BIOARCHAEOLOGY OF VIOLENCE AND SITE ABANDONMENT AT CASAS GRANDES, CHIHUAHUA, MEXICO

by

CHRISTOPHER MICHAEL CASSERINO

A DISSERTATION

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Confirmation of Approval and Acceptance of Dissertation prepared by:

Christopher Casserino

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This dissertation has been accepted and approved in partial fulfillment of the requirements for the Doctor of Philosophy degree in the Department of Anthropology by:

John Lukacs, Chairperson, Anthropology
Guy Tasa, Member, Anthropology
Frances White, Member, Anthropology
John Orbell, Outside Member, Political Science

and Richard Linton, Vice President for Research and Graduate Studies/Dean of the Graduate School for the University of Oregon.

June 13, 2009

Original approval signatures are on file with the Graduate School and the University of Oregon Libraries.

An Abstract of the Dissertation of

Christopher Michael Casserino for the degree of Doctor of Philosophy

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Title: BIOARCHAEOLOGY OF VIOLENCE AND SITE ABANDONMENT AT CASAS GRANDES, CHIHUAHUA, MEXICO

Approved: _____
Dr. John R. Lukacs

The objective of this dissertation is to address violence at the archaeological site of Casas Grandes (Paquimé) in northwest Chihuahua, Mexico. The reasons for the abandonment of Paquimé are uncertain. The prevailing theory claims this geographic area endured centuries of warfare, ritual sacrifice, and at least one massacre; this theory is supported by numerous unburied bodies recovered at the site. These assertions of violence have never been corroborated by osteological data.

Data were collected from a sample of Medio period (A.D. 1200-1450) human skeletal remains recovered from the 1958-1961 excavations at Casas Grandes. These data were synthesized with accelerator mass spectrometry radiocarbon dates, fluoride ion dates, population demographics, and burial context. Frequencies of ante-, peri-, and postmortem trauma were compared to other studies from the Old and New Worlds.

I argue that warfare was not endemic to this region and that a massacre did not occur. Moreover, cannibalism and probably human sacrifice were practiced. I assert that these activities may have been related to the proliferation of the Mesoamerican ballgame in the American Southwest and to Paquimé's role as the distribution center of the region's ritual and exotic goods. This dissertation underscores the importance of including skeletal analysis with other lines of archaeological inquiry when answering questions about human behavior.

CURRICULUM VITAE

NAME OF AUTHOR: Christopher Michael Casserino

PLACE OF BIRTH: Anaheim, California

DATE OF BIRTH: January, 26, 1967

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon
University of Montana
Eastern Washington University
Spokane Falls Community College

DEGREES AWARDED:

Doctor of Philosophy in Anthropology, 2009, University of Oregon
Master of Arts in Anthropology, 2001, University of Montana
Bachelor of Arts in Anthropology, 1997, Eastern Washington University
Bachelor of Science in Biology, 1997, Eastern Washington University
Associate of Arts in General Studies, 1994, Spokane Falls Community College

AREAS OF SPECIAL INTEREST:

Human osteology
Forensic pathology
Prehistory of Northwest Mexico
Forensic Archaeology
Museum collections management and preservation

PROFESSIONAL EXPERIENCE:

Anatomy and Exhibit Installation Specialist, Premier Exhibitions, 2008-present

Museum Collection Specialist, Northwest Museum of Arts and Culture, Spokane, Washington, 2004-present

Adjunct Lecturer, Eastern Washington University Departments of Justice Studies, and Geography and Anthropology, Cheney, Washington, 2000-2008

Deputy Medical Investigator, Spokane County Medical Examiner's Office, Spokane, Washington, 2000-2008

Graduate Teaching Fellow, University of Oregon Department of Anthropology, Eugene, Oregon, 2001-2003

Graduate Teaching Assistant, University of Montana Department of Anthropology, Missoula, Montana, 1999

GRANTS, AWARDS AND HONORS:

University of Oregon Institute for Cognitive and Decision Sciences research grant, 2008

Foundation for the Advancement of Mesoamerican Studies, Inc. research grant, 2008

University of Oregon Graduate School research grant, 2007

University of Oregon Department of Anthropology graduate student research award, 2002, 2007

Eastern Washington University Alumni Foundation grant, 1997

Dean's List, Eastern Washington University, 1995-1997

Lambda Alpha Honor Society of Anthropology, Lifetime

Hewlett-Packard Employees Scholarship, 1985

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CHAPTER I

INTRODUCTION

"Archaeological interpretations of conflict rely on the preservation and interpretation of artifactual and human remains. The question arises: Where are all the dead people or other material indicators that could provide evidence of these wars for Mesoamerican archaeologists? What do physical anthropologists have to say about this matter?"

---M. Nicolás Caretta (2008:387)

Casas Grandes, or Paquimé (CHIH:D:9:1) in northwest Mexico has been called the largest and possibly most complex prehistoric community north of Mesoamerica (Whalen and Minnis 2003:315). In spite of this, the amount of research dedicated to the Casas Grandes region is vastly overshadowed by that undertaken in the United States Southwest and central Mexico. Thus, Casas Grandes has largely been overlooked for its potential as a window into the connections between the two (Cordell 1984).

Many questions about Paquimé remain unanswered. For instance, its rapid development and abandonment remain poorly understood. While several scenarios have been proposed for its rapid population growth, only one has been advanced for its abandonment. Archaeologist Charles DiPeso theorized the city fell into economic despair (DiPeso 1974; DiPeso et al. 1974). Then the people who, for "two and a half generations sat idly by and watched the magnificent city of Paquimé fall into disrepair", were massacred by invaders and the city burned (DiPeso 1974:2:319) (Figure 1). This

theory, based on speculation and a discredited dating sequence, has never been subjected to testing.

The general objective of this study is to use bioarchaeology to address conflict in Northwest Mexico to give a clearer understanding of cultural dynamics. Larsen (2002:119) defines bioarchaeology as the study of human remains from archaeological contexts. DiPeso primarily uses a toppled shrine and over 100 non-interred skeletons as evidence of a massacre that followed centuries of regional warfare (1974:2:612-613). LeBlanc (1999:252) believes that if this number of dead is extrapolated to account for all those killed site-wide, the number could equal 1,000 to 2,000. This implies that one of the greatest massacres in the prehistoric New World occurred at Paquimé.

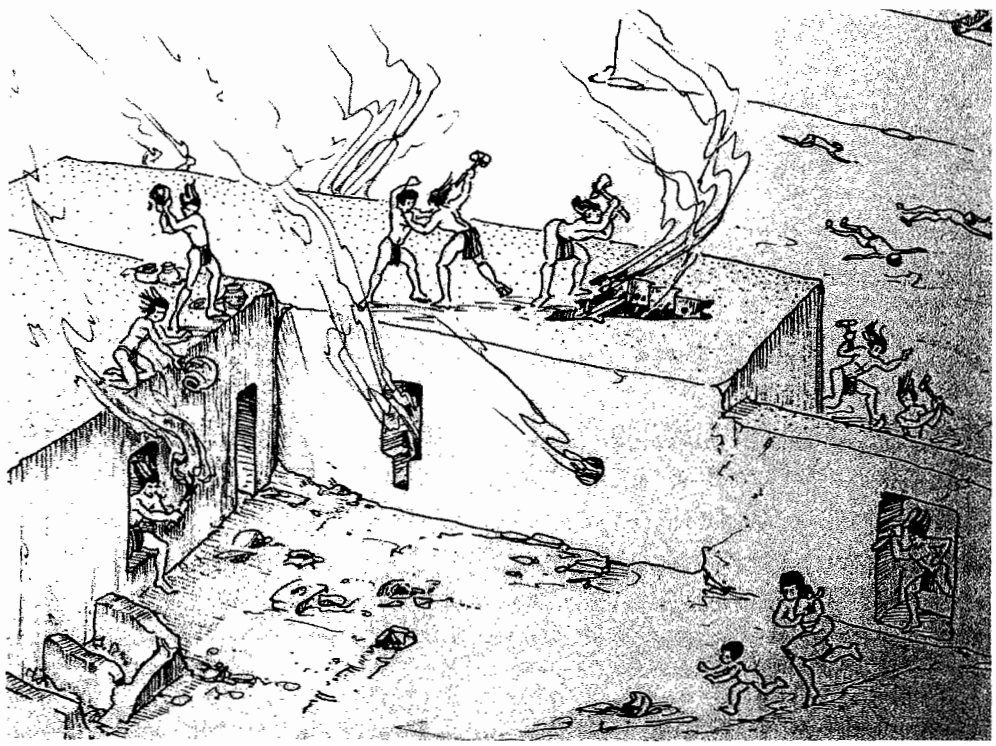


Figure 1. Artist's depiction of the massacre at Paquimé (DiPeso 1974).

LeBlanc (1999:200-203) argues that settlement patterns and locations changed during the Hohokam Late Period (this corresponds to the Medio Period at Casas Grandes). People aggregated in larger settlements that were built in defensive locations (situated high or in relatively inaccessible locations) (refer to Figure 2, for example). Large sites were often built around a good domestic water supply and had cisterns or reservoirs for water storage. Architecturally, these sites could have bastion corners that facilitated defense or could be fortified around their perimeter by the high exterior walls of the apartment blocks, leaving a protected central plaza for public activities. Casas Grandes shows some features that may have served defensive purposes (LeBlanc 1999:253). The House of the Serpent (unit 11) has a bastion corner and other angled exterior walls that could have facilitated defense of the structure. A related site, the Cerro de Moctezuma, located 7 kilometers to the west, is a hilltop sentinel with a pueblo settlement located at its base. Though its function is currently unknown, one possibility is its use as a signaling tower (DiPeso 1974:2:362-364; LeBlanc 1999:253; Swanson 2003). In fact, Swanson (2003) found that signaling 'stations' up to 75 kilometers away were possibly integrated through a signaling system. Whether this system was for simple communication or warning is unclear at present.

Lambert (1997) asserts that skeletal remains can provide a valuable source of information regarding patterns of conflict in prehistory. She believes defensive sites and structures can only suggest the threat of intrusion, while skeletal injury documents actual events. Similarly, Caretta states: "Archaeological interpretations of conflict rely on the preservation and interpretation of artifactual and human remains" (2008:387).

Figure 2. Las Cuarenta Casas site near Madera, Chihuahua, Mexico is built into a rock shelter high on the side of a river canyon. It is only accessible from below.

Thus, it is surprising that skeletal remains have been excluded from discussions of violence at Casas Grandes in the fifty years since its excavation. The effects of warfare and site abandonment were likely far-reaching due to its recognized importance as a regional trading and ceremonial center in prehistory.

Redfern (2008:282) asserts that disarticulated or fragmentary remains have been incorrectly perceived by archaeologists and biological anthropologists as having little data potential. This is especially true of Paquimé as the fragmentary non-interred skeletons have been largely excluded from analyses in the 35 years since DiPeso declared them the remains of the massacre. Since then, studies of another non-interred assemblage from Ram Mesa, New Mexico (Ogilvie and Hilton 2000) found evidence of witch killing, while studies of similar assemblages from throughout the Southwest and Great Basin found evidence of cannibalism (Edgar and Sciulli 2006; Flinn et al. 1976; Haverkort and

Lubell 1999; Hurlbut 2000; Lambert et al. 2000; Novak and Kollmann 2000; Turner and Turner 1999; White 1992). Similar studies from Mexico have also discovered cannibalism (Cáceres et al. 2007; Pijoan et al. 2007; Villa et al. 1986). Evidence of warfare and massacre has been detected on non-interred skeletal remains from the Great Plains (Owsley et al. 1977; Willey 1990). This new era of osteological research opens doors to the available interpretive possibilities.

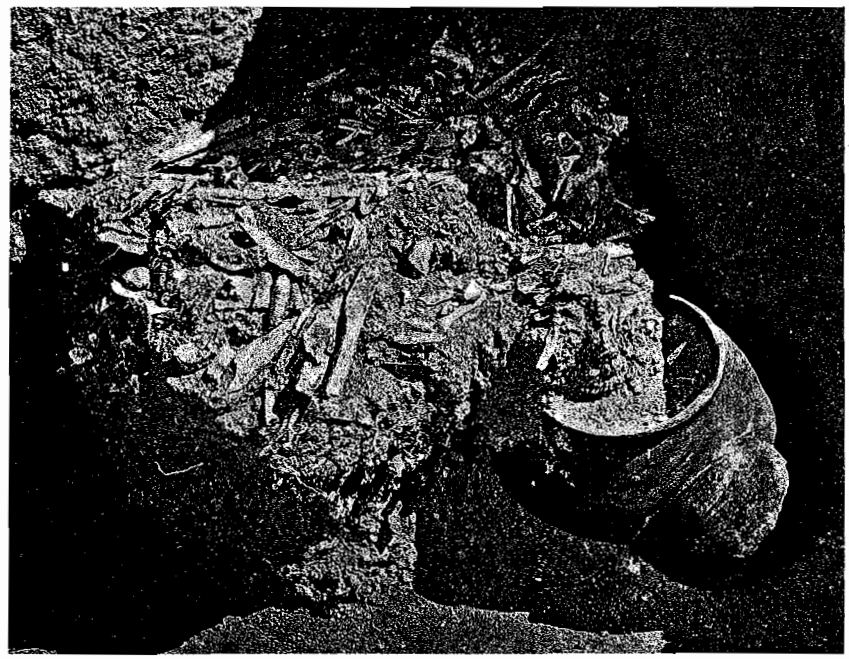


Figure 3. Site excavation photo of "burial" 14-1, in room fill 20 cm above living floor. This is one of the deposits thought to be the remains of a victim of the Paquimé massacre. (Photograph number CG-F/61. Courtesy of the Amerind Foundation, Inc., Dragoon, Arizona. Alfred Cohn, photographer.)

Research Objectives

This dissertation will utilize multiple lines of evidence to answer three important yet unresolved questions. First, was there violent inter-group conflict in and around Casas Grandes, and if so, did it play a significant role in the abandonment of the city?

Second, did a massacre mark the end of the city's occupation? DiPeso's (1974; DiPeso et al. 1974) massacre theory is based on burned structures and the recovery of skeletons, which lacked evidence of formal burial. He believed the unburied skeletons were the remains of the city's final occupants who were murdered and covered by burning architectural debris as the city collapsed following ignition (DiPeso 1974, DiPeso et al. 1974). These two objectives are integrally related since the second is largely predicated on the first.

A third question will also be addressed. Were human sacrifice and cannibalism practiced at Paquimé? Human sacrifice in the New World is well-known (Benson and Boone 1984; Gaither et al. 2008; Pijoan and Mansilla 1990). DiPeso writes of trophy skulls and skeletons that were found in what may have been sacrificial poses and proveniences (under the ballcourts and posed around the base of a structural support pillar). Did the Paquimeans practice other rituals involving destruction of the human body? Although controversial, many osteological studies have documented the practice of cannibalism in the Southwest (Flinn et al. 1976; Haverkort and Lubell 1999; Hurlbut 2000; Novak and Kollmann 2000; Turner and Turner 1999; White 1992). Similar accounts have been offered from Mexico (Pijoan et al. 2007).

This dissertation will question many of DiPeso's interpretations of the archaeological material. He advanced the idea that Toltec *pochteca* (merchants) traveled to northwest Mexico and inspired the local inhabitants to build the city of Paquimé in A.D. 1060. He believed the *pochteca* were responsible for the coordination of the city as a regional production and trade center, sending exotic birds and other luxury items to the Southwest and central Mexico. Under their control, war became necessary to manage the satellite communities subjected to Paquimé's authority. Corrected dates of occupation for Paquimé place its florescence after the fall of the Toltecs (Dean and Ravesloot 1993). Hence, the Toltec *pochteca* explanation unravels, taking with it the warfare complex. Subsequent publications (e.g. LeBlanc 1999; Lekson 1999a) are based on the warfare/massacre theory, which also brings them into question.

Armed with these new dates, many general questions answered by the 1974 Casas Grandes site report need to be revisited, for instance: 1) why were they engaged in warfare?, and if a massacre occurred, why?, and 2) why did the invaders flee such a fertile valley afterward? Specific questions regarding the burials must also be addressed: 1) why are there so few burials at Casas Grandes?, 2) why is there a disparity in representation of the sexes?, and 3) does Casas Grandes share any mortuary similarities with other sites that might explain these inconsistencies? Resolution of these questions with physical evidence will paint a truer picture of the occupation and abandonment of Paquimé.

Hypotheses

Three hypotheses will be tested in this dissertation. The first hypothesis: Violence was endemic in the Casas Grandes region. To evaluate this hypothesis, the trauma frequency of the formally interred group will be compared to other sites. These comparative assemblages will be ones known to have a history of warfare and those without. This hypothesis will be confirmed if the trauma frequency at Casas Grandes is similar to those sites where warfare has been validated with both osteological and artifactual evidence (i.e. defensive location and structures, warrior imagery, armaments).

The second hypothesis: The final population of Paquimé was massacred. This hypothesis will be evaluated by comparing trauma frequencies of the formally and informally buried groups. If I find that trauma frequencies of the informally buried group are significantly higher than that of the formally buried group, the hypothesis will be confirmed. If the informally buried group represents a massacre, then injury should show no predilection for sex or age (Owsley et al.1977; Willey 1990). If all the non-interred individuals died violently, then most or all of the skeletons will show unhealed skeletal injuries. Fluoride ion concentration analysis and accelerator mass spectrometry radiocarbon (AMS) dates from both groups will be compared. A terminal massacre would be characterized by similarities in low fluoride ion concentration among the informally buried individuals as compared to the formally buried, which should show a pattern of continuous fluoride ion concentrations throughout the time period of occupation. AMS dates from selected individuals will be obtained for absolute dating of the massacre.

The third hypothesis: Human sacrifice and cannibalism were practiced at Paquimé. This hypothesis will be evaluated by comparing the types and patterns of trauma found at Paquimé with those from sites where warfare, massacre, witch killing, cannibalism, and simple mortuary corpse processing have been verified. The hypothesis will be confirmed if the types and patterns of trauma at Paquimé are similar to sites where evidence of human sacrifice and/or cannibalism has been found.

Significance

In addition to DiPeso and colleagues' (1974) original site report, osteological research at Paquimé has been limited. This dissertation will add to the small body of work by scholars interested in the biology of the people of Paquimé. It will make three major contributions. First, it will clarify the abandonment of the city and build a better understanding of the interactions of its people with others in the region. These interactions may have had wider reaching consequences for groups in central Mexico and the United States Southwest. Second, it may provide insight into the nature and patterns of prehistoric violence in the New World and a better understanding of the prehistoric foundations of modern violence. Finally, this research will introduce the first AMS dates taken directly from human bones at Paquimé. Though these dates are few, they will certainly assist in more precisely revising the chronology at Paquimé.

Organization of the Dissertation

Chapter II describes the study area and the difficulties of defining it geographically. It describes what excavation has revealed about the prehistory of the Casas Grandes region, and insight into cultural connections to the south and north.

