attributed to excavation procedures. Excavation primarily in rooms would tend to inflate the proportions of infants and children, since both are frequently found subfloor. Loss because of shovel excavation and inexperienced workers who might not recognize smaller individuals would have the

Table 5.13. Comparison of mortuary variables by period and site type

	BM III-Early	Red Mesa		Gallup		McElmo		Mesa Verde
	Red Mesa	small	P. Bonito	small	P. Bonito	small	Kin Kletso	
Number	34	7	7	66	13	35	6	11
Age/sex								
unknown	41.2							
infant				19.7	7.8	17.1	66.7	54.5
child	14.7	28.6	14.3	15.1	23.1	14.3	16.7	
adolescent	2.9			7.6	15.4	5.7		
male	2.9	42.8	57.1	15.1		31.4		27.2
female	2.9	28.6	28.6	31.8	53.8	20.0	16.7	9.1
unk. adult	35.3			10.6		11.4		9.1
Location								
room	5.9		57.1	30.3	100.0	68.6	83.3	54.5?
subfloor	5.9	14.3	42.88	21.2		17.1	16.7	45.4
midden	88.2	85.7		43.9		14.3		
other				4.5				
Position								
extended	11.5	20.0	71.4	3.7	90.1	22.2		16.6
flexed	88.5	80.0	28.6	96.3	7.7	77.8	100.0	83.3
back	34.6		83.3	26.4	91.7	34.6	25.0	40.0
face	7.7			22.6		23.1		30.0
left side	50.0			34.0		11.5	75.0	20.0
right side	7.7		16.7	17.0	8.3	30.7		10.0
Orientation								
north	10.7		20.00	13.4		7.7		30.0
south	10.7	33.3		21.1	9.1	19.2		10.0
east	3.6	16.7	60.0	25.0	72.7	42.3	60.0	10.0
west	53.6	33.3		23.1	9.1	26.9	40.0	40.0
other	21.4	16.7	20.0	17.3	9.1	3.8		10.0
north-south	21.4	33.3	25.0	41.9	10.0	25.9		44.4
east-west	57.2	50.0	75.0	58.1	90.0	74.1	100.0	66.6
Preparation								
pit	unk.	14.2	0	9.1	0	5.7	50.0	0
stones	8.8+	57.1	0?	18.2	0?	8.6	0?	45.4
matting	0	0	28.6+	34.8	30.8+	45.7	16.7	9.1
feather cloth	0	0	28.6+	7.6	0	5.7	0	0
textile	0	0	28.6+	7.6	7.7	11.4	0	9.1
Number of vessels								
zero	64.7	42.8	14.3	31.8	16.7	28.6	33.3	27.3
one	35.3	14.3	28.6+	25.8		31.4	33.3	54.5
two				27.7	8.3	17.1	16.7	9.1
three	2.9	28.6		9.1	25.0	5.7	16.7	9.1
four		14.3		3.0	33.3	14.2		
five or more				7.6	16.7	2.8		
Miniature vessel	5.9+	14.3		15.1		8.6	0?	0?
Effigy vessel				6.1	8.3	7.7		
Number of bowls								
zero	76.5	71.4	14.3+	59.1	16.7	48.6	50.0	63.6
one	20.6	14.3	28.6+	25.8	41.6	17.1	16.7	36.4
two	2.9	14.3		10.6		25.7	16.7	
three				4.5	33.3	8.6	16.7	
four or more					8.3			
Black-on-red bowl				4.5		11.4		
Smudged bowl			14.3	10.6		14.3		
Number of pitchers								
zero	97.0	71.4		68.2	25.0	68.6	83.3	81.8
one	2.9	28.6	14.3+	28.8	41.7	28.6	16.7	18.2
two				3.0	33.3	2.8		
three or more					8.3			
Culinary vessel	11.8	14.3		19.7	0?	5.7	16.7	9.1
Ladle				16.7		8.6		27.3
Turquoise			28.6	7.6	25.0	2.8		9.1
Shell			42.9	6.1	8.3	8.6		
Ornament/cylinder			42.9	16.7	33.3	22.8		9.1

Note: Only those cases for which the variable was recorded are included in this table.

opposite effect. However, since few of the tests showed statistically significant differences based on adult and child distributions, the age distribution should have little if any effect on the conclusions reached.

Midden burials appear to slowly decrease over time. While some of this may be due to excavation bias in favor of rooms in the later sites, it is doubtful that this is the sole cause. More midden than room burials were eliminated from the analysis, mainly because of disturbance or lack of information on the vessels present. Undoubtedly, early pot hunters also disturbed or removed even more of the midden interments.

Extended burials are relatively rare in the small sites, ranging from 3.7 to 22.2%, whereas they are quite high at Pueblo Bonito, with 71.4 and 90.1%. The most extreme contrast within a period is for the Gallup associations, for which small sites had the low of 3.7% and Pueblo Bonito the high of 90.1%.

Placement of the body on the back, face, left, or right side shows no chronological trends. Pueblo Bonito shows the greatest regularity, 91.7 and 83.3% on the back, followed by Kin Kletso (75% on the left side).

Overall, small-site orientation with the head to the east increases until the Mesa Verde sample (3.6, 16.7, 25.0, 42.3, and 10.0%). West is almost the reciprocal, starting high and decreasing through the Gallup sample, but with a slight rise in the McElmo sample (53.6, 33.3, 23.1, 26.9, and 40.0%). The three greathouse samples have the highest proportions--all for east (60.0, 72.7, and 60.0%). Never is a north or south orientation higher than the east or west total, and it is usually at least 20% less.

Positioning of the body suggests that the greathouse sites, although not consistent between Pueblo Bonito and Kin Kletso, were more formal in this part of the mortuary system. Of the small-site samples, it is those burials associated with the carbon-painted or Chaco-McElmo wares that come closest to a similar pattern.

The preparation variables are the most susceptible to preservation differences, disturbance, and the vagaries of archeological recording. Use of a stone covering appears to decrease up to the Mesa Verde sample, but this could be influenced by recording and increases in the recovery of datable burials from rooms that are near the end of the temporal sequence. It does appear that mats, feather cloth, and textiles were most commonly used in mortuary contexts during the Gallup and McElmo vessel periods.

The number and form of vessels has some definite temporal trends. The elimination of eleven to twenty-eight burials without vessels and thirty-three individuals with vessels from the sample should not have too great an effect on the analyses. Since slightly more of the individuals eliminated were known to have vessels, the figures may actually underestimate vessel associations. Burial with no vessels at small sites generally decreases through time (64.7, 42.8, 31.8, 28.6, and 27.3%).

This also is demonstrated in the average number of vessels per person (Table 5.14), which shows an increase in the total sample for adults through McElmo and a slight decrease in the Mesa Verde sample that may be primarily due to the sample size when all individuals are included. Children usually have fewer vessels than adults. Children with vessels at Pueblo Bonito have more vessels than those from the small sites. The main difference is for the Gallup greathouse adults, who average 6 vessels per person compared to 1.5 for the total or 2.4 for those with vessels at the small sites at the same time. The small sample of Red Mesa greathouse burials has even fewer vessels than contemporary small sites (1.0 for the total and 1.2 for those with vessels).

Miniature vessels, assuming all were recorded as such, peak during Red Mesa and Gallup. Apparently none were found in the greathouse samples. Effigy vessels occur only in the Gallup and McElmo samples, perhaps due to their larger sample sizes, but overall there is also a greater diversity of vessel forms at that time.

Like the number of burials with vessels, those with bowls increase steadily with a slight decrease in the Mesa Verde sample--a trend mirrored exactly in the average number of vessels per person. Again, children usually have fewer bowls than adults for all periods, and the Pueblo Bonito adults with Gallup associations have the most. Unlike the number of vessels, Gallup greathouse children have a greater average number of bowls than do small-site children (1.0-0.4, or 2.0-1.2 of those with bowls), whereas the McElmo greathouse and small-site samples are the same.

Black-on-red bowls appear only in the Gallup and McElmo samples, with more in the latter. Smudged bowls have a similar distribution but are more numerous. Black-on-red and smudged wares were largely imported from outside the San Juan Basin (H. W. Toll, personal communication 1986).

Pitcher distribution is quite similar to that for bowls, except that pitchers are less numerous. Table 5.14 shows that this form is slightly more common with adults and actually varies little in the average number per person through time. Pueblo Bonito adults and children do have more during Gallup associations, but the overall Red Mesa averages are identical to those of the small sites.

Culinary and corrugated vessels are not numerous as mortuary offerings, probably because food rather than the pots themselves was left with the burials; food was not served in culinary vessels. These tend to increase through the Gallup sample and then decline (11.8, 14.3, 19.7, 5.7, and 9.1%).

Ladles are found only in the latest three samples--most frequently in the Mesa Verde period, when they occur with over a quarter of the burials, almost as frequently as bowls.

Ornaments are more often found with greathouse burials than with those from the small sites, and there are changes in materials beyond

Table 5.14. Average number of vessels, pitchers, and bowls per burial by period

	Small Site			Greathouse		
	Child	Adult	Total	Child	Adult	Total
Number of vessels						
BM III-E. Red Mesa	0.6/1.0	0.3/1.4	0.4/1.2			
Red Mesa	2.0/2.0	1.2/3.5	1.6/2.7		1.0/1.2	0.9/1.2
Gallup	1.3/1.9	1.5/2.4	1.5/2.2	1.2/3.5	6.0/6.0	4.6/4.9
McElmo	1.4/2.1	1.7/2.3	1.7/2.2	1.2/2.0		1.2/1.4
Mesa Verde	0.5/1.0	1.6/1.6	1.0/1.4			
Number of bowls						
BM III-E. Red Mesa	0.2/1.0	0.2/1.2	0.3/1.1			
Red Mesa	0.5/1.0	0.6/1.5	0.6/1.3		0.7/1.0	0.6/1.0
Gallup	0.4/1.2	0.7/1.7	0.6/1.5	1.0/2.0	4.2/3.4	2.6/3.1
McElmo	0.8/2.0	1.0/1.8	0.9/1.8	0.8/2.0		0.8/1.7
Mesa Verde	0.2/1.0	0.6/1.0	0.4/1.0			
Number of pitchers						
BM III-E. Red Mesa	0.2/1.0	0	0.0/1.0			
Red Mesa	0	0.4/1.0	0.3/1.0		0.3/1.0	0.3/1.0
Gallup	0.3/1.0	0.4/1.1	0.3/1.1	0.5/2.0	1.3/1.3	1.2/1.5
McElmo	0.1/1.0	0.5/1.1	0.3/1.1	0.2/1.0		0.2/1.0
Mesa Verde	0	0.4/1.0	0.2/1.0			

Note: Basketmaker III-Early Red Mesa total includes Shabik'eshchee Village; the adult and child figures do not.
Table shows total sample/those with vessels only.
Blank = none in sample; 0 = 0.

those recorded in Table 5.13. Turquoise is primarily found at Pueblo Bonito, with some at the Gallup-associated small sites and a few at the McElmo small sites. The small chip found with an infant in the Mesa Verde sample may even be an incidental association. Shell is found in the same time and site groups as turquoise but actually increases from Gallup to McElmo (6.1 to 8.6%) while turquoise decreases (7.6 to 2.8%).

Pueblo Bonito

The largest of the Chaco greathouses, Pueblo Bonito covers almost a hectare and consists of 651 rooms in up to four stories (Judd 1964). The pueblo was built in several stages (Lekson 1984a, 1984b) and occupation of all rooms was not contemporaneous. Estimates of the maximum population at any one time range from a low of 100 (Windes 1984) up to 800 (Hayes 1981) and 1,100 (Judd 1964).

Although there are burials scattered throughout the site, the majority are in two clusters of rooms (Figure 5.2). One, located in the northern section, was excavated by Pepper (1909, 1920) and Moorehead (1906); the other, in the western portion, was excavated by Judd (1954). The following detailed description illustrates the magnitude of difference between Pueblo Bonito burials and those from the small sites--a difference that simply does not show in the presence-absence analysis of the previous section, especially since the majority of the burials were disturbed. Table 5.15 provides the dimensions of the eight rooms.

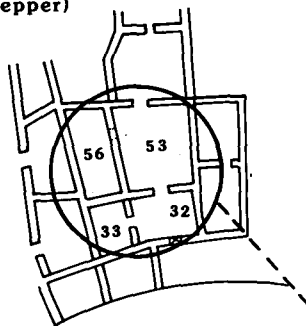
Pepper's Rooms

Four adjacent rooms in the north-central portion of the pueblo contained burials. All were small interior rooms with no outside access. Room 33, the smallest of the group, could be entered only from Room 32 to the east. The latter had doors in three walls but the southern door was partially blocked when excavated. Directly north of Room 32 is Room 53, with entries through the north and south and into Room 56 to its west. Room 56 had no other entry. At least three of the rooms had intact ceilings when excavated.

Room 32

Pepper entered Room 32 from the south to find it partially filled with drift sand originating from the east. In the northwest corner a mass of ceremonial sticks was seen protruding above the sand fill. The human remains, presumably representing a single individual, were an intact ver-

Northern burial rooms (Pepper)



Western burial rooms (Judd)

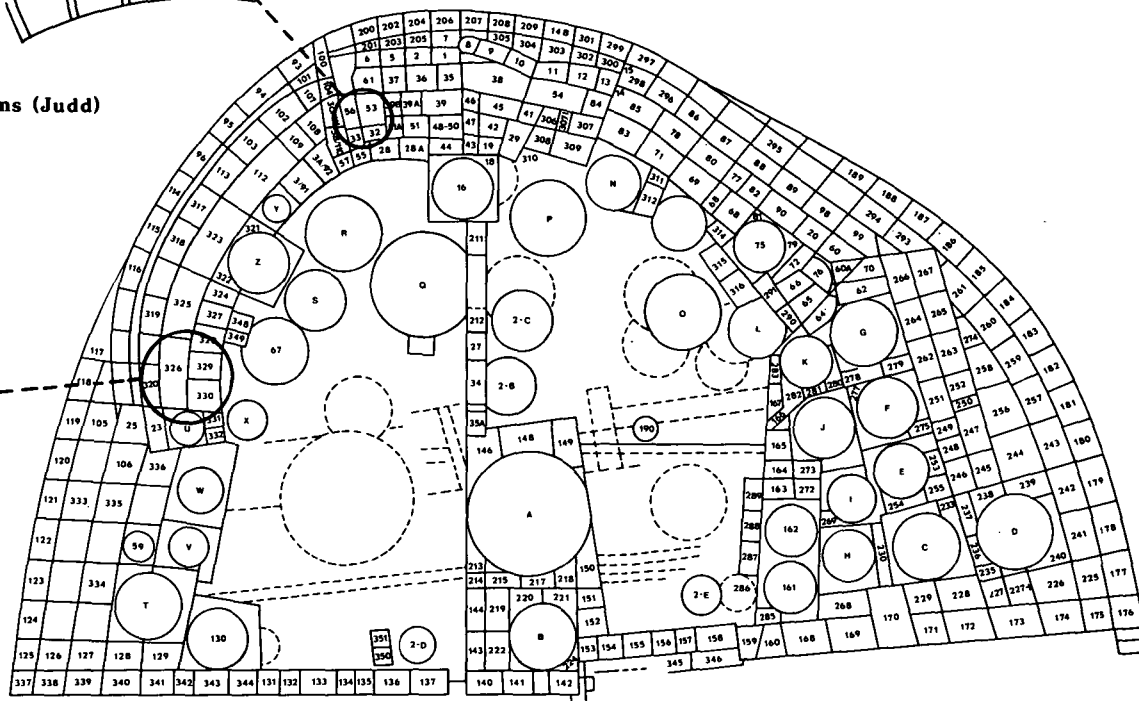
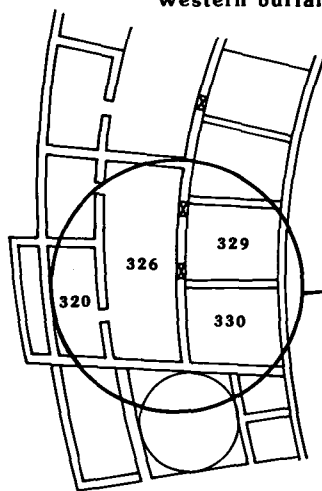


Figure 5.2. Pueblo Bonito

Table 5.15. Pueblo Bonito burial room dimensions

Room Number	North	South	East	West	Ceiling
32	8 ft. 11 in.	8 ft. 8 in.	4 ft. 7 in.	7 ft. 3 in.	5 ft. (Pepper)
33	6 ft.	6 ft. 3 in.	5 ft. 10 in.	6 ft. 10 in.	5 ft. 3 in. (P) 6 ft. (Judd)
53	11 ft. 8 in.	10 ft. 7 in.	14 ft. 2 in.	13 ft. 5 in.	7 ft. 8 in.
56	6 ft. 7 in.	5 ft. 3 in.	16 ft. 3 in.	13 ft. 10 in.	5 ft. 8 in.
320	7 ft. 9 in.	7 ft.	15 ft. 9 in.	16 ft. 5 in.	7 ft. 11 in.
326	13 ft. 4 in.	11 ft. 7 in.	28 ft.	29 ft.	9 ft. 7 in.
329	13 ft.	12 ft. 3 in.	11 ft. 9 in.	11 ft. 10 in.	6 ft. 6 in.
330	12 ft. 11 in.	12 ft. 6 in.	12 ft. 9 in.	12 ft. 6 in.	8 ft. 1 in.

Note: Data taken from Judd (1964) and Pepper (1920).

tebral column and pelvis, several ribs, a clavicle, a femur, and a scapula in the southwest corner. Mixed with or in close proximity and probably associated with these remains were fragments of wooden implements, a hematite bird with turquoise and shell inlay, finely woven cloth, a cactus stalk bound with yucca cord, two pitchers, and a jar. Other objects in the room that may or may not be associated included five pitchers, a jar, three bowls, a cylindrical jar, over 300 ceremonial sticks, a quiver of over 81 arrows, an elk antler club, at least three sandals, two baskets, galena, and gypsum. Other than the hematite bird, no ornaments were reported. The age and sex of the individual are not given and the remains could not be located at the American Museum of Natural History.

Room 33

Entry into this small room was through a doorway 56 cm (1 ft. 10 in.) wide and 68.6 cm (2 ft. 3 in.) high. It, too, was filled primarily with drift sand that did not reach the ceiling. In the fill, twelve (by skulls) to fourteen (by long bones) adults--equal numbers of males and females--were found. Fragments of an infant and a child were also noted in the general axial bone (AMNH 3658) and with skull Number 10 (AMNH 3668). The majority of these individuals were disturbed, but Numbers 1, 5, and 12 were mostly in place. Number 5 was associated with a cylindrical vessel, two bowls, a pitcher, and a jar cover. Another (Number 7) consisted of a skull with several cervical vertebrae in place and a group of four bowls and five pitchers just to the north. Otherwise, few bones were articulated, and associations, other than cloth adhering to the bones, were not possible. A great many turquoise beads and pendants were noted as resting near skull Numbers 2 and 3. Other items found in the room were associated with these individuals, since the room was not used as a trash dump. Additional ceramic vessels included eight bowls, five pitchers, and a cylindrical jar--not much for ten to twelve persons. There were, however, a large number of turquoise ornaments including 24,932 beads, 512 pendants, 451 mosaics, 15 or so effigy or carved pendants, and 1,052 fragments. Shell was less common, with 2,042 beads, 10 haliotis discs, 89 bracelet fragments, 17 pendants, two large olivella beads, an inlaid shell pendant, and a large bird form. Objects of stone and jet included a ring and 173 inlays, as well as sets or inlays of iron pyrites.

Five ceremonial sticks had been stuck in the ceiling beams and others were placed in the northwest and southeast corners. In the northeast corner, standing upright, were 10 ceremonial sticks and two flageolets (large flutes), with another flageolet along the north wall. The southeast corner held five more flageolets and 11 ceremonial sticks between the post and wall. Other ceremonial sticks were intermingled with the burials (see Pepper [1909] or [1920] for a description of the several kinds of ceremonial sticks found). In the north corner, grouped around the posts just above the floor surface, were two sandstone jar covers and a number of shell and turquoise beads.

Other materials included walnuts, pinyon nuts, seeds, gourd rind, textiles, a quartz crystal, a chipped quartz crystal knife, gypsum, limonite, azurite, mica, red inlay stone, yellow ochre, six projectile points, chalcedony, gizzard stones, a few fragments of pottery, a circular yucca mat, animal bones, and an awl fragment.

Room 33 was incredibly small to house so many burials. The maximum wall length was only 2.08 m (6 ft. 10 in., a foot longer than the shortest). The burial layer, judging from Pepper's report and assuming that he took measurements from relatively flat portions of the ceilings, was between 1.12 m (3 ft. 8 in.) and 1.57 m (5 ft. 2 in.) below the ceiling, or less than 0.46 m (1 ft. 6 in.) deep. As noted, at least three skeletons were mostly intact, another had several vertebrae still articulated with the skull, and an articulated foot and leg were found along the west wall. Only one skull was crushed. The crania were spread fairly evenly around the room. Pepper's explanation of the disturbance was that it resulted from water pouring through the east doorway. This seems unlikely since water would probably tend to concentrate objects along the walls. Also unusual is the fact that the mostly intact skeletons were neither the highest or the lowest--a pattern not likely to result from one grave intruding on another. Pepper was probably working in this very small dark room with lamps, torches, and candles, and in such a concentrated deposit many associations were undoubtedly lost.

The ceramic assemblage includes Red Mesa, Puerco, Gallup, Chaco, and McElmo black-on-white types, suggesting that the burials covered a span of time possibly as short as 50 years or as long as 275 years. Some disturbance in so small a room might be expected on those grounds alone, especially when combined with natural forces, dogs, and perhaps children playing in dark and forbidden places. Another possibility is that the burials had been moved from other areas. Various stages of decomposition and an attempt to gather up all parts and the burial goods would add to the scramble. The ceremonial sticks, flageolets, and cache of beads around the post all suggest that the room had been set aside for the burials.

Once the bones and debris were removed from the room, Pepper found a floor constructed of boards laid east-west. In the eastern end of one board was a hole 10 cm in diameter. Beneath the floor were the burials of two adult males with an incredible amount of ornamentation. This portion of the room had definitely been set aside for the interments. The original floor had been covered by a layer of yellow sand and then one of wood ashes. Pepper (1909:249) thought the two bodies were placed there at the same time, although Number 13 was extended and oriented northeast-southwest and Number 14 extended north-south with his feet resting against the southern wall. Plotting the positions, the two must have crossed, and presumably Number 13 overlay Number 14 since the former's skull was at 1.68 m (5 ft. 6 in.) below the ceiling and the other at 2.36 m (7 ft. 9 in.). Pepper also noted that Number 14 had two holes and a gash in the frontal bone; these indeed appear to be green bone fractures. Number 14 also has what appear to be chops along the left parietal and temporal

junction, a gash in the right parietal, and cuts or chops on the left femur, suggesting that he died in a confrontation of some sort.

Other indications that the room had been set aside for a special purpose were the offerings in all four corners of the room. Around the northeastern post were 983 turquoise beads and pendants, 26 pieces of turquoise (some worked), 27 turquoise sets, six stone and jet sets, a shell bead, and two fragmentary reed arrows with wooden foreshafts. The northwestern corner held 51 beads, five pendants, and five worked pieces of turquoise, a piece of malachite, a disc of haliotis shell, and a fragment of a reed arrow shaft. In the southeastern corner were 589 beads, 57 pendants, seven sets, and 65 pieces of matrix and worked turquoise, a jet inlay, and a pendant of haliotis shell. The southwest corner offering consisted of 42 pieces of malachite, shell bracelet fragments, and a bracelet made of bone. The only ceramic vessels present were a Red Mesa Black-on-white bowl and a smudged bowl resting against the north wall.

Number 13 had scattered around the lower part of his legs 2,997 turquoise beads, with another 698 around the right ankle. The upper right arm was surrounded by 1,628 beads, a large pendant, and a small set, all of turquoise. Around him were an additional 567 beads, three sets, and nine pendants of turquoise.

Number 14 had even more ornamentation and offerings. An ornament composed of 1,980 turquoise beads lay on his chest. A deposit of 2,642 small beads, 168 small pendants, three sets, two pendants in a rabbit shape, one as a shoe, and another that was apparently unfinished, all of turquoise, plus five jet inlays, lay on his abdomen. Around his right wrist were 617 beads, 147 small pendants, and four sets of turquoise, a shell bead, and two small stone beads. The left wrist was surrounded by 2,384 disc beads, four cylindrical beads, 194 pendants--five shaped as birds, a foot, a bifurcated form, and an irregular form--of turquoise, and five irregularly shaped shell pendants. Around the right ankle were 322 disc beads, two cylindrical beads, and five pendants of turquoise. The left ankle was surrounded by 434 beads and eight pendants of turquoise, eight small stone and shell beads, and a cylindrical shell bead. At his right knee was a shell trumpet with four complete haliotis shells, along with 26 complete and 15 fragments of shell bracelets. Under one haliotis shell were the remains of a 8- by 15-cm cylindrical basket that had been covered with 1,214 pieces of turquoise mosaic. Filling this basket were 2,150 beads, 152 small and 22 large pendants of turquoise, 3,317 shell beads and small pendants, 78 cylindrical shell beads (8 that appear to have held inlays), 68 large pendants (19 with holes for inlay), and an animal-form stone pendant with areas for inlay.

Another cache near Number 14 consisted of the remains of a turquoise and shell mosaic on basketwork composed of rows of turquoise beads alternating with double rows of thin overlapping pieces of shell. Other objects associated with this burial were a long inlay of red stone, fragments of shell ornaments, pieces of turquoise matrix, small turquoise sets, and one valve of a bivalve shell.