Chapter III describes the burials and summarizes the application of osteological analysis to archaeology. Brief treatment is given to prior osteological studies done at Casas Grandes, followed by a discussion of the properties of bone and bone fracture, and the challenges associated with determining cause and manner of death. Chapter IV describes the sample selection process and methodologies employed in osteological data collection, demographic analysis, data analysis, and chronometric dating. Chapter V presents the results of the osteological and statistical analyses, and chronometric dating along with results of the skeletal element representation analysis. Chapter VI discusses the results within the context of the three hypotheses. Chapter VII discusses site-wide applications of the results and the influence culture may have played in the observed burial attributes. Chapter VIII summarizes and draws conclusions about the research and offers ideas on future research directions related to this project. A final series of appendices presents supplementary information, which is followed by the bibliography.

CHAPTER II

THE CASAS GRANDES REGION

Defining the Geographic Study Area

The term Southwest has been used to describe an expanse of north and central America that includes parts of the United States and Mexico. Cordell (1997) describes its north-south geographic boundaries as beginning at Durango, Colorado and terminating at Durango, Mexico and its east-west boundaries as beginning in Las Vegas, New Mexico and extending to Las Vegas, Nevada. The Southwest culture area distinguishes itself from neighboring cultures by the practices of digging stick agriculture to cultivate the staples of corn, beans, and squash, the use of manos and metates (grinding stones), the manufacture of high-grade pottery, the construction of multiroom pueblo villages and *rancherias* (dispersed settlements), and the occasional development of more complex towns with unique forms of public architecture. This culture area lacks state-level government and accompanying social stratification, a developed writing system, and large urban centers with monumental architecture on the scale of the Oaxacan pyramids (Cordell 1997:4).

The geographic area often referred to as Northwest Mexico is problematic in its inclusion in geographically inclusive terms such as "the Southwest" or "Greater Southwest." These terms derive from their geographic position within North America. The difficulty of affiliating Casas Grandes and other northern Mexican pueblo-type sites with a larger geographic area lies in their enigmatic position below the United States-

Mexico border, and the numerous cultural similarities they share with the Southwest. The terms "Southwest," "American Southwest," and "Greater Southwest" are inappropriate in that they imply the exclusion of northern Mexico. Likewise, DiPeso's term "Gran Chichimeca," which he devised to include the expanse of land on both sides of the international border thought to have been inhabited by the Chichimec people, is a derogatory term derived from the Nahuatl term for "lineage of the dog" (Coe and Koontz 2002; DiPeso 1974). Thus, it is culturally insensitive and will not be used.

If one looks at the cultural similarities between the pueblo sites in northern Mexico and the United States Southwest, the international distinction would become less obvious. A recent edited volume (Webster et al. 2008) takes this issue to task, noting the inclusion of such terms as "North American Southwest" and "the western U.S.-Mexico borderlands" (McBrinn and Webster 2008:3), and; "Arid America" and "Oasis America," (Mendiola Galvan 2008:294). However, no nomenclatural consensus is reached in the volume.

Riley (2005) prefers the term Aztlan. This Aztec word referred to the mythical "Place of the Herons," from which the Aztecs believed they originated. This place was far to the north and west of the Aztec kingdom. Spanish accounts cite that the Aztecs allegedly undertook a pilgrimage to Aztlan sometime during the reign of Moctezuma I (A.D. 1440-1469) (Riley 2005:5). Riley (2005:6) defines Aztlan geographically as:

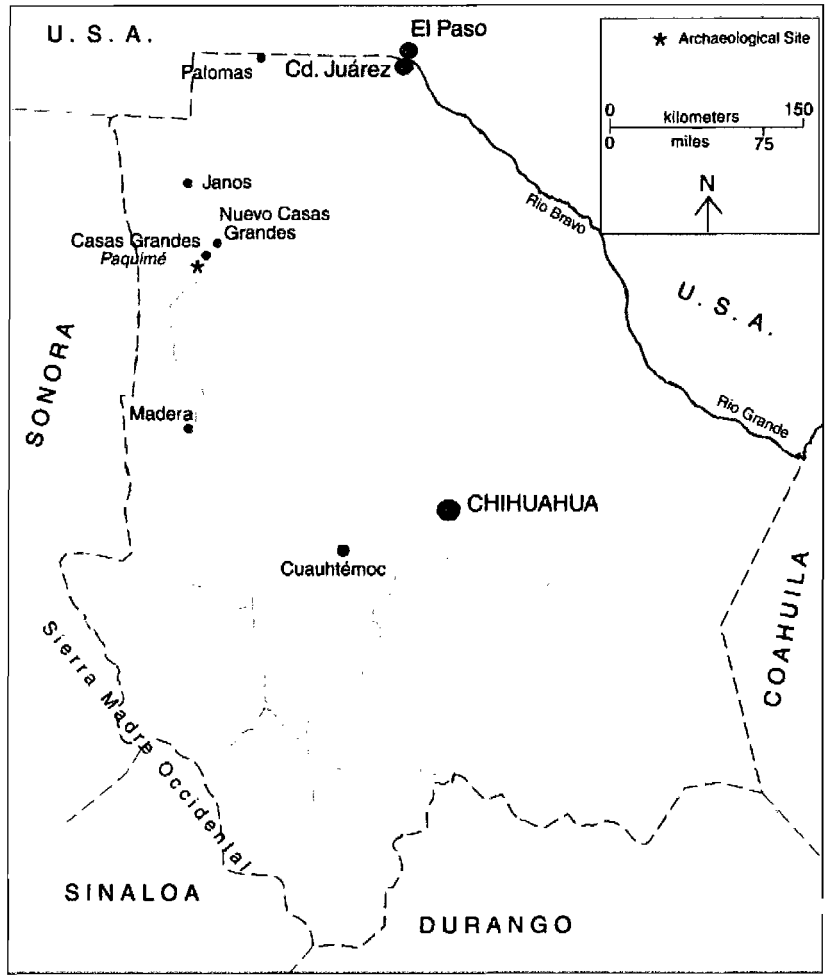
> "generally bounded by the southern Great Plains and the northern Mexican plateaus to the east, and the southern flank of the Rocky Mountains to the north. Its western boundary is the lower Colorado River and Gulf of California. To the south a fuzzy line of demarcation runs from the major Sonoran river basins eastward across the Sierra Madre Occidental through the high plateaus and interior basins of Chihuahua and Coahuila. In

> modern terms the region includes the U.S. states of Arizona and New Mexico, as well as parts of Utah, Nevada, Colorado, California and Texas. In Mexico it encompasses much of Sonora and Chihuahua, with influences that reach into portions of Sinaloa, Durango, and Baja California Norte."

Further compounding the problem, Casas Grandes shares a number of similarities with cultures of central Mexico and the pueblo cultures in Arizona and New Mexico. In this dissertation I will consider Casas Grandes as part of Northwest Mexico, interacting with cultures to the north and south. I prefer to think of it as part of the "borderlands" or on the "frontier" due to its intermediate location in the expanse of land north of the great cultures of central Mexico and south of the pueblo cultures of the Southwest. For me, this obscures the modern international border and forces one to look at the Casas Grandes culture with respect to its state-level neighbors to the south and the pueblo cultures to the north. This concept seems useful as the Casas Grandes culture shared attributes of both and should be considered unique in this respect.

The Site and Its History

The cultural phenomenon known as Casas Grandes existed from about A.D. 800 and peaked from about A.D. 1200 to about 1450 with the florescence of the city of Paquimé. The site is located on the vast, fertile floodplain of the Casas Grandes River in northern Chihuahua, Mexico, approximately 120 km south of the Mexico-New Mexico border in the relatively high Basin and Range country (Map 1). Several small rivers—the Carmen, the Santa Maria and the Casas Grandes—are located in the vicinity of Casas Grandes and likely attracted people to the area prehistorically. The Casas Grandes River is the largest in northwest Chihuahua, and the floodplain within a 5 km area of the site is



Map 1. Location of Casas Grandes (Paquimé).

estimated to have sustained 3,000 people (Whalen and Minnis 2003:319). A nearby natural spring and an underground well at the site provided ample potable water. Whether the people of Casas Grandes were hunting, gathering, or farming, this land at the eastern foot of the Sierra Madre Occidental was a very good area to forge an existence. In fact, it may have been one of the best places in northern Mexico and the United States Southwest to make a living (Whalen and Minnis 2001a:320). The modern-day people in this area continue to exploit it for the same reasons.

The first record of Paquimé made by a European was that of Baltasar de Obregón, a Spanish servant to King Phillip II, who in 1565 passed through the Casas Grandes valley on an expedition into northern Mexico (Hammond and Rey 1928). Obregón, so impressed with the enormity and skillful construction of the city, wrote it "seemed to have been built by the ancient Romans" (Hammond and Rey 1928:205). He further describes the six- to seven-story walls as being solidly built, whitewashed and painted in color with pictures. Architectural features such as floors and patios paved with stones resembling jasper, and the large wooden pillars supported by circular stones were also noted. He describes the Casas Grandes valley as "fertile and beautiful... surrounded by splendid and rich mountains and small mountain ridges...the most useful and beneficial of all the rivers we found in those provinces," (Hammond and Rey 1928:206). Obregón talked (using signs, not words) with nearby native peoples to find out where the former occupants had gone. He writes:

> "they were settled and living six days down the river toward the north, and that they had been forced to move away on account of the war waged on them by their enemies who came from the other side of the mountains. They added that about four days to the west lived many other people who occupied houses of great height, who wore clothes, and who possessed large amounts of cotton clothing, corn, beans, calabashes, fowls, and native cattle" [i.e. they had knowledge of Southwestern people] (Hammond and Rey 1928:208).

The site was excavated by the Joint Casas Grandes Expedition (JCGE) from 1958 to 1961, a collaborative effort between the Amerind Foundation of Dragoon, Arizona, and the Instituto Nacional de Antropologia e Historia (INAH) of Mexico (DiPeso 1974). The project was under the direction of Charles DiPeso, and in his estimation excavated

approximately 42 percent of the total settlement (DiPeso 1974; Woosley and Olinger 1993). In addition to the architectural features of the massive city, the excavation unearthed abundant ceramics, nearly four million pieces of shell, the remains of turkeys, macaws, and 576 human burials. One hundred twenty-nine of these individuals were recovered from the surfaces of residential floors and plazas, and in room fill above the floors rather than the customary formal sub-floor burial context (DiPeso et al. 1974:8:325). DiPeso interpreted 126 of these non-interred bodies as the mortal remains of "women, children, old people, and men of fighting age who died at the hands of an enemy people on the fatal day of the city's destruction" (DiPeso, 1974:2:639).

Excavation found it to be one of the largest prehistoric or protohistoric pueblos, boasting I-shaped Mesoamerican style ballcourts, flat topped mound structures, and multistoried apartment structures (Whalen and Minnis 2001a:3) (Figure 4). It was composed of multi-story poured adobe apartment complexes that served as the core, with public and sacred ceremonial spaces such as flat-top mounds, plazas, agave roasting pits, and ball courts built around it (Cordell 1997; Whalen and Minnis 2001a). According to DiPeso (1974), the total number of rooms was close to 2,000, which he believed would have housed a minimum of approximately 2,240 people and a maximum of 4,700 people.

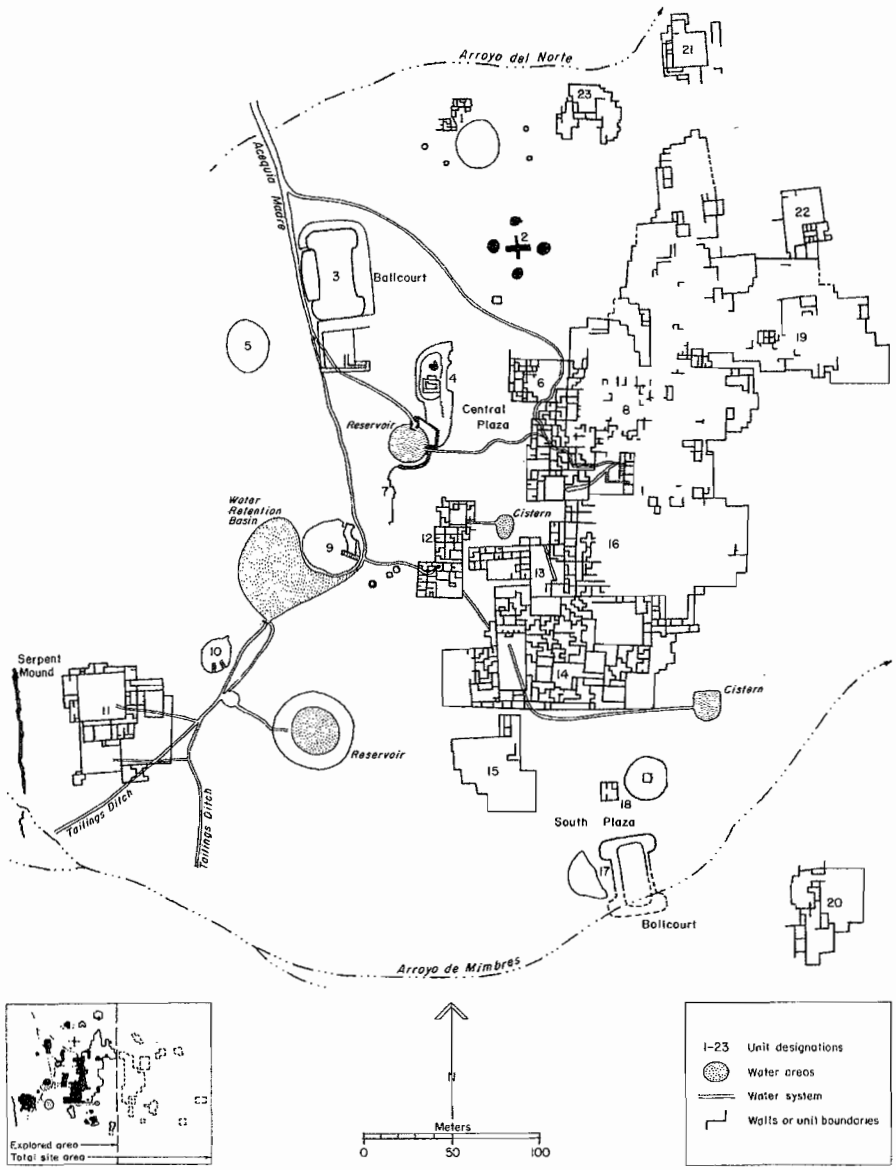


Figure 4. Casas Grandes site plan (from Dean and Ravesloot 1993).

Unit 1: House of the Ovens
Unit 2: Mound of the Cross
Unit 3: Ball Court 1
Unit 4: The Mound of the Offerings
Unit 5: Mound 1-5
Unit 6: Buena Fe phase ranch-style compound
Unit 7: Retaining wall and room
Unit 8: The House of the Well
Unit 9: Mound of the Heroes
Unit 10: Mound of the Bird
Unit 11: The House of the Serpent
Unit 12: The House of the Macaws
Unit 13: The House of the Dead
Unit 14: The House of the Pillars
Unit 15: House cluster
Unit 16: The House of the Skulls
Unit 17: Ball Court II
Unit 18: South Plaza rooms
Unit 19: House cluster
Unit 20: House cluster
Unit 21: North house
Unit 22: House cluster
Unit 23: House cluster

Site Chronology

The site's chronology is divided into two periods, the Viejo (A.D. 800-1200) and the Medio (A.D. 1200-1450) (Figure 5). DiPeso's dates of occupation, which were based on non-cutting tree-ring dates, further divided each period into phases. The Viejo period contained the Convento, Pilón and Perros Bravos phases; the Medio period contained the Buena Fé, Paquimé, Diablo and Tardio phases. The Buena Fé phase (A.D. 1060-1205) was characterized by the beginning of intense construction and urban renewal which came to its pinnacle during the Paquimé phase (A.D. 1206-1260), before falling into disrepair during the Diablo phase (A.D. 1261-1340). Schaafsma and Riley (1999:Table 1) assert there is inadequate evidence to make phase distinctions in the Medio period.

The Casas Grandes chronology has been a subject of contention among Southwest archaeologists since it was initially proposed by DiPeso. This is due mostly to inconsistencies between the dendrochronology and the ceramic sequence. Ironically, a major focus of the JCGE was to build a chronology of the Casas Grandes region to aid in placing it in the Southwest scheme (DiPeso et al. 1974:4:9). Three hundred eighty-six tree-ring samples were collected, which produced 53 dates that span the interval from A.D. 1044 to 1338 (Dean and Ravesloot 1993:89; DiPeso et al. 1974:4:13). These samples came from twenty-nine rooms in five architectural units. However, the samples did not represent actual cutting dates as a number of the outer rings were removed when shaping the beams and posts during construction. DiPeso made the crucial error of assuming few rings had been removed and treated the samples as near cutting dates (Dean and Ravesloot 1993:89). He used these assumed dates, ceramic distributions,

obsidian hydration dates, and radiocarbon dates from other area sites to develop the controversial Casas Grandes chronology (Dean and Ravesloot 1993:89-91; DiPeso et al. 1974:4:13).

In 1993, Jeffrey Dean and John Ravesloot re-evaluated the Casas Grandes tree ring dates. Using a regression equation to estimate the number of outer rings lost during construction, they were able to estimate dates from 45 samples. These dates spanned from A.D. 1160 to 1419. The bulk of them (thirty-nine) fell in the thirteenth and fourteenth centuries, demonstrating that construction was concentrated during this time. Furthermore, they believed the site may have been inhabited as late as the 1470's (Figure 5). This new chronology correlates better with the Southwest ceramic and cultural sequences and is believed to be more accurate than the one DiPeso proposed.

Cultural Connections

Several scholars see similarities between Paquimé and Mesoamerica, and the group of sites at Chaco Canyon, New Mexico (DiPeso 1974; LeBlanc 1986; Lekson 1999a; 1999b; Lister 1978). DiPeso (1974) attributed the origin of Paquimé to the Toltecs of the Valley of Mexico due to their contemporaneity (according to his original dating scheme), and the presence at Paquimé of several Mesoamerican elements. These included stone disc post foundations, t-shaped doorways, colonnaded structures, decorated effigy vessels, copper bells, macaws, ballcourts, plazas, platform mounds, and images on pottery of the plumed serpent god Quetzalcoatl. Several of these elements are found at other sites throughout the United States Southwest (Cordell 1997; LeBlanc 1986; Whalen and Minnis 1996). These elements, associated with the Mesoamerican Mixteca-

Figure 5. Relationship of Casas Grandes with other chronologies.

<table>
<tr><td rowspan="2">1400</td><td rowspan="5">Post-Classic</td><td rowspan="3">Medio</td><td rowspan="6">Medio</td><td>Tardio</td><td rowspan="2">Pueblo IV</td><td>Cliff Phase</td></tr>
<tr><td>1300</td><td>Diablo</td><td rowspan="2">Black Mountain Phase</td></tr>
<tr><td>1200</td><td>Paquimé</td><td rowspan="3">Pueblo III</td></tr>
<tr><td></td><td rowspan="5">Viejo</td><td>Buena Fé</td><td rowspan="2">Mimbres Phase</td></tr>
<tr><td>1000</td><td rowspan="5">Viejo</td><td>Perros Bravos</td></tr>
<tr><td>900</td><td rowspan="3">(Terminal) Classic</td><td>Pilón</td><td>Pueblo II</td><td rowspan="3">Late Pithouse Period</td></tr>
<tr><td></td><td rowspan="2">Convento</td><td rowspan="2">Pueblo I</td></tr>
<tr><td>800</td><td></td></tr>
<tr><td>700 A.D.</td><td></td><td></td><td></td><td>(Phases)</td><td>Basketmaker II</td><td>Early Pithouse Period</td></tr>
<tr><td></td><td>Mesoamerican Chronology</td><td>New Casas Grandes Chronology[a]</td><td colspan="2">DiPeso's Original Chronology</td><td>Southwest Pecos Chronology</td><td>Mimbres Chronology</td></tr>
</table>

[a]after Dean and Ravesloot, 1993.

Puebla style probably originated in the Valley of Mexico diffusing up the western coast and into the American Southwest and Paquimé via trade (Coe 1994).

The influence of Casas Grandes in the Southwest is believed to have superceded that of the Mimbres Valley Classic Animas Phase (A.D. 1100 to 1350). This is reflected in the ceramic assemblage containing Playas Red Incised, El Paso Polychrome and Ramos Polychrome, which is used as evidence of a close cultural association between the Mimbres Valley and Casas Grandes (Cordell 1984). The shift from cobble-walled structures to adobe and the move to the south of the Mimbres Valley may also be evidence of this (Cordell 1984).

It is generally agreed that Casas Grandes served as the hub of a regional system based on trade and a common system of religious beliefs (Cordell 1984; DiPeso et al. 1974; Douglas 1995; Whalen and Minnis 2001a). The Casas Grandes regional system bears similarities to the Chaco Canyon system due to its central core area and satellite communities. Likewise, both systems were linked through a system of roads, paths, and possibly a signaling system (Cordell 1984; DiPeso 1974; Lekson 1999a; Swanson 2003). A minor difference is that the Chaco core area consisted of several settlements within Chaco Canyon whereas the Casas Grandes core consists of a single, large settlement with several smaller outlying communities (Cordell 1984; DiPeso et al. 1974; Lekson 1999a). In terms of size, Paquimé is about six times larger than the next largest regional settlement (Whalen and Minnis 2001a).

Casas Grandes has been recognized as the primary center of the region since the publication of the site report (DiPeso 1974; DiPeso et al. 1974). However, the degree and extent of its influence have been the subject of recent discussion. Whalen and Minnis' (2001a) book on the Casas Grandes region is the culmination of extensive surveys.

They see the Casas Grandes region as operating through a core-periphery relationship. The core-periphery model is based on Wallerstein's (1974) 'world system' theory, which proposed that a dominant civilization (the core) subjected less powerful groups (the periphery) to its authority. DiPeso (1974) referred to these elements as the "donor" and "recipient" cultures. Wallerstein's (1974) ideas were more specific to European colonialism and have been modified into the core-

periphery model in order to make it more applicable to societies throughout human history and prehistory (Whalen and Minnis 2001a).

Whalen and Minnis (2001a:38) believe Casas Grandes was the center of the area's economic, ritual, and political structure that manipulated the flow of material, energy, and even people on at least a regional level. According to them, the center emerged as the result of peer-polity exchange. The peer-polity approach uses conflict between social groups of approximately comparable size and social complexity as the stimulus for change and integration of diverse cultural trappings within a geographic area (Whalen and Minnis 2003). They believe the Medio period settlements were arranged into three levels of interaction: the Inner, Middle, and Outer Zones. The Inner Zone extended about 30 km around Casas Grandes and was the area of most intensive interaction, characterized by the occurrence of the highest concentration of large to very large communities, the most ritual architecture, and the most exotica. The Middle Zone extended to the northwest of Casas Grandes to a distance of 30-60 km and is characterized by smaller communities, a lower concentration of large settlements and the absence of very large settlements. The Outer Zone extends 100-150 km farther north and west to the Carreras Basin, just below the southwest corner of New Mexico (Whalen and Minnis 2001b:318-319).

Though viewed by DiPeso (1974) as a brutal centralized authority over all of northern Mexico and the American Southwest (an opinion rooted in his belief that Paquimé operated as an extension of the Mexican Toltec state), Whalen and Minnis (2001a, 2001b) have proposed an alternative view based on their region-wide survey

data. Their rank-size distribution comparison of sites in the Inner and Middle Zones shows consistencies with different levels of integration. Rank-size graphing is more thoroughly discussed in Whalen and Minnis (2001a). This comparison showed that the Inner Zone settlements, including Paquimé, bore a distribution characteristic of a settlement system made up of a regionally dominant center with a relatively independent, loosely organized adjacent area and settlements that lacked significant integration. The Middle Zone's distribution was more suggestive of a low degree of organization and integration lacking a centralized settlement.

Sociopolitically, Paquimé is characterized as a mid-level society (Whalen and Minnis 2001a), which shares similarities with ranked chiefdoms (Bailey and Peoples 1999). Mid-level societies are characterized as having developed beyond egalitarianism, but lack formal stratification and rigid decision-making hierarchies and bureaucratic authority (Whalen and Minnis 2001a). While it appears there was no rigid social stratification, there were likely people of higher status who regulated the flow of prestige and trade goods, and who were in charge of urban planning and organizing labor for such public projects as the building and maintenance of the water distribution system and ceremonial areas of the city. These differences in status are reflected in the uneven distribution and quality of burial goods (Ravesloot 1988).

Paquimé's Genesis and Decadence

Much of the confusion surrounding the origin and affinities of Paquimé lies in the presence of a mixture of cultural elements from both the United States Southwest and Mesoamerica. An early account by Bandelier (1890) attributes the origin of

Paquimé to the Southwest, an idea that pervaded the archaeological literature of the early 20th century (Brand 1935; Carey 1931; Ekholm 1940; Kidder 1916; Lister 1958). Brand (1935:287) went so far as to say "the prehistoric or archaeologic cultures of Northwest Mexico are definitely Southwestern in affiliation," due to their lack of Mesoamerican cultural elements as identified by Kroeber (1928). It is difficult to escape the fact that pueblo style adobe architecture characterizes the city of Paquimé and its contemporaries in northwest Mexico (Cordell 1997; Whalen and Minnis 2003).

Mesoamerican Influence

It is widely recognized that Paquimé was a ceremonial center that produced and facilitated trade of exotica, much of it associated with religious rites. Much of DiPeso's argument for ritual human sacrifice rests on the discovery of ceremonial ballcourts and recovery of ritual paraphernalia at the site. The ballcourts may figure prominently into arguments that human sacrifice and cannibalism were operating at Paquimé.

The ballgame was important to the ancient Mesoamericans for many reasons. It was used as a stage for performances of rituals and sacrifice, and as a means for the acquisition and consumption of goods (Fash and Fash 2007:267). Players acted out dramas tied to fertility and the agricultural cycle, and for settling disputes between communities (Fash and Fash 2007:270-271). A contest that marked a sacred event served to stimulate production, acquisition, and consumption of sacred and secular goods in the same fashion as sporting events do today (Fash and Fash 2007:278). It was truly a multipurpose event.

Certainly Paquimé was a center for the collection and production of exotic materials, though the degree to which the city exported these items is still contentious. The abundance of west Mexican goods shows the city was part of the extensive Aztatlán trading system (DiPeso 1974:2:625-629; Kelley 2000; VanPool and VanPool 2007:135), a system that could have served as the vehicle for diffusion of the ballgame up the west coast of Mexico and east to Paquimé (Wilcox 1991:105). The VanPool's (2007) argue that an emerging ruling class developed a complex ritual-religious system to reduce the increased scalar stress that resulted from the growing settlement and the demands on the population as the users and distributors of the region's exotica (macaws, shells, and copper bells, minerals). This ruling class synthesized the existing religious structure with imported symbolism, creating a system that utilized exotica, the Mesoamerican ballgame, tobacco shamanism, and esoteric knowledge of how the universe operated (VanPool and VanPool 2007:133). The elites centered themselves as performers of rituals and intermediaries between the natural and supernatural worlds, images of which are depicted in abundance on Casas Grandes polychrome pottery (Davis-Salazar 2007:197; VanPool and VanPool 2007).

Davis-Salazar (2007:198) argues that accumulation and control of ritual objects in the hands of a few elites could legitimize their power and further distinguish them socially. As performers of rituals, the elites or shamans (these could be one in the same) separate themselves from the audience through their control of knowledge of sacred rites and control of ritual objects (Davis-Salazar 2007:199). The

implementation of the ballgame would have been an ideal way to integrate the region and provide a stage on which to perform rituals or dramas in front of a regional crowd (Wilcox 1991). Thus, the ballgame would have been important to the elite of Paquimé because: 1) it provided a means for dispute resolution and social integration between regional groups, 2) it served to bring people and their goods together for trade and/or redistribution, and 3) it legitimized their power and reiterated the distinction between the elites and the lesser social classes.

The ballgame may have served an integrative ceremonial function in the region (DiPeso 1974:2:414; Riley 2005:131). Whalen and Minnis (1996) recorded 12 additional ballcourts in their survey of the valleys and foothills of the Sierra Madre to the west. Seven more have been recorded at more distant sites—four in northeast Sonora and three in the Animas region of extreme southwest New Mexico (Riley 2005:129-131). DiPeso (1974:2:415-415) advanced the theory that, like further south in Mesoamerica, these games were closely tied to human sacrifice. In the center of the T-shaped ballcourt at Paquimé, DiPeso found a multiple burial below the court's surface that contained the skeletal remains of two males buried in a position he believes was consistent with a Veracruz palma design depicting fertility symbolism. Beneath the surface of the south and north ends of the same ballcourt, he recovered burials containing two females (one of them pregnant), and two females and a male skull, respectively. At least one of the females may have suffered some post-mortem ritual dismemberment of her right arm, which was found draped over her head.

Development and Emergence of Paquimé

The emergence of the city remains poorly understood. A number of theories about its rapid development have been proposed, among them: it was founded and developed as an outpost by the Toltecs (DiPeso 1974), or Aztec merchants (Riley 2005) to facilitate the flow of luxury items (turquoise, copper) between the southwest United States and the Valley of Mexico; it was founded by southward-migrating Mogollon peoples who were fleeing drought and sociopolitical upheaval (Lekson 1999a), and; it developed *in situ* bolstering the positions of local leaders, while borrowing cultural elements from outside the area (Whalen and Minnis 2003).

DiPeso (1974:2:299) attributes the rise of the Medio period city of Paquimé to economic expansion of the Toltec Empire from the Valley of Mexico. He believes this expansion was facilitated by an emerging class of Mesoamerican merchants/paramilitary spies known by the Nahuatl term *pochteca* (singular *pochtecatl*) (Riley 1993:17). He (1974:2:290) believed that a few Toltec *pochteca* came to the Casas Grandes valley around A.D. 1060 to exploit its rich mineral and metals resources. In doing so, they inspired the locals to build the city of Paquimé and established it as a great frontier trade center, sending such goods as turquoise and copper to Mesoamerica and sacred turkeys and macaws to the Southwest.

DiPeso supports his model with three secondary, headless human burials from the Mound of the Offerings, which he believes were those of *pochteca* (DiPeso et al. 1974:8:335). DiPeso and colleagues (1974:8:335) recount Spanish explorer Sahagún's description of a *pochtecatl* death ceremony from Aztec times, where the

deceased is dressed and adorned with body paint, then carried to a mountain top where his body was consumed by animals. Afterwards, the remains were carried back and buried. McGuire (1980) and Ravesloot (1984) question this conclusion at Paquimé, noting that the artifacts found with these burials were local in origin rather than Mesoamerican as would be expected. Moreover, the mortuary treatment of these high status individuals must be examined in terms of the Casas Grandes total mortuary program rather than only by the quantity and quality of grave goods (Ravesloot 1984:212).

In Riley's (2005:117) view, "Paquimé represented the most overt Mesoamericanization in all of Aztlan." He believes Paquimé shows continuity with Mesoamerica in religious and sociopolitical systems, sophistication in construction techniques, mound structures, colonnaded structures, a water system (called an *acequia*) and a sewer system. Probably the most important feature was the presence of Mesoamerican-style ballcourts found throughout the region, three of which were found at Paquimé (Riley 2005:131).

Lekson (1999a) sees an ancestor-descendant relationship between the Chaco communities and Paquimé. He believes the Casas Grandes valley was underpopulated relative to its carrying capacity during the Viejo period. Thus, the seemingly instantaneous rise in population is attributable to a sudden influx of people moving southward from New Mexico. This is given validity by the extensive movements of Puebloan peoples during the 13th century due to increasingly dry climatic conditions (Dean 1996; discussed below). Lekson believes the original

inhabitants of Chaco Canyon moved directly north to the site of Aztec due to climate change. Social and political factors forced them to leave Aztec after a short period of time. They then moved directly south of Aztec and Chaco to the Casas Grandes valley along a sacred north-south meridian that would forever bind them to their homeland.

Jeffrey Dean's work on tree-ring analysis offers convincing evidence for Lekson's model. Dean's (1996) reconstruction of long-term paleoenvironments in the Southwest using principal component analysis of tree-rings provides crucial information about annual precipitation and stream flow in the northern Southwest. Dean found unimodal and bimodal precipitation patterns that repeated over the period A.D. 966 to 1988 with the exception of the period A.D. 1250 to 1450, "when the long-term pattern broke down into chaotic distributions of three or four principal components that exhibit no logical geographic patterning" (Dean 1996:43). The northwest component in Dean's study (the northwest area of the Four Corners) experienced the greatest disruption of this pattern and sites in this area were abandoned between A.D. 1250 and 1450. This time period and geographic location correspond to an increase in violence and cannibalism (Turner and Turner 1999). The southeast component was little changed and the sites in this area continued to be occupied through this time. Therefore, it is possible that sites to the south such as Casas Grandes, which were outside this chaotic rainfall pattern, saw tremendous population growth during this time period due to the southern migration of Mogollon peoples (Cordell 1997).

Whalen and Minnis (2003) believe Casas Grandes developed locally, pointing to the availability of copious arable land in the Casas Grandes River valley, an abundance of local floral and faunal food resources and a previously undocumented continuity of occupation in the area. Whalen and Minnis (2003:327) call it "the most productive agricultural setting in the region." The Tinaja site 20 km southwest of Casas Grandes, which dates to the early Medio, shows early development of many architectural elements previously thought to be unique to Paquimé. Thirteenth century components of the Tinaja site such as the I-shaped ball court, T-shaped doorways, stairs, and poured adobe house construction show striking similarities to those at Paquimé. The site demonstrates continuity in building style and fills the thirteenth century temporal gap noted by Lekson (1999a) during which it was thought there was an occupational hiatus.

To summarize, Casas Grandes existed as a cultural phenomenon from the thirteenth to the fifteenth century. The Medio period city of Paquimé incorporated architecture and technologies characteristic of both the Southwest and Mesoamerica. Several viewpoints have been offered to explain the florescence of the city of Paquimé. While no consensus has been reached, the local development model is strongly supported by the extensive survey and excavation work by Whalen and Minnis (2001; 2003), while a mass exodus from the Southwest (Lekson 1999a) is supported by climatological work by Dean (1996). However, Lekson's (1999a) sacred meridian theory is difficult to support archaeologically. DiPeso's (1974) Toltec *pochteca* model has fallen out of favor due to improved dating and the insight

that Ravesloot's (1984) analysis has offered. Paquimé does show material culture likely derived from central Mexico, but whether it was the Aztlan of the Aztecs, as Riley (2005) claims, is still speculative.

CHAPTER III

REVIEW OF OSTEOLOGICAL LITERATURE

The Burials

The excavation recovered 652 individuals, 576 of which were identified as dating to the Medio period (DiPeso et al. 1974:8:360). Period determination was made by their association among the building structures and ceramic assemblages. DiPeso recorded twelve main burial types at Paquimé, many of which were further divided into sub-types (Figure 6). DiPeso's burial coding method used a bipartite system. The first number was the individual burial number from a unit; the second number was the unit designation. For example, burial 27-14 is the 27th burial recovered from unit 14. Humans were typically wrapped in blankets or sleeping mats and buried under the floors of occupied houses or plazas. Differences in social status were reflected in grave accompaniments, which ranged from ceramics and jewelry to tools and macaw and turkey carcasses (DiPeso 1974:2:650-651; Ravesloot 1984; 1988). Nearly one half of the room burials and one fourth of the plaza burials contained ceramic vessels. Some vessels contained cultivated or uncultivated food remains. Burial practices consisted of a mixture of single and multiple, primary and secondary burials. A primary burial is distinguished as beginning and ending with the initial disposal of the body (Schroeder 2001:82). This is the typical modern burial method in North America. During secondary burials, the human remains are removed

from the initial resting place and replaced either in the initial disposal facility or removed to a second disposal site (Schroeder 2001:82).

Taphonomic indicators of secondary burial are the absence of small hand and foot bones, under-representation of normally well-preserved elements, fragmentation and lack of complete elements, and smaller than expected numbers of teeth in skulls (Roksandic 2002:109-110). Evidence of cutmarks for the purpose of soft tissue removal, dry fractures and canid gnawing may also be present (Redfern 2008:293). The Medio period burials showed no apparent positional or postural preference, with an unequal mixture of cardinal orientations, and of flexed, prone, and prostrate positions. Five individuals were buried secondarily in three urns.

A limited number of studies have included the Casas Grandes skeletons in their data sets. The only studies of the Casas Grandes osseous remains are found in doctoral dissertations by Benfer (1968), Butler (1971), and Walker (2006), and in publications by Weaver (1981) and Woodall (1968). Ravesloot's (1984, 1988) study of burial practices and social status is also noteworthy.