Room 53

This somewhat larger room was one of the two investigated by Moorehead's group, who had torn down the north and east walls to gain entry. Fortunately, they did not completely excavate the room, and Pepper removed a number of objects including two pitchers, a small bowl, and a cylindrical jar portion along the east wall and a child's skull with a deposit of over 4,000 turquoise beads and 30 shell pendants nearby. A skeleton missing only the cranium was found at the south end of the room, and in the southwest corner were pieces of feather blankets and portions of two cradle boards. The general debris contained fragments of ceremonial and game sticks and a wooden slab. Pepper thought some of the debris was from Room 56 but did not distinguish it from his in situ deposits.

At the American Museum of Natural History are a number of human bones attributed to this room, including the mandibles of two males and a female, the child's skull mentioned above, and two mixed groups of bones that represent a newborn infant, at least one and possibly two adolescents, a male, a female, and another adult. It is not clear from the report or provenience with the burials whether these were scattered in the fill left by Moorehead or the fill removed by Pepper.

Room 56

Apparently this is the room in which Moorehead found what he described as "a splendidly preserved skeleton of a young woman wrapped in a large feather robe" (1906:34) under the floor. This is probably the complete skeleton (N3075) transferred to the Peabody Museum from Phillips-Andover, where much of Moorehead's collection resides; the accompanying information states that it is from under one of the floors at Pueblo Bonito. In any case, it is a male of 40 to 44 years. At least four well preserved skulls from Pueblo Bonito are now at the Field Museum of Natural History in Chicago (donated by Moorehead) and were probably taken from this room or Room 53.

Pepper's comments on this room note two subfloor graves as well as bones scattered throughout the dirt piled in the northeastern part of the room and the northwestern corner "so it was impossible to determine how many bodies had been buried there" (1909:216). The two graves were separated by the wall of the former room extending east-west from below the level of the graves up to the level of the floor. No observations other than size could be made on the northern grave. The southern was smaller and had a bottom formed of sticks and sides formed of boards. It was covered by boards or possibly matting; fragments of both were found in Room 53.

It is unfortunate that Moorehead plundered these two rooms. There are indications that a fair number of persons were buried in them. It is unlikely that they contained the amount of ornamentation found in Room 33, as none is mentioned by Moorehead in his report, little is listed in the Phillips-Andover catalog, and Moorehead stated that no remarkable discoveries were made.

Judd's Rooms

Working with Judd's (1954) report on the Pueblo Bonito burials is a frustrating experience. Although he tended to look down on Pepper for publishing just his field notes, Pepper's report is far more complete. Much of the information is missed if only Judd's section on the burials (1954:325-341) is considered. Some objects and individual burials are well described, but it is only when the provenience of the illustrated objects and the section on dress and adornment are reviewed that it becomes clear that much is left out of the description. It was necessary to use the U.S. National Museum catalog to compile a list of the contents of the rooms, and even then much of the information is not quantified.

Judd's burial cluster consisted of four adjacent interior rooms with no outside access. Preservation was not as good in these larger rooms, partially because the roofs had collapsed and the rooms had been used for dumping--a factor that also leads to some confusion over what was associated with the burials.

Room 320

This back-most of the burial rooms opened only into Room 326 to its east. It was a small storage room with a flagstone floor. The room may have been set aside for burials, as a four-strand turquoise necklace was found coiled with two pairs of pendants between two stones and covered with plaster. In this room were ten burials, eight women and two girls, according to Judd (1954) and Hrdlička (n.d.). In a recent reexamination of the bones recovered from Room 320, Palkovich (1984) found twenty-one individuals represented: one less than a year old; two 5-9 years old; two 10-14 year olds; a male, a female, and two for which the sex is unknown between 15 and 19 years; three females aged 25-29; two from 30-34; two 35-39; one 40-44; two 45-49; and two over 50. The fairly great discrepancy between the numbers undoubtedly results from an element-by-element examination to discern individuals. Those represented by few parts would not have been noted by Hrdlička, who based his counts on skulls.

Burial 2 was largely intact, missing only the skull, and apparently was associated with two ring baskets. This older woman may have been moved from her original position while mostly intact or placed over parts

of at least two other individuals. Two undisturbed adult females lay side by side on a rush mat spread on the floor at the south end of the room. They were extended, on their back with heads east. Traces of feather cloth, cotton, and yucca cordage were found. An offering a short distance away consisted of a Red Mesa pitcher, half a bowl, and two baskets.

In the northwest corner on the floor were six crania, a mandible, some vertebrae, and an articulated portion of a vertebral column and ribs, along with a number of ceramic vessels and baskets. Judd noted that the ten bodies had been lightly covered with soil that included some sherds and pieces of adobe mortar. The layer containing the bones averaged little more than 30 cm deep. Wind-blown sand covered and leveled the deposit before the ceiling collapsed and the room came to be used as a dump.

Judd does not mention, and the catalog does not distinguish, the large amount of material that may also be associated with the burials. In addition to the materials assigned above to given burials there were seven bowls, 14 pitchers, six Chaco Black-on-white cylindrical vessels, a ladle, a pipe, six elongated rectangular beads, seven pendants and 126 disc beads of turquoise, a "handful" of shell and stone beads (including figure-8-shaped shell beads) and pendants, galena, malachite, azurite, sulphur, bone awls, a bone scraper, projectile points, six cylindrical baskets, a coiled basket cup, a bifurcated basket with a painted design, a sandal and sandal fragments, other basketry and matting fragments, two willow mats, two sets of four loom sticks, at least four ceremonial sticks, a digging stick fragment, and a bow. If all the vessels and ornaments were associated with the disturbed burials, each person would average two to four vessels and most would have a turquoise bead or pendant and maybe a basket.

Room 326

Room 326 lies directly in front of Room 320 and is the largest of the rooms to be used for burials. It was originally a habitation room that Judd thought became a burial chamber after a woman of 30 to 40 years died in her sleep on a mat. The body was covered with dried mud mortar and left with no offerings.

Ten or eleven female adults, plus one infant, were evidently buried here. Judd (1954) and Hrdlička (n.d.) also indicated that a male was represented by a jumble of leg bones at the south end of the room. The current catalog now identifies these as a female. Palkovich (1984) found parts of four males, ten females, two children (1-5 years), and two adolescents (10-15 years) in this room. One male was aged 25-29, one 30-34, and two 35-39. The females were represented by almost every age group: one 20-24, one 25-29, one 30-34, two 35-39, one 40-44, one 45-49, and three over 50. Judd noted that only three of these were disturbed and suggested that they either had been moved only a short distance while

fairly intact or possibly were disturbed by later burials. However, the current catalog identifies two of these (Lots 1 and 2, as he called them) as parts of three skeletons inseparably mixed. Judd did not mention his adult male--mostly leg bones in front of the south door on the west side. It would appear that there were at least four and maybe as many as eleven disturbed or partial burials.

The intact burials were primarily in the southern portion of the room, where five extended burials lay almost side by side. The fill brought in to cover the woman who died in her sleep was leveled to 15 to 20 cm, and a mat was laid out for Burial 12, who Judd thought was the second interred. With her were 14 vessels (11 bowls, two pitchers, and an olla), an oval basket tray and humerus scraper, a turquoise pendant, and a three-coil turquoise bracelet. She, too, was covered with construction debris and overlain by a burial mat that probably held the remains of the other partially disarticulated female found along the south wall. An infant with parts of a cylindrical and a bifurcated basket just above it lay flexed north of the southeast post.

Two others were another dual burial, with a joint offering of three bowls, two humerus scrapers (one with turquoise and jet inlay), oval tray sets, and a cylindrical basket. With one of these women was three additional bowls, a pitcher, and two pendants of jet and turquoise. Two digging sticks and a sandstone slab lay between her feet. The other had a bowl, two pitchers, and a turquoise pendant.

After these interments, the room was filled with two layers of trash 20 cm deep and then filled naturally for 35 to 50 cm before a second set of burials was made. Judd thought that the next five burials occurred all at once or in fairly rapid succession. Three were undisturbed and lay parallel to each other on mats--each with offerings of pottery vessels and other utensils just beyond their heads. Three bowls and a pitcher were noted for one and four bowls and two pitchers for another. Lots 1 and 2 (the three mixed skeletons) were described as dragged from their burial mats while still held together by flesh and ligaments. Little or no fill covered these last individuals before the ceiling collapsed and the room again became a dump.

Judd simply noted that there were other vessels not associated with a given body and that still others were restored from the household rubbish. In all, 62 bowls, 15 pitchers, and two ollas were recovered from this room. At least 25 bowls and 8 pitchers were associated with the intact and described burials, leaving up to 34 bowls and seven pitchers among the disturbed and two undescribed burials. Even if some bowls were part of the debris, a substantial number of offerings are left.

Other materials in the room that are more likely to be offerings than rubbish are six turquoise pendants, small turquoise pendants and fragments, worked turquoise fragments, stone beads, a hematite bead, a quartz crystal, a fluorite crystal pendant, a cylinder of green stone, hematite fragments, tubular bone beads, a discoidal bone button, eight projectile

points, two cylindrical and two bifurcate baskets, wooden staves and ends, and fragments of cotton cloth and basketry.

It would appear that the individuals in this room were all accompanied by burial mats, at least three or four vessels, and a turquoise pendant.

Room 329

When investigated, Room 329's only doorway, located in the southwest corner, led into Room 326. It was plugged and Judd surmised that the room must have been entered through a ceiling hatchway. The presence of a central fireplace and low ventilator in the east wall suggested to him that the room was a council or secret society chamber that was abandoned after Room 326 became used for burials.

Room 329 differed from the preceding two rooms in that a relatively large number of children were also interred. Judd counted seventeen females, one male, and six children; all the adults were disturbed. Hrdlicka's (n.d.) tally was one infant, ten children, a juvenile, a male, and eleven females. Palkovich (1984) found five in the 1- to 4-year age range, five 5-9 nine years, two 10-14, two males 20-24 and 35-39, and ten females, three 20-24, three 25-29, two 40-44, one each 45-49, and one over 50 years.

Two of the children lay directly on the floor. Over them and throughout the room was 35 cm of household debris and blown sand. In and on this fill were the rest of the remains, with bones scattered everywhere. The offerings with the undisturbed children included a mat, three pitchers, and a bowl with an 8-year old; a willow screen, two pitchers, and a bowl with a 12-year old; two pitchers, a small bowl, and a duck pot with a child under 6; three bowls and two shell pendants with another child under 6. There were no offerings with another child under 6 and an infant. The only turquoise pendant from the room was noted as being with a child--but not which child. The intact burials tended to be placed on or near the floor and at the edges and corners of the room. It is unlikely that their placement caused the amount of disturbance found in the rest of the burial layer.

Judd stated that the burial level contained four fragments of shell bracelets, a few olivella beads, a jet bead, and a handful of shell and stone disc beads; a turquoise duck effigy was also found in the room. In all, 25 bowls, 10 pitchers, and six cylindrical vessels were found. The undisturbed burials account for six of the bowls and eight pitchers--leaving 19 bowls, two pitchers, and the cylindrical vases.

The catalog cards and artifact descriptions in other portions of the Judd text identified 17 unassociated bowls, eight pitchers, a Gallup effigy pitcher, another effigy in a bifurcate basket form, a reddish brown

pitcher, the six cylindrical vessels, turquoise beads, undrilled turquoise beads, turquoise mosaics and fragments, azurite and malachite pellets, shell pendants, two kinds of figure-8 shell beads that probably represent a necklace, cotton cloth fragments, 10 awls, and copper bell fragments.

It appears that the individuals from Room 329 were accompanied by fewer vessels than those in Rooms 320 and 326 and may not have had as much in ornamentation, although this is difficult to confirm without counts of the beads and pendants.

Room 330

The fourth room in Judd's cluster is this square room located just south of Room 329 and east of Room 326. It, too, had a central firepit, and the only entry was through a ceiling hatchway. Disturbed burials predominated. Judd's counts suggest thirteen males, four females, and six children; Hrdlička's, thirteen males--three of which were adolescents, four females, at least four children, and two that are unidentified. Again, Palkovich's (1984) counts were higher, indicating one less than 4 years old, four 5-9, two 10-14, and 16 males: one 15-19, three 20-24, four 25-29, three 30-34, three 35-39, one 40-44, and one 45-49. The nine females were four 20-24, two 25-29, two 30-34, and one over 50.

The undisturbed burials from Room 330, apparently some of the earliest placed in the room, were three males and a child less than 6 years old. One of the males (Burial 22), described by Judd as an arthritic, is not detailed except for a note of a pair of haliotis discs by his side; nor is another male (Burial 23), a subfloor burial, described. Fortunately a photograph was included. The third male, a "warrior in his prime," lay in the center of the room with his heels together and knees spread. Between the knees were 28 projectile points arranged in a triangle, and under his right hip was a bundle of reed-shafted arrows. A Red Mesa bowl rested beside the arrangement of projectile points. The child was found in a small bin formed by adobe walls, possibly constructed for the burial. No mention was made of burial goods.

The remainder were described as "callously pulled and kicked about" (Judd 1954:333). The photographs indicate that the disturbance had occurred not long after interment; many elements were still articulated and, in fact, Judd was able to list a number of associations including pendants and earrings with a child, a lignite disc with an adult male, four jet rings with another male, eight projectile points with a third male, a bullrush mat with an adolescent male, a fiber mat with yet another male, a shell necklace and two zoomorphic pendants with a 25- to 28-year old male, and fragments of shell pendants with an 8- to 10-year old child.

Catalog cards and other text also identify 16 bowls, 14-16 pitchers, a duck pot, a canteen, six cylindrical vessels, a double-stirrup canteen,

a ladle, a turquoise-on-shell mosaic, "a few" turquoise beads, mosaics, undrilled beads, and fragments, a jet effigy with turquoise inlay, 3.45 m (11 ft. 4 in.) of stone beads "at the head of a skeleton," stone beads, seven or so shell pendants, figure 8-shell beads, shell mosaic fragments, a shell and shell-bead necklace measuring 6.91 m (22 ft. 8 in.), unfinished red shale pendants, galena fragments, a garnet, kaolin, yellow and red pigment, azurite pellets, fragments of cotton and willow mats, a cylindrical basket with a painted design, basket fragments, and three bone awls. The number of vessels averages as many as two for each burial. Enough ornaments were found to have furnished most individuals with some form of ornamentation.

Pueblo Bonito Discussion

Judd was convinced that nearly all of the disturbance in the burial rooms resulted from vandalism. "Lack of turquoise ornaments and, indeed, the paucity of ornaments of any kind, suggest a motivating reason for the vandalism" (1954:335). By his counts 67.7% of the burials were disturbed. He thought that all the graves had been made within a relatively short period late in the history of Pueblo Bonito. He also believed that, since both sets of burial rooms were in the older portion of the site, the newer population that built much of the pueblo had already left and the

defensive power of the remainder would have been proportionately weakened. Under such circumstances, a relatively small band of raiders, striking with speed and ruthlessness, could so paralyze the broken community that its stores of maize, its womenfolk, and even the jewels on its shallowly buried dead might be seized at little risk [1954:340].

This particular scenario is no better than Pepper's swirling water for a number of reasons. Disturbed burials are not at all uncommon in Chaco Canyon. At least one quarter (and a reasonable number of the rest are unknown) of those listed in Appendix B (not including Pueblo Bonito) were disturbed to some extent. On the floor of Room 5 at Bc 51 was the remainder of three adults indiscriminately scattered. Portions of the bodies, a right foot, a left leg, six vertebrae, and a skull with mandible, were still articulated. The room contained pieces of textiles, matting, feather cloth, five bowls, a ladle, a bird vessel, bone beads, two coiled baskets, a bone scraper, two wooden planks, and two pieces of malachite (Archive 1709). Room 10 at Bc 53 represents a similar situation, with two females and two infants scattered over the floor. With them were a pitcher, beads, a stone knife, worked wood, and a polishing stone (Archive 2103). The notes on this room are poor, but a sketch appears to indicate at least some articulated vertebrae. At 29SJ 299 four adults were found scattered in the fill of a kiva 50 cm above the floor. Parts of the vertebral columns and some long bones were still articulated. There were no grave goods.

Other rooms at these same Bc sites contained disturbed and undisturbed burials, yet no one has suggested that these were plundered for their ornaments. There are a number of factors that lead to disturbance. Children, dogs, and rodents, as well as normal daily activities, can lead to considerable mixture. Judd himself admitted that household rubbish was found with some of the scattered remains. In order to gain entry into Room 320 to disturb all but two of the individuals, plunderers would have had to pass through Room 326--the room with the least disturbance, not to mention a collapsed ceiling. Judd may have been disappointed at not finding the same amount of material as Pepper, leading to the logic that it had been stolen. Yet even Pepper's disturbed burials had a large number of ornaments, much more than Judd's undisturbed burials.

Judd's report gives the impression that the undisturbed burials were usually laid out on a surface and then covered with soil or debris, rather than being actual interments. Disturbance that can be attributed to intrusion of one grave into another appears to have been minimal and was suggested by Judd only once as a possible cause.

Without detailed notes and drawings it is difficult to account for all that went on. However, especially Pepper's rooms and some of Judd's may hold secondary burials. Perhaps at some point it became advisable to bring some of the dead who had been interred elsewhere into central facilities. The quick inventory I made of the individuals from Room 33 at the American Museum of Natural History suggests that not all parts of every individual were present, and in fact an infant and possibly a separate child were represented by only skull fragments and a femur. Similarly, the discrepancy between Hrdlička's counts (based only on skulls) and Palkovich's (based on all elements) suggests that, while some burials were in place, others may have been moved in various states of decomposition. Grave robbers might have done more damage to the skeletons themselves, yet there is little breakage. Secondary burial combined with a variety of phenomena such as rodent and carnivore activity, trash deposition, and the effects of rain is at least as plausible as previous explanations.

Patterns in the Mortuary Data

Given that the mortuary practices of a group are not independent of the social organization, the Chaco burials can be examined as one means of studying social complexity. Starting with the small-site spectrum, there is little to suggest differentiation of any kind. The few variables that do have statistically significant distributions are almost all between children and adults and are related to position or orientation. Much of this may be simple practicality: adults may be more likely to be flexed because they then require a smaller pit; or, as at Long House, Mesa Verde, orientation may be parallel to the contour of the slope (rather than directional by compass) to diminish washing out (Cattanch 1980:146). Yet Ellis (1968) notes that with the historic Tewa the orientation was to the east because the spirit must begin its journey in the east. Most likely

position and orientation are a combination of practical and ritual matters. Lumping a number of sites by period probably does obscure some of the variation.

The fact that adults tended to have vessels more often and to have slightly more vessels may suggest that some system of age grading also operated in the past. Unfortunately, the kinds of differences most likely to be found in the small-site spectrum are those (such as moieties or sodalities) that are often distinguished by preinterment rituals, body preparation, or inclusion of mainly organic grave goods (Chapman and Randsborg 1981).

Some individuals did have more grave goods than others, but none are suggestive of more than achieved status. In general the burial goods (vessels and ornaments) correspond to their availability within the system at that time. Thus, if only the small-site spectrum is considered, Chaco would appear to represent a simple egalitarian system. However, there are also the Pueblo Bonito burials, and unless we are willing to propose that Pueblo Bonito did not operate within the same socioeconomic system as the small sites, these two disparate samples must be reconciled.

The majority of the significant differences in the Chaco sample (Appendix C) were based on a dichotomy between greathouse and small site. It is, therefore, reasonable to infer some sort of differentiation between the two site types. Interment at greathouses was more standardized and contained more goods of all kinds. Evaluation of the kind and type of grave goods (i.e., nonvalued versus those implying high energy expenditure) entails a digression back to the kinds of materials found in burials.

A wide range of objects were found in Chaco graves (e.g., projectile points, awls, baskets, and ground stone), but most occur infrequently and tend to be more consistent with achieved status or personal possession functions. The two most common classes of burial goods at Chaco are ceramic and ornamental.

Ceramics are the single most frequent offerings found in Chaco burial contexts. The type appears to reflect mainly time (Red Mesa, Gallup, McElmo, etc.), but many of the vessels are unavailable or located in museums too distant for examination, and the archival and photographic identifications may have masked differences in quality. There are forms that are exclusive, such as the cylindrical vessels--only one possible sherd from this type of vessel has been found at a small site and for that matter only one such sherd was found at Pueblo Alto (another greathouse site). Most of the cylindrical vessels are from Pueblo Bonito, where Room 28 (adjacent to the northern burial rooms) contained 111 of them. A few were also found with both clusters of burials.

While one-to-one comparison of burial vessels and rim sherd percentages from excavated assemblages may not be exact, it is the only comparison possible (Tables 5.16 and 5.17). The net effect is to underrepresent those forms with small orifices--ladles, jars, pitchers, and ollas--and to

Table 5.16. Rim sherd vessel forms from burials^a

Form	Site and ceramic group				
	29SJ 629 RM	29SJ 1360 RM-Gal	29SJ 627 RM-McE	P. Alto RM-McE	29SJ 633 MV
Bowl	66.1	59.9	61.0	49.2	58.6
Jar/pitcher	8.0	7.2	7.1	6.1	3.2
Ladle	3.7	4.5	4.9	4.6	6.0
Olla	1.9	3.2	2.7	3.3	.8
Culinary	17.6	21.9	20.5	35.1	28.5
Other	2.7	3.3	3.8	1.7	1.7
n	1110	1434	5464	4006	249

^aAdapted from Toll (1984:Table 4)

Table 5.17. Whole vessel forms from burials

Form	Ceramic group and site type							
	BMIII-ERM small	Red Mesa		Gallup		McElmo		Mesa Verde small
		small	Bonito	small	Bonito	small	Kin Kletso	
Bowl	69.2	36.4	66.6	40.8	63.2	61.1	71.4	36.4
Jar/pitcher	7.7	18.2	33.3	23.5	28.6	22.2	14.2	18.2
Ladle				12.2		5.5		27.3
Olla					2.0			
Culinary	23.1	9.1		13.3		3.7	14.2	9.1
Other		36.3		10.2	6.2	7.5		9.1
n	13	11	6	98	49	54	7	11

overrepresent bowls and culinary jars. Even taking this factor into consideration, jar/pitcher is the vessel type found in mortuary contexts in a greater proportion with respect to its availability. The two forms most underrepresented as burial goods are culinary jars and ollas (large storage jars). While rim counts for culinary wares from five Chaco sites range from 17.6 to 35.1% of the assemblage, those in burial contexts account for 13.3% in the only sample large enough to be considered representative. Only two ollas have been found with burials, both from one of the western rooms at Pueblo Bonito. This may indicate that larger items used by a family or group are less likely to occur in mortuary contexts. Bowls, pitchers, and ladles could represent personal possessions or objects contributed to the interment.

Ceramic consumption rates or estimates of how many vessels were discarded or broken per family on an annual basis suggest as many as 28.4 per family at the small sites and from 1.2 to 125.5 per family at Pueblo Alto (Toll 1984). Give these rates, the inclusion of one or even a few vessels in a burial would not be a hardship or great loss to the group or even to a family; this places ceramics in the realm of nonvalued offerings.

The other common form of offering that occurs in burial contexts is ornamentation. While ornaments are found at both greathouses and small sites, their presence and quantity is greater at the former, especially the long-distance transport items such as those of turquoise and shell. An important distinction is seen in how these materials enter the archaeological record at the two site types. In the small sites it is predominantly through loss and on rare occasion with a burial. This is not to say that these ornaments were unavailable to the small-site population, but that such objects appear to have been passed on rather than retired from the system by inclusion in mortuary ritual. At 29SJ 1360, a woman who was accidentally buried wore a necklace of almost 4,000 shale beads (McKenna 1984), far more than any intentionally interred individual at a small site. The only small-site burial with a somewhat comparable accumulation was an adult (probably a female) from Bc 59 who had a necklace of 103 jet and 52 shell beads. The few turquoise ornaments found were generally with females; again, this may suggest hereditary passage.

At the greathouses, ceremonial depositions (sealed in niches or boxes in kivas) and burial contexts are the more frequent sources of ornaments. Large showy items not found at the small sites, such as shell trumpets, turquoise mosaic-encrusted baskets, inlaid pendants, and shell discs, occur at Pueblo Bonito with burials and occasionally in ceremonial deposits. Some of these items may have served as symbols of office rather than as prestige goods, and large numbers of ornaments left the system through inclusion with these burials. Increased access to such materials through higher status as well as ascribed status are implied.

Nonlocal minerals and fossils seem to follow the same pattern as ornaments. At large sites they are included as offerings in burials and in ceremonial deposits; they are most commonly losses at the small sites.

Perishable items are found at the small sites and at Pueblo Bonito, but their distribution is more strongly affected by preservation in the shallow small sites. Ceremonial sticks have not been found in the small sites, but they appear in both of the Pueblo Bonito clusters. Their numbers are far greater in the northern rooms and there are more forms, as well as wooden flageolets, which were not found in the western burial rooms. Contexts other than burials have produced ceremonial sticks, but these are generally caches or ceremonial settings.

Social Complexity and Chaco Canyon

Archeological Evidence of Complexity: Theory

Wealth by itself is not an index of complexity. Brown (1981) emphasizes the need to distinguish between ranking, authority, and power; the degree of ranking is a measure of the size and complexity of the system. The distinction between rank without centralized power, as in a "big man" system, and centralization of authority and power is crucial to the evaluation of ritual. A number of studies have offered criteria for distinguishing rank (Brown 1981; O'Shea 1984; Peebles and Kus 1977) and are in general agreement as to the most important factors. One of the more recent studies (Creamer and Haas 1985) is used here to evaluate Chaco in general. Creamer and Haas examined ethnographic and archeological materials to aid in distinguishing decentralized nonhierarchical societies (which they call tribes) and centralized hierarchical ones (referred to as chiefdoms). Their findings concerning the operation of each of these societies and what we would expect to find in the archeological record are most relevant to the Chaco analysis.