Benfer (1968) provided the first analysis of the Casas Grandes skeletal material. His goals were to characterize the demographics of the Viejo and Medio period individuals and determine their biological affinity with others from Mexico and the Southwest. Unfortunately, he only included individuals between the ages of 20 and 50, due to the inability of aging techniques to produce solid age

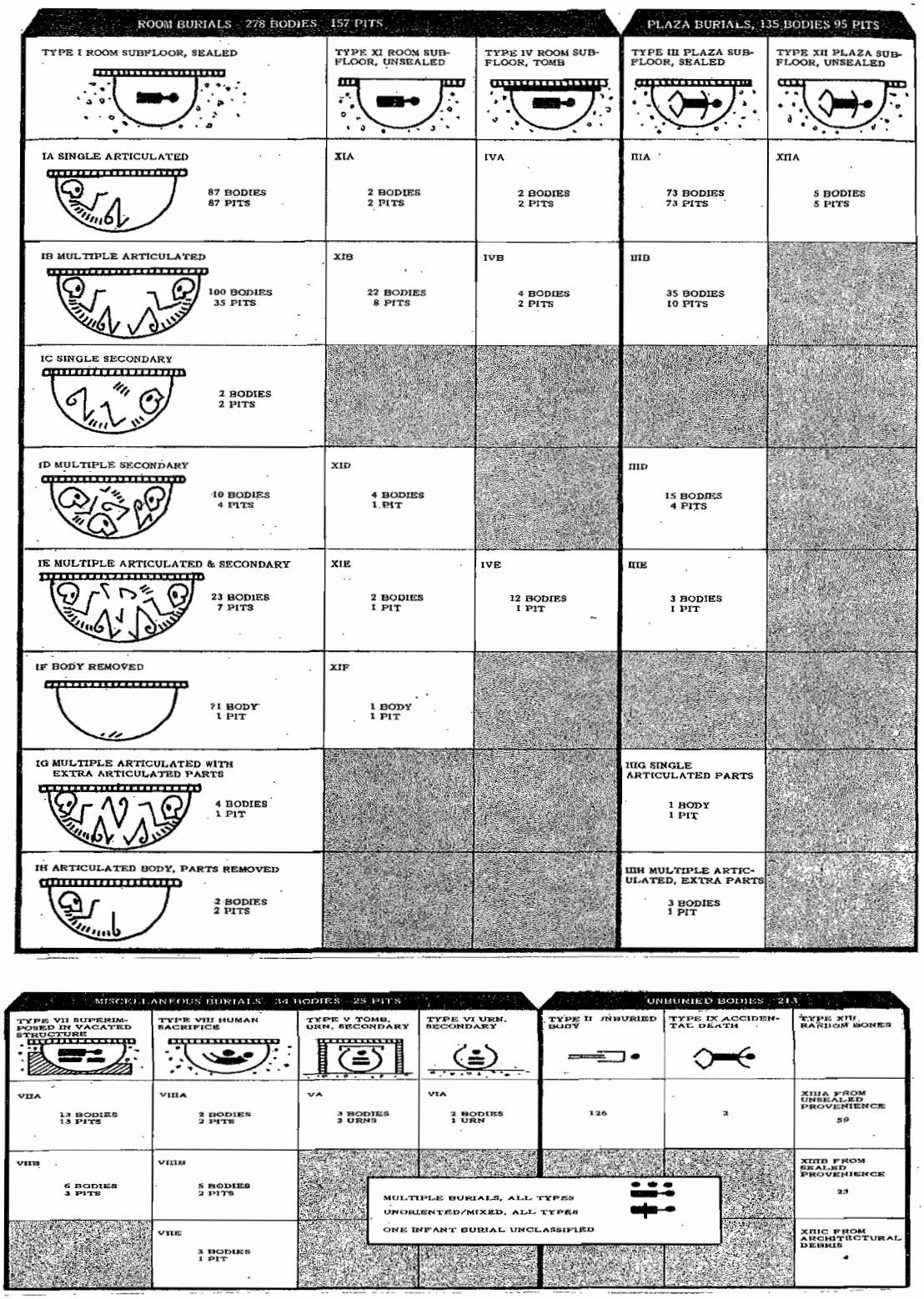


Figure 6. Casas Grandes burial types (from DiPeso et al. 1974:Figure 358-8).

determinations above 50. He provides no explanation for excluding the subadults, but concedes he may have been remiss in doing so stating, "that project, along with others, remains for future workers" (Benfer 1968:2). Since Benfer's focus was on population affinity, his treatment of pathology and trauma was limited with the exception of describing the trophy skulls.

Butler (1971) described the crania and dentitions of the Casas Grandes assemblage across the Viejo, Medio, Tardio, and Spanish contact periods. She hypothesized that if small groups of *pochteca* from an outside "donor" culture did indeed inspire the indigenous people to build Paquimé as a Mesoamerican outpost, then the skeletons would show heterogeneity in their expression of inherited discrete traits. Her results showed no evidence for population heterogeneity until approximately the time of Spanish contact.

Butler included 306 of the adult Medio period skeletons (those over age 18) in her analysis. Her totals by sex were: 104 males, 148 females and 54 of unknown sex. Thirty-seven of the 54 of unknown sex were also of unknown age. This differential representation of sexes is the evidence DiPeso used to speculate a warfare complex existed, and that the missing males were lost on distant battlefields or buried in a separate, yet unexcavated warrior cemetery.

Woodall (1968) indexed nutrition and morbidity in the Casas Grandes skeletons by documenting the occurrence of Harris growth disruption lines in tibias. Harris lines are thought to represent periods of disruption in normal growth. He found seven of the thirty-nine individuals in the study showed the transverse lines.

Though his results were largely inconclusive, it did show one of the possibilities for skeletal research.

Weaver (1981) investigated diet change between the Viejo and Medio periods. He hypothesized the people would suffer a decrease in health that corresponded with the transition from foraging to agriculture. By recording the frequency of occurrence of porotic hyperostosis and periostitis, skeletal indications of nutritional deficiency and disease, he concluded there was a significant difference in their occurrence between the Viejo and Medio period populations. He believed this was due to a decreased standard of living with the adoption of agriculture. However, Corruccini (1983) points out inconsistencies in Weaver's chi-square analysis of the samples, which when corrected showed no significant differences between the frequencies of these pathologies. Thus, the study shows results similar to Woodall's (1968).

Walker (2006) investigated biological affinities of individuals from cave burials he excavated from the Pima and Tarahumara regions of southwestern Chihuahua, Mexico. While his focus was not on Paquimé, he did include a sample of the Medio period skeletons. He found some long-term continuity between the individuals from the cave contexts and the modern inhabitants of the area. However, despite the temporal overlap of these burials with those from Paquimé, he found little evidence to suggest continuity among the two.

Ravesloot (1984; 1988) studied the influence of ascribed social status on mortuary practices at Casas Grandes. He examined the total mortuary program (body preparation, burial facility, location of burial facility, quantity and quality of grave

goods) using principal component analysis rather than by the number and quality of funerary objects alone. He found differences in the mortuary practices that showed Casas Grandes may have been organized by ascriptive ranking, supporting DiPeso's assertion of a social hierarchy. He also noted that many of the non-interred skeletons were processed in a manner similar to the formally interred ones (plaza subfloor unsealed grave pits, plaza fill, room fill, and single interment). He writes: "This may reflect a digression in the organizational complexity of the community near the time of its decay and abandonment. Or, it may represent another dimension of status differentiation operating during the Medio" (Ravesloot 1984:207; 1988:72-73).

Ravesloot (1984) proposes an alternative to the *pochteca* political model based on his mortuary study. He writes the Paquimeans may have been organized on the basis of ancestor worship where

> "an individual's placement within the social hierarchy at Casas Grandes was presumably assigned at birth on the basis of his or her genealogical relationship to these ancestors. This genealogical relationship determined social positions accessible within the status hierarchy including ones that carried political, economic, and religious authority or power" (Ravesloot 1984:213).

He supports this proposal with evidence that few individuals at Casas Grandes were given elaborate ritual treatment, which included burial in special tombs in special locations of the city. Many of these tombs contained multiple burials of both sexes and various ages. Several of these tombs are associated with ceramic drums and headless turkeys, both of which are associated with formalized funerary rituals. In the end, Ravesloot (1984:3) stresses the value of re-examining archaeological material from alternative perspectives.

In summary, skeletal studies of the people of Casas Grandes show a lack of nutritional deficiencies during the transition to agriculture, a low disease load, introduction of foreign genes was negligible until Spanish times, and they show no biological relationship to extant local populations. These studies demonstrate the promise that skeletal analysis holds for increasing our knowledge of the culture and biology of the people of Casas Grandes. However, the material still holds a wealth of untapped information. Specifically, none of these studies address skeletal trauma, the concern of this research. With the exception of Ravesloot's (1984) analysis, exclusion of the non-interred skeletons serves as a common thread.

The Nature and Properties of Bone

The skeletal system constitutes less than 20% of the weight of the human body but functions as one of its most important systems (White and Folkens 2005). It protects and supports soft tissue, anchors muscles, tendons and ligaments, acts as levers to produce movement, and provides centers for the production of blood cells and storage of fats and minerals (Baker et al. 2005:5). Bone is composed of two basic components known as compact or cortical bone, and spongy (also called trabecular or cancellous) bone. Their composition is the same at the cellular and molecular levels; the only difference is in the degree of porosity (White and Folkens 2005). Bone is a composite of collagen and hydroxyapatite, the organic and inorganic components, respectively. The organic component provides the rigidity, hardness, and resistance against compression (Baker et al. 2005:5). Collagen makes up about 90% of this organic content. The bones of children are comprised of mostly

organic material, which gives them greater elasticity, flexibility, and resistance to breakage than those of adults. This lack of mineralization also makes them less likely to be preserved in archaeological contexts. Much of the organic fraction is replaced by inorganic matrix with advancing age.

According to Berryman and Symes (1998), fresh bone is a viscoelastic material. Due to its viscoelastic properties, bone is nearly twice as strong in compression as in tension. It deforms under load but has the capability to restore its original shape once the load is lifted. If the load exceeds the bone's elastic capabilities it will become permanently deformed even after the load is lifted. Hence, when the bone's elastic and plastic capabilities are exceeded it will fail. Once the bone dries after death this elastic property is reduced, causing easier breakage, which explains why archaeological bone subjected to the compressive forces of burial is often recovered in a fragmented state.

The Timing and Types of Bone Fracture

Before discussing damage to bone, a distinction must be made between bone *fracturing* and *splitting*. According to Noe-Nygaard (1977), bone fracturing results from cutting, beating, breaking, or crushing the bone, either accidentally or purposefully. Intentional bone splitting is distinguished by the desired end result of splitting a bone longitudinally for easier and greater access to the marrow contents during animal processing. This is accomplished by intentionally striking the bone diaphysis with a series of precise blows along its longitudinal axis. Noe-Nygaard was able to demonstrate experimentally that this is best accomplished after removal of soft

tissue from the bone. Archaeologically, soft tissue removal would have been accomplished by passive exposure, removal following exposure to heat (fire or boiling), or by cutting it away with a sharp tool.

Damage to bone is classified by its timing relative to the time of death. The three classifications are: antemortem (sometime before death), perimortem (around the time of death), and postmortem (after death). Antemortem fractures show some degree of bone callous formation or complete healing (Sauer 1998:322). In cases of depressed fractures of the skull, the margins of the fracture will heal, but the depressed area remains throughout life (Walker 1997).

Perimortem injuries can undergo some degree of healing, but may lack complete healing as it can take approximately two weeks before healing begins, and the affected area can remain plastic for up to two months (Roksandic et al. 2006; Sauer 1998:325). These can be recognized archaeologically by their sharp edges, and the presence of adhering bone fragments. Pickering and colleagues (2005) report that breaks to fresh bone are more acutely angled (relative to the long axis of the bone) than similar breaks to dry bone. This is due to the presence of a higher organic fraction in the bone at the time of breakage and the use of percussive force (Pickering et al. 2005:248).

Postmortem fractures that occur to dry bone are relatively easy to recognize as the edges are sharp, there is no evidence of healing, the angle of fracture in longbones is less acute, and adhering bone fragments are absent (Pickering et al. 2005:248; Sauer 1998:325). Often, postmortem fractures are the result of recovery techniques

and the edges of these breaks are distinguished by a difference in color (White 1992). I will use this classification in this dissertation, though fractures to wet bone after death will be considered postmortem.

Cause and Manner of Death from the Skeleton

When confronted with human remains, researchers are often interested in determining the cause and manner of death. Cause of death is the disease or injury that caused the person to die (i.e. heart attack, stroke, asphyxiation), whereas manner of death concerns the circumstances of how the death occurred (homicide, accident, suicide, natural causes, undetermined) (Clark et al. 1996:185). Though violent death often leaves damage to the skeleton making cause of death more apparent, manner of death can be more difficult to determine and often relies on other factors related or unrelated to the body (time-since-death, eyewitnesses, position of the body, trace evidence, associated artifacts, for example).

Violent deaths often leave skeletal damage from which a researcher may infer the cause of death. Depressed cranial fractures are often recorded as a type of injury attributed to interpersonal violence that occurred in prehistory. Blunt-force instruments such as stone tools and clubs are likely to cause these localized depressed fractures that lack radiating cracks. Severe depressed cranial fractures can be highly lethal, whereas less severe ones may be non-lethal if they do not penetrate the inner table of the cranial bone and into the skull cavity. Sharp-force injuries attributable to a spear or arrow can be differentially diagnosed because they often leave the stone point or part of it embedded in the bone (Walker 2001:Figure 1).

Determining manner of death from skeletal remains from modern or prehistoric context can be difficult if not impossible. Once skeletal damage is identified, one must differentiate between accidental and intentional injuries. Several studies have found that skulls of those engaged in recurrent bouts of war showed multiple healed and in some cases unhealed depressed cranial fractures (Lambert 1997; Torres-Rouff and Costa Junqueira 2006; Tung 2007; Walker 1989). The percent of those affected by war-related trauma was lower (24-35%) than those found in massacre assemblages.

Differences in injury location and among age groups and sexes are also informative. Two studies found that over half of non-lethal cranial injuries were to the frontal bone, which suggests face-to-face conflict (Lambert 1997; Torres-Rouff and Costa Junqueira 2006). Furthermore, the greater occurrence of injury on the left frontal of males suggested the aggressors were predominantly right-handed. Cranial injuries to females were more diffuse and were primarily located on the posterior portion of the skull, which is more suggestive of spousal abuse or some other form of violence rather than warfare. Lambert (1997; also Walker 1997) found that healed fractures were much more common in males than in females. Healed cranial vault injuries were most common in those aged 18 to 40, while children under ten years and those 40 years and older were infrequently affected. This suggests that most injuries were incurred during the adolescent and young adult years, and that those who were not involved in the violent episodes lived longer.

Fractures of the distal ulna, the so-called "parry" fracture, can indicate defensive wounds resulting from interpersonal violence. The name "parry," coined by Elliot Smith and Wood Jones was used to describe fractures of the distal ulna that were thought to have occurred in an individual's attempts to deflect blows from an incoming weapon (Jurmain 1999:215). However, this cause is equivocal as some studies have found that fractures of the distal ulna are common in non-warring groups, and equally distributed between the sexes (Judd-Roberts 1999; Jurmain 1991; Neves et al. 1999). Isolated cases lacking other trauma are more likely the result of accidental falls (Smith 1996:84). However, when found together with other injuries such as those of the skull, this type of fracture may be due to interpersonal violence (Tung 2007:945).

In any case, physical and circumstantial evidence should be treated as the primary basis for making a decision rather than drawing conclusions based on myth and speculation. I will illustrate this point using three brief examples. The collapse of the ancient city of Mohenjo-daro is surrounded by myth. Dales (1979) argues that while South Asian lore indicts Aryan invaders for the fall of Harappan civilization, the lack of mass casualties from both sides makes it difficult to accept. While there are some scattered human remains at Mohenjo-daro, their small numbers (37 individuals) and imprecise dates make it difficult to attribute them to one time period much less one single event. Kennedy (1984) also takes this position after examining the skeletal remains from Mohenjo-daro and finding conclusive evidence of only one

case of traumatic death. While this death was attributed to violence, the identification of one victim is not evidence of a massacre.

Room 38 in unit 11 at Paquimé serves as the second example. The stratigraphy of Room 38 shows layers of room fill containing macaw remains, fragmented human remains, and several stones inside the doorway. DiPeso (1974:5:476) contends the function of this early Medio period room was sacred. Later, it was converted to a utilitarian space, during which time a macaw aviary was constructed on its roof. A drawing of the horned serpent god Quetzalcoatl is attributed to a youth who doodled on the wall while tending the macaws up until the time the roof collapsed, killing both the boy and the birds. The room was subsequently used as a cemetery for later occupants of the city. Finally, the last inhabitants barricaded themselves in the room during the massacre, sealing the entry with stones. The invaders pushed through the door, sending the stones down the ramped entry before killing the occupants.

Using the same data, Walker (2002) questions the homicidal manner of death of these individuals. Citing similar stratigraphic sequences at kivas in the Southwest, he proposes the sequence better represents the construction of a kiva, a ritual closure of its ramp, and its remodeling into a more specialized room before being used as a cemetery space. The macaws (a highly sacred animal) were reared on the roof and the drawing of Quetzalcoatl was intentionally made in the sacred room. Finally, macaw and human remains were deposited in the room during the ritual closure. Thus, the unrelated sequence of events proposed by DiPeso lacks parsimony when

declaring an accidental death and subsequent massacre occurred in this room. I think it is also possible that this room was modified to serve as a burial crypt rather than a kiva (Weiss-Krejci 2001:778).

The final example illustrates how occasionally, not only are cause and manner of death uncertain, but also the identity of the victims. Turner and Morris (1970) analyzed skeletal remains from Polacca Wash, New Mexico, which they believe to be the remains of captives taken after the eighteenth century massacre at Awatovi. Relying on oral histories as the primary source of information regarding witchcraft and violence in the Southwest, Darling (1998) believes the remains at Polacca Wash are those of people killed following the Awatovi massacre. When rebuking Turner and Morris' (1970) assertion of cannibalism at Polacca Wash, he cites stories that often do not agree with each other depending on the source. According to legend, intercommunity suspicions of witchcraft surrounded the people of Awatovi. One night, warriors from nearby pueblos converged on Awatovi where most of the men of the village were in kivas. The warriors removed the ladders from the entrances as the underground structures were ignited. In one version of the story, the women and children were taken captive and later tortured, killed, and dismembered at other locations. In another, a group of surviving warriors from Awatovi tried to rescue the captives, but were themselves taken captive, tortured, killed, and dismembered at a different location.

The location of the "death mound" where the captives were killed is not certain. Turner and Morris (1970) found that when talking with local people, several

mounds associated with killing events were strewn throughout the area, and their associations depended on the point of reference of the informant. Hence, no one is sure of which mound corresponds with the Awatovi captive massacre, and whether the Polacca Wash remains are those of the captives.

Case Studies

How does one distinguish between skeletal damage resulting from warfare, massacre, witch killing, mortuary processing or cannibalism? Each of these different activities leaves signature damage types and patterns on bone, and when viewed in concert with other archaeological data can render a tenable assessment. Owsley and colleagues (1977) examined the skeletal assemblage from the Larson site on the Great Plains. They excavated the village cemetery and several living areas where multiple bodies were found buried under roof fall. They found that 41% of the skulls recovered from the living areas showed evidence of scalping. This figure is an estimate and may actually have been substantially different as an additional 31% of the skulls recovered were too damaged to be evaluated. The overall rate of trauma of the living area population was much higher than that found in the cemetery population. They also found widespread evidence of blunt-force cranial trauma, decapitation, dismemberment and crushing of the face. They concluded that the individuals recovered from the living areas had died in a massacre and were subsequently mutilated. They were left in the lodges, which were burned and collapsed on themselves.

Willey's (1990) analysis of the Crow Creek, South Dakota skeletal assemblage documents a dramatic example of skeletal evidence of a large scale massacre followed by corpse mutilation. The 486 skeletons appear to be the remains of occupants of a Plains village that were massacred. Over 90% of the preserved frontal bones showed cut marks, with 42% of the crania showing depressed fractures, mostly of the frontal and parietal regions. Willey noted cases of decapitation, scalping, nose removal, and possibly tongue removal, identified by consistently located cutmarks. Post-cranial cutmarks were rare, but chewing to the ends of bones was abundant, suggesting that scavengers were the source of dismemberment.

Ogilvie and Hilton (2000) studied a collection of skeletal remains recovered from a kiva at Ram Mesa, New Mexico. They describe blunt force cranial trauma, green fracturing of longbones, cutmarks to the skull and mandible, avulsion of the anterior teeth, and a high incidence of burning. Notably, cutmarks did not occur on articular surfaces or at major muscle attachments of bones, which would indicate dismemberment. The authors suggest the skeletons were the remains of witches, and the damage was the result of their being murdered and their bodies rendered unrecognizable. This interpretation is based on earlier work by Darling (1998) and the "pervasiveness of witchcraft beliefs in recent times" (Ogilvie and Hilton 2000:42).