In tribal societies, production is by the household, kin group, or community and is at the subsistence level. Limited surplus tends to be invested in the security of that group rather than in specialized labor projects unrelated to subsistence endeavors. Surplus can be used for exchange to establish relationships with other economically independent groups; however, this is limited to status goods and nonbasic resources. Surplus can also be used to establish and maintain "big man" systems. Here ranking allows some kin units to have higher status, and the same is true for individuals with the requisite skills. The important factor is that the system is decentralized; the higher-status persons do not make decisions for the group as a whole (Creamer and Haas 1985:739).

Where there is a centralized hierarchy, the communities involved are economically interdependent. There are clearly defined hierarchies that are "manifest and indeed maintained by the restricted and conspicuous use of sumptuary goods by chiefs and their kin" (1985:740). The chiefs serve mostly as information processors or managers of internal interaction. While the authority extends to the realms of religion, warfare, communal labor projects, mutual exchange, and external trade--subsistence produc-

tion remains with the populace, who have equal access to basic resources. Surplus goes to the chief for redistribution, to maintain the bureaucracy and to support a small number of craft specialists (1985:740).

These differences in social structure might be visible in the archaeological record in several ways. A chiefdom would have at least two site types, including a structurally distinct central place; the latter would show some differences in size and quality of the residential architecture, reflecting status distinctions. Communal labor projects would be regional, but they would be limited to off-season work (in general). Tribal communal labor projects would be limited to the community or multicommunity level. Only the chiefdoms would have centralized food-storage facilities and specialization beyond that of religious specialist. Craft-production sites would be associated with the central place and storage; in tribal groups, these would be limited and community-centered. Evidence of status differentiation in burial groups would be limited in tribes and rank-ordered with clear status levels in chiefdoms. The distribution of status goods would be infrequent in tribes. In chiefdoms, caches or large grave collections of valuables removed from circulation would be seen. Evidence of interregional trade would be restricted to those of highest status in a chiefdom; it would be dispersed in a tribal organization (1985:742-743).

General Evidence from Chaco

There are at least two site types in Chaco Canyon. Very basically, these are the greathouses and the small sites. In addition, Pueblo Bonito--possibly in conjunction with the other greathouses that form the core of the canyon (Pueblo del Arroyo, Chetro Ketl, and Pueblo Alto)--probably functioned as a central place (Lekson 1984a; Schelberg 1984). The greathouses represent more than large houses. Most include not only residences but also public ceremonial architecture such as great kivas and formal plaza areas, storage facilities, and boundary walls, and they are connected by a system of roads (Lekson 1984a, 1984b).

The roads are an engineered and constructed system. Each is generally 9-10 m wide, relatively straight--avoiding only major topographical features--and fairly uniform in overall characteristics throughout the San Juan Basin (Nials 1983). Maintenance of several hundred kilometers of road system could be considered a communal labor project at a regional level. Transport of roofing materials for the canyon greathouses from 70 km or so might also transcend the labor capacity of a multicommunity group.

The greathouse structures include large numbers of interior, featureless rooms that are thought to be storage rooms. The potential storage space far exceeds the needs of each of these sites (Lekson 1984a). What, if anything, was stored in these facilities remains unknown, but surplus to support the greathouse residents is one possibility.

Craft specialization was at best a part-time activity that does not appear to have been restricted to the greathouse sites or central place (Mathien 1984). Scraps from ornament manufacture have been found in both site types; however, we do not have the quantitative information from Pueblo Bonito to consider this question further. Other kinds of crafts, such as basketwork, may have left few or no remains. Evidence of inter-regional trade again suggests that residents of both site types had access to some of these materials, but quantitative information is missing.

Status goods, in this case ornaments, do have a differential distribution between the two site types. While not restricted, status items are more abundant and their contexts at the greathouses tend to be as caches, offerings, or included with burials.

Most of the archeological criteria for a centralized hierarchy at Chaco Canyon can be fulfilled to some extent. The nonhierarchical and decentralized hierarchical systems probably represent a continuum. Given the local conditions, the Chacoans probably did achieve as much complexity as was possible.

Mortuary Evidence from Chaco

Brown (1981) notes several important archeological expectations for societies in which some hierarchy exists. Children should have elaborate treatment in inverse proportion to their likelihood of replacement in the following generation; that is, only when the birth rate is low or the family circle small should the treatment be elaborate. With increased authority there should also be increases in the wealth and effort expended on burials. As power increases, the powerful become attached to locations indicative of their power base. The archeological aspects to consider include energy expenditure, the presence of symbols of authority, and demographic structure. Differences in wealth displayed in graves must transcend the distinctions that mark grades of achieved status, and artifacts indicative of authority should cut across age and sex distinctions. Unfortunately, some of these artifacts may not be preserved or may be of a form we would not recognize. Ruling elites should make up a small proportion of a group and should include members of all ages and both sexes (Brown 1981).

The northern burial cluster from the Pueblo Bonito burials represents a distinct grade in wealth that surpasses any found in the small-site spectrum. The effort expended, especially for the two Room 33 subfloor burials, also exceeds that for the small sites. Although achieved wealth and shows of prestige are still a possibility, there is a considerable difference in the quality and quantity of artifacts, and there are unique forms. The subfloor burials were both adult males--the usual situation for persons of authority. They resided in the largest of the greathouses, which was also the storehouse of materials that could represent accumulated ritual knowledge or authority for the group. Caches of ceremonial

sticks, flageolets, scarlet macaw skeletons, and cylindrical vessels with and near the burials suggest something beyond mere wealth. The ceremonial sticks and conceivably some ornament or ornament combinations could have served as symbols of authority. No single item can definitely be said to perform that function.

The demographic aspects of the northern rooms are difficult to address. Fragments of infant bone were found mixed in with the adults. It is quite likely that others were discarded as animal bones by the excavators.

Although not conclusive, the Chaco burials tend to support a conclusion of hereditary ranking. When combined with the other criteria, such as the hierarchy of site types, a stronger case can be made not only for hereditary ranking but also for the complexity of the Chacoan organization.

Summary

The Chaco mortuary data seem to indicate the presence of at least three levels of rank. As O'Shea points out, "it seems clear, not only that the archaeological record will manifest less organization than the cultural behavior that generated it, but also that less of this organization that is present will actually come to be detected and recognized" (1984:31), implying that more levels may occur. In fact, the intermediate large sites such as Pueblo Alto and the outlier sites may represent yet another level that includes the prestige of living in a large house but less access to valued goods and less authority (see also Schelberg 1982).

The lowest levels, represented by the small sites, can be described as having few distinctions among individuals. Adults may tend to have more than children and males more than females, but the differences are not great. There do not appear to be artifact types that are restricted by age or sex. Females do occasionally have the ornaments produced from long-distance transport materials; however, these are very few in number. Most of the small sites represent family or extended family residences. Detailed analysis within this level was not undertaken, largely because the number of burials from any given site is small, especially when time divisions are considered.

Objects interred with individuals at this level are primarily non-valued or those readily available to all or most individuals in the group. Ceramic vessels are the most common offerings, yet these average less than two per person throughout the time span. Given that a large number of vessels leave the system through breakage, their placement with a burial was not a great loss. The occasional inclusion of an ornament is most likely a token of high esteem or affection within this level.

The next level apparent in the sample is the western burial cluster at Pueblo Bonito. Its spatial isolation suggests some unity that is undoubtedly hereditary. Prestige and increased access to goods are implied by residence at Pueblo Bonito. The fact that fewer valued goods, especially turquoise, are found may suggest less access to these goods than for those interred in the northern portion of the pueblo. The range in age of individuals (Palkovich 1984) and indications that they spanned some period of time again indicates a hereditary facility. The clusters of interconnected rooms devoted to burials is quite formal compared to the haphazard midden or subfloor burial typical of the northern portion of the Southwest. Yet access to the area was not prohibited; episodes of trash dumping were common in these rooms.

The average number of vessels and ornaments per individual in this cluster suggests more vessels per person than at the smaller sites and some form of ornamentation for each individual. It is difficult to say more when such basic data as the number of individuals and quantity of artifacts are so unclear.

The northern burial rooms represent the highest strata. Again, habitation at Pueblo Bonito implies status and access to goods not available at lower levels. Yet in this case there is more than just a spatial separation. These rooms are deep within the roomblock and did not allow the same access as did those in the western rooms. Trash dumping did not occur; the rooms filled naturally. This older section of the pueblo appears to have served as a repository. Quantities of ceremonial sticks, cylindrical vessels, and caches of objects best referred to as ceremonial paraphernalia (such as pipes, fossils, ceremonial sticks) were found in this area of the site. The inclusion of human burials with these items is yet another distinction from the western burials.

The two Room 33 subfloor burials exhibit the greatest energy investment in terms of preparation of the facility and quantity of goods--distinctions that indicate at least authority and probably a high degree of power. Even the individuals above the floor had more valued objects than did those in the western cluster.

Thus the mortuary data indicate that several hereditary ranks functioned during the height of the Chacoan system. The consistency of the burial organizational variables at Shabik'eshchee Village compared to other sites at that time may suggest that the roots of ranking within the Chacoan system extend back into Late Basketmaker III-Early Pueblo I times.

DISCUSSION AND CONCLUSIONS

The Chacoan People

The results of the biological studies confirm that the environment and the dependence on maize agriculture had an effect on the health of the Chaco population. Indications of subsistence stress, such as hypoplasia, and of dietary deficiencies, such as porotic hyperostosis, are numerous in the population studied. Males and females show no statistically significant differences in patterns of degenerative disease. While this may be due in part to the small sample size, it also suggests that both were involved in strenuous tasks. One possible case of tuberculosis was found, but there is little else to suggest high incidence of infectious disease. The settlement pattern of small sites representing single or extended family units and a scattered distribution would not necessarily provide the conditions necessary for density-dependent diseases. The greathouses, with their larger human concentrations, may have differed in this respect.

Examination of the mortuary sample suggests that there was little difference in the treatment of individuals due to age or sex. Ceramic vessels, the most stable offering, varied little in the average number per individual over time. In the small-site samples these begin with a 0.4 average and reached a high of 1.7 vessels per person. Greathouse burials averaged more, but only 4.6 vessels per individual. The presence of ornaments in mortuary contexts, especially turquoise, consistently distinguishes the residents of the small and greathouse sites and suggests an elite status for at least the residents of Pueblo Bonito. The wealth and effort put into the Room 33 subfloor burials suggest that the two were persons of authority in the Chacoan system.

Little attention has been paid to assessing the health of different status groups. Buikstra (1984) suggests that individuals who have access to scarce and expensive resources at death may also have had access to rare items in life--such as food resources during the growing years--which would have allowed them to attain more of their growth potential. Extra height among persons of high status should indicate inherited status, since this would have been a long-term process. Different status groups in a Middle Woodland sample from Illinois had a 3.3-cm difference between the high- and low-status males and no difference between females. The latter is attributed to sex differences in the timing of growth events, susceptibility to stress, or underlying environmental factors (Cook 1984).

There are differences in the statures of both the males and females from Pueblo Bonito and their small-site counterparts (Table 6.1). The mean for the Pueblo Bonito males is 4.6 cm greater than that for small-site males; that for the Pueblo Bonito females is also 4.6 cm greater.

Table 6.1. Stature estimates for the Pueblo Bonito northern burial rooms and small-site samples (cm)

	n	\bar{x}	Min	Max	s	s ²
Pueblo Bonito						
male	7	169.3	165.2	173.4	3.3	10.9
female	7	162.0	160.1	163.5	1.3	1.7
Small site						
male	15	164.7	156.8	170.3	3.5	12.6
female	22	157.4	151.7	160.7	2.7	7.3
t test	t	df	p (1-tailed)			
male	2.86	20	.005			
female	4.25	26	.00012			

Note: Stature estimates in Appendix D.

Table 6.2. Femur lengths for Pueblo Bonito northern rooms, Pueblo Bonito western rooms, and small-site samples (cm)

	n	\bar{x}	Min	Max	s	s ²
Pueblo Bonito						
Room 33						
male	7	44.5	43.1	46.9	1.4	1.9
female	7	41.6	40.7	42.2	0.6	0.4
Western rooms ^a						
male	9	43.6			2.8	
female	7	41.3			2.0	
Small sites						
male	6	42.8	39.3	44.6	2.0	3.9
female	10	39.1	35.0	41.0	1.8	3.3
t test	t	df	p (1-tailed)			
Room 33 and small site						
male	1.83	11	.047			
female	3.33	15	.002			

Note: Femur lengths in Appendix D.

^aData from Corruccini (1972).

The sample sizes are unfortunately small, but there is a suggestion that status may have affected stature through better nutrition. Figures 6.1 and 6.2 demonstrate that the overall stature curve is relatively normal, with the Pueblo Bonito distributions falling at the high end.

Femur length (Table 6.2 and Figures 6.3 and 6.4) was also compared since there are published means for some of Judd's Pueblo Bonito western room sample (Corrucinni 1972). These figures fall squarely between those for the northern rooms and for the small-site samples, providing additional evidence for the three levels of status discussed in the preceding section. That the difference in stature is present in both males and females suggests a more equal treatment of the sexes in the Chaco population than occurred in Cook's Middle Woodland population.

We can also compare the Pueblo Bonito western room sample (Judd's) infant mortality (Palkovich 1984) with that for the small-site sample. Infant mortality for Pueblo Bonito is extremely low--9.5% of the population was under 5 years, compared to 25.9% in the small-site sample reported here. Lower infant mortality suggests overall better health for the Pueblo Bonito inhabitants. Likewise, more of the Pueblo Bonito residents lived past 40 years (17.9% as compared to 13.5%).

After reviewing Judd's collection, Hrdlička (n.d.) noted that the collection was remarkably healthy with good and proper nutrition "shown by the generally excellent condition of the teeth." Most of the adults were "entirely free from any pathological condition" other than the usual arthritis in older individuals. His figure of 21% (n = 28) for porotic hyperostosis is quite close to Palkovich's (n = 20; 25%) for the same collection; both are lower than this small-site sample with 57.6%. Pepper's Room 33 and Room 53 individuals were not free from evidence of disease. Osteoarthritis and collapsed thoracic vertebrae were observed among the mixed elements from Room 53 (AMNH 5885), and both the infant from Room 53 (AMNH 5628) and infant skull fragments (AMNH 3658) had signs of porotic hyperostosis. A female, probably in her early 20s (AMNH 3665), had a trace of cribra orbitalia in both orbits.

It is clear that the residents of Pueblo Bonito did not escape the rigors of life in Chaco Canyon. It is not clear that we should expect to find concrete differences in all aspects of health between high- and low-status individuals. In her study of a Middle Woodland population, Cook (1984) found that children from the higher-status groups did not differ from lower-status individuals in femur length, suggesting that the disadvantages experienced by all children under 6 years of age were greater than the distinctions afforded by social stratification.

Methods are available and are being refined that could go farther in assessing the extent of access to better foods. Cook (1981) again compared high- and low-status individuals from a Middle Woodland population whose subsistence relied on intensive harvesting of wild food sources. High-status individuals were distinct in several ways, including arthritis patterning, trace-elements patterning, and stature. Cook examined microscopic alterations of internal tooth structure (striae of Retzius and

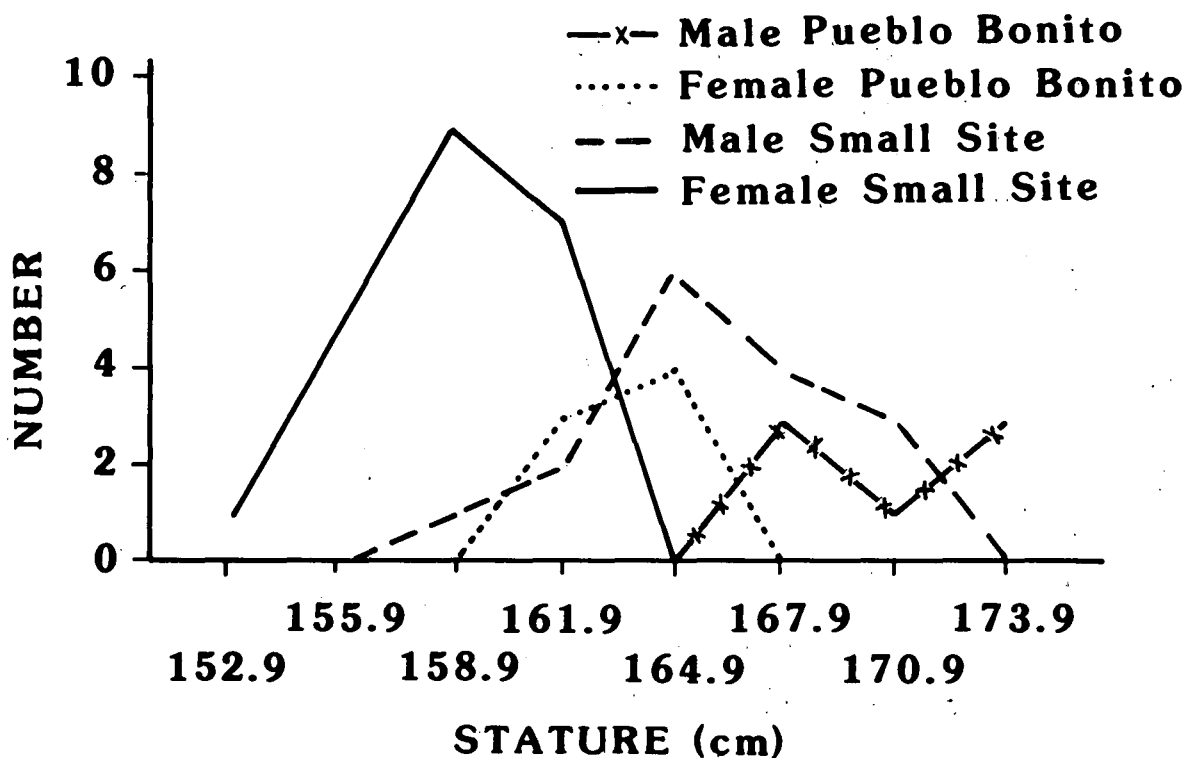


Figure 6.1. Stature estimates

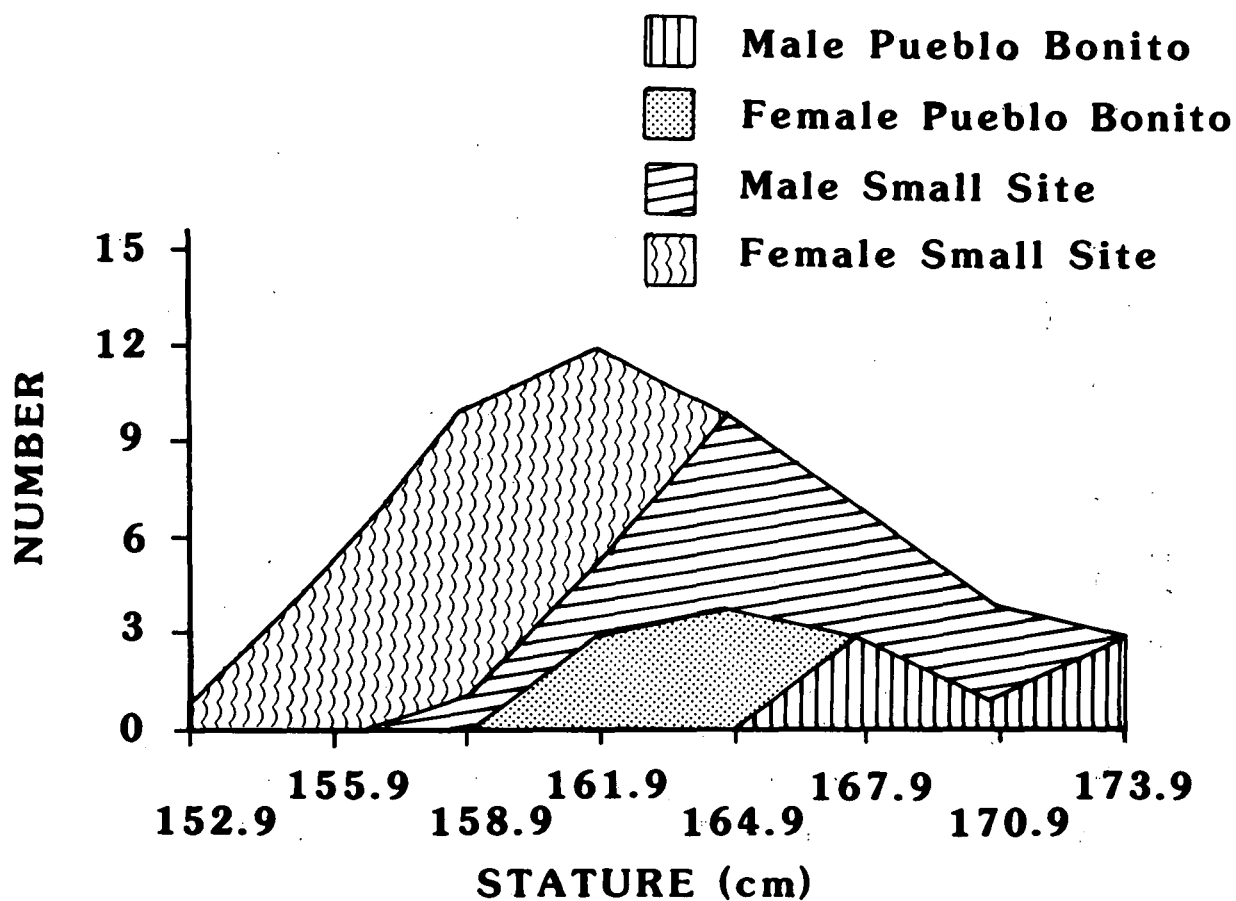


Figure 6.2. Stature estimates (cumulative line)

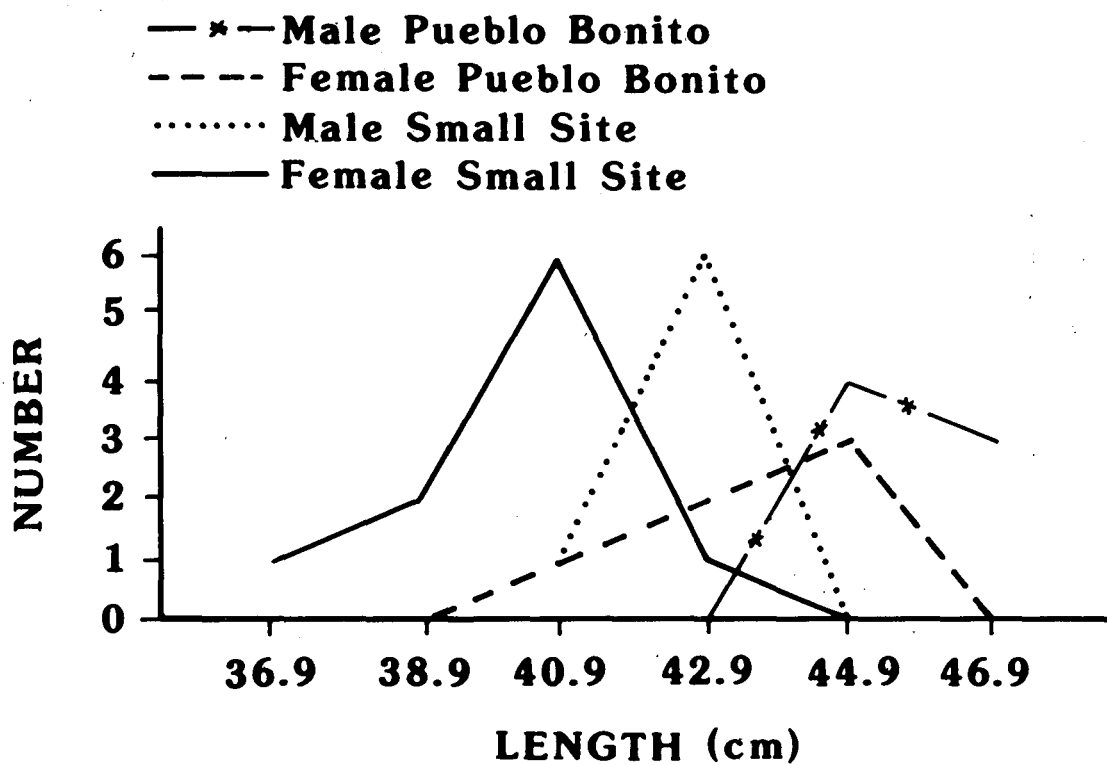


Figure 6.3. Femur length

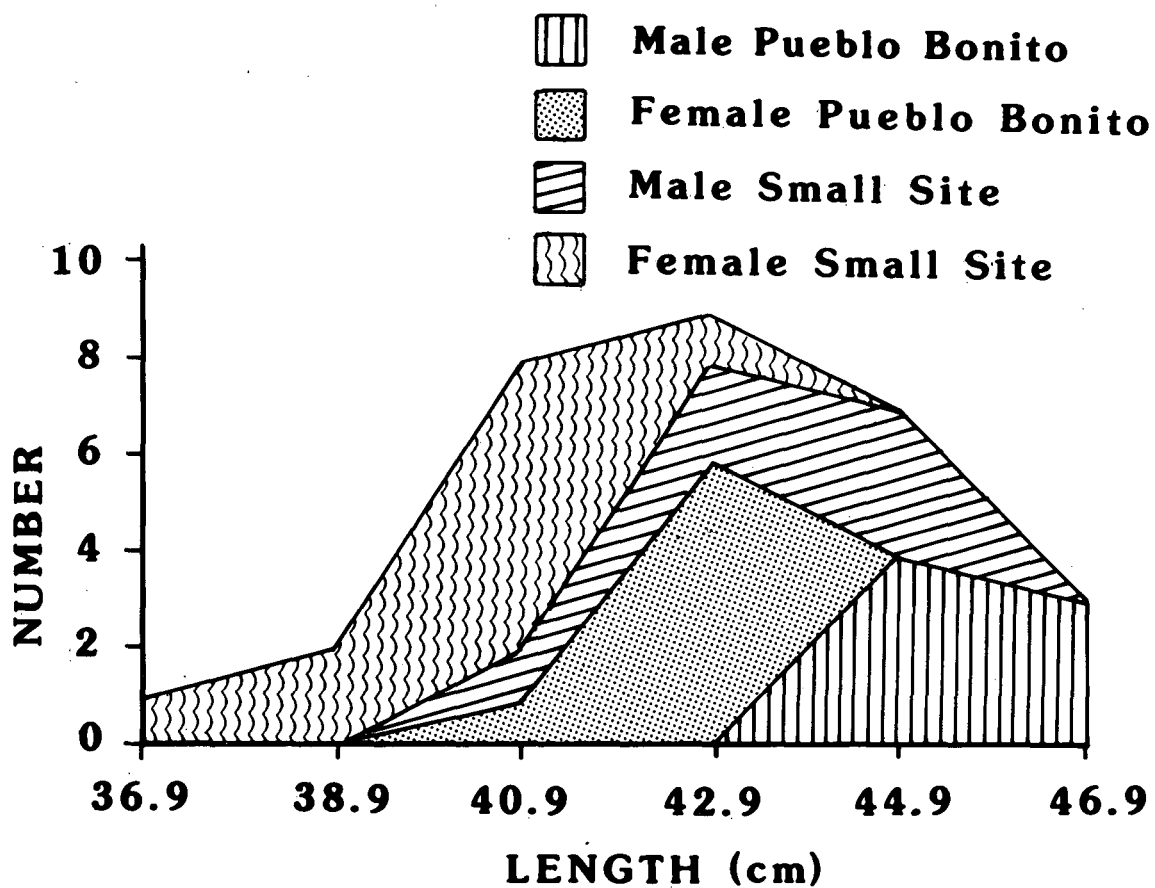


Figure 6.4. Femur length (cumulative line)

prism defects) in the teeth of 212 individuals. High-status individuals consistently had a lower number of these lines (which act as measures of disturbance in development) than did lower-status persons. Combining this or a similar method that reflects differences in resource access in very young with measures of stature that monitor later growth would give a more complete idea of whether or not there was differential access to resources beyond the usual maize-dominated diet.

There are chemical techniques that may provide even more direct evidence for reconstruction of diet. Carbon isotope ratios can be used to determine weaning age, composition of the weaning diet, and dietary differences within communities (Buikstra and Cook 1980) and to assess the importance of maize in the diet (Huss-Ashmore et al. 1982). Trace-mineral analysis has been of use in documenting dietary differences related to access to animal protein (Buikstra and Cook 1980; Huss-Ashmore et al. 1982).

The Chacoan System

The mortuary remains provide some of our best evidence for the presence of authority-holding elites in at least some of the greathouse sites. Craniometric studies indicate that the Pueblo Bonito burials represent two hereditary groups that had access to more valued goods. The stature analysis suggests that they had greater access to food resources than the residents of the small sites. Other evidence for high-status individuals in the canyon is sparse. Pepper (1909:248) reported that Peñasco Blanco also had masses of turquoise associated with burials in rooms, and Judd (1954:345) noted that Navajos employed by Richard Wetherill found two boxes of turquoise when excavating a number of rooms at that site. The American Museum of Natural History catalog lists a number of human bones from "Waylo's" work in rooms at Peñasco Blanco (including one lot that was broken, split, and burned--C 11801) and two skulls with another catalog number; these at least establish that the work was done at Peñasco Blanco and that it was probably under the direction of Wetherill. Beyond Pepper's mention of the burials and turquoise, there may be no other record. Kin Kletso, a McElmo style greathouse, had a few burials that varied little from the Gallup small-site sample in mortuary practices. Pueblo Alto produced no Anasazi burials, and those from Pueblo del Arroyo appear to be late in time and are poorly described (Judd 1959). No convincing evidence of contemporary elite persons has been found at the outlier sites; many had main occupations postdating the classic Chaco system and others are unexcavated or only partially excavated.

At its height (A.D. 1020-1120) the Chacoan system moved impressive amounts of materials. Over half (60.0%) of the ceramics found in the recent excavations were imported from the Chuska area 80 km to the west (Toll 1984). Also from the Chuskas came a fair amount of the chert (27%) found at Pueblo Alto (Cameron 1984). Dean and Warren (1983) estimate that between A.D. 1030 and 1060 alone 20,202 trees were felled for use in

Chetro Ketl, one greathouse site, and that 200,000 trees were used in construction of the ten greathouse sites in Chaco Canyon. Ponderosa pine was the most utilized of the woods, and the nearest extensive forest is more than 40 km from Chaco (Lekson 1984b). Spruce and fir, which supplied as many as 45,000 logs, were transported from over 75 km (Betancourt et al. 1984). Transport of some food items (such as meat) has been suggested (Akins 1985), but it is difficult to confirm any of large scale. Movement of such materials throughout the basin further suggests an economic and political element of a far-reaching system. Since no one commodity can be shown to leave the center (or Chaco Canyon proper), a managerial role originating from local subsistence insecurity and limited subsistence supply is more consistent with the evidence at hand than explanations based on control of scarce or critical resources.

Ecologically, the San Juan Basin is too poor to have sustained a well-developed hierarchy for long. However, it does appear that for a short period conditions were right for such a development within the basic Anasazi adaptation.

This study should not serve as an end; it is intended to encourage further research. Certain statistical techniques, such as cluster analysis, might be applied to parts of the mortuary data. A regional approach to the health status of the San Juan Basin Anasazi would clarify some aspects of basin productivity. Detailed analysis of the Pueblo Bonito skeletal remains is absolutely necessary for resolution of the role of the greathouse residents.

Finally, these materials should be made more readily available. The widespread distribution of collections from some sites (Pueblo Bonito stretches from Chicago to Washington, D.C., to New York City and Boston; Bc 59 from Tempe and Albuquerque to New York City) inhibits much of this potential. Human remains should be deposited in research facilities rather than dead storage so that as new methodologies are developed (and the current ones applied) they can be further studied.

APPENDIX A
Biological Studies Data

Table A.1. Master table

Site	Burial	Age (y) ^a	Sex ^b	Stature ^c	Develop. congen.	Dental	Arthritis/ trauma	Hemato- logical	Other
Bc 50	60/?	40+5 T	U		x	x	x		x
Bc 50	#50	adults? S	U					x	
Bc 50	X	30+5 T	male S			x			
Bc 51	60/1	adult S	male S	170.3 hum+ulna	x		x		
Bc 51	60/8	9-13 E	U		x				
Bc 51	60/12	adult S	U				x		
Bc 51	60/13a	40+5 T	U		x	x	x	x	x
Bc 51	60/13b	adult S	male? S		x				
Bc 51	60/16	adult S	male? S				x	x	
Bc 51	60/17	adult S	male S						x
Bc 51	60/17	<3 S	U					x	
Bc 51	60/24	30+5 T	female I		x				
Bc 51	60/24a	12-17 T, 11-15 E	U			x			x
Bc 51	60/27	adult S	U		x		x		
Bc 51	60/32	40-50 I	female I	155.9 fib	x		x		
Bc 51	60/51	35+5 T	female I	156.5 fem	x	x	x		x
Bc 51	60/51a	4+1 T	U			x		x	
Bc 51	60/53	25-39 T	female I	147.3 fem+fib	x	x	x		
Bc 51	60/53a	7-7.5 M	U						
Bc 51	60/55	35+5 T	U			x		x	
Bc 51	no #	35+5 T	U			x			
Bc 51	RSU	12-16m T, 6-18m M	U					x	x
Bc 53	60/1	35-50 I	female I	158.7 fem+tib	x	x	x		x
Bc 53	a(60/1)	30+5 T	female S		x	x			
Bc 53	60/1	9+3m T, 12m M	U					x	x
Bc 53	60/2	3+1 T, .5-1.5 M	U					x	
Bc 53	60/2	@15 E	female I		x		x		
Bc 53	60/2	adult S	female S						x
Bc 53	60/3	40+ T	male I	164.1 rad	x	x	x		
Bc 53	60/3	3+1 T, 9m CM	U		x			x	
Bc 53	60/4	3+1 T	U						x
Bc 53	60/4	1.5-2.5 M	U					x	
Bc 53	60/5	30+ T	U		x	x			
Bc 53	60/5	4+1 T, 2.5-3.5 M	U		x			x	x
Bc 53	60/6	30+ T	female sac		x	x	x		x
Bc 53	60/8	@25 E	male S			x	x		
Bc 53	60/9	nb+2m T	U					x	
Bc 53	60/10	16-18 I,F	female I	167.9 fib	x	x	x		x
Bc 53	60/10	adult S	U	157.2 hum	x				
Bc 53	60/11	18-25 I	female I	154.1 fem+fib	x		x		
Bc 53	60/11	30-40 I	male I,S		x	x	x		
Bc 53	60/12	9+3m T, 6m T	U					x	x
Bc 53	Room 7	adult S	U		x				
Bc 53	C	adult S	U		x				
Bc 53	dump	40+ T	U			x	x		
Bc 56		adult S	U	160.7 fem	x				
Bc 57	60/1	9+3m T, 3-6m M	U					x	x
Bc 57	60/2	25+ J	female I	158.3 fem+fib	x		x		
Bc 57	60/3	2y+8m T, 1-1.5y M	U					x	x
Bc 57	60/4	40-45 I	male I	164.7 hum	x	x	x		x
Bc 57	60/7	7+2 T	U						
Bc 57	60/8	40+ I	male I	167.7 fem+fib	x	x	x		
Bc 57	60/9	nb+2m T, 2m M	U		x			x	
Bc 57	60/10	50+ I	female I	160.7 fem	x	x	x		x
Bc 57	60/11	5y+16m T, (?)3y M	U		x			x	x
Bc 57	60/12	18+6m T, 6-8m M	U		x			x	
Bc 57	60/13	6 T	U			x		x	
Bc 57	60/13	3-4 T	U			x		x	
Bc 59	60/1	9+2 E	U						
Bc 59	60/3	30+ J,I	female I	161.7 hum+rad	x	x	x		x
Bc 59	60/4	9+2 T	U						x
Bc 59	60/5	16 E	female sac	159.9 rad	x		x		
Bc 59	60/7	35+ T	male? S		x	x	x		
Bc 59	60/8	35-45 I	female I	159.7 hum	x	x	x		x
Bc 59	60/9	adult S	female I	157.1 fib	x		x		
Bc 59	60/10	adult S	male S				x		x
Bc 59	60/11	35+ T	male S	163.7 hum	x	x	x		
Bc 63	60/6	35+ T	female S	156.1 fem	x	x	x		x
Bc 126	60/2	30-40? I	male I	169.7 tib	x	x	x		x
Bc 126	SW1#2	9+2 T	female? I		x	x		x	x

Table A.1. (continued)

Site	Burial	Age (y) ^a	Sex ^b	Stature ^c	Develop. congen.	Dental	Arthritis/ trauma	Hemato- logical	Other
Bc 191?	Buck'ham	25+ J	male I	168.4 fem	x		x		
Bc 192	Room 6	35-45 I	female I	157.0 hum+ulna	x	x	x		
Bc 236	#62	nb+2m T	U					x	
Bc 236	#63	25+5 E,J	female I	158.2 hum+ulna	x		x		
Bc	N	adult S	U		x		x		
29SJ 299	1	40+ T	U	161.6 fem	x	x	x		
29SJ 299	2	25+5 T	female I	154.2 rad	x	x			
29SJ 299	3	30+5 J	female I	153.6 tib	x	x	x		x
29SJ 299	4	35-45 I	male I	166.3 fem	x	x	x		
29SJ 389	PS 470	12+4m T	U		x			x	
29SJ 563	PS 162	40+ T,J	female I	160.5 fem+fib	x	x	x		x
29SJ 597	1	45-55 I	female I	159.8 fem	x	x	x		x
29SJ 597	2	20-22 E	male I	162.5 fem+fib	x	x	x		x
29SJ 627	1	22-28 I	female I	159.4 fem+fib	x	x	x		x
29SJ 627	2	30+5 T	male I	156.8 fem	x	x	x	x	
29SJ 627	3	3+1 T	U					x	
29SJ 627	4	01 S	U					x	
29SJ 629	1	30+5 T	male S	162.9 fib	x	x	x		
29SJ 629	2	adult S	male S	161.2 fub	x				
29SJ 633	1	12+4m T, 6-12m M	U		x			x	
29SJ 633	2	24+8m T, 10-18m M	U		x			x	
29SJ 633	3	18-20 I	male I	166.1 fem	x	x	x		x
29SJ 633	4	12+4m T, 6m M	U					x	
29SJ 721	PS 40	20+3 T	female I	151.7+ fem	x	x			
29SJ 1360	1	40-45 I	female I	157.9 hum	x	x	x		x
29SJ 1360	2	35-40 I	female I	153.2 fem+fib	x	x	x		x
29SJ 1360	3	3+1 T, 1.5 M	U		x			x	x
29SJ 1360	5	3+3m T, 4-6m M	U					x	
29SJ 1360	6	1-2 S	U					x	
29SJ 1360	7	01 S	U		x			x	
29SJ 1396	PS 538	5y+16m T	U					x	
unknown	99-5	30-45 I	female I	156.6 fem+fib	x	x	x		
unknown	99-6	30+5 T	male? S	163.3 fem	x	x	x		x
unknown	#260	30+5 T	male S		x	x			
unknown	#261	35+5 T	male S		x	x			
unknown	#262	40+5 T	U		x	x			
unknown	d 0/1	35+ T	U		x	x			x
Casa Rin.	d 2.1/1	35-50 I	male S	157.4 rad	x	x	x		
Wijiji	d 3/1	5-6 CM	U		x				
Wijiji	d 3/1	5+16m T, 3-4 M	U					x	x
Wijiji	d 3/2	1-2 S	U					x	
Wijiji	d 3/3	22-30 I	male I	164.4 tib	x	x	x		
Wijiji	d 3/3	18-19 I	female I		x		x		
near P. Blanco	d 4/1	19-20 I	female I	157.8 rad	x		x		x
near P. Blanco	d 4/1	30-40 I	male I,S	161.8 hum+rad	x	x	x		
near P. Blanco	d 4.1/1	adult S	U				x		
near P. Blanco	d 4/2	25-40 I	male I	167.0 rad					
near P. Blanco	d 4/2a	4-5 T	U					x	
near Mesa Fajada	d 5/1	30-60 I	male S		x	x		x	
Talus U.	RSU	3-6m T, 6m M	U					x	x
Talus U.	Bc 257	60/2	female I	160.5 fem+fib	x	x	x	x	
Talus U.	Bc 257	60/4	U		x	x		x	x
Talus U.	Bc 257	60/5	U					x	x
Talus U.	Bc 257	60/6	U		x			x	
Talus U.	CK#44	30-50 I	female I	157.1 fem+fib	x	x	x	x	x
Chetro Ketl	#992	3+1 T, 1-1.5 M	U					x	
Chetro Ketl	d 1.1/1	18-20 I	female I	152.2 tib	x		x		x
Chetro Ketl	d 1.1/1	adult S	male S		x	x	x		
Kin Kletso	Bc 248	60/1	U			x	x	x	x
Kin Kletso	CC-KK gen	adult S	female S						x
Kin Kletso	no #	adult S	U						x
Kin Ya'a		30-45 I	male I	158.5 fem+fib	x		x		

^aYears unless otherwise indicated;

@=approximate;

criteria for age determination:

CM=Chaco curve measurement

E=epiphyseal union

I=innominate bones

J=joints, amount of arthritis

M=measurement

S=size

T=teeth: development, eruption or attrition

^bcriteria for sex determination:

I=innominate bones

S=size

sac=sacrum

U=unknown sex

^c values for estimated statures (Trotter and Gleser 1958):

femur + fibula 3.18

femur + tibia 3.24

fibula 3.24

tibia 3.27

femur 3.80

humerus + ulna 4.14

humerus + radius 4.16

humerus 4.25

radius 4.60

ulna 4.66

Table A.2. Congenital and developmental disorders

Site	Number	Age (y) ^a	Sex	Deltoid tuberosity	Squatting features	Cranial deform.	Wormians	Pacch. Pits	Sacral clefts/spina bifida	Septal aperture	Fusion defects	Other
Bc 50	60/7	40+5	U	M	E	U	U		U			
Bc 51	60/1	adult	M	SL	U	U	U		U	YU		
Bc 51	60/8	9-13	U	U	U	U	U		U	YU		
Bc 51	60/13a	40+5	U	U	U	P,R	Y	4+	U			
Bc 51	60/13b	adult	M?	U	U	O,P,R	U	2	U			
Bc 51	60/24	30+5	F	M	U	U	U		U			
Bc 51	60/27	adult	F	SL-M	M-E	U	U		S5			
Bc 51	60/32	40-50	F	M	M-E	U	U			NU		lrg. gluteal tuberos.
Bc 51	60/51	35+5	F	M	M-E	U	N		S5			C vert. process asymmet.
Bc 51	60/53	25-39	F	M	M-E	U	N		U		C2&C3 fused	femora - 3rd trochanter fibula S-shaped; lower arm bones curved hole in sternum (corpus)
Bc 53	60/1	35-50	F	M+	M-E	O,P,R	Y	5+	S1-2	YN		
Bc 53	a (60/1)	30+5	F	U	U	U	U	3+				
Bc 53	60/2	815	F	N-SL	M-E	U	U					
Bc 53	60/3	40+	M	M	M-E	U	U		S5 min.	NU		C5-C7 8-shaped foramina
Bc 53	60/3	3+1	U	U	U	U	Y					
Bc 53	60/5	30+	U	U	U	U	U	3+				
Bc 53	60/5	4+1	U									left clavicle larger scaphocephaly
Bc 53	60/6	30+	F	M	U	SL,P,R	N	2	S4-5		S1-S2 bodies not fused	lower T verte asymmet.
Bc 53	60/10	16-18	F	N-SL	M	U	N		N	YY	C2 arch misal.	xiphoid unusual shape
Bc 53	60/10	adult	U	M	M	U	U		U	YN		C1-C4 irregular from C2
Bc 53	60/11	18-25	F	L	M-E	U	U		S1,S4,S5	YY	C5&C6 no plate	T7&T8 extra platforms
Bc 53	60/11	30-40	M	U	SL-M	U	U		U			
Bc 53	Room 7	adult	U	SL	E	U	U		U	YU		
Bc 53	C	adult	U	SL	M-E	U	U		U	NU		C1 bifurcate spine absent
Bc 56		adult	U	U	U	U	U		U	YN		femur 3rd trochanter
Bc 57	60/2	25+	F	M	M	U	U		S5	NN		exostosis hand phal.1
Bc 57	60/4	40-45	M	SL	M-E	U	U		S1,2+	NU	notched patella	2 centers of ossification
Bc 57	60/8	40+	M	SL-M	M,F	P,R	Y			NU		
Bc 57	60/9	nb+2m	U									gap along met. suture: small frontals
Bc 57	60/10	50+	F	E	M,F	U	N	1+	S5	NN		vert. plates different growth rates
Bc 57	60/11	5y+16m	U									spurs on humerus
Bc 57	60/12	6-18m	U						S5 min.	NN		
Bc 59	60/3	30+5	F	SL	M-E	U	U		S1,S4,S5		C1 cleft: extra facets C2	
Bc 59	60/5	16	F	U	U	U	U					
Bc 59	60/7	35+	M?	U	M-E	U	U		U			large sternohyoid att.
Bc 59	60/8	35-45	F	M	M,F	U	U		S4-S5			squam- & temporo-occip. sutures fused - unusual head shape: hole in st. corpus; v. lrg. sternohyoid att; C6 8-shaped foramen
Bc 59	60/9	adult	F	U	M	U	U		U			calcaneus -lrg. attach.
Bc 59	60/11	35+	M	SL	M,F	U	U		U	YY		lrg. sternohyoid att.
Bc 63	60/6	35+	F	E	M-E	U	U		N	YY		L humerus slight twist
Bc 126	60/2	30-40?	M	SL	M,F	U	U		S3-S5+	YU	3 foot phal. 2&3 fused	
Bc 126	SW1 #2	9+2	F?			O,P,Sy	Y	S5				lesions parietals and temporals
Bc 191?		25+	M	SL-M	M	U	U	N				
Bc 192		35-45	F	N	SL-M	U	U	S5	NU			xiphoid deformed
Bc 236	#63	30+5	F	SL	U	U	U	U	NN			exostoses R metacarpal 4; C6 8-shaped foramen
Bc	N	adult	U	U	U	U	U	U				
298J 299	1	40+	U	U	E	P,R	Y	4+	U			
298J 299	2	25+5	F	SL-M	M	SL,P,R	Y	3+	U	NU	C2&C3-w.plates	tibia 2-3 Harris lines
298J 299	3	30+5	F	M	M	O,P,Sy	Y		S4-S5			tibia 1 Harris line
298J 299	4	35-45	M	N	E	SL,P,L	Y	1+	S1-S5	NU	L5 wings fused to sacrum	

Table A.2. (continued)

Site	Number	Age (y) ^a	Sex	Deltoid tuberosity	Squatting features	Cranial deform.	Wormians	Pacch. Pits	Sacral clefts/ spina bifida	Septal aperture	Fusion defects	Other
29SJ 389	FS 470	12+4m	U			N						
29SJ 563	FS 162	40*	F	SL	M	O,P,L	Y		N	YY	metopic unfused	
29SJ 597	1	45-55	F	N	E,F	O,P,R	U	1+	U	NN		mandibular tori
29SJ 597	2	20-22	M	M	M-E	P,L	N		N	YY	C2-C3 spines partial; rest twisted	
29SJ 627	1	22-28	F	N-SL	E	O,P,R	Y	6	U	YN		
29SJ 627	2	30+5	M	N-SL	M	U	U	4	N	NN		
29SJ 629	1	30-35	M	N	M-E	U	U	2	U			
29SJ 629	2	adult	M	SL-M	E	U	U		U			
29SJ 633	1	12+4m	U			O,P,R					mandibular suture not fused	
29SJ 633	2	24+8m	U			O,P,R						
29SJ 633	3	18-20	M	N	M-E,F	U	U	N	N			lrg. conoid tubercle
29SJ 721	FS 40	20+3	F	SL-M	M	U	Y		U			
29SJ 1360	1	40-45	F	M	M-E	SL,P,R	Y		S4-S5	YN	2+ fused foot phalanges 263	tibia 2 Harris lines
29SJ 1360	2	35-40	F	SL-M	M	P,L	N		S1,Caul.	NN	3 fused foot phalanges 263	R clavicle shorter, enlarged deltoid att. tibia-3 Harris lines atlas arch asymmet. with small spur
29SJ 1360	3	3+1	U			O,P,L	Y					notch in squamosal
29SJ 1360	7	81	U								metopic unfused	
unknown	99-5	30-45	F	SL	N-SL	U	N		N		C6 arch misalign, cleft;	
unknown	99-6	30+5m	M?	M-E	M-E	U					S1&S2 unfused	lrg. sternoclav. att.
unknown	C260	35+5	M	U	U	P,R	N	U	U			
unknown	C261	35+5	M	U	U	P,R	N	U	U			
unknown	C262	40+5	U	U	U	N	N	U	U		C1 to skull	scaphocephalic
unknown	d 0/1	35+	U	U	U	U		1	U			sutures almost obliterated
Casa Rin.	d 2.1/1	35-50	M?	U	M	U		N	N			fem-lrg. glu. mm. attach.
Wijiji	d 3/1	1.5-2	U									tibia - 4 Harris lines
Wijiji	d 3/3	22-30	M	N	M	U	N		U	NU		bowed fib. & rad: ulna compensatory shape; spur proximal fibula
Wijiji	d 3/3	18-19	F	N	M	O,P,L	N	4	S5	YU		
near FB1	d 4/1	19-20	F	SL	M	U			U	NU		scalloped margin on rib
near FB1	d 4/1	30-40	M	M-E	U	U			U	YU		C7 2 foramina left side
near FB1	d 4/2	25-40	M	SL-M	U	U			U	NU		
near FaJ	d 5/1	30-60	M	N	M	U			U			
TU	60/2	20-25	F	SL	M,F	U	N	N	S5	YY	atlas arch cleft small 12th rib with extra foramen fused f.ph 263	
TU	60/4	4+1	U									i.s absent; sternum
TU	60/6	18-24+6m	U									irreg; ribs twisted & flat
TU	CK#4	30-50	F	E	M	U	N	2+	N	NU	metacarp. 3, left process not fused to body	innominate unusual shape T.vert. bodies asymmet.
C Ketl	d 1.1/1	18-20	F	M	SL-M	U	U		U	NN		
C Ketl	d 1.1/1	adult	M	U	U	U	U		S5		S1 arch mis- align; S4 defect in arch	ribs do not curve in dist.
Kin Ya'a		30-45	M	SL	M-E	U	U		S1-S5		S1-S2 not fused	4 Harris lines; T9-T12 bodies asymmet.; hole in manubrium

Codes: C = cervical N = absent SL = slight
 E = extensive O = occipital Sy = symmetrical
 F = facet P = partial T = Thoracic
 L = left R = right U = unknown
 M = moderate S = sacrum Y = present
 min = at least;
 element damaged

^aYears unless otherwise indicated; @ = approximate.