Pueblo witches were believed to be possessed by malevolent powers and the performers of human sacrifice and cannibalism (Darling 1998:737). Punishment for witchcraft was either through banishment or execution. In cases of execution, the body was rendered unrecognizable so its spirit could not re-enter it. Darling

(1998:735) cites ethnographic accounts of how spirits were released from the witch's body by pounding it with large stones or pieces of wood. This method would certainly have caused extensive fracturing. Though no standards for comparison have been definitively established, Ogilvie and Hilton (2000:46) argue that witch execution is the most parsimonious explanation for the pattern and extreme degree of corpse processing seen at Ram Mesa coupled with the deposition of the bones in a kiva.

Nelson and colleagues (1992) analyzed the remains of 14 individuals deposited on the floor surface of a room at La Quemada, Zacatecas. The bones were found in three concentrations within the room and the skeletons appeared not to have been articulated at the time of deposition. They found no cutmarks that would indicate dismemberment or mutilation, but there was a lack of vertebrae and bones of the hands and feet. They concluded the bones were those of individuals who died, their bodies left to decay naturally and the bones gathered and deposited in the room, which likely functioned as a charnel house. Under-representation of small and cancellous bones is likely due to diagenesis and poor recovery of small bones by the persons who deposited the bones in the room.

Following the article by Turner and Morris (1970) several investigations have documented cannibalism at sites primarily in the Four Corners area of the Southwest (for a summary see Turner and Turner 1999). Similar evidence has been recorded at Old World archaeological sites in Spain (Cáceres et al. 2007), Algeria (Haverkort and Lubell 1999) and France (Villa et al. 1986), and in the New World in Mexico (Pijoan et al. 2007). Though ethnographic claims of cannibalism have been challenged

(Arens 1979; Barker et al. 1998; Goldman 1999), archaeological evidence pointing to this practice prehistorically is difficult to ignore. In all cases, the conclusion of cannibalism is based on the recognition of damage from corpse processing that is similar to that found on butchered game animals for consumption as food. I will explore this topic in more depth.

White defines cannibalism as "conspecific consumption of human tissue" (1992:9). Early on, accusations of cannibalism were based on ethnographic accounts gathered by ethnographers, missionaries, and explorers. Often, the informant never witnessed the practice, but perpetuated the stories or myths based on word-of-mouth (Arens 1979). However, recognition of this practice using archaeological bone assemblages removes the subjectivity of the informant and the naïveté of the ethnographer who is willing to believe much of what an informant reports.

Cannibalism Diagnosis

It is recognized that accusing someone of cannibalism is a serious charge and thus, the threshold of diagnosing it in the archaeological record is set high (White 1992:8). Today only the most severe occurrences tend to be reported as cannibalism, whereas assemblages containing a few bones showing cutmarks or a few broken bones are noted, but are often discounted as anomalies. In the latter half of the 20th century, research has focused on the recognition and quantification of archaeological bone modification. Using this new body of knowledge it is now possible to recognize whether the agents responsible for bone modification are human or non-human. As a

result, researchers interested in characterizing skeletal trauma now have more tools at their disposal.

Turner and Turner (1999:chapter 2) offer a thorough discussion of skeletal damage which they interpret as resulting from cannibalism. The following discussion is abstracted from this source. There are three basic observations that must be made: 1) the damage pattern on the human bones is similar to that of butchered game animals, 2) the damage appears dissimilar to that caused by animal or environmental forces, and 3) cannibalized human bone deposits appear dissimilar to deposits resulting from formal interment. Let us consider each of these separately.

The most striking observation made of butchered human bones is that the damage frequency and patterns are nearly identical to those observed in archaeological assemblages of faunal remains. The remains are characterized by a high degree of longbone fragmentation by spiral fracture, cutmarks, and burning or charring. Percussion impact sites and anvil abrasions are commonly associated with the breakage and fragmentation of the bones. Spiral fracture, peeling and splitting of bones are diagnostic of fresh bone fracture. A low incidence of pot-polish (smoothing of sharp bone fragments resulting from vigorous cooking in a ceramic vessel) and the near absence of animal gnawing or chewing are also characteristic of both butchered human and non-human assemblages.

Animal and environmental damage leave taphonomic signatures that are different than those left by humans. Animals often gnaw or chew on exposed bones, an activity that leaves distinctively different damage than cutmarks left by tools,

though the two are often confused. The former are characterized by a U-shaped cross section, while the latter appear V-shaped and may also exhibit ridging within the cut (Shipman and Rose 1983). Skeletal material that is in sub-surface contexts can suffer environmental damage from plant roots, which can leave linear marks on bones and large tree roots, which can penetrate and break skeletal elements. Bone preservation is also altered by soil content and pH. Calcium carbonate, for instance, causes bones to crack and the exterior surface to exfoliate. Surface deposited remains can be altered from the effects of sun-bleaching, which can include severe drying, cracking, and exfoliation of the outer bone surface.

The deposition and preservation of cannibalized bones is similar to that of faunal bones that have been cooked. Preservation from this type of preparation and deposition is markedly different from skeletal material interred while still covered in flesh. Cannibalized bones are commonly piled or scattered on the surface rather than formally buried. They are also characterized by an excellent state of preservation, which is thought to stem from removal of organic materials such as flesh and fat during cooking. This results in a lack of normal macro- and microorganism activity, which results in bone leaching by acidic by-products. In sum, cannibalized bones are most often deposited on the surface and are generally characterized by excellent preservation, extensive longbone fragmentation and a low incidence of burning and gnawing, whereas non-cannibalized, interred bones are often more poorly preserved, having suffered organic and chemical degradation resulting from the subsurface deposition and the activities of soft tissue decomposition.

To summarize, the Casas Grandes skeletal assemblage—especially the non-interred material—has been grossly understudied. Recent scientific inquiry has shown that types, patterns, and timing of fractures are useful in reconstructing the events preceding and following death. Physical and circumstantial evidence should be treated as paramount in investigations of death whether modern or prehistoric.

CHAPTER IV

MATERIALS AND METHODS

Sampling

The Casas Grandes Medio period skeletal assemblage is composed of individuals showing evidence of formal interment (henceforth referred to as interred skeletons, or IS) and those lacking such evidence (non-interred skeletons, or NIS). The skeletal material came from 16 excavation units containing unequal numbers of individuals. The individuals included in this study were chosen as randomly as possible given the circumstances of their storage. A sampling methodology was devised to include individuals from all excavated units in equal proportions. Appendix A contains the list of individuals analyzed and their burial type.

To ensure equal representation from each sub-population (IS, NIS) and from each unit, the total number of individuals that could be analyzed over the study period was estimated and this number was converted into a percentage of each sub-population. These percentages were applied to the separate sub-populations from each unit and the corresponding number of individuals was calculated for each. A list of individual burial numbers corresponding to each sub-population was drawn up using DiPeso and colleagues' (1974:8:359-409) list and these lists were taken to the storage room for location of representative individuals. Coffin boxes of interest were visually located and removed for analysis if they fit into one of the sub-populations of

interest. The stored coffin boxes were stacked in no particular order and in some cases individuals listed in the site report were absent from the storage facility. Boxes contained as few as a single individual and as many as four or five depending on the size and/or completeness of the individuals contained within them. One hundred seventy-nine—42 NIS, 137 IS—were evaluated for this study.

Sorting of individual skeletons was at times difficult, if not impossible in some cases. A passage from Barbara Butler's Ph.D. dissertation explains the source of much of this difficulty:

> "1) The archaeologists tried to excavate complete individuals but sometimes several individuals were buried together and mixture of individuals occurred both in the ground and as they were being removed.
> 2) In the lab, examples of bones with pathological lesions were removed from the storage boxes; also maxillae and mandibles were removed and placed in separate storage areas. Many teeth had been removed from their sockets (for separate examination). 3) Some remains were very fragmentary as the result of poor preservation in the ground and poor handling and preservation in the lab" (Butler 1971:15).

It is important to note that following Butler's analysis, a number of other researchers examined the skeletons in their research, so an additional amount of mixing and mis-identification of skeletal elements has occurred. It was not uncommon to find a box containing multiple individuals—sub-adults and adults alike—but with all the teeth in one bag marked "Teeth" and one burial number on the bag. Thus, the teeth in question had to be sorted by chronological age, grouped accordingly, and reunited with their respective skeletons.

Data Collection

The skeletons were analyzed for injury. They were inspected for evidence of unhealed, healing, and healed fractures, cutmarks, projectile injuries, and burning (Frayer 1997; Lambert 1997; Ortner and Putschar 1981; Owsley 1994; Sauer 1998; White 1992). It was expected that if warfare was endemic in the region, individuals would show a combination of healed and unhealed injuries (Lambert 1997; Roksandic et al. 2006; Torres-Ruff and Costa Junqueira 2006; Tung 2006). Description of injuries follows Lovell's (1997) protocol, which takes into account the location, shape, and type of fracture, as well as any subsequent remodeling or infection.

Data were collected in the modern town of Casas Grandes, Chihuahua, Mexico over an eight-week period during the summer of 2007. The skeletal collection is stored in a room at the city's *Palacio Municipal* (city hall). Analysis was performed in a similar room next to the storage room. The storage room is not climate-controlled and during summer months temperatures can typically exceed 90 degrees Fahrenheit with winter temperatures approaching 30 degrees Fahrenheit. Thus, these conditions are not ideal for the long-term preservation of skeletal materials, which is reflected in their current state of preservation.

Data were collected during 8-hour days (7 a.m.—4 p.m. with one hour for lunch), 5 days per week. This schedule allowed for analysis of 4 to 7 skeletons per day depending on their completeness and the amount documentation required for each. Skeletons that were more complete or showed extensive trauma, pathology, or

those requiring several photographs required more time than the more fragmentary skeletons that showed little to no trauma or pathology.

Data were collected using visual and metrical methods. Visual analysis was performed under acutely angled secondary light using a 10x hand lens and natural sunlight when needed to visualize smaller features. Measurements were taken to the nearest 0.1 mm using a CenTech digital sliding caliper. Digital images were captured in TIFF format using an Olympus E-500 35 mm DSLR camera with a 17.5-45mm zoom lens. These images were processed using Adobe Photoshop CS2 software from which JPEG images were created and stored on gold compact discs. Copies of these discs were sent to INAH, Chihuahua.

Burial Provenience Data

I separated the NIS into more distinct groupings to look for any patterns or trends in their deposition. This procedure was similar to DiPeso's coding of the IS. The scheme was as follows: 2A, floor surface articulated; 2B, floor surface disarticulated; 2C, fill articulated; 2D, fill disarticulated, and; 2E, no provenience/test trench.

Sex and Age Determination

The study of archaeological human remains yields information about mortality and longevity in earlier populations (Lovejoy et al. 1985:1). Inferences about fertility and crude death rates can be made using this information. Many of the methods used herein are based on modern reference populations, which allegedly reduces their reliability when applied to prehistoric populations (Bocquet-Appel and

Masset 1982). (The reader is directed to Buikstra and Konigsberg [1985] for further discussion and rebuttal). Bearing this in mind, the following broad age cohorts were used: fetus/perinatal (<birth), infant (0-3 years), children (3-12 years), adolescents (12-20 years), young adult (21-35 years), middle adults (35-50 years), and old adults (50+ years) (Buikstra and Ubelaker 1994:9).

The construction of a paleodemographic profile of the Casas Grandes population was not a central purpose of this study, however, knowledge of the demographic structure of the skeletal sample could have important implications when justifying warfare or a massacre. Therefore, sex and age were determined for all individuals when possible.

Sex was determined using the standards described by Buikstra and Ubelaker (1994). Some osteological traits are sexually dimorphic in humans. Morphological features of the pelvis and cranium are the best sources for accurately determining sex from skeletal remains (France 1998). Several researchers (Phenice 1969; Rathbun and Buikstra 1984:Table III-I; Sutherland and Suchey 1991) report a sex determination accuracy of 90 to 96% using pelvic methods, while the skull returned accurate determinations of 80-90%. Konigsberg and Hens (1998) reported an accuracy of 79% when using only the cranium. In many cases the diagnostic portions of either the cranium or pelvis were missing, forcing me to use only one or the other. Some additional burials contained neither pelvis nor cranium, in which case I was forced to make provisional sex determinations based on extreme divergence of the diameter of the femoral or humeral head from the mean diameter (France 1998).

Sexually dimorphic attributes of the pelvic bones are preferred for determining sex from the skeleton. Differences in expression and scoring of the pelvic and cranial sexing attributes are summarized in Table 1 and discussed in more detail below. The subpubic region contains three sexually dimorphic attributes, the ventral arc, subpubic concavity and ischiopubic ramus ridge. They are scored with values of 1 (female) to 3 (male). The greater sciatic notch ranges from broad in females to narrow in males and is scored with values of 1 to 5, respectively. The preauricular sulcus is thought to appear more commonly in females than males. Scores range from 0 (absent) to different expressions ranging from 1 to 4 (wide to narrow). Each aspect should be weighted equally and the total morphological suite should be used in the determination.

Features of the cranium can be used for sex determination, although they are slightly less reliable. Buikstra and Ubelaker (1994) illustrate five aspects of cranial morphology used to distinguish sex: 1) robusticity of the nuchal crest, 2) size of the mastoid process, 3) sharpness of the supraorbital margin, 4) prominence of glabella, and 5) projection of the mental eminence. These are scored on a scale of 1 to 5 with 1 being characteristic of females, 5 being male and 3 being generally ambiguous. All traits should be weighted equally and considered together.

The head of the humerus and femur were used in some instances to determine provisional sex. This method is described in detail by France (1998). The head of the humerus has been found to yield correct sex determinations in archaeological Native American populations with accuracies between 89 and 95%. Meindl and Russell

(1998:379), however, caution that sexing the skeleton based solely on pure size is often problematic due to the role that the environment played in growth in prehistory. Therefore, this method is used as a last resort since often times these portions of the skeleton are preserved when other sex-determining elements are missing.

Table 1. Skeletal sexing attributes (compiled from Buikstra and Ubelaker [1994] and France [1998]).

	Score (except preauricular sulcus)		
	1		3, 4, or 5
	Range of Variation		
	Female ←----------		----------→ Male
Pelvis			
Subpubic angle	More than 90 degrees		Less than 90 degrees
Ventral arc	Well-defined		No ridge (not well-defined)
Subpubic concavity	Concave		Convex
Ischiopubic ramus ridge	Narrow, crestlike ridge		Broad and flat
Greater sciatic notch	Wide		Narrow (fits snugly around your thumb)
Preauricular sulcus	Present		Absent
Cranial			
Nuchal crest	Smooth, no bony projections		Bony ledge or hook
Mastoid process	Short, narrow		Long, robust
Supraorbital margin	Sharp		Dull, blunted
Prominence of glabella	Smooth, no projection		Prominent, rounded
Mental eminence	Little to no projection, single point		Massive, bilobed
Post-cranial			
Humerus (transverse)	Smaller	39.7 mm	Larger
(vertical)	Smaller	42.4 mm	Larger
Femur (max. diameter)	Smaller	44.6 mm	Larger

The method requires measurement of either the vertical or transverse diameter of the head of the humerus, which is compared to published cutoff points. For this study, the cutoff points of the Arikara and Pecos Pueblo populations (as described by France 1998) were averaged, which produced a cutoff point of 39.7 mm for the transverse diameter and 42.4 mm for the vertical diameter. Thus, a humerus head

with a transverse or vertical diameter smaller than its respective cutoff point is most likely from a female; one whose diameter measures larger is most likely from a male. Sex determination from the maximum diameter of the femoral head is done in a similar manner using a cutoff figure of 44.6 mm. This method yields an accurate determination 88.7% of the time and is based on a central California Native American population (France 1998).

Age at death in archaeological material can be estimated from both dental and skeletal tissues. In subadults, the sequence of dental development is the preferred indicator (Baker et al. 2005:157), as it best approximates the true age, yielding ages with ranges of variation of as little as six months (Ubelaker 1989). This is due to the more regular formation and eruption of teeth as compared to the more variable epiphyseal fusion times of the bones.

The dentition was the primary source for subadult age estimation, using formation and eruption sequences described in Buikstra and Ubelaker (1994). The skeleton was used as the secondary source of age estimation. This was done using epiphyseal closure sequences as described by Baker and colleagues (2005), Buikstra and Ubelaker (1994), and White and Folkens (2005). Age from subadult skeletal tissues is estimated by observing the appearance and fusion of the 450 skeletal elements present at birth as they develop into the 206 bones present in adults (Baker et al. 2005:6). Growth proceeds from the ossification centers of the bones. Once growth is completed, the ends of the bone portions fuse at cartilaginous plates, known as epiphyseal plates, which ossify, uniting the pieces into a single bone. The timing

of these ossifications is more or less regular and their rate can be used to approximate age at death.

Age of adult skeletons was estimated by observing degenerative changes in the teeth and skeleton. Age was estimated using morphology of the symphyseal surface of the os pubis (Brooks and Suchey 1990; Buikstra and Ubelaker 1994) and auricular surface of the ilium (Lovejoy et al. 1985; Buikstra and Ubelaker 1994), dental attrition of the anterior teeth (Smith 1984) and molars (Scott 1979), and cranial suture closure (Meindl and Lovejoy 1985). Sex and age of many of the NIS were unable to be determined as they lacked the correct elements required. All of these indicators were used in as many instances as possible, though most age estimations were based on less than the full suite due to skeletal damage and missing elements.

Age-related changes of the sympheseal surface of the pubis are considered the most reliable criteria available for approximating age at death in adults (Buikstra and Ubelaker 1994:21). However, it is often under-utilized since this portion of the skeleton does not survive well archaeologically. A method for evaluating the auricular surface of the ilium has been developed due its better survival archaeologically, though this method is more complex and difficult to score. In both cases, the presence or morphology of key features must be evaluated.

The pubic symphysis is observed for the following features: ridge-and-furrow system, dorsal margin, dorsal platform, ventral rampart, ossific nodules, rim, and delimited extremities. The presence and morphology of these features are compared to six phase-by-phase descriptions by Brooks and Suchey (1990), which divides the

morphological continuum. Each of the phases correlates with an age range. Sex of the individual must first be determined as this method takes into consideration the differences in age-related changes between the sexes. The precision is greater for males than females, which may be due to greater variation in pubic morphology of females due to childbirth or the three-fold difference in sample size of males over females.

Age-related assessment of the auricular surface of the ilium proceeds in a similar manner, though morphological attributes of different regions of the auricular surface are considered. Four regions of the surface (apex, superior and inferior demifaces, retroarticular area) are graded for relief, granularity, density and porosity. These qualitative assessments are compared to phase descriptions as in the pubic method, and each phase correlates with an age range. Both pelvic aging methods are described in more detail in Buikstra and Ubelaker (1994) and White and Folkens (2005).