Table A.3. Dental conditions

Site	Number	Age (y)*	Sex	Hypoplasia	Caries	AM loss/ resorption	Abscess	Calculus formation	Comment
Bc 50	60/7	40+5	U	U	N/U	RM ₁ -3BI ₁ RM ₁ , 3LI ₁ PM ₁ -H ₃	N	N	
Bc 50	X	30-35	M	U	U	BM ₂ ; N, P, Res	BM ₂	U	
Bc 51	60/13a	40+5	U	U	2+	RM ₁ PM ₂ -M ₃ LM ₂ -3+; P, Res	LPM ₁ -2LM ₁ -2	U	
Bc 51	60/24a	12-17	U	BI ₁	N	N	N	N	
Bc 51	60/51	35+5	F	2+LC ₁ , 1=RC ₁ I ₂ LC ₁ , 1 ¹ PM ₁	N/U	LM ₂ PM ₂ RM ₁ ; Res	LPM ₂	SL	LC ₁ between PMs
Bc 51	60/51a	4+1	U	unrupted i ₁ n=2	U	N	N	N	RI ₁ -2 fused
Bc 51	60/53	25-39	U	U	U	N	RM ₁	U	1 M ₃ present
Bc 51	60/55	35+5	U	LC ₁	2+	U	U?	Mod-H	I ₁ rotated 45°
Bc 51	no #	35+5	U	U	2+	LM ₁ -2I ₁ +; S, Res	LM ₂ RI ₁ M ₁		mandible only
Bc 53	a(60/1)	30+5	F	N/U	N/U	N/U	N/U	SL	maxilla only
Bc 53	60/3	40+	M	U	1+	most; Res	LPM ₁ RC ₁ or PM ₁		mandible only
Bc 53	60/5	30+	U	U	1+/U	N/U	N/U		maxilla only
Bc 53	60/6	30+	F	N/U	U	RM ₃ -PM ₁ I ₁ I ₂ -H ₃ ; Maj, Res	N/U		maxilla only
Bc 53	60/8	825	M	RC ₁	2+	RPM ₂ -M ₁ ; P, Res	N/U	SL	
Bc 53	60/10	16-18	F	Cl-C ₁	N/U	N	N	N	lingual pit LM ₂
Bc 53	60/11	30-40	U	U	N/U	RM ₂ -3; P	N/U		1/3 maxilla
Bc 53	dump	40+	U	U	2+	RM ₃ -PM ₂ BI ₁ LPM ₁ -H ₃ ; Maj, Res	RPM ₁		maxilla only
Bc 57	60/4	40-45	M	U	U	RM ₁ LM ₁ -3RI ₁ M ₁ LM ₃ ; Res	RC ₁ LC ₁ PM ₁ -2	U	missing and broken
Bc 57	60/8	40+	M	U	U	most; Res	LC ₁		PD molars
Bc 57	60/10	50+	F	U	U	all?; Res	U		1/2 mandible, 1/3 maxilla
Bc 57	60/13	6	U	N	N				
Bc 57	60/13a	3-4	U	N	N				
Bc 59	60/1	5-7	U	U	1	N/U			
Bc 59	60/3	30+	F	U	U	LM ₃ -PM ₁ ; Res	LC ₁	U	mandible, M ₁ buccal pit
Bc 59	60/7	35+	M	2-Ri ₂	U	U	U		1/2 mandible, 1/3 maxilla
Bc 59	60/8	35-45	F	U	U	N	U		teeth only
Bc 59	60/11	35+	M	LI ₁	U	U	U		broken and missing
Bc 59	60/6	35+	F	U	U	U	U		1 tooth
Bc 126	60/2	30-40?	M	U	U	LM ₁ -3I ₁ RI ₁ PM ₂ -M ₂ ; Res	LI ₁ ?		
Bc 126	SWI#2	9+2	FT	1=I ₂ -I ₂ , 2=BI ₁	N/U	LM ₂ -3RI ₁ -3RI ₁ ; Res	LM ₁		some missing
Bc 192		35-45	F	U/Ri ₁	U	RPM ₂ M ₁ -3LPM ₂ ; Res	N/U		most upper teeth missing
29SJ 299	1	40+	U	U	3+	LM ₃ PM ₁ N ₂ RM ₁ -3H ₁ , 3; Maj, Res	RPM ₁ Cl ₁ I ₂ PM ₂ LI ₂ , PM ₁ I ₁ , 2		
29SJ 299	2	25+5	F	LC ₁ , RPM ₁ -LC ₁	5	N	LM ₁		enamel damaged on I ₁ : acc. peg tooth between RC ₁ and PM ₁ ; H ₃ extra lingual cusp
29SJ 299	3	30+5	F	RPM ₁ LI ₁	1	RM ₂ ; Res		SL	
29SJ 299	4#	35-45	M	N	2	N	N		PD left mandible
29SJ 563	FS162	40+	F	U	N/U	LM ₂ -3RM ₁ -3H ₂ -PM ₁ ; N, Res	LM ₂		12 teeth missing
29SJ 597	1	45-55	F	U/LC ₁	3+	RPM ₂ -H ₃ LM ₃ LPM ₁ N ₂ M ₁ , 3; N, P, Maj	LPM ₁ -2		bad overbite; PD, porosities
29SJ 597	2	20-22	M	C ₁ -C ₁	1	N	?RM ₁		crowded, Cl rotated, LC ₁
29SJ 627	1	22-28	F	U/LC ₁ -RI ₁	U	N/U	N	Mod	outside row; PD M ₂ -3
29SJ 627	2	30+5	M	LPM ₁ -I ₂ BI ₁ -2RM ₁	N	N	N	Mod	teeth damaged
29SJ 629	1	30+5	M	LM ₁ -PM ₁ -2BC ₁ RPM ₁	N	N	N	SL	LM ₂ mes-ling depress.
29SJ 633	3	18-20	M	BC ₁	N	N	N	Mod	
29SJ 721	PS 40	20+3	F	N	N	N	N		
29SJ 1360	1	40-45	F	Cl-C ₁ RPM ₁ -I ₂	8	RM ₂ LM ₁ ; S	RM ₃ LM ₁		PD
29SJ 1360	2	35-40	F	LC ₁ -I ₁	1	LM ₁ RM ₁ -2; Maj Res	LM ₁ RI ₁		RM ₃ impac., rotated 90° RC ₁ not erupted
unknown	99-5	30-45	F	U	2+	RM ₂ ; Res	RC ₁ I ₂ I ₂		1/2 maxilla, 1/2 mandib
unknown	99-6	30+5	M	RM ₂ LPM ₁ -I ₂ RM ₁	1	N	N	Mod	supernumary T-shaped, rotated, I ₁ -2, labial
unknown	#260	30+5	M	BC ₁ I ₂ C ₁ -Cl	4	N	?LM ₃		
unknown	#261	35+5	M	N/U	2+	N	N		1/2 teeth missing
unknown	#262	40+5	U	U	U	most; Res	U		
unknown	d 0/1	35+	U	N/U	N/U	N/U	N/U		2/3 maxilla, 4 teeth
Case Rin.	d 2.1/1	35-50	M	N/U	N/U	RC ₁ LPM ₁ -2M ₁ -3RPM ₂ M ₃ ; Res	RI ₁		2 upper N taurodont; some damage
Wijijj	d 3/3	22-30	M	U/RC ₁	N/U	N	N		LI ₁ rotated 45°
near P81	d 4/1	30-40	M	U	N/U	N/U	U/I ₂		PD molars
near Paj	d 5/1	30-60	M	U	U	U	N/U		
TU	60/2	20-25	F	2=BC ₁ , 1=RC ₁ -LPM ₁	2+	N	N	SL	crowded
TU	60/4	4+1	U	N	2(1)				cong. absence both i ₂
C Ketl	d 1.1/1	adult	M	N	N	RM ₁ -2LM ₁ RM ₁ LPM ₂ -M ₂ ; Res	RM ₂ -3LI ₁ N ₂ PM ₁ M ₁		enamel pearl
K Kletso	7+2		U	N	N	pm ₂ ; P	pm ₂ ?		1/2 mandible only

Codes:	General	Hypoplasia	AM loss/resorption
	B = both C = canine L = left I = incisor PM = premolar M = molar U = unknown N = absent/none	1 = two lines 1 = one line	S = slight resorption P = partial resorption Maj = most resorbed Res = total resorption
	Calculus formation		
	SL = slight Mod = moderate H = heavy		

PD = periodontal disease

*Years unless otherwise indicated; @ = approximate.

Table A.4. Arthritis and trauma

Site	Number	Age (y)*	Sex	Jaw	Cerv.	Thor.	Lumb.	Sacrum	Shoulder	Elbow	Thoracic	Pelvis/hip	Knee	Hands/feet	Comments ^b
Bc 51	60/1	adult	M	U	U	U	U	U	N	S1	U	U	U	U	ossified sternohyoid attach.
Bc 51	60/12	adult	U	U	U	U	U	U	N	N	*	U	U	U	right condyle smaller,
Bc 51	60/13a	40+5	U	*	U	U	U	U	U	U	U	U	U	U	different shape
Bc 51	60/16	adult	M?	U	U	S1	U	U	U	U	S1*	U	U	U	ribs: costal cartilage
Bc 51	60/27	adult	U	U	U	U	U	U	U	U	S1*	U	U	U	sternum
Bc 51	60/32	40-50	F	U	U	W*	U	U	S1RH	S1	S1*	BOH*	U	S1	T11, slight wedging; osteophytes in ob. foramen; femur facets, pigeon-toed B on prox femur
Bc 51	60/51	35+5	F	N	S1	S1	M	M	N	S1-M	U	S1	N	N	spur on post. ilium;
Bc 51	60/53	25-39	F	U	N-S1	N-M	N-M	U	RR*	N	N/U	S1*	N	N	B right humerus
Bc 53	60/1	35-50	F	U	N-S1	N-S1W*	S1-E	S1	N	N	S1	MO*	N	N	some destruction of bodies T6-T11; osteophytes ob. foramen
Bc 53	60/2	@15	F	U	N	N	N	U	N	U	U	E*	U	U	sacroiliac large spurs,
Bc 53	60/3	40+	M	U	U	U	U	U	S1	N	N-S1*	N	N	N	irregular joint surface
Bc 53	60/6	30+	F	U	N	N-S1	N	N	B*	U	N	U	U	NP*	ribs
Bc 53	60/8	@25	M	N	N	N	T*	S1	N	N	U	U	U	N/U	B left scapula; F foot phal.
Bc 53	60/10	16-18	F	N	N	N	N	N	N	N	N	N	N	T*	parietal-4 pits may be
Bc 53	60/11	18-24	F	U	N	N-S1	U	N	N	N	N	N	N	N	trauma-pronounced lippling L3-L5
Bc 53	60/11	30-40	M	U	U	U	U	U	U	N/U	O*	N	U	U	knot on phal. (trauma?)
Bc 53	dump	40+40	U	U	*	N	U	U	U	U	U	U	U	U	osteophytes ob. foramen
Bc 53	60/2	25+	F	U	N	S1S*	N-S1	U	S1	N	N	N	RR*	N	2 Schmorl's, T4/T5, one recent;
Bc 57	60/4	40-45	M	U	N-EP	S1	M	M	RR*	N	S1	S1	N	NT*	B 1 femur
Bc 57	60/8	40+	M	OH	S1P	N-S1AP*	MWS*	MP	EB2H*	2BH*	M	MO*	5+BHS1*	S1-M	EL prox. humerus;
Bc 57															T first foot phal.
Bc 57															T4-T5 ankyllosed, lesion side of T1; L1 Schmorl's and wedging;
Bc 57															B18 shoulder; 2 hum., 2
Bc 57															scapula; 2 elbow, 1 hum., 1
Bc 57															radius, femur, tibia, and
Bc 57															patella; osteophytes ob.
Bc 57															foramen
Bc 57															compression fracture; B
Bc 57															shoulder; B hum; elbow L hum;
Bc 57															knee R femur
Bc 57															extreme asym. trauma?
Bc 57															slight collapse of L5; damage to
Bc 57															L clavicle
Bc 57															P clavicle at sternal and
Bc 57															slight wedging L1; corpus and
Bc 57															xiphoid fused
Bc 57															B 1 humerus
Bc 57															B 1 humerus ridge; tibia; left
Bc 57															metacarpal 3 healed fractures,
Bc 57															spur on one metatarsal
Bc 57															T dislocation R hum; B shoulder,
Bc 57															L hum; elbow L hum & ulna; knee
Bc 57															2 on patella; possible healed
Bc 57															fibula fracture
Bc 57															L condyle atrophic; S 79, T10;
Bc 57															fracture? hand phal. 2
Bc 57															prox R hum trauma. aseptic
Bc 57															necrosis
Bc 57															W15; RR hum; hand bones thin
Bc 57															healed rib fracture
Bc 57															eburnation C5, T1
Bc 57															pit in condyle
Bc 57															RR scapula
Bc 57															S C5, T10-T12, L1; W T11, L2
Bc 57															RR femur; fracture? greater
Bc 57															multitangular
Bc 57															S and W T12; mechanical
Bc 57															disturbance of knees
Bc 57															possible rib fracture; see
Bc 57															Table A-6
Bc 57															S T7; RR humerus; L femur
Bc 57															B recent, L condyle
Bc 57															2 depressions; first foot phal.
Bc 57															rotated, with boney pad;
Bc 57															T1: prox. femur
Bc 57															B both humeri; F possible mid-rib
Bc 57															healed; knee R femur
Bc 57															S 2 in T12; B both humeri;
Bc 57															"shaf. hole" in ulna; F metacar-
Bc 57															pal, spurs between phal. 1&2
unknown	99-5	30-45	F	N	N	S1	S1-EP	S1P	N	S1	M	S1	S1ER*	E*	B both distal femora;
unknown															pyogenic arthritis;
unknown															destruction of joint surfaces R
unknown															M13 & phal.
Case Kin.	d 2.1/1	35-50	M	U	M	N-S1	EA*	E	PP*	MD	M	U	S1	S1	L1, L5 ankyllosed;
Wijiji	d 3/3	18-19	F	N	N	N-S1	N	N	N	N	N	S1	N	N	BL hum.; PL clav.
Wijiji	d 3/3	22-30	M	N	U	U	U	U	BB*	S1	N	U	S1	N	B R hum.; spur on fibula
near FBI	d 4/1	19-20	F	U	S1	N	N	N	N	N	N	N	U	U	
near FBI	d 4/1	30-40	M	N	N-MD	M-E	M-E	U	S1RH*	S1	S1P*	N	N	N	RR hum; F clav & 4 ribs, healed
near FBI	d 4.1/1	adult	U	U	U	U	E*	U	U	U	N/U	U	U	U	only one L vertebra
near FBI	d 4/2	25-40	M	U	U	U	U	U	ERH*	S1	S1	M	U	M	RR hum + hypertrophic change;
near FBI															femur: myositis ossif. linea
near FBI															aspara
near FBI															S 3; T12, 2 unk. thoracic verte
near FBI															L traumatic lippling
near FBI															W right wedging T11, T12; T
near FBI															coccyx. verte fused & misalign
near FBI															B shoulder, R hum; elbow L hum
near FBI															B R humerus
near FBI															B R humerus
near FBI															healed fracture of humerus?
near FBI															S T12; T T2 spine broken, healed
near FBI															T dis. fem osteochondritis
near FBI															dissecans.
Codes:	A =	ankylosed	F =	fracture	P =	porosities									
	B =	degenerative (non-lipping)	H =	healing	R =	right									
	C =	collapse	L =	left	S =	Schmorl's nodes									
	D =	bone destruction	M =	moderate	S1 =	slight									
	E =	extensive	N =	absent	T =	trauma									
	EB =	eburnation	U =	unknown	U =	unknown									
				O =	osteophytes	W =	wedge								

Table A.5. Hematological conditions

Site	Number	Age (y) ^a	Sex	Cribra orbitalis	Parietal porotic hyperostosis	Other
Bc 50	#50	adult?	U	extensive; remodeled		
Bc 51	60/13a	40+5	U	no	no	thick occipitals
Bc 51	60/16	adult	M?	no	no	thick occipitals
Bc 51	60/17	<3	U	unknown	extreme, hyperostosis; remodeling	(fragmentary)
Bc 51	60/51a	4+1	U	no	no	thick parietals
Bc 51	60/55	35+5	U			porosities in ribs,
Bc 51	RSU	12-16m	U	moderate involvement; no remodeling	moderate, hypertrophy; remodeling foramen-like grooves	most long bones; grooves on some ribs
Bc 53	60/1	9+3m	U	no	slight; remodeled	
Bc 53	60/2	3+1	U	unknown	slight to moderate; remodeled	(fragmentary)
Bc 53	60/3	3+1	U	slight; healed	moderate; slight hypertrophy; remodeling	
Bc 53	60/4#2	1.5-2	U	slight to moderate; remodeled	slight pitting near occipital suture; well remodeled	
Bc 53	60/5	3-4	U	very slight left; remodeled	no	pores near audit. opening
Bc 53	60/9	nb+2m	U	no	no	
Bc 53	60/12	9+3m	U	no	extensive; all skull bones; hypertrophy; no remodeling	brown teeth
Bc 57	60/1	9+3m	U	very slight	absent to very slight	inner table stria
Bc 57	60/3	2y+8m	U	slight; remodeling	moderate; hypertrophy; mostly remodeled	
Bc 57	60/9	nb+2m	U	no	no	
Bc 57	60/11	5y+16m	U	no	no	
Bc 57	60/12	18+6m	U	moderate; slight hypertrophy	slight; remodeling	
Bc 57	60/13	6	U	slight	extensive; hypertrophy	
Bc 57	60/13	3-4	U	moderate; remodeled	(could belong to either individual)	
Bc 126	SWI#2	9+2	F?	extensive 'coral-like'; remodeling	no	
Bc 236	#62	nb+2m	U	unknown	no	
29SJ 389	#470	1y+4m	U	absent/slight; rounded	extensive; hypertrophy; remodeling	slight porosity of ribs
29SJ 627	2	@30	M	no	no	thick occipitals
29SJ 627	3	3+1	U	moderate and unknown	no/unknown (fragmentary)	
29SJ 627	5	@1	U	unknown	extensive (fragmentary)	
29SJ 633	1	12+4m	U	slight; remodeling	moderate; remodeled	
29SJ 633	2	24+8m	U	no	no	
29SJ 633	4	12+4m	U	probably; remodeling	extensive; remodeling	thin cortical bone
29SJ 1360	3	3+1	U	very slight; remodeled	no	
29SJ 1360	5	3+3m	U	very slight; no remodeling	very slight; remodeling	
29SJ 1360	6	1-2	U	very slight; remodeled	slight; remodeling	
29SJ 1360	7	@1	U	slight to moderate; rounded	scattered pores, raised area remodeled or remodeling?	
29SJ 1396	FS 538	5y+16m	U	absent/slight; remodeling	no	
Wijiji	d 3/1	5y+16m	U	unknown	no	
Wijiji	d 3/3	1-2	U	unknown	moderate; remodeling	
near PB1	d 4/2a	4-5	U	unknown	no	
TU	RSU	3-6m	U	moderate; some remodeling	moderate; lesions through both bone tables	most other bones thin and porous
TU	60/2	20-25	F	moderate; no hypertrophy; no remodeling	occipitals, rounded	
TU	60/4	4+1	U	moderate; left hypertrophy; right remodeling	slight; remodeled	bones thin and light; porosities on long bones, ribs, and vertebrae
TU	60/5	5y+16m	U	slight; remodeled	no	remodeled porosities over audit. opening
TU	60/6	18-24+6m	U	very slight; remodeling	moderate to scattered; remodeled	
C Ketl	CK#4	30-50	F	healed area left, right?	no	
K Kletao	#992	3+1	U	very slight; remodeled	no	
K Kletao		2-2.5	U	unknown	unknown	occipital hyperostosis and porous; little or no remodeling

^aYears unless otherwise indicated; @ = approximate.

Table A.6. Other conditions and disorders of uncertain origin

Site	Number	Age (y) ^a	Sex	Description
Bc 50	60/7	40±5	U	nonspecific periosteal infection; right femur proximal shaft and lower shaft (RTS); large lesion above right orbit, partially healed
Bc 51	60/13a	40±5	U	2 button osteomas, frontals
Bc 61	60/17	adult	M	ossified larynx
Bc 51	60/24a	12-15	U	large anterior foramina on thoracic and lumbar vertebral bodies
Bc 51	60/51	35±5	F	anterior-posterior bowing of femora
Bc 51	RSU	12-16m	U	large foramen between auditories and zygoma; lumbar vertebral bodies porous with lesions or fusion defects
Bc 53	60/1	35-50	F	3 button osteomas, left frontal
Bc 53	60/1	9±3m	U	ribs wide at sternal end; small lytic lesion in left femur, bone coalesced and edges rounded, flat and shallow--subperiosteal cortical defect?
Bc 53	60/2	adult	F	lesion in right lower orbit, with new bone but a depression remains
Bc 53	60/4	3±1	U	pitting on interior of parietals
Bc 53	60/5	4±1	U	porosities above both auditory canal openings; small lesions in opening
Bc 53	60/6	30+	F	3 button osteomas, 2 frontal, 1 parietal
Bc 53	60/10	16-18	F	"lacy" patches on T11-T12 bodies, lateral
Bc 53	60/12	9±3m	U	teeth dark brown; no Harris lines; possible periosteal elevation of most skull bones
Bc 57	60/1	9±3m	U	parietals: endocranial atriae radiating from center of ossification
Bc 57	60/3	1-1.5y	U	distal right fibula: bulge and thickened cortex
Bc 57	60/4	40-45	M	patella: osteomyelitis?, mostly healed; hand phalanges very porous and light compared to the other bones; small porosities on the occipital, remodeled; ossified larynx
Bc 57	60/10	50+	F	button osteomas, frontal and 1 rib; proximal humerus: osteomyelitis, some new bone formation but light and fragile; right knee: dislocation or pulled ligament
Bc 57	60/11	5y±16m	F	fibula: puffy with thick cortex and x-ray opaque areas
Bc 59	60/3	30+	F	lumbar vertebrae: extreme asymmetry; ripples in several ribs; pubic symphysis; trauma
Bc 59	60/4	9±2	U	spot on axis vertebra facet, may be postmortem
Bc 59	60/8	35-45	F	left clavicle: enlarged at sternal end, atrophied at acromion; right clavicle: swelling near the acromion and no conoid tubercle; mastoid area may be enlarged
Bc 59	60/10	adult	M	first metatarsal: possible osteomyelitis, lesions and a facet, trauma induced?
Bc 63	60/6	35+	F	bulbous tibiae, broad shafts, very thin walls; all bones very light
Bc 126	60/2	30-40	M	osteomyelitis?: 2 lesions fifth right hand phalanx 1; healed lesion and depressed area on a second foot phalanx may also be osteomyelitis
Bc 126	SW1#2	9±2	F?	lytic lesion in occipital, rounded edges, bone very thin
295J 299	3	30±5	F	C2 and C3 fused; plates present
295J 563	162	40+	F	postmenopausal osteoporosis [WLM]
295J 597	1	45-55	F	proximal tibiae: mechanical disturbance
295J 597	2	20-22	M	distal femur: nonspecific periosteal infection
295J 627	1	22-28	F	left first metatarsal: lesions at each end, pits with coalesced bone inside; very large foramen with sharp edges on right first metatarsal; slight bow to all long bones.
295J 633	3	18-20	M	proximal femur: osteomyelitis, lytic lesion just off the femoral cap
295J 1360	1	40-45	F	3 button osteomas, 1 frontal, 2 parietal
295J 1360	2	35-40	F	3 button osteomas, frontal
unknown	99-6	30±5	M	left femur: flat facet, medial 2/3 down
unknown	4 0/1	35+	U	button osteoma, parietal; depression area in left parietal, healed trauma?
W11j1	4 3/1	5y±16m	U	C7 lesion, granuloma? [WLM]
near PBl	4 4/1	19-20	F	pubic plate trauma, not completely healed
TU	RSU	6m	U	bones thin and porous; lesions through bone table
TU	60/4	4±1	U	cystic lesions in 4 thoracic vertebral arches; 2-3 Harris lines [WLM suggests malnutrition and possibly tuberculosis]
TU	60/5	5y±16m	U	porosities on temporal around auditory opening
TU	CK#4	30-50	F	osteomyelitis?, right capitae
C Ketl	4 1.1/1	18-20	F	pubic plate trauma, nodule, healed
K Kletso		2-5	U	fibula bowed, thin walls; humeri slight twist; large pores in tibia and some ribs;
K Kletso	CC-KK	adult	F	thickened and spongy occipitals; large abscess? in mandible
K Kletso	no #	adult	U	humerus: oblique fracture with osteomyelitis [WLM] humerus: osteomyelitis

Notes: RTS = examined by R. Ted Steinbock.

WLM = examined by William L. Minear.

^aYears unless otherwise indicated; @ = approximate.

APPENDIX B

Chaco Burial Data

Table B.1. List of Chaco burials

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
<u>Bc 50</u>										
60/1	ERM	child 6y	west trench fill, outside of Room 11	extended face down head south		RM pitcher 3 RM sherds				S, A
60/2	Gal ^a	infant 1-2y	Room 7 fill	disturbed	in a pit				skull only	S, A
60/3b	McE	adult	Room 22 fill	disturbed east-west		undecorated pitcher				S, A
60/3a	McE	infant	Room 22 fill	disturbed	reed mat, ashes	Wing bowl			6 vessels near a & b	S, A
60/4	McE	infant	Room 22 fill	extended face down head west	reed mat juniper bark		shell ear plug			B, A
60/5	McE	adult male	Room 22 fill	flexed right side head north	twilled mat slab over knees sherd over head	Gal bowl Cit bowl McE pitcher Wing bowl		awl 2 malach		S, A
60/6	Gal	infant 3y	Room 11 subfloor cist	semiflexed on back head south	reed mat	bowl large sherd	12 bone beads 5 nut beads			S, A
60/7a	Gal	infant	Room 3 fill	disturbed east-west	grass mat in a pit	min RM bowl				S, A
60/7b	Gal	infant <1y	Room 3 fill	semiflexed left side head west	grass mat	McE or Esc bowl				S, A
60/8	Gal ^a	infant	Room 3	disturbed						S, A
60/9	McE	adult female	Room 6 fill	semiflexed back head east	twilled mat	MV/McE bowl Esc pitcher		charred corn cobs		S, A
60/10	McE	adult male	Room 6 fill	semiflexed left side head south		McE bowl		charred corn		S, A
60/7	ERM	adult @40y	Substructure 5, 3" above floor	flexed left side head SE		RM? pitcher				bag, cat
X #50	unk ^a	adult male	Room X, L IV						mandible face & ulna	none
	unk ^a	adult								none
<u>Bc 51</u>										
60/1	McE	adult male	Room 1 fill	disturbed				stone ax		S, A
60/2	McE	8-12y	Room 1 fill	disturbed		RM bowl		3 awls	rad, ulna innominate	S, A
60/3	Gal	adult	Room 1 subfloor	flexed face east head south	matting netting in a pit	lrg. sherds of RM, Esc, corrug	shell pend			S, A
60/4	McE	adult female	Room 1 subfloor	flexed right side head west?	in a pit grass mat	McE bowl bowl		bone scraper		B, S, A
60/8	McE	15y	Room 2 fill	semiflexed left side head east	twilled mat	Esc or Gal ladle bowl		mano food in bowl?		K, R, A
60/9	McE	adult male 45-49y	Room 2 fill	semiflexed face down head east	cotton cloth twilled rush mat	Esc or Gal bowl		mano		K, R, A
60/10	McE	adult female 21-35y	Room 2 below 60/8	semiflexed face down head east	twilled rush mat feather cloth textile	Sunset red bowl McE pitcher corrug sherd (12) RM bowl				K, R, A
60/12 & 60/13	unk ^a	3 adults 2+ males	Room 5 floor	scattered	(12) textile and mat (13) headboard	McE bowl and ladle (13) Deadmans B/R bowl Wing bowl U Gila corrug RM bird vessel	bone beads	bone scraper 2 planks 2 coiled baskets 2 malach		K, R, A
60/14	unk ^a	adult	Room 5 west side	disturbed	twilled mat feather cloth wood pillow				left leg only	K, R, A
60/15	McE	adult male?	Room 2 below 60/10	semiflexed face down head east	twilled mat feather cloth	McE jar, bowl RM jar, Gal bowl U. Gila Corrug RM and La Plata sherds	2 bone beads	coiled basket	some may go with 60/18	K, R, A
60/16	ERM	adult male 30-35y	Room 2 subfloor	flexed right side head west						K, R, A
60/17	McE	child 6y	Room 2 below 60/22	extended back head east	head board twilled mat	corrug small pitcher	3 bone beads	flake corn cob		K, R, A
60/18	McE	child <6y	Room 2	extended back head east	twilled mat	RM bowl Esc? bowl Sunset? red bowl Ch pitcher				K, R, A
also in Room 2										
60/19	unk ^a	adult child	Room 7 fill	disturbed	matting slab	4 Gal pitchers		awl	prob with 60/15 partial	A
60/20	Gal	infant	Room 16 occup. surf.	unknown		Gal sherds corrug				
60/21	Gal?	adult	Room 16 occup. surf.	disturbed		Esc bowl at same level, Gal sherd				A

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
60/22	McE	child	Room 2, beside 60/18	extended back head east	twilled mat may go with 60/18					K,R,A
60/23	McE	adult male?	Room 21 fill	flexed right side head west		Wing bowl & sherds, Esc or McE bowl	piece of frog effigy	mano		A
60/24	McE	adult female 30+5y	Room 20 fill	semiflexed face down head south	twilled mat in a pit	McE sherd		selen crystal awl, squash seed cordage coiled basket		K,R,A
60/25	unk ^a	unknown	Room 18	disturbed		b/w sherd				K,R,A
60/26	Gal	adult female 35-49y	Room 2 subfloor	semiflexed right side head east	2 reed mats mat pillow	Gal pitcher Esc bowl 1/2 red bowl	turquoise ball	chipped stone		K,R,A
60/27	McE	adult male 21-35y	Room 21	semiflexed right side head east		Wing bowl Esc bowl McE bowl & ladle		mano		K,R,A
60/28	Gal? ^a	adult	Kiva 6 floor	secondary or disturbed		Lino & Gal sherds				A
60/29	Gal	infant <1y	Room 2 subfloor	flexed left side head east	slab over head					
60/30	unk ^a	child 4-6y	Kiva 1 vent shaft						skull only	A
60/31	RM	adult female 25-30y	Trench 26 Section 2	extended back head west	slabs around feet and sides stones over	RM bowl & pitcher corrug pitcher neck-banded				K,R,A
60/32	Gal	adult female 840y	Room 2 subfloor	semiflexed left side head south		Gal or Esc pitcher sherd				K,R,A
60/33	Gal	adolescent 13-17y	T.T. 13 trash	disturbed		Gal effigy Esc bowl	shell bracelet frag		skull frags only	A
60/40 or 60/a	McE	adult/older	Trash K13 and L 15	flexed face down head NE or W	in a pit	1/2 McE pot	bone bead shell brace- let frag., concretion	hammerstone arrow point abrader		A
60/41 or 60/b	McE	child	Block IV N-S trench	unknown		Gal worked sherd & bowl McE bowl		awl point		A
60/42	unk ^a	adult	Trash G13-G15	semiflexed left side head east	2 metates over in a pit			2 knife frags		A
60/43	unk ^a	unknown	Trash M-N9	scattered						A
60/44	Gal	infant	Trash M,N13-15	flexed face down head east	in a pit some charcoal	Gal effigy, bowl & handle	shell bead 4 bone beads	ax, concretion		A
60/45	RM	adult male 55-75y	Trash J13-15	semiflexed back head east		1/4 RM bowl				A
60/46	Gal	adult	Trash J13-113	semiflexed back head west		Ch & Gal pitchers corrug & Gal sherds Esc ladle		stone knife 4 selen pieces		A
60/47	unk ^a	adult	trash cross corr. trench	flexed back		none				A
60/48	RM	child	Trash M23 N24		rocks on rocks	small RM bowl				A
60/49	BMIII- PI	adult	pithouse?	scattered		1/2 Lino Gray/ Pug bowl				A
60/50	unk ^a	child	Trash M23, M25	unknown						A
60/51	Gal	adult female 35+5y	Trash I11, I13	semiflexed face down head west	feather robe cotton cloth 2 twilled mats	Ch bowl, smud bowl, pitcher RM effigy Gal ladle handle	2 turq beads 1 shell pend	coiled basket mano, seeds 3 pahos, bone gouge & flesher 2 sticks w/ 60/51		A
60/51a	Gal	child 4y	Trash I13	flexed face down head east	twilled mat feather cloth					A
60/52	unk ^a	unknown							skull frags	A
60/53	unk ^a	adult female 25-39y	Trash J11	semiflexed left side head west	matting in a pit	lrg. corrug sherd				A
60/54	Gal	adolescent 12-15y	Trash J13	semiflexed left side head west	in a pit	Deadmans B/R sherds				A
60/55	unk ^a	adult	trash	facing south		min corrug				A
Burial 1	McE ^a	adult	Room 25 floor	disturbed	matting	5 bowls in area no direct assoc.				A
Burial 2	McE	adult	Room 25 2nd floor	flexed back head south	twilled mat	McE min bowl & bowl Gal bowl RM/Esc effigy smud bowl				A
Room 53	Gal	infant	Room 23 floor level			Gal bowl & min pitcher Esc pitcher				A,CCat
Room 33	Gal	adolescent 14-17y	Room 33 subfloor	flexed left side head SW		Puerco B/R bowl		twilled matting or sandal		A

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
<u>Bc 52</u> Burial	Gal	adult	Room 7 NE corner	semiflexed back head east	cedar bark matting	b/w bowl, mug, & small bowl small corrug pot corrug bowl		block of wood originally called Bc 56		A
<u>Bc 53</u> Burial 1	Gal	adult female 45-50y	Room 6 fill	flexed left side head south	matting feather cloth slabs over	large bowl sherd	hema pend	basketry, corn cobs, seeds sandstone plaque		A
Burial 1	Gal	adult female 30+5y	Room 7 subfloor	extended face down head west		Wing pitcher & bowl, Esc bowl & pitcher	turq earring			A
Burial 2	Gal	infant 2-3y	Room 6 fill	semiflexed back head north	stones over on a patch of clean sand poles, matting, stones over	Puerco pitcher corrug	turq pend	basketry seeds in pitcher 3 small sticks awl, seeds, corn		A
Burial 3	Gal?	adult male 40+y	Room 2 floor in a masonry box	semiflexed right side head south		portion of a Forestdale Smud				A
Burial 4	Gal	child 3-5y	Room 6 floor	semiflexed side head west	slab over					A
B. 2,3&4 1941	unk ^a	2 adult fems. 2 infants	Room 10 floor	disturbed or secondary		MV pitcher?	beads	stone knife worked wood polishing stone		A
60/5 1940	unk ^a	child 4y	Room 8	unknown						bag
Burial 5	unk ^a	adult male?	trash, south trench	disturbed					face only	A
Burial 6	unk ^a	adult	trash, 6" deep	semiflexed right side head south		1 corrug vessel 3 other vessels		2 awls		A
Burial 7	McE	adult male? 30-50y	trash, south trench	semiflexed face down head west		Toadlena pitcher	turq pend & earring	basket		A
Burial 8	Gal	adult male 825 y	Room 15 fill	semiflexed right side head west		Chuska B/W bowl Puerco B/R bowl Gal olla sherd Esc pitcher, corrug Forestdale Smud Gal? sherd		basket cedar knot		A
Burial 9	Gal	infant nb-2 m	Room 10 subfloor	semiflexed face down head west						A
Burial 10	Gal	adult fem? 16-18y	Room 7 subfloor	semiflexed back head east	cedar bark mat basketry under head, cloth	2 Esc bowls smud bowl, Gal bowl Mancos & min corrug pitchers U. Gila bowl Forestdale Smud		block of wood pinyon shells basket		A
Burial 11	Gal	adult female 19-24y	Room 8 subfloor	flexed back head south	feather blanket					A
Burial 12	Gal	infant 5-9m	Room 8 subfloor	extended back south	metate over head			stick (nodule of malach may be associated)		A
<u>Bc 54</u> Burial	unk ^a	child 6-10y	dump	semiflexed back head west	twilled matting	1/2 Forestdale Smud				A
<u>Bc 55</u> Burial	unk ^a	unknown	under a rock south of ruin	unknown		olla				A
<u>Bc 56</u> no #	unk ^a	2 individuals	Room 6	unknown				"soft spots"		A
<u>Bc 57</u> Burial 1	McE	infant 9m	Room 1 SW corner	semiflexed back head north	matting wrapped in cotton cloth	neck-banded pot				A
Burial 2	McE	adult female 25+y	Room 1 fill	semiflexed right side east-west		1/2 corrug pot	bead	flat ground stone		A
Burial 3	McE	infant 1-1.5y	Room 1 subfloor	extended? back head west		sherds b/r bowl b/w olla and ladle				A
Burial 4	McE	adult male 35-45y	Room 1 subfloor	flexed right side head west	stone-lined pit twilled matting cloth stones over matting under head	Ch bowl smud bowl McE pitcher b/w ladle b/w sherds		17" strip of wood		A
Burial 5	McE	adult male 45-50y	Room 3, just under floor	flexed right side head west				3 awls		A
Burial 6	McE	infant 3-4m	Room 9 SE corner	flexed right side head NW		none				A
Burial 7	unk ^a	child 6y	unknown			MV bowl				A
Burial 8	unk ^a	infant 2-4m	Room 5 subfloor	scattered extended right side	stone over feet large rocks around ashes over	b/w mug				A
Burial 9	McE	adult male 25-45y	Room 9	head east						A

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
Burial 10	unk ^a	adult female 50+y	unknown							none
60/11	unk ^a	child 5y	unknown							none
60/12	unk ^a	infant 18m	unknown							none
60/13	unk ^a	2 children 3-4 & 6y	unknown							none
Bc 58 no #	unk ^a	unknown	Room 1 floor			RM bowl		3 artifacts		cat.
Bc 59										
Burial 1	unk ^a	child 9y	midden near surface	flexed head SE				charred corn		A
Burial 2	Gal	adult 35-40y	Room 8 just above floor	flexed back head north	rock covered	none		awls scraper fragment		A
Burial 3	Gal	adult female 30+y	Room 8 fill		cord mat	Mancos B/W bowl MV ladle		tiny black seeds		A
Burial 4	Gal	adult female elderly	Room 8 just above floor	flexed left side head east	juniper matting in a pit 2 sticks on skull	gray bowl MV? mug, bowl 2 dippers		red pigment malach		A
60/5	McE	female 16y	Room 6 SE corner			pitcher				A
Burial 6	unk ^a	adult	Kiva 2	carnivore- disturbed				gaming piece or bone ornament		A
Burial 7	Gal	adult male 35+y	Rooms 4 & 5 trash fill above floor	flexed left side head west?	twilled mat mat	Toadlena? ladle		black cylindrical stone 20 x 7mm		A
Burial 8	Gal	adult female 35-45y	Rooms 4 & 5 against S wall	flexed left side head west	matting		2 turq pends	egg shell burned		A
Burial 9	Gal	adult female	Rooms 4 & 5 NW corner	semiflexed left side head NW	3 mats	Ch bowl & mug	3 proj pts at neck	textile bag 4 hammerstones charred bean		A
Burial 10	Gal	adult male	Rooms 4 & 5 below B.9	unknown	twinned material	b/w pitcher				A
Burial 11	Gal	adult male 25-30y	Rooms 4 & 5 NW corner, above floor	flexed left side	twinned mat	Ch pitcher Esc bowl smud bowl		hammerstone seeds	burned	A
Burial ?	unk ^a	unknown	Room 6	scattered	large stones and ashes over pit		stone, shell & turq necklace (30 beads)			A
59/B1 C1891	MV ^a	adult female young	Kiva 3 floor	disturbed		MV sherd				A
59/B2 C1892	McE	adult (prob female)	Room 16 subfloor	flexed left side head south		McE pitcher smud bowl	103 jet, 52 shell bead	2 quartz crystals 4 atlatl cylinders necklace ground clear stone w/ jet bird effigy pendant		A
59/B3	Gal	child 3y	Room 16 subfloor	semiflexed left side head south		Ch pitcher RM min ladle				A
59/B4 C1894	Gal	adult female older	refuse	flexed left side head east		1/2 Gal bowl Puerco pitcher bottom corrug sherd		polishing stone		A
59/B5 C1895	unk ^a	adult & child	refuse						skull frags	A
Burial 5 59/B6 C1896	unk ^a McE	small child child 3y	unknown refuse			McE bowl & pitcher Forestdale Saud				A A
59/B7 C1897	Gal	adult female?	refuse	flexed back head south semiflexed left side head SSW disturbed	twilled mat around	Gal & Forestdale sherds				A
59/B8 C1898	unk ^a	adult female?	refuse	disturbed		no offerings				A
59/B9 C1899	unk ^a	adolescent	refuse	disturbed		no offerings				A
59/B10 C1900	unk ^a	adult male?	refuse	flexed back head west semiflexed disturbed		1/4 bowl				A
59/B11	Gal	child 5y	refuse	flexed back head SE left side head north flexed left side head NW		Ch 2 bowls 1 pitcher lugs				A
59/B12 C1902	Gal	child 4-6y	refuse			2/3 Esc canteen				A
59/B13 C1903	Gal	adult female	refuse			Puerco sherds				A
59/B14 C1904	Gal	child	refuse			Esc bowl				A

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
59/B15 C1905	Gal	child	refuse	semiflexed face down		RM dipper 1/4 Esc bowl, Ch bowl				A
59/B16 C1906	Gal	adult male and infant	refuse	disturbed		Esc? ladle corrug jar corrug pitcher				A
59/B17 C1907	Gal	child	refuse	semiflexed face down						A
59/B18 C1908	unk	child	refuse	disturbed		large sherd				A
59/B19 C1909	Gal	adolescent @12y	refuse	disturbed back		Esc ladle corrug jar			skull & arm	A
59/B20 C1910	unk	adult female? elderly	refuse	disturbed		no offerings				A
59/B21 C1911	unk	2 adults?	refuse	disturbed/ mixed		no offerings				A
59/B22 C1912	Gal	adult female	refuse	flexed right side head SE		red ware sherds Esc pitcher				A
59/B23 C1913	ERM	adult female?	refuse	semiflexed back head south		Lino Gray vessel sherds				A
59/B24 C1914	unk	adult female	refuse	disturbed		no offerings				A
59/B25 C1915	unk	adult	refuse	flexed left side head SE		no offerings				A
59/B26 C1916	unk	child	refuse	flexed face down head SW						A
59/B27 C1917	ERM	child?	refuse	extended back north-south		ERM bowl b/r bowl frag				A
59/B28 C1918	unk	child <12y	refuse	disturbed		broken bowl				A
59/B29 C1919	McE	infant	refuse	unknown		Winona Saud bowl min pitcher bird effigy U. Gila Red bowl				A
59/B30 C1920	unk	adult female	refuse	semiflexed east-west disturbed						A
59/B31 C1921	unk	infant 6-10m	refuse	semiflexed back north-south		no offerings				A
59/B32 C1922	unk	adult female infant skull frag	refuse	disturbed		no offerings				A
59/B33 C1923	unk	adult male	refuse	flexed back head south		broken utility vessel				A
59/B34 C1924	Gal	adult female? 19-20y	refuse	flexed right side head NW		Esc bowl 1/2 Gal bowl				A
59/B35 C1925	unk	small adult	refuse	flexed north-south						A
59/36 C1926	Gal	adolescent @16y	refuse	flexed left side		1/2 RM/Esc bowl Gal bowl, cul jar				A
59/B37 C1927	Gal	adult female	refuse	flexed right side head south		Ch pitcher RM/Esc bowl				A
SK 1	unk	child	refuse	head south	stones?	small pitcher				P
SK 2	unk	adult	refuse 6" deep	semiflexed back head south						P
SK 3	unk	unknown	refuse 3" deep	flexed? head NE	stones?	bowl, pitcher, square piece				P
SK 4	unk	older adult	refuse 1'2" deep	flexed back head east	stones?	pitcher, bowl olla portion		large stones by bowl		P
SK 5	unk	adult	refuse 1'11" deep	extended back NW-SE	stones?	large bowl, small bowl pitcher				
SK 6	unk	adult	refuse 4' deep	semiflexed back head SE	stones?	corrug neck corrug jar water bottle small bottle				P
SK 7	unk	adult female	refuse 8" deep	flexed back east-west	stones?	corrug pitcher				P
SK 8	unk	unknown	refuse 4" deep	head SE	stones?	no offerings				P
SK 9	unk	adult	refuse 3" deep	flexed back head south	stones?	jar		awl		P
SK 10	unk	child	refuse 3' deep	face down north-south	stones?	pitcher sherd				P

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
SK 11	unk ^a	adult	refuse 1'2" deep	semiflexed back head west	stones?					P
SK no#	unk ^a	unknown	unknown		stones?	corrug jar, sherd		"bone celt"	skull only	P
<u>Bc 126</u>										
Burial 1	unk ^a	adolescent 12y	Room 3 6" above floor	scattered	matting	1/2 b/r bowl				A
Burial 2	unk ^a	adult male 35-40y	Room 3 in adobe bin	extended back head NE	plank over bin layer of bark 3 mats, stones		breast plate of reeds			A
<u>Bc 192</u> RSU	Gal	adult female 35-45y	Room 6 subfloor	semiflexed right side head south		no offerings				A
<u>Bc 236</u>										
Burial 1	MV	infant nb+2m	Room 2 floor	disturbed		MV bowl				A
Burial 2	unk ^a	adult female 25+5y	refuse	extended back head north						A
<u>Bc 326</u>										
Burial 1	Gal	infant 2-3m	Room 13 subfloor	semiflexed back head north	reed mat cotton cloth fine charcoal	min corrug Esc bowl corrug jar				A
Burial 2	Gal	adult female 822y	plaza	flexed back head north	reed shroud	Esc pitcher & 1/2 bowl				A
<u>29SJ 299</u> Bl-4	RM ^a	4 adults (1 male, 2 females, 1 female?)	kiva	disturbed						NPS
<u>29SJ 389, Pueblo</u> FS470	Nav ^a	infant 1y	kiva fill	head west						NPS
<u>29SJ 563</u>										
Burial 1	unk ^a	adult female 40+y	isolated	semiflexed back south	fur robe matting pillow, cloth	bowl sherd		basket? sandal		NPS
<u>29SJ 597</u>										
Burial 1	Gal	adult female 45-55y	trash area	semiflexed back head north	stones over	min corrug				NPS
Burial 2	unk ^a	adult male 20-22y	trash area	flexed back head NNW	shallow indistinct pit					NPS
<u>29SJ 626</u>										
Burial 1	RM ^a	adult	trash midden Level 2	disturbed					cranium	NPS
Burial 3	Gal	adult	trash midden	semiflexed disturbed		Gal duck pot				NPS
<u>29SJ 627</u>										
Burial 1	RM	adult female 22-28y	Room 1 Floor 2	semiflexed back head south		RM 2 bowl, 1 pitcher olla frag gray sherds		10 well-made proj pts		NPS
Burial 2	Gal	adult male 30+5y	Room 9 Floor 1	semiflexed back head east		corrug sherds Esc bowl Gal seed jar frag	hema tube	proj pt		NPS
Burial 3	RM	child 3y	test trench	disturbed head south		2 RM min bowls min pitcher		2 ground stones		NPS
Burial 5	Gal	infant 1y	Room 5 subfloor SW corner	semiflexed face down? head SE	juniper bark mat	Mancos ladle bowl min corrug 2 sherds				NPS
<u>29SJ 629</u>										
Burial 1	RM	adult male 30+5y	trash	semiflexed back head west	shallow pit stones over					NPS
Burial 2	RM	adult male?	trash	semiflexed back head NW	slab over skull					NPS
<u>29SJ 633</u>										
Burial 1	MV	infant 1y	Room 8 subfloor	semiflexed left side head west	in floor feat. ashes over pigment on parietals	corrug sherd Crumble House ladle				NPS
Burial 2	MV	infant 2y	Room 8 subfloor	semiflexed face-down head west	in a stone- lined pit ashes over stone over pit	MV ladle & bowl	turq chip			NPS
Burial 3	MV	adult male 18-19y	Room 7 on the floor	flexed face down head north	slabs over skull	b/w ladle	worked selen quartz crystal			NPS
Burial 4	MV	infant 1y	Room 7 subfloor	semiflexed face down head SE	stone-plugged pit	corrug sherd				NPS

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
<u>29SJ 721</u>										
FS 40	McE	adult female 820y	kiva fill	semiflexed back head east		smud sherd				NPS
<u>29SJ 1396</u>										
Burial 1	unk ^a	child 5y	trash	disturbed face down head east	small pit	sherds	shell bead			NPS
<u>29SJ 1629</u>										
Burial 1	Gal	adult female	isolated	flexed left side head east	matting fur cloth textile	RM ladle Gal canteen				NPS
<u>The Three C site</u>										
Burial 1	ERM	adult	trash	flexed head north		Kana'a jar Kiat bowl			pelvis & long bones	A
Burial 2	ERM	adult	trash	disturbed semiflexed		RM bowl no offerings			legs only	A
Burial 3	ERM	adult	trash	disturbed		RM bowl			skull & some long bones	A
Burial 4	ERM	adult	Room A subfloor	extended back head west	slabs over	no offerings				A
Burial 5	ERM	adult	trash	flexed left side head NW		small Kana'a				A
Burial 6	Gal?	child	trash	head north		Esc pitcher				A
Burial 7	ERM	child	trash	disturbed back head north		no offerings				A
Burial 8	ERM	adult	trash	semiflexed back head south		no offerings				A
Burial 9	ERM	adult	trash	disturbed		White Mound bowl			fibulae	A
Burial 10	ERM	adult	trash	flexed back head SW		large sherds				A
Burial 11	ERM	adult	trash	semiflexed back head SW	slab over head					A
Burial 12	ERM	adult	trash	flexed face down head west		no offerings				A
Burial 13	ERM	child	trash	disturbed head SW		small cul bowl frag				A
Burial 14	ERM	adult	trash	unknown	covered by slab				legs only	A
Burial 15	ERM	child maybe >1y	trash	disturbed head NW		no offerings				A
Burial 16	ERM	youth	trash	semiflexed back head NW		no offerings				A
<u>Leytt Kin, Bc</u>										
Burial	MV	infant	Room 16 subfloor	extended back head west	reed mat juniper mat cloth	2 halves of MV vessels		pumpkin seeds turkey carcass		D
<u>Kin Kletso</u>										
Burial 1	McE	infant 2-3y	Room 41 fill	flexed back head east		no offerings				VM
Burial 2	McE	infant	Room 37 fill	semiflexed left side head west	7 poles & mat cradle board? twilled matting pit sealed	1/2 McE bowl cul jar		4 squash seeds proj pt		VM, A
Burial 3	McE	child 9-12y	Room 52 subfloor pit	disturbed head west		1 sherd				VM
Burial 4	McE	infant <1y	Room 16 floor	disturbed left side head east	shallow pit	Gal bowl Ch pitcher (McE bowl?)				VM
Burial 5	McE	infant 1-2y	Room 16 floor	flexed left side head east	shallow pit	2 Chuska bowls Black Mesa bowl 1/2 Tusayan B/R bowl 1/2 McE bowl McE? bowl				VM
Burial 6	McE?	adult female 17-18y	Room 11 fill	scattered						VM
<u>Bc 248</u>										
60/1	unk ^a	child 7y	cross trench V	flexed face down head west						bag
<u>Kin Ya'a</u>										
Burial	McE ^a	adult male 35-45y	NW corner room of Tower Kiva, fell from 2nd story	disturbed		McE bowl			no skull	bag