Methods of Data Analysis

Most data were compared using the G-test of independence. The G-test (or log-likelihood ratio) is preferred to the chi-square as it better approximates the theoretical chi-square distribution when a cell has a larger than expected absolute value (Sokal and Rohlf 1994). The test was performed using DOS-based computer software published by James Mallet (2006) of the Galton Laboratory, Department of Genetics, Evolution and Environment, University College, London. The test reports

two statistics, G and x^2, and a P value, which represents the probability that the experimental results are due to chance.

Fisher's exact test was used to compare trauma frequencies between the sexes, the IS and NIS, and between Paquimé and other sites. This statistical test is applied to evaluate whether the differences in sample proportions of binary data are due to chance (Tung 2007). Fisher's is useful for small sample sizes and reports a P value, which represents the probability that randomization alone is responsible for the disparity observed between two proportions (Ramsey and Schafer 1997:548-550).

Pair-wise differences were the subject of interest of the element representation comparison. The Wilcoxon signed-rank test was used to compare paired frequencies of skeletal elements. Though some useful information about the magnitudes of pair-wise differences is excluded, the Wilcoxon mitigates the effects of outliers (Ramsey and Schafer 1997:96).

Dating

Cortical longbone samples from 19 individuals were collected for use in chronometric dating. The samples were from both IS and NIS. These were collected individually and immediately placed in separate plastic Ziploc bags to avoid mixing and contamination. Portions of these samples were sent to the University of Notre Dame Department of Anthropology for analysis of fluoride ion concentration. Five gram samples were sent to the University of Arizona NSF Laboratory and Geochron Laboratories for AMS dating.

Fluoride ion analysis measures the amount of fluoride taken up by buried bones from ground water (Schurr 1989:265). It works well for bones that were deposited less than 1,500 years ago and over a short period of time such as a few hundred years (Haddy and Hanson 1982). The method is very sensitive and can statistically distinguish samples with fluoride concentration differences of 0.024%, which can represent a time span of 10 to 20 years (Schurr 2007). It is helpful when sorting individual samples or sub-assemblages chronologically. Samples of interest can then be selected for the more costly AMS dating (Aitken 1990:219). This method provided key evidence in debunking the Piltdown forgery by showing the skull and mandible of the purported "missing link" were of different ages (Spencer 1990).

AMS yields absolute (calendrical) dates. AMS dating has its roots in the post-WWII discovery that the age of materials containing radioactive elements could be determined by measuring the amount of decay of the elements (Price and Feinman 1993:13; Taylor 1997:66-67). Plants and animals ingest radioactive carbon (^{14}C) throughout their lives. When an animal's carbon intake ceases (the animal dies), the process of decay of the radioactive carbon begins (Price and Feinman 1993:13-14). An approximate time since death is rendered by knowing the rate at which ^{14}C decays (the half-life) and measuring the amount of radioactive decay that has occurred.

Five milligram samples of adult cortical longbone were weighed on separate papers on a triple-beam balance. These were submitted to the University of Notre Dame for fluoride ion analysis, a process that took approximately one month. Once

results were obtained from fluoride ion analysis, samples from five individuals were submitted for AMS dating.

The University of Arizona NSF Radiocarbon Laboratory was the primary facility used for dating, and sample size for all AMS dates was 5 grams. The oldest and youngest NIS and IS samples (those with the greatest and least concentrations of fluoride) were chosen to bracket the lower and upper temporal bounds of both groups. A fifth individual from the middle of the NIS group was dated by AMS as its fluoride measurement was similar to one other NIS sample and two IS samples. Thus, a single AMS date from this sample would yield an approximate date for three others. Samples of the upper and lower NIS were also sent Geochron Laboratories, which was used as a reference check against the University of Arizona Laboratory. The samples were pretreated by the laboratories using a modified version of Longin's (1971) technique for eliminating contaminating sources of carbon and isolating bone collagen. The AMS dates were originally calibrated with both CALIB 5.0.1 and OxCal 4.1.1 using the IntCal04 data set curve for northern hemisphere non-marine samples (Bronk Ramsey 1995; 2001; Reimer et al. 2004; Stuiver and Reimer 1993). The two programs gave similar results, though the OxCal output was chosen over CALIB for its greater graphic capabilities.

CHAPTER V

RESULTS

Sample Population Demographics

The results of age and sex determination are presented in Figures 7 and 8. Reproductive theory dictates that the sexes are represented approximately equally in primates (Dunbar 1984:196). My comparison of frequencies of individuals of known sex shows a 20% female bias (refer to Table 2). DiPeso et al. (1974:8:359) reported a similar figure for the IS adult population, which is slightly higher than the 16% reported here, though his frequency of unknown sex was only 13.9% compared to 43% here. The source of the some of the discrepancy may be due to their use of the "? Adult 18+" age category. According to Butler (1971), age determination was made almost exclusively from dental eruption, toothwear, and cranial suture closure. In cases of young adults or juveniles where there were no ageable teeth, age was determined from the spheno-occipital synchondrosis, which made the individual adolescent or adult. Thus, the precision and reliability of these ages, based on a single suture should be questioned. Due to inherent human variation, the possibility remains that some individuals in this category were in their mid-teens, in which case sex determination would be questionable. According to chance, the sexes of this

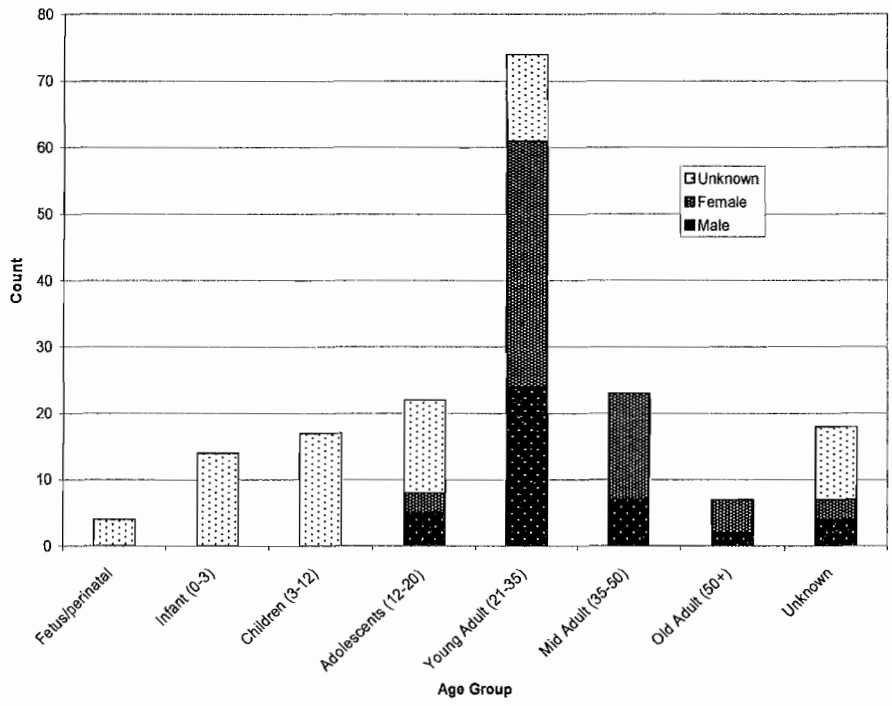


Figure 7. Demographics of the study population

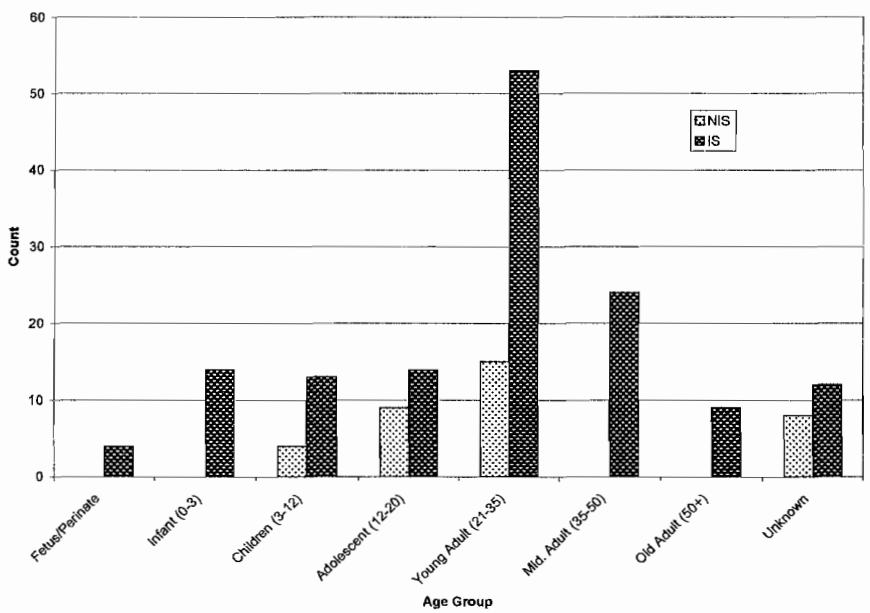


Figure 8. Age distribution of NIS compared to IS.

group should be represented approximately equally. However, the numbers of individuals of known sex from this age category (not considering those for whom sex was unknown) gave totals of 9 males and 29 females, a result highly divergent from chance. Moreover, 6 juveniles between the ages of 13 and 19 were sexed—all of them female. Hence, 80 percent of the 44 individuals who were either in their teens or about 18 years of age were sexed as female. This is not surprising given that the human skeleton looks morphologically female until after puberty. The point of this discussion is that by chance, approximately one half of the 44 individuals should be female and the other half male.

Table 2. Total counts and frequencies of sex by sub-population.

Population	Males	Males (%)	Females	Females (%)	Unknown	Unknown (%)	Total
NIS + IS (total)	42	23	64	36	73	41	179
NIS + IS (known sex)	42	40	64	60	...	...	106
NIS	13	31	15	36	14	33	42
IS	28	20	49	36	59	43	137
IS (DiPeso et al. 1974)	86	33.2	137	52.9	36	13.9	259
IS (Butler 1971)	106	21.7	153	31	234	47.5	493

To test this possibility, the 44 individuals were divided into equal halves by sex. This division both increased the males and reduced the females by 13. This decreased DiPeso's IS frequency difference from 19.7% to 9.8%. Given this small difference, and that neither reported sex frequency accounts for more than one half the total population, the group of unknown sex could make up for the disparity. This leaves open the possibility that some of the female sex bias is introduced rather than real. The sex and age frequencies from this study are not significantly different from

those reported by Butler (1971:21) for Medio period skeletons (G=.66, d.f.=2, P > .05, G=7.53, d.f.= 5, P > .05, respectively) (Table 2).

Comparison of NIS and IS demographics showed some disparity, with age distributions showing significant difference (G=32.04, d.f.=7, P < .01). There were no individuals under the age of three or over the age of 35 in the NIS (see Figure 8). If the IS demographics are considered to represent the expected distribution of the general population at any given time of site occupation, the age structure of the NIS departs from the distribution. Sex distribution was not significantly different between the IS and NIS groups (G=.30, d.f.=2, P > .05).

Non-Interred Skeleton Burial Provenience

The NIS burial provenience data show that 15% of the NIS were articulated, and 83% were fragmentary and not articulated (see Table 3). Forty-one percent were deposited on floor surfaces, 57% were deposited above floor surfaces and mixed with fill. The only discernable pattern was that the articulated skeletons buried in fill (type 2C; 12 individuals) were distributed almost evenly among units 8, 14, 15, and 16 (one was recovered from unit 4). In short, what DiPeso and subsequent authors considered one burial group is actually made up of four unique sub-groups. The differences seen here will have consequences for the interpretation of the NIS group representing a massacre.

Antemortem and Perimortem Fractures

Evidence of skeletal trauma was observed, but in much lower frequencies than expected for an assemblage representing long-standing warfare. Fourteen individuals

Table 3. Provenience coding and count of NIS skeletal material, which includes the two type 9 burials (DiPeso's "accidental death" is a manner of death designation, not a burial type).

NIS Burial Type	Count (percent of total)
2A	8 (6)
2B	45 (35)
2C	12 (9)
2D	62 (48)
2E	1 (1)

(7%) showed evidence of ante- or perimortem fracture. A total of 15 fractures were recorded (one individual had two fractures). Nine individuals had antemortem fractures, four had perimortem fractures, and one had both. Tables 4 and 5 present this information in more detail. Frequencies of longbone fracture compared to the total number of skeletons analyzed were as follows: clavicle 1.7%, radius 1%, ulna 1.8%, fibula 3.5%. Ten of these fractures were found on the IS, four were found on the NIS. Two cases of antemortem forearm fracture were noted, which could be parry fractures or simply the result of accidents (Figure 9). One male survived a potentially lethal blow to the right facial region that fractured the right frontal and nasal bones resulting in orbital and nasal deformity (Figure 10). A single juvenile NIS (burial 29-8) suffered a perimortem blow to the right parietal, which left an opening into the skull (Figure 11). This was one of two NIS where interpersonal violence may have caused the injury, though it could be an artifact of postmortem processing of which there was further evidence. A second NIS (burial 30A-1) had a

Table 4. Detail of skeletal trauma separated by timing.

Skeleton Number	Trauma
	Antemortem
20-1	Left distal ulna (NIS)
30-1	Right distal fibula (IS)
35-6	Right distal ulna, radius (crush?) (IS)
5-8	Right clavicle (IS)
24-8	Right clavicle (IS)
1-11	Right distal fibula (NIS)
34-12	Left 5th metatarsal (IS)
23-14	Left distal fibula (NIS)
1-21	Left metatarsal (IS)
	Perimortem
30A-1	Right frontal (IS)
29-8	Right parietal (NIS)
15-12	Left distal fibula (IS)
13-13	Left parietal (IS)
39-14	Left parietal (IS)

Table 5. Tally of fractures by timing and location (total of 14 individuals).

Location	Antemortem	Perimortem
Ulna/radius	2	...
Fibula	3	1
Metatarsal	2	...
Clavicle	2	...
Skull	1	4
Total	*10*	*5*

perimortem depressed cranial fracture, which may also have been an artifact of postmortem processing, as the skeleton was very fragmented (Figure 12). No projectile injuries were detected in any of the material. Statistical comparison showed no significant difference between the IS and NIS groups ($G=.32$, d.f. 1, $P > .05$).

Peri-/Postmortem Fractures

Several individuals showed perimortem modification that occurred soon after death and often after soft tissue had been removed from the bones (see section on bone splitting, above). I have termed this as postmortem modification (PM). Postmortem modification was encountered on the remains of 36 individuals composed of both IS and NIS. Twenty-two (52 %) of the 42 NIS showed evidence of postmortem modification, whereas 14 (10 %) of the 137 IS showed similar damage. This PM group was characterized as highly fragmented and incomplete, although two individuals were approximately 40 to 60% complete. The age distribution of this assemblage is shown in Figure 13. The damage occurred to the bones soon after

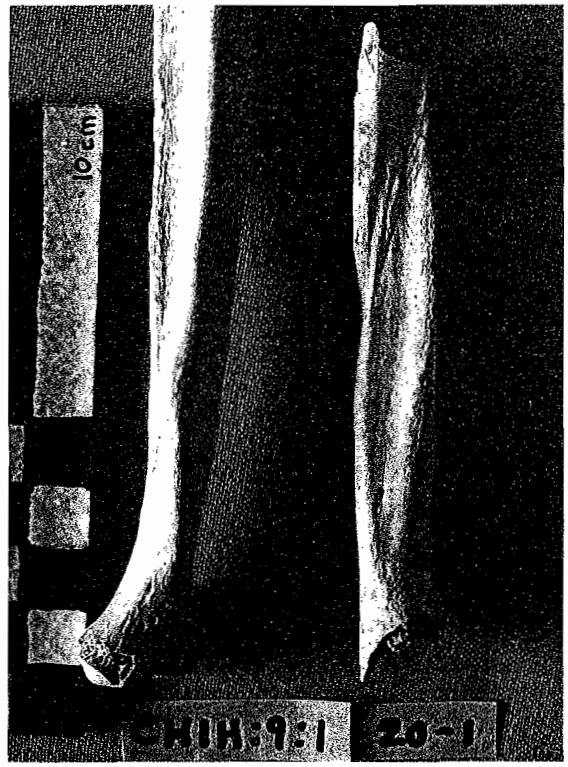


Figure 9. Normal ulna (left), ulna with healed fracture (right) (burial 20-1).

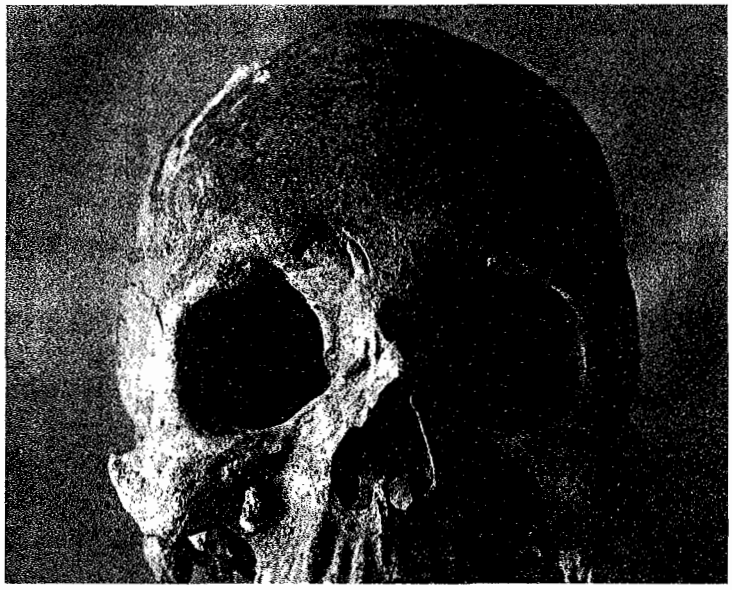


Figure 10. Old adult male with healed cranial and facial fractures (burial 20-8).

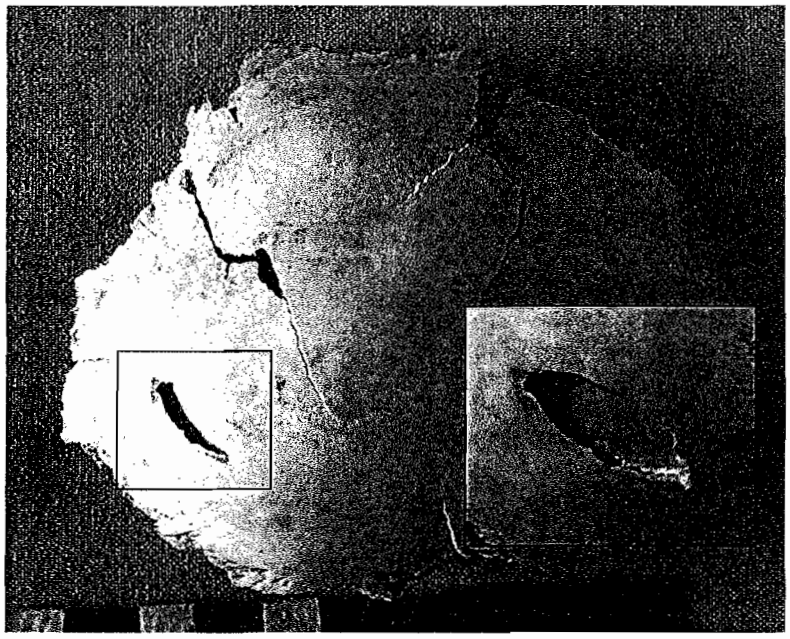


Figure 11. Portion of child's parietal with hinge fracture (burial 29-8).