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
<u>Near Una Vida</u>										
Burial	unk ^a	infant and child	1/2-1 mile along talus slope	flexed		2 pitchers 3 lrg. bowls 3 small bowls	2 pink pends			A
<u>Casa Rinconada</u>										
Burial	Gal	adult male 40-50y	outside east wall	semiflexed sitting head west		1/2 Gal bowl				A
<u>Near Peñasco Blanco</u>										
Burial	unk ^a	child 4y	low mounds	flexed		no offerings				A
<u>Talus behind Wiji</u>										
Burials	unk ^a	2 infants 1 child 2 adults	talus	unknown		4 pieces b/w				A
<u>Pueblo Bonito</u>										
327127	Gal	adolescent 8-10y	Room 329	extended back head east	bullrush mat	Gal pitcher 2 pitchers bowl				J, H
327102	Gal	female @12y	Room 329 NW corner	back head west	willow screen	Gal bowl 2 b/w pitchers				J, H
327103	Gal	child <6y	Room 329	extended back head east		duck pitcher 2 pitchers small bowl				J, H
327104	Gal	child <6y	Room 329 SW corner	semiflexed right side head NE		3 bowls	2 shell pends	food in bowls		J, H
327105	Gal	child 6y	Room 329	head south		no offerings				J, H
327107	unk ^a	infant <2y	Room 329	unknown						J, H
327106,	unk ^a	16 females	Room 329	disturbed	cotton cloth	17 b/w bowls 8 b/w pitchers 1 b/w effigy 1 b/w other 1 red-brn pitcher 6 cyl vessels worked sherds	turq: beads, mosaic, frags shell pends "8" beads	food in 3 bowls arrowheads, 10 awls azurite & malach stone jar covers worked calcite copper bell frags		J, H
327111- 327129		1 male 6 children								
327049	unk ^a	adult female older	Room 320A	extended face down head east	willow mat			2 baskets	no skull	J, H
327058	RM	adult female	Room 320 beside 327059	extended back head east	reed mat feather robe textile	RM pitcher 1/2 RM bowl		2 baskets		J, H
327059	RM	adult female	Room 320 beside 327058	extended back head east	reed mat feather robe textile					J, H
327048, 327058- 327065	unk ^a	7 adult fems. 1 adult male 1 fetus	Room 320	disturbed	willow mats mat frags	14 pitchers 6 cyl vessels 7 bowls ladle pipe	turq beads, pende & frags shell "8" beads, pende stone beads	9 baskets, galena malach, azurite sulphur, awls scraper, proj pts flakes, jar covers yucca carrying band loom stick ceremonial staffs digging stick 25 proj pts arrow shafts with 16 proj pts		J, H
327088	RM	adult male late 20s	Room 330 center	extended back head east		RM bowl				J, H
327098	RM	child <6y	Room 330 floor, NW	flexed	in adobe bin stick over unknown					J, H
327100	RM	adult male 25-28y	Room 330 subfloor	semiflexed back	unknown	RM bowl b/w pitcher	shell necklace eardrops, beads pende, earrings			J, H
3270792b	unk ^a	child	Room 330	disturbed						J, H
3270812	unk ^a	adult male	Room 330	disturbed	fiber mat		jet disc			J, H
3270832	unk ^a	adult male	Room 330	disturbed			4 jet rings			J, H
3270842	unk ^a	adult male	Room 330	disturbed				8 proj pts		J, H
3270872	unk ^a	?	Room 330	disturbed						J, H
3270942	unk ^a	adoles. male	Room 330	disturbed	bullrush mat					J, H
3270982	unk ^a	child 8-10y	Room 330	disturbed						J, H
3270992	unk ^a	adult male	Room 330	unknown			haliotus shell discs, pend 2 shell discs	pot rest		J, R
327080, 327082, 327085, 327086, 327088- 327093, 327095- 327097, and X		1 adoles. male 5 adult males 4 adult females 3 children	Room 330	disturbed	cotton and willow mats	16 bowls 2 smud bowls 16 pitchers Ch canteen 6 cyl vessels bifur vessel ladle & frags worked sherds duck pitcher	turq: on shell mosaic, beads, baskets, garnet discs, frags jet: bird ring, 2 rings stone beads shell: 7+ pende, "8" beads, mosaic red shale pende	azurite, pigment galena, awls, 8 proj pts stone jar covers		J, H
327069	Gal	adult female	Room 326 above floor	extended back head east	basket pillow	3 RM bowls 1 Gal pitcher ceramic ring				J, H

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
327070	Gal	adult female	Room 326 above floor	extended back	mat?	RM bowl, pitcher 2 Puerco/Esc bowls Ch pitcher		oval basket tray		J, H
327071	Gal	adult female	Room 326 above floor	extended back	rush mat twilled mat	unknown		humerus scraper		J, H
327072	Gal	adult female	Room 326 above floor	extended back	mat?	RM bowl RM/Puerco/Esc bowls Ch bowl, pitcher 1/2 joint offerings: RM & 2 Puer bowls RM/Puerco pitcher b/w bowl Puerco/Mancos pitcher 1/2 joint offerings above	turq pend jet pend 4 hemat cyls	2 digging sticks passive abrader 1/2 oval basket trays 2 humerus scrapers bifur and 2 cyl baskets 1/2 joint offerings above		J, H
327073	Gal	adult female	Room 326 above floor	extended back	mat?		turq pend			J, H
327074	Gal	infant	Room 326 above floor	semiflexed back	mat?			cyl basket bifur basket		J, H
327075	unk ^a	adult female	Room 326	disturbed	mat	b/w bowl				J, H
327076	Gal	adult female	Room 326	extended back	bullrush mat	5 Ch bowls 2 Ch pitchers RM olla 3 Gal/Ch bowls 3 RM bowls	turq pend & bead bracelet	humerus scraper oval basket tray		J, H
327077	unk ^a	adult female 30-40y	Room 326 floor	semiflexed right side head east	bullrush mat				burial?	J, H
327078	unk ^a	1 male 1 female +?	Room 326	disturbed	mats	9-35 b/w bowls smud bowl 3-6 pitchers 17 olla corrug jar frag worked sherds	turq: 6 pend, frags stone beads hemat bead ring frag crystal pend stone cyl bone beads button	quartz pebbles galena, hemat clay ball on stick awls, gaming piece stone tablets sandal lasts 8 proj pts jar covers cyl baskets		J, H
327131	unk ^a	infant	Room 287 fill	unknown						J, H
327133	unk ^a	infant <1y	Room 290 fireplace	semiflexed face down head west	ashes around					J, H
327134	unk ^a	fetus	Room 309 SE corner behind screen					macaw skeleton behind screen		J, H
327135	unk ^a	fetus	Room 306 hole in floor		sticks over hole			3 macaws buried in this room		J, H
3659	unk ^a	adult male @30y	Room 33	extended back						P
3660	unk ^a	adult male 40+y	Room 33	head west disturbed	cloth	corrug bowl nearby	turq beads and pend near skulls	ceremonial reed objects		P
3661	unk ^a	adult male @35y	Room 33	disturbed	cloth		turq beads and pend near skulls			P
3662	unk ^a	adult female 35+y	Room 33	disturbed				galena nearby		P
3663	Gal	adult female @30y	Room 33	extended back	cloth	Puerco cyl vessel & bowl Ch pitcher Ch pitcher		jar cover cord		P
3664	unk ^a	adult male 30+y	Room 33	disturbed		4 bowls 5 pitchers				P
3665	unk ^a	adult female @25y	Room 33 SW corner	disturbed						P
3666	unk ^a	adult female 35-40y	Room 33	disturbed						P
3667	unk ^a	adult male	Room 33	disturbed						P
3668	unk ^a	adult female?	Room 33	disturbed						P
3669	unk ^a	adult female	Room 33	disturbed						P
3670	unk ^a	adult male 35+y	Room 33	extended back						P
associated with 3659-3670			Room 33	head west	1 burial mat	1 corrug bowl 5 pitchers 6 bowls 1 corrug jar 1 cyl vessel	turq: 512 pend, 24932 beads, 1052 matrix, 451 sets shell: 2042 beads, reed object, 98 worked pieces, 2 jar covers, 10 discs, 89 bracelet frags, textiles, quartz 2 olivella beads, crystals, and knife inlaid pend 173 jet and stone 6 proj pts, circ inlays jet ring 2 iron pyrite sets	6 flageolets, 12 ceremonial sticks, 2 throwing sticks, seeds, nuts, minerals and pigments yucca mat, bones, awl fragment		P

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
3671	EM	adult male 35+y	Room 33	extended right side head NE	under plank floor clean sand ashes		5900+ turq beads, sets, pende	many other objects in room including offerings in each corner		P
3672	EM	adult male 25+y	Room 33	semiflexed back? head north	under plank floor clean sand ashes		turq: 1000s of beads, pende, mosaic cyl sets shell: beads bracelets, pende, trumpet, effigies, mosaics stone inlays			P
no #	McE?*	adult	Room 32 fill	disturbed head SE	cloth wrapping stone over	2 bowls pitcher dipper corrug cyl vessel	hemat bird w/ turq inlay jet ornament 9 turq beads 2 shell beads	wooden implements fish vertebrae 4 jar covers		P
also in Room 32					cloth	5 pitchers, 1 jar, 3 bowls 1 cyl vessel		300+ ceremonial sticks, game sticks, decorated wooden slab, 2 other slabs, 81+ quiver of arrows, elk antler club, 3+ sandals, 2+ baskets, galena, and gypsum		P
SK 1	unk	child	Room 90 subfloor	head north					from notes	P
5634	unk*	child	Room 53 near east wall		feather cord blanket		4000+ turq & shell beads	prob. more in room debris	skull	P
Peabody N/3075	unk*	adult	Room 56 subfloor	unknown	feather robe cloth	some pottery		wooden objects		Mh
<u>Pueblo del Arroyo</u>										
321140	McE/MV*	male? 15y	Room 13A	semiflexed back head west	rush mat			basket vegetal objects	burial?	J, A
327132	McE/MH*	infant	Room 4 above floor	head west	textile- wrapped					J, A
327139	unk*	adult male	Room 10A NE corner above floor	disturbed		no offerings				J, A
327138	unk*	adolescent	Room 11A west end	disturbed				3 awls bone scraper		J
331211	McE/MV*	adult male	Room 40 floor SW	semiflexed right side head north	stones around many are tools	McE/MV bowl & pitcher		2 pieces of split cedar		J
331212	unk*	adult female	Kiva H bench level	scattered						J
331213	unk*	child	Kiva H bench north side	scattered						J
331214	unk*	child	Kiva I fill							J
331215	unk*	unknown	Room 63	flexed right side head west					bad condition	J
331215	unk*	unknown	Room 40 NE corner							J
331215	unk*	unknown	Room 43 fill SW corner							J
RSU	unk*	adult male 825y	Room 82A	disturbed right side	matting					A
<u>Talus Unit</u>										
CK/4	McE*	adult female 29+y	Room 10 high in fill	semiflexed back head east	woven garment w/red design slab over pelvis	2 Puerco bowls triangular vessel 4 b/w vessels, corrug b/w ladle 1/2 bowl		obsidian and chalcadony flakes		A
60/2	unk*	adult female 20-28y	Kiva 8 lowest floor	flexed face down head east				2 proj pts		A
60/4	unk*	infant 4+y	Room 2 under floor 3	flexed right side head north		broken pot		squash rind		A
60/5	unk*	child 5y	unknown							none
60/6	unk*	infant 2y	scattered above floor	disturbed				awl		none
RSU	unk*	unknown	Room 19b	disturbed		b/w bowl animal effigy 2/3 Ch bowl 3 corrug sherds		awl		memo
RSU #1	Gal	infant 6-12 m	unknown	semiflexed back head east						memo
<u>Chetro Ketl</u>										
CK d 1.1/1	Gal*	adult (notes) 3 females and 1 male (bag)	dump level 11	flexed or extended left side (notes) head south or north (bag)		Gal/Ch pitcher 3 b/w pots	turq pend? awl?	notes and bag conflict		A, bag

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
<u>Pepper's Burial Mound 2 south side of the canyon, west of Chetro Kati (Ec 117 and 118 or 29SJ 383?)</u>										
SK 12	unk ^a	adult	Sec 4 3'3" deep	head NW	stones over					P
SK 13	unk ^a	adult	Sec 7 9" deep	disturbed head NW		large bowl smaller bowl		sandstone gourd		P
SK 14	unk ^a	unknown	Sec 6 2' deep	unknown	large flat stone					P
SK 15	unk ^a	small child	Sec 6 & 7 1'7" deep	semiflexed back head SE						P
SK 16	McE ^a	unknown	Sec 9 1" deep	unknown		large bowl, jar red bowl				P
SK 17	unk ^a	unknown	Sec 6 8" deep	disturbed		bowl				P
SK 18	unk ^a	unknown	Sec 12 6" deep	rodent-disturbed head NW		jar, bowl				P
SK 19	unk ^a	adult male?	Sec 1 1' deep	semiflexed back head south						P
SK 20	unk ^a	young person	Sec 4 1'6" deep	disturbed face down		2 bowls 1 pitcher		ground stone		P
SK 21	unk ^a	unknown	Sec 6 1'8" deep	head west		red bowl, sherd ladle, corrug jar				P
SK 22	unk ^a	unknown	Sec 7 1' deep	disturbed head west		bowl				P
SK 23	unk ^a	child	Sec 8 10" deep	head west		large bowl frag bowl-shaped jar				P
SK 24	Gal	adult	Sec 8 10" deep	semiflexed back head SE		2 bowls 1 min corrug		awl		P
SK 25	unk ^a	young person	Sec 9 10" deep	head south		red bowl				P
SK 26	unk ^a	unknown	Sec 7 1'6" deep	bad condition		3 bowl frags corrug bowl corrug sherd				P
SK 27	unk ^a	adult	Sec 8 1'3" deep	semiflexed head south		bowl, water jar				P
SK 28	unk ^a	adult	Sec 10 10" deep	flexed right side head south		no vessels				P
SK 29	unk ^a	adult female? older	Sec 10 1'1" deep	flexed back head SW		pitcher frag bowl				P
SK 30	unk ^a	adult	Sec 15 7" deep	left side		bowl, pitcher			occipital & legs	P
<u>Shabik'eshchee Village</u>										
14 skeletons			9 under refuse 4 in refuse 1 pit in room	13 semiflexed 12 left side 1 right side 1 on back with head east 12 heads west 1 head north		11 w/ no objects 1 w/ smudg bowl 1 w/ La Plata bowl 1 w/ plain bowl				R
<u>Turkey House (Roberts excavation)</u>										
Burial 1	Gal?	child 4-5y	dump 1' deep	flexed right side head east	ring of stones slab over	min pitcher				A
Burial 2	Gal?	adult female child parts	dump 1'4" deep	unknown	slabs over	Gal canteen frag 1/2 red bowl				A
Burial 3	Gal?	infant 2-3y	dump 2' deep	left side head west	slabs over bed of ashes	corrug pitcher b/w bowl		some bones charred		A
Burial 4	Gal?	infant 2-3y	dump shallow	left side head west		Gal pitcher 1/2 red bowl				A
Burial 5	Gal?	adult male	dump 2.5' deep	flexed face down head east	large slab ashes	b/w ladle 1/2 sand bowl		some bones charred		A
Burial 6	Gal?	adult male	dump 4' deep	face down head NE	large slabs and stones	small b/w pitcher		concretion red pigment		A
<u>10 miles east of Pueblo Bonito (Roberts excavation)</u>										
Burial	MV?	infant	room floor	back head west	cedar twig (cradle board?) slab over	corrug sherd				A
Burial	MV	adult	room?	right side head north	unknown	MV bowl				A
Burial	unk ^a	infant <9m	room NE corner	left side head north	slab over			stone bowl pretty rock		A
Burial	unk ^a	child 4-5y	same room as above, south wall	face down head east	unknown		bone bead			A
Burial	MV ^a	2 children	Room 7			bowl, corrug jar MV ladle			skulls only	A

Table B.1. (continued)

Number	Period	Age/sex	Location	Position	Preparation	Ceramics	Ornaments	Other	Comments	Refer.
Burial	MV	adult male	Room 9	semiflexed back	stick and slabs over	MV mug				A
Burial	MV	adult female?	Room 9?	head north left side		MV bowl, canteen				A
Burial	MV	adult male older	Room 9 subfloor	head east back		corrug pitcher MV bowl & pitcher				A
<u>29SJ 2358 (Roberts excavation)</u>										
Burial	unk ^a	unknown	Room 4 subfloor	disturbed					burned skulls and long bones	A
Burial	unk ^a	adult male	Room 7 subfloor	flexed right side		b/w bowls small corrug jar				A
Burial	unk ^a	infant 2y	east court	head east flexed? left side head east		bowl frag				A
<u>Tosser-Parabee expedition 8 miles west of Pueblo Bonito, three other "burial mounds," Mesa Tierra, and Picture Cliff</u>										
Md 1 #5	unk ^a	unknown	10' deep	disarticulated		small cooking pot small bowl, bowl frag				A
Md 2 #4	unk ^a	adult		flexed left side		min corrug large b/w sherd corrug pot				A
Md 2 #7	unk ^a	child								A
Md 2 #8	unk ^a	child	just below surface							A
Picture Cliff	unk ^a	adult		semiflexed head south	stone-lined cloth	small undec. pot	jet pend			A
<u>Kin Neole* 1/3 mile west of Kin Bineola; Hrdlička states it originally held 100 graves</u>										
		23 infants	deep stone	all flexed		all had some (usually two)				
		6 children	cysts							
		4 adolescents								
		4 adult males								
		11 adult females								
		20 adult unknowns								
		4 unknown								

Codes:	Period	Ceramics	References
ERM = Basketmaker- Early Red Mesa		bifur = bifurcated	A = archives
RM = Red Mesa		Ch = Chaco Black-on-white	B = Brand et al. 1937
Gal = Gallup		Cit = Citadel Polychrome	bag = bag with skeleton
McE = McElmo		corrug = corrugated ware	CCat = Chaco catalog cards
MV = Mesa Verde		cul = culinary	cat = other catalog
unk = unknown		cyl = cylindrical vessel	D = Dutton 1938
		Esc = Escavada Black-on-white	H = Hrdlička n.d.
		frag = fragment	J = Judd 1954 or 1959
		Fug = Fugitive Red	KR = Kluckhohn and Reiter 1939
		Gal = Gallup Black-on-white	memo = NPS memo
		Kiat = Kiatuthlanna Black-on-white	Mh = Moorehead 1906
		McE = McElmo Black-on-white	NPS = NPS field notes
		min = miniature	P = Pepper 1909 or 1920
		MV = Mesa Verde Black-on-white	R = Roberts 1929
		RM = Red Mesa Black-on-white	S = Senter 1937
		smud = smudged wares	VM = Vivian and Mathews 1965
		U. Gila = Upper Gila Corrugated	
		Wing = Wingate Black-on-red	
<u>Ornaments</u>			
hemat = hematite			
malach = malachite			
pend = pendant			
proj pt = projectile point			
selen = selenite			
steat = steatite			
turq = turquoise			

*Entries noted by * are not used in this analysis.

*^b indicates a partial list of associations--due to disturbance.

APPENDIX C

Mortuary Practices: Significance Tests

Table C.1. Mortuary practices: Significance tests

Variable 1	Variable 2	χ^2	$p(\chi^2)$	df	χ^2_c	$p(\chi^2_c)$	Fisher's Exact p
<u>RM III-Early Red Mesa</u>							
Shabik., other sites	location: room, midden						.45
	position: extended, flexed						.11
	orientation: N-S, E-W						.005
	vessel: + -						.19
location: room, midden	age: adult, child						.38
position: extended, flexed							.04
orientation: N-S, E-W							.24
vessel: + -							.38
bowl: + -							.53
<u>Red Mesa</u>							
<u>small sites</u>							
location: room, midden	age: adult, child						.71
orientation: N-S, E-W							.40
stone/slab: + -							.71
vessel: + -							.29
bowl: + -							.71
pitcher: + -							.48
<u>Bonito, small sites</u>							
Bonito, small sites	sex: female, male						.65
	position: extended, flexed						.12
	orientation: N-S, E-W						.59
	matting: + -						.30
	ornament: + -						.03
<u>RM III-Early Red Mesa and Red Mesa</u>							
<u>small sites</u>							
ERM, RM	age: adult, child						.63
ERM, RM, incl. Shabik.	location: room, midden						.63
ERM, RM, incl. Shabik.	position: extended,						.52
ERM, RM	orientation: N-S, E-W						.34
ERM, RM, incl. Shabik.							.53
ERM, RM	vessel: + -						.65
ERM, RM, incl. Shabik.							.22
ERM, RM	bowl: + -						.21
ERM, RM, incl. Shabik.							.11
ERM, RM	pitcher: + -						.18
ERM, RM, incl. Shabik.							.07
<u>Gallup</u>							
<u>small sites</u>							
location: room, midden	age: infant, child			1	3.91	.047	
	sex: male, female						.20
	age: adult, child	0.81	.37	1			
position: b, f, l, r	sex: male, female	1.75	.63	3			
	age: adult, child	2.54	.47	3			
position: b, f, side	sex: male, female	1.53	.47	2			
	age: adult, child	2.34	.31	2			
orientation: N, S, E, W	age: adult, child	0.54	.91	3			
orientation: N-S, E-W	age: infant, child						.38
	sex: male, female						.08
	age: adult, child						.42
slab, stone: + -	age: adult, child			1	0.45	.50	
matting: + -	age: infant, child						.14
	sex: male, female						.60
	age: adult, child			1	1.40	.24	
textile: + -	age: adult, child						.63
# vessel: 0, 1, 2-3, 4-5	sex: male, female	1.42	.70	3			
	age: adult, child	0.44	.93	3			
# vessel: + -	age: infant, child						.46
	age: child, adolescent						.63
	sex: male, female						.25
	age: adult, child			1	0.04	.84	
miniature vessel: + -	age: infant, child						.46
	age: child, adolescent						.48
	sex: male, female						.55
	age: adult, child			1	1.18	.27	
effigy vessel: + -	age: infant, child						.56
	age: child, adolescent						.71
	sex: male, female						.69
	age: adult, child						.71
bowl: + -	a/s: inf, ch, adol, m, f	1.55	.81	4			
	age: infant, child						.51
	age: child, adolescent						.29
	sex: male, female			1	0.09	.57	.50
	age: adult, child						.56
smudged bowl: + -	age: infant, child						.17
	sex: male, female						.15
	age: adult, child						

Table C.1. (continued)

Variable 1	Variable 2	χ^2	$p(\chi^2)$	df	χ^2_c	$p(\chi^2_c)$	Fisher's Exact p
<u>Gallup</u>							
small sites (continued)							
pitcher: + -	age: infant, child						.54
	age: child, adolescent						.26
	sex: male, female			1	0.01	.92	
	age: adult, child			1	0.43	.51	
ladle: + -	age: infant, child						.40
	sex: male, female			1	0.18	.67	
turquoise: + -	age: adult, child						.38
	sex: male, female						.56
	age: infant, child			1	0.01	.93	.30
	age: adult, child						.66
shell: + -	age: infant, child			1	0.20	.65	
ornament/cylinder: + -	age: adult, child						.60
	age: child, adolescent						.57
	sex: male, female						.60
	age: adult, child			1	0.20	.66	
location: room, midden	position: extended, flexed			1	0.28	.60	
	position: b, f, r, l	5.55	.14	3			
	position: b, f, side	5.06	.08	2			
	orientation: N, S, E, W	3.07	.38	3			
	orientation: N-S, E-W	1.38	.24	1			
	stone/slab: + -			1	2.35	.99	
matting: + -				1	7.67	.006	
	feather cloth: + -						.58
textile: + -							.63
	vessel: + -			1	0.86	.35	
miniature vessel: + -				1	0.51	.48	
	effigy vessel: + -			1	2.95	.08	
bowl: + -		0.08	.77	1			
	b/r bowl: + -			1	1.09	.30	
smudged bowl: + -				1	1.79	.18	
	pitcher: + -			1	0.15	.70	
corrugated: + -				1	0.05	.41	
	ladle: + -			1	0.38	.53	
ornament: + -				1	1.70	.19	
<u>Bonito</u>							
vessel: + -	age: adult, child						.13
	age: adult, child						.13
bowl: + -	age: adult, child						.03
	age: adult, child						.59
<u>Bonito, small sites</u>							
Bonito, small	age: infant, child						.27
	age: child, adolescent						.59
	age: adult, child						.43
	position: extended, flexed			1	40.55	1.9-19	
Bonito, small room				1	22.95	1.66-6	
Bonito, small midden				1	30.47	3.39-8	
Bonito, small	orientation: N-S, E-W						.08
Bonito, small room							.05
Bonito, small midden							.27
Bonito, small	vessel: + -			1	0.51	.47	
Bonito, small room				1	1.02	.31	
Bonito, small midden							.47
Bonito, small	bowl: + -			1	4.99	.02	
Bonito, small room				1	3.71	.05	
Bonito, small midden				1	3.66	.05	
Bonito, small	pitcher: + -			1	6.27	.01	
Bonito, small room				1	4.15	.04	
Bonito, small midden							.007
Bonito, small	turquoise: + -						.03
Bonito, small room							.11
Bonito, small midden							.02
Bonito, small	shell: + -						.58
Bonito, small room							.46
Bonito, small midden							.67
Bonito, small	ornament/cylinder: + -						.03
Bonito, small room							.46
Bonito, small midden							.10
<u>Red Mesa, Gallup</u>							
small sites							
Red Mesa, Gallup	age: adult, child			1	0.18	.67	
	location: room, midden			1	2.54	.11	
	position: extended, flexed			1	0.27	.60	
	orientation: + -			1	0.16	.69	
stone/slab: + -				1	3.57	.06	
	vessel: + -			1	0.03	.42	

Table C.1. (continued)

Variable 1	Variable 2	χ^2	$p(\chi^2)$	df	χ^2_c	$p(\chi^2_c)$	Fisher's Exact p
<u>Red Mesa, Gallup</u>							
small sites (continued)							
	bowl: + -			1	0.14	.71	
	pitcher: + -			1	0.06	.80	
	ornament: + -			1	0.60	.44	
greathouses							
Bonito, Kin Kletso	age: adult, child						.32
	orientation: N-S, E-W						.50
	vessel: + -						.47
	bowl: + -						.23
	pitcher: + -						.07
	ornament: + -						.52
<u>McElmo</u>							
small sites							
location: room, midden	age: adult, child						.19
position: extended, flexed	age: infant, child						.71
	sex: male, female						.62
	age: adult, child						.002
position: N-S, E-W	age: infant, child						.71
	sex: male, female						.70
	age: adult, child						.63
vessel: + -	age: infant, child						.35
	sex: male, female						.27
	age: adult, child						.44
bowl: + -	age: infant, child						.39
	age: child, adolescent						.71
	sex: male, female			1	0.01	.90	.65
	age: adult, child						.45
pitcher: + -	age: infant, child						.71
	age: child, adolescent						.65
	sex: male, female						.04
	age: adult, child						.73
ornament: + -	age: infant, child						.48
	sex: male, female						.45
	age: adult, child						
Kin Kletso, small sites							
Kin Kletso, small sites	age: infant, child						.46
	sex: male, female						.43
	age: adult, child						.03
	orientation: N-S, E-W						.25
	vessel: + -						.58
	bowl: + -			1	0.67	.41	
	pitcher: + -			1	0.15	.70	
<u>Gallup and McElmo</u>							
small sites							
Gallup, McElmo	position: extended, flexed			1	5.01	.02	
	orientation: N-S, E-W			1	1.46	.23	
	matting: + -	1.14	.29	1			
	feather cloth: + -			1	0.003	.95	
	textile: + -			1	0.08	.78	
				1	0.15	.70	
Gallup rooms, McElmo	vessel: + -	0.11	.74	1			
Gallup, McElmo	bowl: + -	0.75	.38	1			
	pitcher: + -	0.0016	.97	1			
Gallup, McElmo children	vessel: + -			1	0.001	.97	
	bowls: + -			1	0.05	.41	
	pitcher: + -						.25
Gallup, McElmo adults	vessel: + -			1	0.07	.79	
	bowl: + -	0.87	.35	1			
	pitcher: + -			1	0.03	.86	
	turquoise: + -			1	0.26	.61	
Gallup, McElmo				1	0.93	.34	
Gallup rooms, McElmo	shell: + -			1	0.004	.95	
Gallup, McElmo				1	0.23	.63	
Gallup rooms, McElmo				1	0.01	.91	
Gallup, McElmo	ornament: + -			1	0.12	.73	
Gallup rooms, McElmo							
greathouses							
Bonito, Kin Kletso	position: extended, flexed						.004
	orientation: N-S, E-W						.60
	vessel: + -						.41
	bowl: + -						.17
	pitcher: + -						.03
	turquoise: + -						.16
	ornament: + -						.16
small sites and greathouses							
Gallup, Kin Kletso	position: extended, flexed			1	1.06	.30	
	orientation: N-S, E-W			1	2.37	.12	
	vessel: + -			1	0.14	.70	
	bowl: + -			1	0.01	.90	
	pitcher: + -			1	0.09	.76	

Table C.1. (continued)

Variable 1	Variable 2	χ^2	$p(\chi^2)$	df	χ^2_c	$p(\chi^2_c)$	Fisher's Exact p
Gallup small, Kin Kletso (continued)	ornament: + -			1	0.42	.52	
	turquoise: + -			1	0.26	.61	
	shell: + -			1	0.02	.98	
<u>Mesa Verde</u>							
orientation: N-S, E-W	age: adult, child						.04
vessel: + -							.12
bowl: + -							.40
pitcher/mug: + -							.18
ladle: + -							.58
<u>Mesa Verde and McElmo</u>							
small sites							
infants	position: extended, flexed						.37
infants	orientation: N-S, E-W						.42
adults							.01
adults	vessel: + -						.25
adults	bowl: + -						.61

APPENDIX D

Stature Estimates and Femur Lengths

Table D.1. Stature Estimates

	Stature (cm)	Elements
<u>Pueblo Bonito</u>		
male		
AMNH 3658	173.4	femur
AMNH 3658	169.5	femur
AMNH 3658	165.9	femur
AMNH 3658	166.9	femur
AMNH 3658	165.2	femur
AMNH 3671	172.5	femur + fibula
AMNH 3672	171.5	mean femur + tibia
<u>Pueblo Bonito</u>		
female		
AMNH 3658	161.6	femur
AMNH 3658	160.7	femur
AMNH 3658	162.0	femur
AMNH 3658	160.1	femur
AMNH 3658	163.5	femur
AMNH 5634	163.3	femur
AMNH 5634	162.9	femur
<u>Small sites</u>		
male		
Bc 51	170.3	humerus + ulna
Bc 53	164.1	radius
Bc 57	164.7	humerus
Bc 57	167.7	femur + fibula
Bc 59	163.7	humerus
Bc 126	169.7	mean tibia
Bc 191	168.4	femur
29SJ 299	166.3	femur
29SJ 597	162.5	femur + fibula
29SJ 627	156.8	femur
29SJ 629	162.9	fibula
29SJ 629	161.2	fibula
29SJ 633	166.1	femur
near Wijiji	164.4	tibia
near Peñasco Blanco	161.8	humerus + radius
<u>Small sites</u>		
female		
Bc 51	155.9	fibula
Bc 51	156.5	femur
Bc 53	158.7	femur + tibia
Bc 53	154.1	femur + fibula
Bc 57	158.3	femur + fibula
Bc 57	160.7	femur
Bc 59	161.7	humerus + radius
Bc 59	159.9	radius
Bc 59	159.7	humerus
Bc 59	157.1	fibula
Bc 63	156.1	femur
Bc 192	157.0	humerus + ulna
Bc 236	158.2	humerus + ulna
29SJ 299	154.2	radius
29SJ 299	153.6	tibia
29SJ 563	160.5	femur + fibula
29SJ 597	159.8	femur
29SJ 627	159.4	femur + fibula
29SJ 721	151.7	femur
29SJ 1360	157.9	humerus
29SJ 1360	153.3	femur + fibula
near Peñasco Blanco	157.8	radius

Table D.2. Femur Lengths

	Length (cm) ^a
<u>Pueblo Bonito</u>	
male	
AMNH 3658	46.9
AMNH 3658	45.1
AMNH 3658	43.4
AMNH 3658	43.9
AMNH 3658	43.1
AMNH 3671	45.4
AMNH 3672	43.6
<u>Pueblo Bonito</u>	
female	
AMNH 3658	41.4
AMNH 3658	41.0
AMNH 3658	41.6
AMNH 3658	40.7
AMNH 3658	42.3
AMNH 5634	42.0
AMNH 5634	42.2
<u>Small sites</u>	
male	
Bc 57	44.4
29SJ 191	44.6
29SJ 299	42.8
29SJ 627	39.3
29SJ 633	43.5
unknown 99-6	42.2
<u>Small sites</u>	
female	
Bc 51	39.3
Bc 51	35.0
Bc 53	40.8
Bc 53	37.8
Bc 57	40.0
Bc 57	41.0
TU 257	40.1
29 CK#4	39.6
29SJ 627	40.1
29SJ 1360	37.8

^aRight femur when both are present.

APPENDIX E

Parasite Analysis of Prehistoric
Coprolites from Chaco Canyon

By

Karl J. Reinhard and Karen H. Clary

Introduction

Twenty Anasazi period fecal specimens from Chaco Canyon were analyzed for parasite infection. The majority of the coprolites (13) were from Pueblo Bonito, five were from Kin Kletso, and two were from Pueblo Alto. A dietary reliance on cultivars, especially maize, seasonally available plant foods, and small mammals (mice, prairie dogs, and rabbits) was revealed by a complementary examination of macrobotanical, bone, and pollen remains (Clary 1983; Gillespie 1981; Toll 1981). Table E.1 lists the sample numbers, provenience, and time-scale information. Direct dates are not available for the feces. Instead, coprolites are dated by association with the building phase of the particular feature in which they are found (William B. Gillespie, Stephen H. Lekson, and Thomas C. Windes, personal communication 1981). The specimens from Room 107 in Pueblo Bonito were deposited in a portion of the pueblo built in the latter part of the A.D. 900s and are thought to be the oldest of the specimens analyzed. The other specimens from Pueblo Bonito, Rooms 24, 25, and 92 are contemporary with the coprolites from Pueblo Alto and Kin Kletso (deposited after the late 1000s to mid-1100s).

Materials and Methods

Twenty fecal specimens collected from the sites of Pueblo Alto, Pueblo Bonito, and Kin Kletso were examined. The analysis was designed for the recovery and identification of eggs of helminth parasites (tapeworms, flukes, roundworms, thorny-headed worms). Most feces appeared to be from humans; one specimen appears to be from a turkey.

The samples from Pueblo Bonito deserve special note. Over the years since the coprolites were excavated, they became fragmented in their storage bags. In this analysis, an attempt was made to sort out as many fragments as possible from separate coprolites. A 0.5-gram fragment from each identifiable, separate coprolite was rehydrated utilizing the trisodium-phosphate technique as devised by Callen and Cameron (1960) and applied by others (Ferreira et al. 1980; Fry 1977; Reinhard 1985a; Samuels 1965). This rehydration technique has proven effective in reconstituting desiccated helminth eggs.

Many techniques are available for the isolation of parasite eggs from various sources. Clinical parasitologists working with modern feces most often use heavy-density flotation techniques or formalin-ether concentration techniques. Although some of these techniques have been adapted for prehistoric remains (Hall 1972), they are not always effective in recovery of helminth eggs from coprolites (Fry 1977; Reinhard 1985b; Reinhard et al. 1985). Flotation can be used to isolate helminth eggs from latrine soils (Jones 1985; Pike 1967).

Table E.1. Provenience information for Anasazi-period
Chacoan fecal specimens

Site/Lab. No.	Field No.	Provenience	Date (A.D.)
Pueblo Bonito (29SJ 387)			
37	H-4675	Rm. 24, debris in room	1080-1130
38	H-4675	Rm. 24, debris in room	1080-1130
39	H-4676- 4678	Rm. 25, debris in room	1080-1130
40	H-4676- 4678	Rm. 25, debris in room	1080-1130
41	H-4676- 4678	Rm. 25, debris in room	1080-1130
42	H-4676- 4678	Rm. 25, debris in room	1080-1130
43	H-4676- 4678	Rm. 25, debris in room	1080-1130
35	H-4675	Rm. 24, debris in room	1080-1130
36	H-4675	Rm. 24, debris in room	1080-1130
44	H-4676- 4678	Rm. 25, debris in room	1080-1130
45	H-8402	Rm. 107, debris in room	920-1020
46	H-8402	Rm. 107, debris in room	920-1020
47	H-8402	Rm. 107, debris in room	920-1020
Pueblo Alto (29SJ 389)			
51	FS 4586	trash mound, Grid 262	1050-1100
--	FS 6897	Rm. 143, Floor 2	----
Kin Kletso (29SJ 393)			
27	none	Rm. 16, fill	1100-1150
28	none	Kiva C, NE kiva corner	1100-1150
29	none	Rm. 2, floor	1100-1150
30	none	Rm. 2, floor	1100-1150
52	none	Rm. 5, ash fill, refuse	1100-1150

Most effective for recovery of helminth eggs from coprolites are sedimentation techniques. These techniques are effective in recovering helminth larvae as well as eggs (de Araujo et al. 1981; Ferreira et al. 1980; Reinhard 1985b, 1985c). The sedimentation technique utilized in this analysis is a modification of that devised by Fry (1977). The procedure for this analysis is as follows:

(1) Following rehydration, each coprolite is disaggregated with a magnetic stirrer.

(2) The disaggregated coprolite is washed through a 0.5-mm mesh screen. The sediment passing through the screen is collected in a large beaker and the sediment resting on top of the screen is dried and saved.

(3) The sediment collected in the beaker is washed through a 0.15-mm mesh screen. The sediment resting on top of the screen is transferred to a vial and stored in acetic formalin alcohol (A.F.A.) for later examination for helminth larvae. The sediment that passes through the screen is collected, centrifuged, and transferred to a separate vial in A.F.A. for later examination for larvae and eggs.

(4) Examination of each vial is accomplished by aspirating a small amount of the upper sediment and placing a few drops of sediment on a microscope slide. Glycerol is added to the slide after most of the A.F.A. evaporates. The sediments are mixed with the glycerol with an applicator stick, and a coverslip is placed on top. The coverslip is sealed in place with nail polish. Three microscope preparations of each sediment sample are made.

Glycerol is used as a mounting medium because it permeates objects, resulting in swelling. This is important because eggs and larvae are often collapsed, probably through desiccation. The A.F.A. is preferred over formalin or alcohol because it acts as a fixative as well as a preservative. Each microscope preparation was examined at 100x magnification. Photographs were taken at 100x and 400x magnification with both bright field and Hoffman settings (Figures E.1 and E.2).

Results

No helminths were found in the feces from either Pueblo Alto or Kin Kletso. In contrast, of twelve human feces from Pueblo Bonito, two samples contained well-preserved Enterobius vermicularis (pinworm) eggs (#47 and #39), two samples contained decomposed E. vermicularis eggs (#32 and #40), two samples contained larvae of free-living nematodes (#41a and #40), and one sample (#47) contained larvae of what might be a parasitic nematode species, perhaps Strongyloides (Reinhard 1985c).

Some E. vermicularis eggs were in a bad state of preservation. This is a point worthy of note because in analyses of other Anasazi coprolites



Figure E.1. Pinworm (Enterobius vermicularis), one of which (center) is folded upon itself

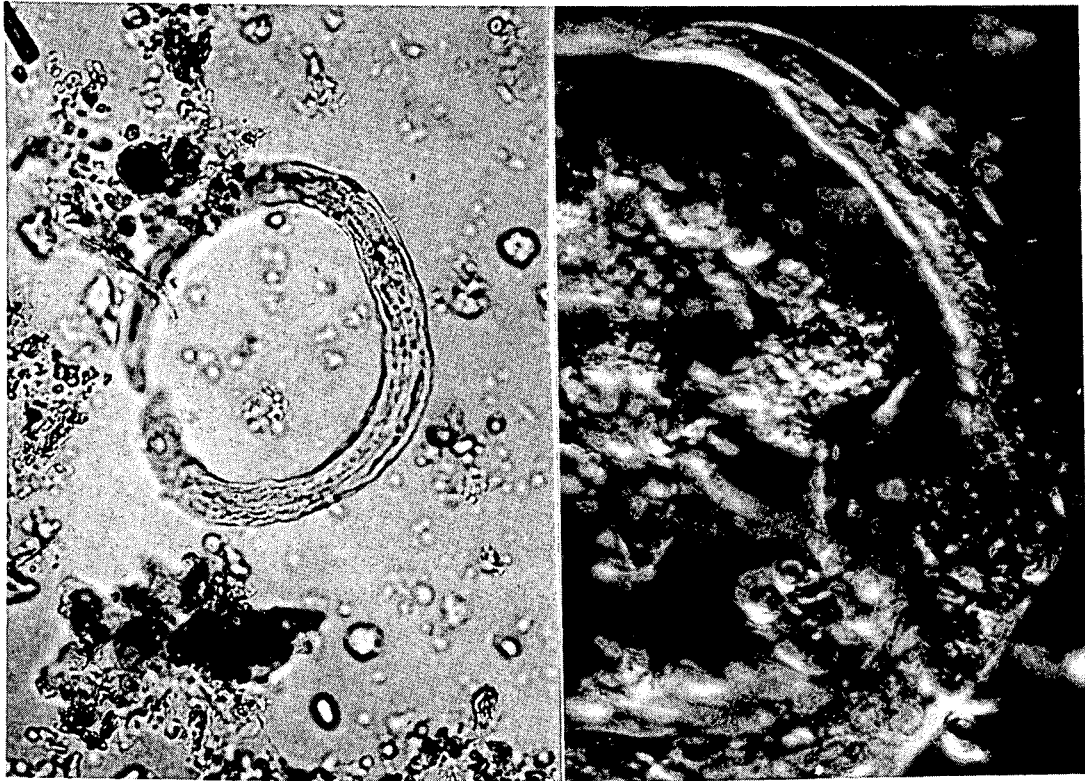


Figure E.2. Larvae of a possible Pueblo Bonito parasite (lateral line evident in the close-up of the larval posterior)

from Antelope House, Salmon Ruin, and Turkey Pen Cave, as well as latrine soils from Mt. Elden Pueblo, E. vermicularis eggs have always been found in excellent preservation. The fact that some Pueblo Bonito eggs were broken, folded (Figure E.1), or decomposed suggests that factors of preservation at the site were less ideal than at other sites. The presence of mite exoskeletons in all Pueblo Bonito feces, and free-living nematodes in two, indicates degradation by scatophagus organisms.

Nematode larvae were found in three coprolites. In general, the morphology of the larvae resembles that of first- or second-stage larvae of the parasitic genus Strongyloides or the nonparasitic genus Rhabditis. Distinction of "free-living" versus "parasitic" nematodes is problematic. Certain free-living and parasitic forms have morphological characteristics too similar to enable a diagnosis of parasitic infection. In the case of nematode larvae, the morphology of the worms is checked against that of free-living forms to determine whether or not the larvae represent a parasitic infection. In most cases, nematodes found in coprolites are of free-living species that enter the feces after defecation (Samuels 1965). In the case of two Pueblo Bonito coprolites, the larvae are smaller than parasitic species and have tail morphology consistent with that of free-living species. In one coprolite, however, the morphology of the larvae is similar to that of parasitic forms, suggesting, but not confirming, a parasitic infection. An interesting feature of these possible parasites is a lateral line that runs along the posterior section of the cuticle (Figure E.2). This feature may aid in identifying the larvae at some future date. We could find no comparable structures described in the literature for either parasitic or free-living animals during this analysis.

Discussion

The monumental village plans of sites such as Pueblo Alto, Pueblo Bonito, Kin Kletso, and other large pueblos in and around Chaco Canyon suggest, as does the heavy concentration of smaller habitations, that the Chaco area was the focus of a large Anasazi population. The parasite analysis is consistent with this notion. Expressed as a percentage, 20% of the Chaco feces contained E. vermicularis eggs. If the coprolites examined for this report are representative of Chaco Canyon parasitism, parasitism at Chaco Canyon with E. vermicularis was similar to parasitism of Turkey Pen Cave (20%) and Antelope House (17%), which were heavily parasitized in comparison to Salmon Ruin and sites on Mesa Verde. The life cycle of E. vermicularis (Reinhard et al. 1985) depends upon poor personal sanitation. Parasitism with this helminth is aggravated by higher population densities. One could interpret that, based on this analysis, the parasite finds indicate a low level of personal hygiene among Chaco Canyon's prehistoric inhabitants and a concentrated population.

The coprolites from Chaco Canyon were badly preserved in comparison to others examined by Reinhard from Glen Canyon, Salmon Ruin, Antelope

House, Dust Devil Cave, and Turkey Pen Cave (Figure E.3). Microscopic examination revealed evidence of postdefecatory mite, fungal, or nematode activity in all coprolites. This has two implications in regard to parasitological interpretations. First, the evidence of biotic decomposers indicates that the feces remained moist long after defecation. Under such conditions, the eggs of some nematode species hatch and the larvae crawl away. This eliminates the ability to effectively isolate every infection of Strongyloides, Trichostrongylus, or hookworm genera. Second, degradation of parasite remains by decomposer organisms probably occurred. Consequently, the remains reported here should be considered only a minimal count of parasites that were once present in the feces. It is probable that analysis of more feces would reveal other parasite species inhabiting the prehistoric people of Chaco Canyon and perhaps resolve the identification problem presented by the nematode larvae.

Parasitism was common among the several farming cultures in the prehistoric Southwest. Currently, from Anasazi, San Rafael Fremont, and Sinagua fecal remains on the Colorado Plateau, eight helminth species are known from prehistory (Figure E.3). Strongyloides sp. (threadworm) is known from Antelope House, Arizona (Reinhard 1985b, 1985c) and Clyde's Cavern, Utah (Hall 1972). Trichuris trichiura (whipworm) and Ascaris lumbricoides (intestinal roundworm) are known from Elden Pueblo, Arizona (Hevly et al. 1979). Acanthocephalans (thorny-headed worms) have been found at Clyde's Cavern, Black Mesa, Arizona (Gummerman et al. 1972:191) and Glen Canyon, Utah (Fry 1977, 1980). Trichostrongylus (hairworm) is known from Antelope House. Taeniid tapeworms have been recovered at Elden Pueblo and Glen Canyon. Hymenolepid tapeworm eggs were recovered from Elden Pueblo and Antelope House. Enterobius vermicularis has been found at Turkey Pen Cave in the Grand Gulch (Reinhard, current research), Step House (Samuels 1965) and Hoy House (Stiger 1977) on Mesa Verde, Antelope House, Elden Pueblo, and Salmon Ruin (Reinhard, current research). Consequently, it is not surprising that Chaco Canyon inhabitants were also parasitized.

The impact of parasitism on Chaco Canyon inhabitants would have been small if pinworm was the only helminth parasitizing the population. However, if Strongyloides also parasitized the population, the impact may have been much worse. Strongyloides is similar to hookworm in its life cycle and in its impact upon health. The fact that infective Strongyloides larvae inhabit moist soil explains why only agriculturalists in the Southwest and not Archaic hunter-gatherers became infected with this worm. Anemia is the major metabolic impact of these worms. The destruction of the intestinal lining is severe; this animal burrows into the intestinal mucosa, detaches portions of the mucosa, and perforates the intestinal wall. Because Strongyloides requires a moist habitat, as do several other parasites (hookworms and trichostrongyles, for example), the finding of Strongyloides indicates that other parasites were likely to have infected the human population. Goals of future parasitological research in Chaco Canyon are the verification of Strongyloides infection and evaluation of more coprolite samples for presence of other moisture-dependent helminths.

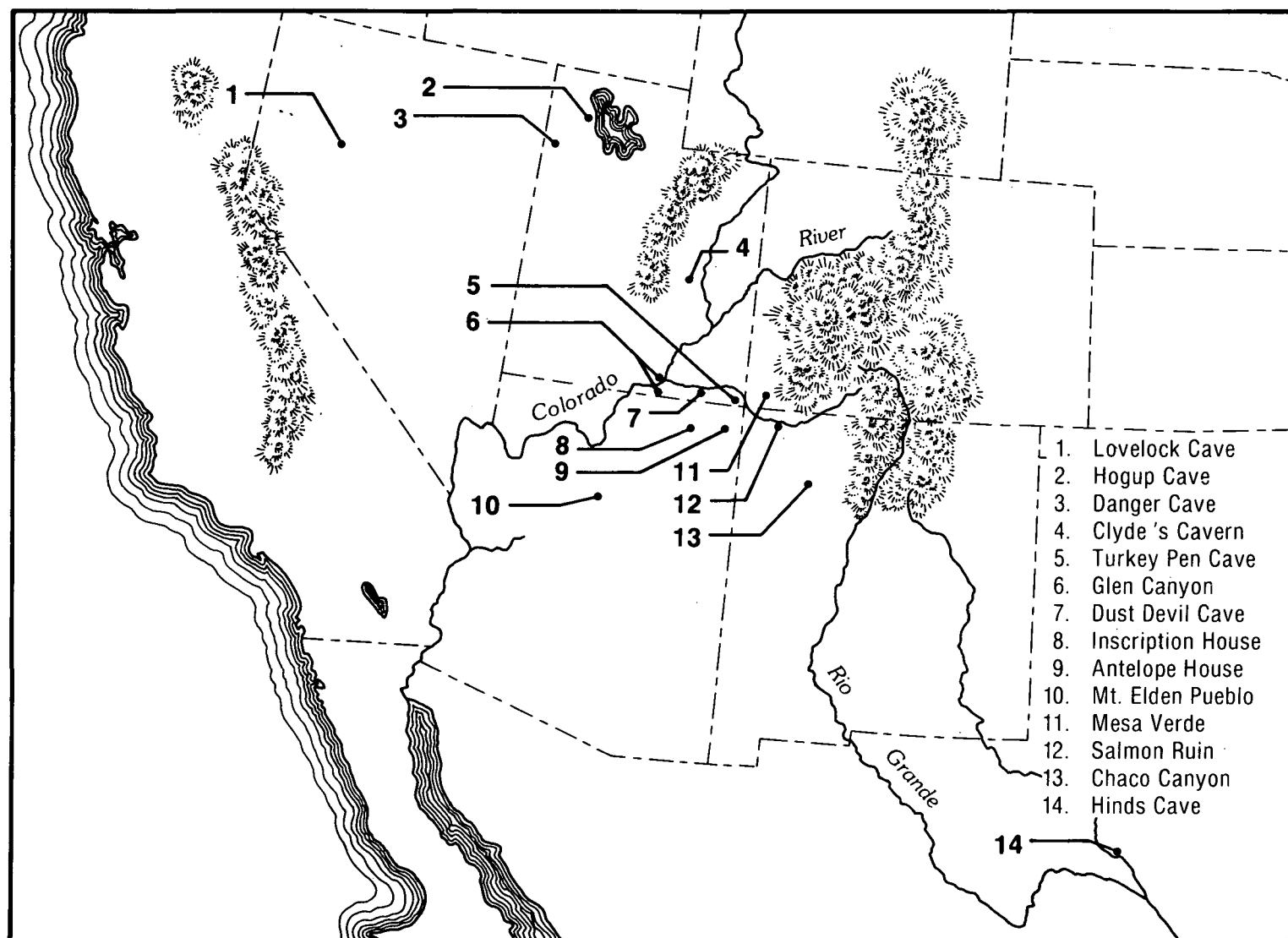


Figure E.3. Sites of prehistoric parasitological analyses

The analysis of the Chaco Canyon coprolites has revealed one, and possibly two, helminth parasites. Unfortunately, nineteen human samples is not sufficient for an in-depth examination of parasitism. However, the analysis demonstrates that feces recovered from Chaco Canyon are in a sufficient state of preservation to allow for the recovery of some helminth remains. As long as coprolites or latrine soils are excavated in the future, continued parasitological study should be fruitful.

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