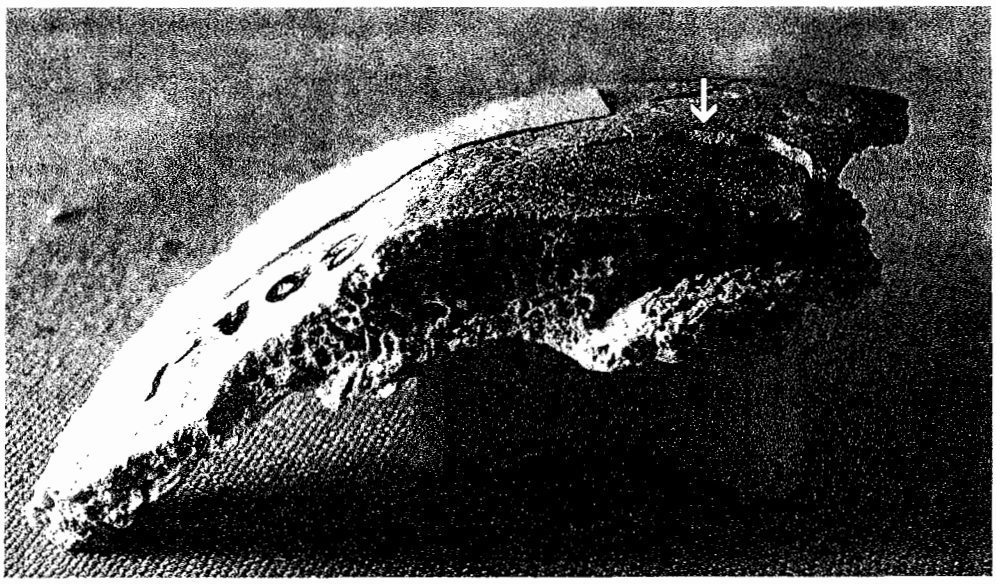


Figure 12. Portion of frontal bone showing unhealed depressed fracture (arrow) (burial 30A-1).

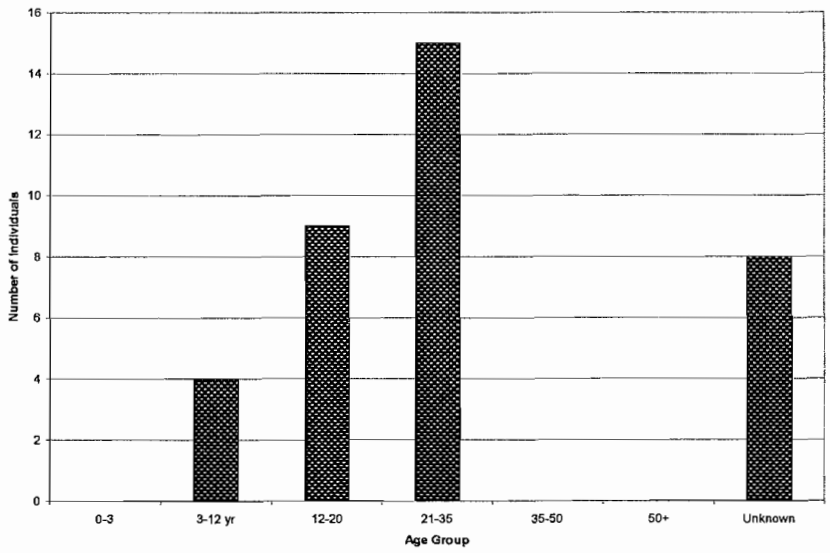


Figure 13. Age distribution of group with postmortem modification.

death as the breaks were acute- angled, spiral, concoidal, and often had adhering bone fragments. Additionally, peeling was found on some specimens, which also indicates fresh bone breakage. Other damage included cutmarks, charring/burning, percussion sites, and anvil abrasions. These PM remains were characterized by an excellent degree of preservation, both absolutely and relatively when compared to remains lacking this damage.

The PM group was characterized by extreme bone fragmentation, especially the crania and longbones. Semicircular percussion sites and striations indicative of abrasions caused by an anvil were numerous on longbone fragments. Many percussion sites had adhering bone fragments, which indicate the bones were broken while fresh. Examples of this damage are seen in Figure 14. A striking example of bone fracture was found on both os coxae of a single individual (9A-15) where the iliac blades were removed. Figure 15 shows these bones after re-assembly. Table 6 summarizes the types of skeletal modification by individual.

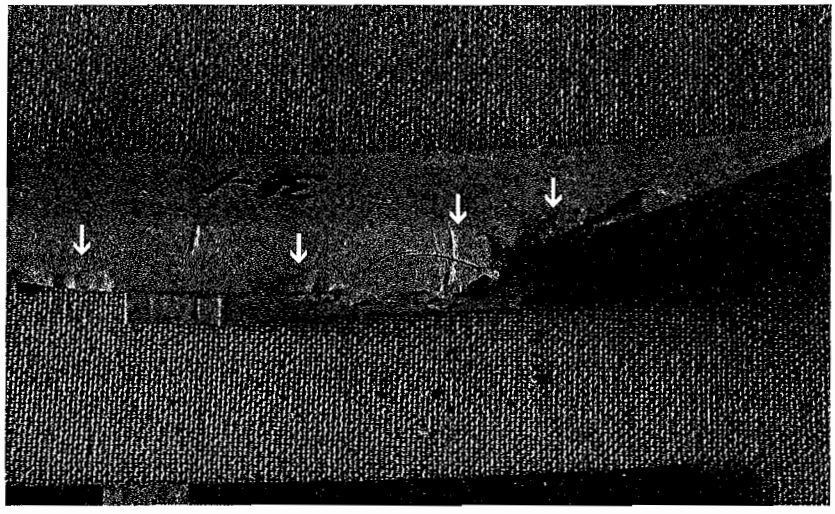


Figure 14. Longbone fragment with various types of peri-/postmortem damage.

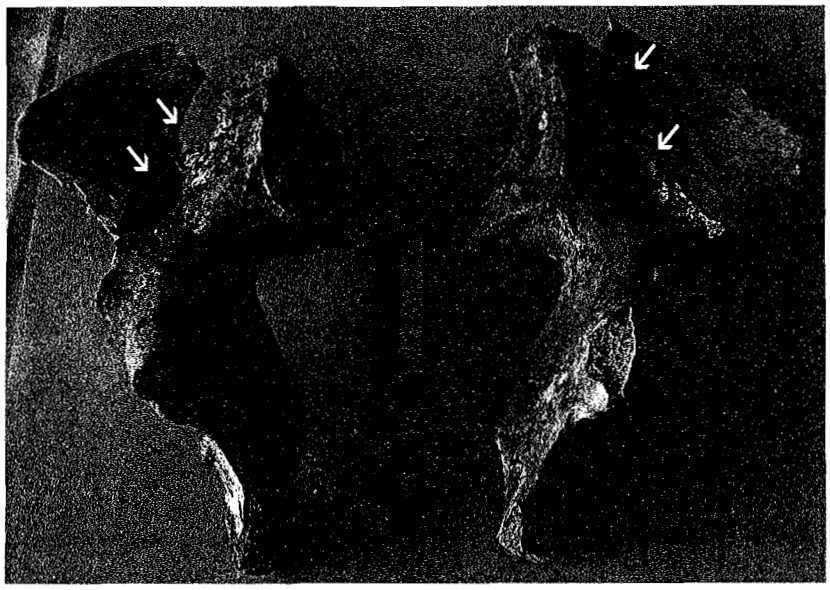


Figure 15. Pelvic innominates of a single individual (9A-15) showing postmortem chop marks (arrows) for removal of iliac blades.

Cutmarks were found on fragments representing nearly every element of the skeleton. The bones of the skull were most frequently affected. Specifically, the area of the frontal bone superior to glabella, the supramastoid crests, and the nuchal line were the most common sites of damage. Cutmarks to the anterior edge of the coronoid process occurred on two specimens. Cutmarks on longbones were found most frequently on the articular areas near the ends of the bones, which are likely indicators of dismemberment (White 1992:267). A single sternal body (9B-15) showed multiple vertical cutmarks running its entire length. Evidence consistent with decapitation (Haverkort and Lubell 1999:157) came from a single individual (9-11) with two cutmarks to the articular surface of the odontoid process (Figure 16). A single right scaphoid bone (1-11) showed four distinct cutmarks.

Table 6. Summary of postmortem skeletal modification.

Unit	Burial Number	Burial Type	Percent of Skeleton Recovered	Sex	CM	BU	SC	BT	DC	PO
1	14	N	5	U	x			x		x
	20	N	<5	M	x					
	30	I	5	U		x				
	19A	N	10	U	x	x				
	19C	N	<5	F	x	x				
	21A	N	15	F	x					
	30D	I	5	U	x	x				
6	4	N	<5	U	x		x			
	17	I	20	U	x					
	24	N	<5	U	x		x			
	31	I	40	U	x		x			
	5A	N	15	M	x	x	x			
	5B	N	<5	U	x		x			
8	44	I	25	M			x	x		
11	1	N	15	M	x	x	x			
	3	I	10	F	x					
	8	N	10	M	x		x			
	9	N	20	F	x		x		x	
	18	N	<5	F	x					x
12	31	N	10	F		x				
	34	I	60	M				x		
13	16	I	<5	F	x					
	19	I	15	F	x					
14	23	N	<5	U	x					
	25	N	5	F	x		x			
	27	N	5	U	x					
	28	N	5	U	x		x			
15	2	N	30	M	x	x				
	9A	I	20	F	x	x				
	9B	I	10	M	x	x				
19	8	N	<5	U	x					x
CP	21A	I	<5	U	x		x			
	21B	I	<5	F	x		x			
	21D	I	<5	F	x					

I=IS, N=NIS, F=female, M=male, U=unknown, CM=cutmarks, BU=burning, SC=scalping, BT=blunt-force trauma, DC=decapitation, PO=pot-polish.

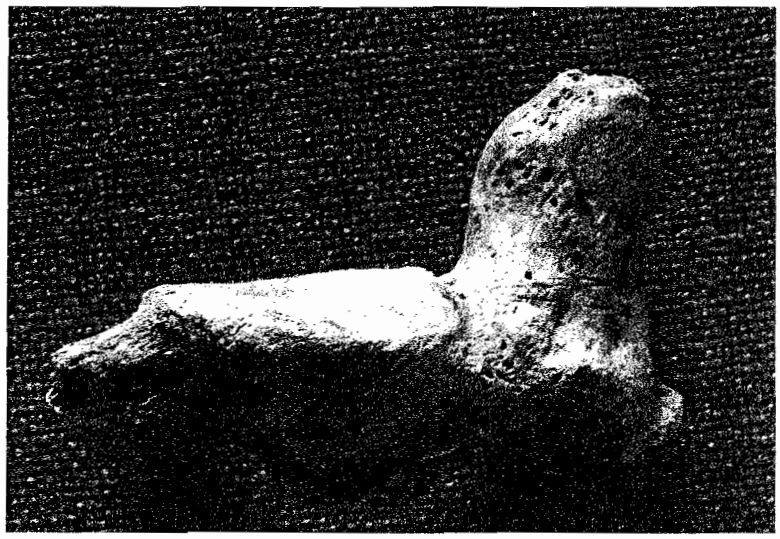


Figure 16. Second cervical vertebra with cutmarks on the odontoid process.

Complete longbones were rarely encountered in any of the NIS. Skull fragments from 13 individuals showed evidence of scalping. Figures 17 and 18 illustrate several types of this damage. Table 7 compares this group of 36 individuals with Southwest sites showing similar damage used as evidence of cannibalism.

Ten individuals showed evidence of burning/charring with color ranging from light tan to black in color. Burning was encountered on seven skulls, with a consistent pattern of thermal coloration concentrated on the endocranial surface of the calotte (Figure 19), though one mandible (21A-1) was burned. Three talus bones (two right, one left), one rib fragment, one fibula and one unspecified longbone fragment also showed evidence of burning.

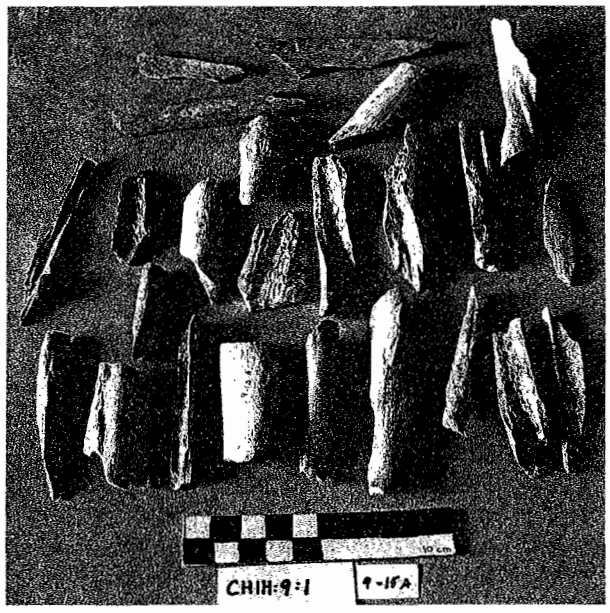


Figure 17. Longbone assemblage from a single individual (9A-15.

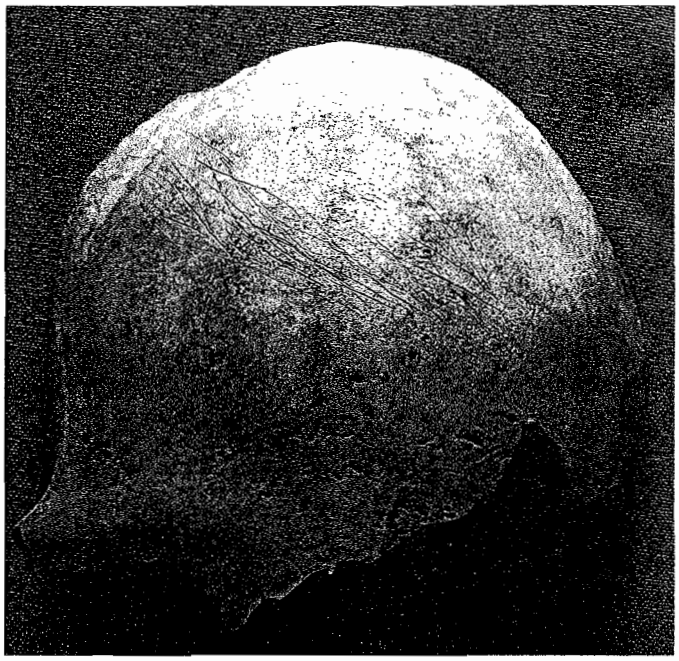


Figure 18. Partial skull showing multiple diagonal cutmarks running upper right to lower left across the frontal bone (burial 8-11).

Table 7. Comparison of Paquimé with Southwest sites showing evidence of cannibalism.

	Paquimé	Mancos (5MTUMR-2346)[a]	Cowboy Wash (5MT10010)[b]	Castle Rock (5MT-1825)[c]	Polacca Wash (NA8502)[d]	Burnt Mesa (LA4528)[e]
surface context	X [#]	X	X	X		X
fragmentation	X	X	X	X	X	X
anvil abrasions	X	X	X	X		
concoidal breaks	X	X		X	X	X
cutmarks	X	X	X	X	X	X
few verts, h/f bones	X	X	X		X	X
burning (low)	X	X	X	X	X	X
pot polish (low)	X	X		X		
well-preserved	X	X				X
gnawing absent	X	X	X	X	X	X
charred crania	X	X	X	X		X

[#]floor surface and in fill

[a]White 1992; [b]Billman et al. 2000; [c]Kuckelman et al. 2002; [d]Turner and Morris 1970; [e]Flinn et al. 1976.

Figure 19. Charred and fragmented skull. Note that charring is restricted to the outer crown of the skull.

Three examples of pot-polish were noted on a longbone fragment, a clavicle, and a rib fragment. The blunted bone edges suggesting pot polish were visualized under 10-power magnification, though an often shiny appearance was seen with the unaided eye. Rodent gnawing was noted on only two longbone fragments.

Statistical comparison of individuals of known sex showed no significant difference in the occurrence of postmortem modification between the sexes of either the IS (P= 0.221, Fisher's exact; N=80) or the NIS (P=0.665, Fisher's exact; N=22). Thus, neither sex from either provenience was more likely to show this modification, though IS females were three times more likely than their male counterparts. Inter-site comparison of Paquimé (N= 18) and Burnt Mesa LA 4528 (N=6) (Flinn et al. 1976) showed no significant difference for the occurrence of this modification (P=0.169, Fisher's exact). Difference in the frequency of postmortem damage between the IS and NIS was highly significant (G = 24.19, d.f. 1, P < .001).

Spatial Distribution

Postmortem modified remains were encountered in every fully excavated unit (see Figure 20), though not all NIS showed evidence of PM. The bulk of remains were deposited in units 1, 6, 11, and 14. Postmortem modified remains were found in units 13, 15, 19, and Central Plaza, but in much lower frequencies. Non-interred skeletons were found in units 8, 12, 15, and 19. This could imply that units 1, 6, 11, and 14 were abandoned earlier than 8, 12, 19, and Central Plaza. However, units 8, 16, and 19 were not completely excavated, so they may still contain more burials. Curiously, the modified remains found in unit 13 and the Central Plaza were only

from sub-floor interments. This may imply a ritual activity unrelated to the non-interred remains found in the rooms as DiPeso (1974:8:336) initially asserted. Statistical comparison of the spatial distribution of individuals with postmortem modification showed no significant difference between excavated units (G = 15.04, d.f. 9, P > .05).

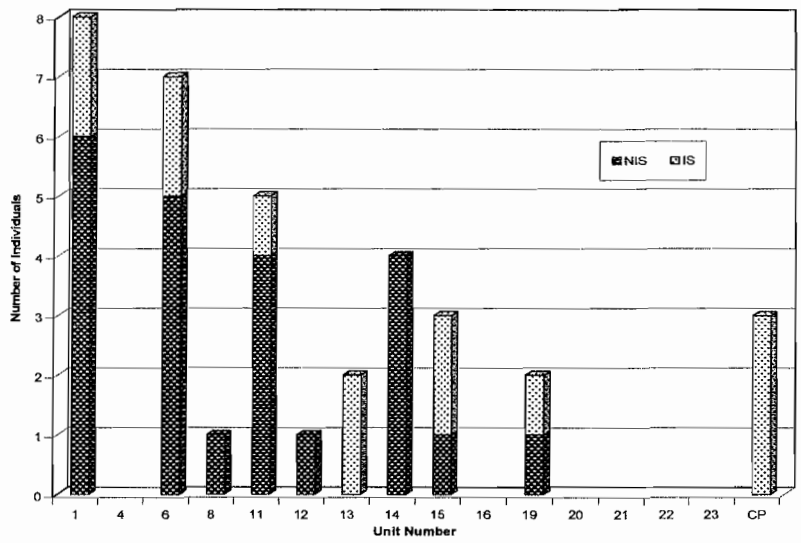


Figure 20. Distribution of postmortem modified remains by burial provenience and unit.

Skeletal Element Representation

The PM skeletons were highly fragmented and incomplete. Turner and Turner (1999) maintain that cannibalized assemblages are characterized by a paucity of ribs and vertebrae as compared to longbones. Though this could be the result of processing related to cannibalism, other taphonomic processes can account for these discrepancies (see page 46). To determine if this pattern held true for Paquimé, bone fragments were counted and separated by skeletal element or into groups. These

counts were converted into frequencies of total bones recovered. They were compared to the frequencies of occurrence of whole bones of a complete human skeleton. Turner and Turner's (1999) assertion holds true for Paquimé. Figure 21 illustrates this with the arms and legs considered separately. The pattern becomes more apparent in Figure 22 when all identifiable longbone fragments are pooled.

The PM group was characterized by much higher than expected frequencies of cranial bones and longbones, while frequencies of vertebrae, and hand and foot bones were approximately one-half and one-quarter the frequencies expected, respectively (refer to Table 7). Frequencies of axial elements and ribs were nearly identical to those expected. The Wilcoxon signed-rank test showed no statistical differences between the paired element frequencies ($Z=.262$; two-sided $p=.79$). However, the G-test did show a significant difference between the observed and expected frequencies for the entire skeleton ($G=59.43$, d.f. 5, $P < .01$). Though I realize I am comparing fragmented archaeological bone counts to whole bone counts from a complete skeleton, the frequencies of elements should be similar.

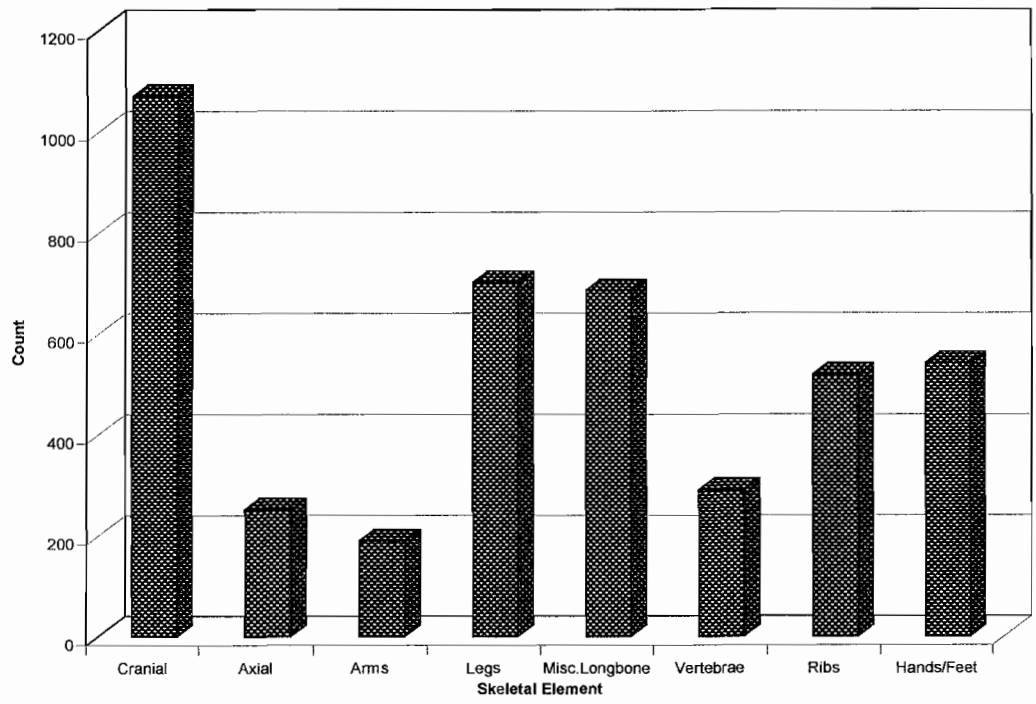


Figure 21. Bone fragment count (arms and legs considered separately).

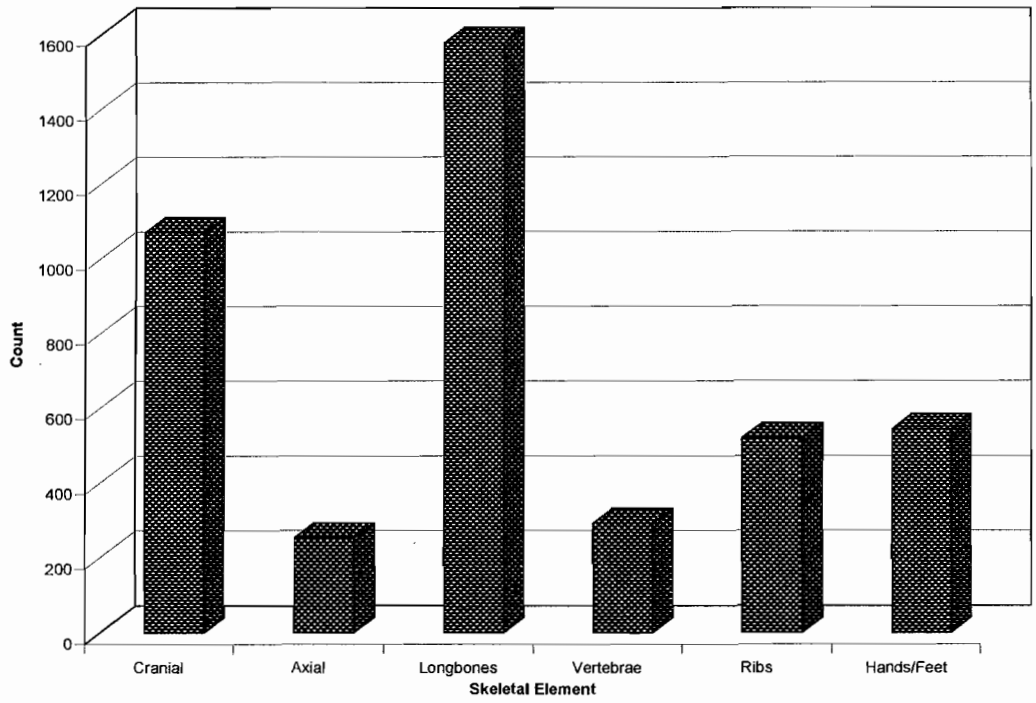


Figure 22. Bone fragment count (all longbones pooled).

Table 8. Comparison of skeletal element frequencies (%) between a laboratory skeleton (expected) and Paquimé (observed) remains.

Skeletal Element/Group	Skeleton	Paquimé	Difference
cranial	11	25	14
axial	4.5	5.9	1.4
longbones	6	37	31
vertebrae	12	6.8	-5.2
ribs	12	12.2	0.2
hands/feet	53.8	12.7	-41.1

In summary, 52 percent of the NIS and 10 percent of the IS showed postmortem modification and/or burning related to cannibalism. The damage included: extensive fracturing and splitting of longbones; chipping and abrasions; cutmarks to the cranium and postcranial elements, with focus on the articular areas and major muscle attachment sites of the longbones; burning/charring mainly focused on the calotte, and; one case of probable decapitation. The group was characterized by an under-representation of vertebrae, and hand and foot bones, and the remains were distributed throughout all excavated units.

Fluorine Dates

Results from fluoride ion concentration analysis represent a skeletal assemblage that was deposited continuously through time (see Figure 23). The distribution of the NIS and IS are similar when plotted against each other (Figure 24). No distinct clustering is seen that would indicate a large, single skeletal deposition event. Appendix II lists this information in more detail.

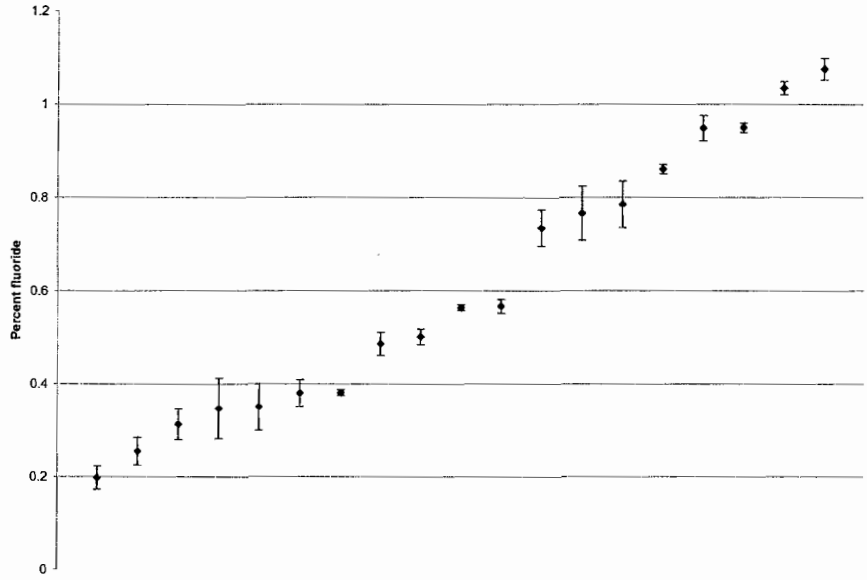


Figure 23. Fluoride ion concentration distribution. Dots represent mean fluoride concentration from three replicate measurements; lines represent standard deviations. Chronologically younger samples are at the bottom, older are at the top.

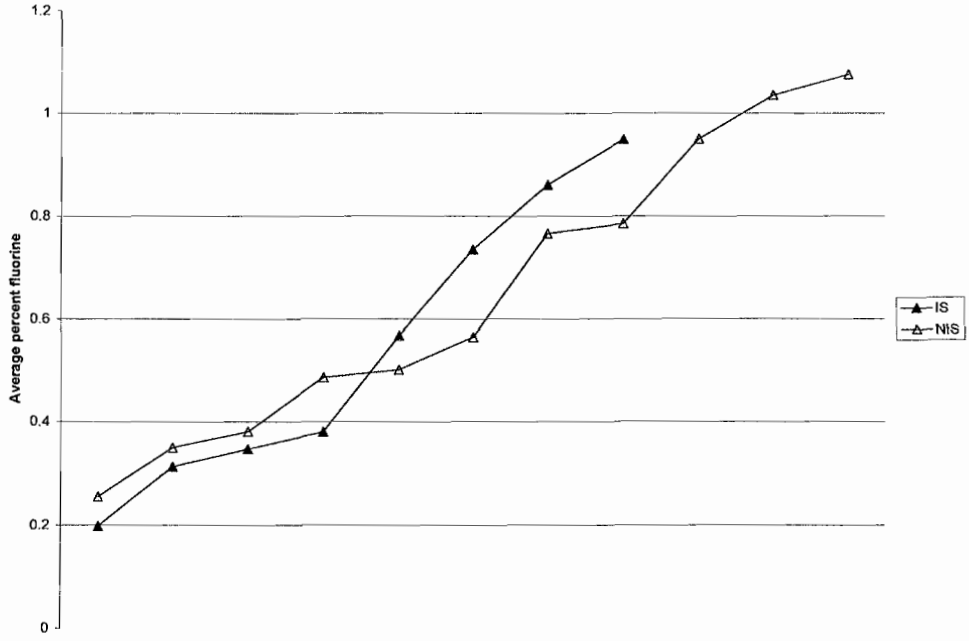


Figure 24. Comparison of the distribution of fluoride concentration between populations.

AMS Radiocarbon Dates

Four of the five samples submitted for analysis (17-6, 19-13, 19A-1, and 27-14) returned AMS radiocarbon dates. One sample (31-12) was not analyzed as it produced no collagen. The results, with their respective fluoride results are shown in Table 9. The calibrated AMS dates are shown in Figure 25. It is worth noting that the average percentages of fluoride in the samples are consistent with their AMS dates. Table 9 indicates that samples 19A-1 and 17-6 exhibit highly overlapping age ranges. These two samples appear as shadows of each other on the OxCal plot in Figure 25.

Table 9. Summary of AMS and fluoride data.

Sample	Burial type	Average percent fluoride	14C age yr B.P.	Mean Cal age yr A.D.	95.4% (2σ) cal age range A.D.
19-13	IS	.949	689 ± 42	1325	1255-1395
27-14	NIS	1.076	650 ± 40	1338	1278-1398
19A-1	NIS	.255	570 ±40	1364	1298-1429
17-6	IS	.198	567 ± 42	1365	1299-1431

In summary, the results show skeletal evidence of antemortem, perimortem, and postmortem trauma. Division of the type 2 (NIS) burials into four burial types allows for a better examination of the NIS burial provenience. Fluorine and AMS dates demonstrate a continuity of deposition of bodies during the recognized boundaries of the Medio period. These data will be instrumental in determining circumstances surrounding the deaths of the individuals studied.

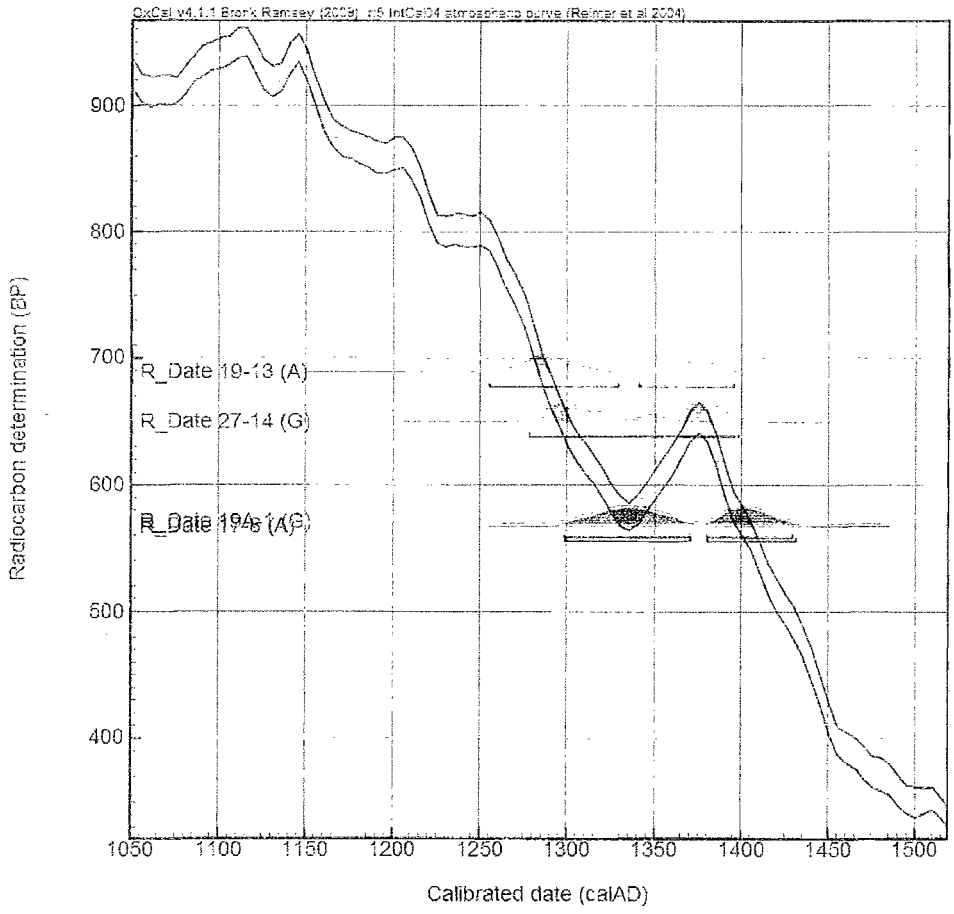


Figure 25. Raw AMS dates plotted against their calibrated dates. Diagonal curve is the IntCal.04 atmospheric radiation calibration curve. Peaks above date ranges are probabilities. Note tremendous overlap of 19A-1 and 17-6 between 500 and 600 B.P. (A) = date from University of Arizona Laboratory, (G) = date from Geochron Laboratory.

CHAPTER VI

EVALUATION OF HYPOTHESES

This chapter evaluates the three hypotheses stated in Chapter I. The primary line of evidence used is the osteological data. Additional evidence such as chronometric dates and burial context will be used in evaluation of hypotheses 2 and 3. When assessing whether violence was responsible for creating archaeological assemblages, frequencies and patterns of injury may be as important as the individual traumatic lesions themselves. Table 10 shows the patterns of injury generally

Table 10. Comparison of skeletal damage and preservation associated with different types of corpse processing.

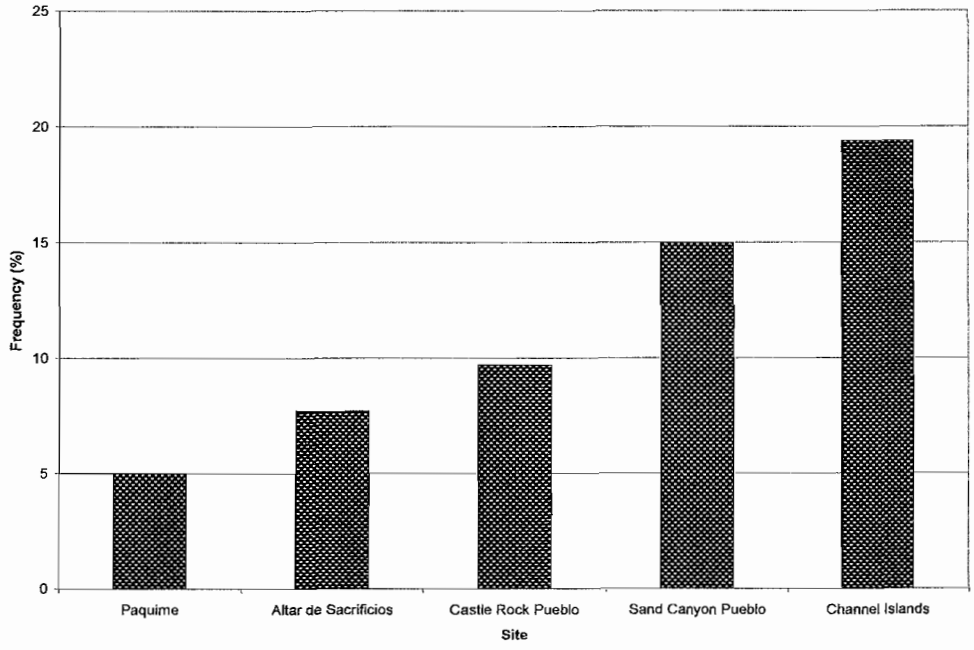
	Warfare	Mass-acre	Sacrifice	Mortuary process-ing	Witch killing	Cannibal-ism	Scaveng-ing
Fracture							
cranial	x	x	...	...	x	...	x
post-cranial	x	x	...	...	x	x	x
chewing	...	x	...	...	...	...	x
gnawing	...	x	...	...	...	...	x
Cutmarks							
scalping	x	x	...	...	...	...	...
disarticula-tion	...	x	x	x	x	x	...
defleshing	...	x	x	x	...	x	...
Other							
burning	...	x	...	...	...	x	...
well-preserved	...	...	...	...	...	x	...

observed on skeletal assemblages resulting from each event. The Paquimé skeletal material will be evaluated against each category to identify similarities and differences.

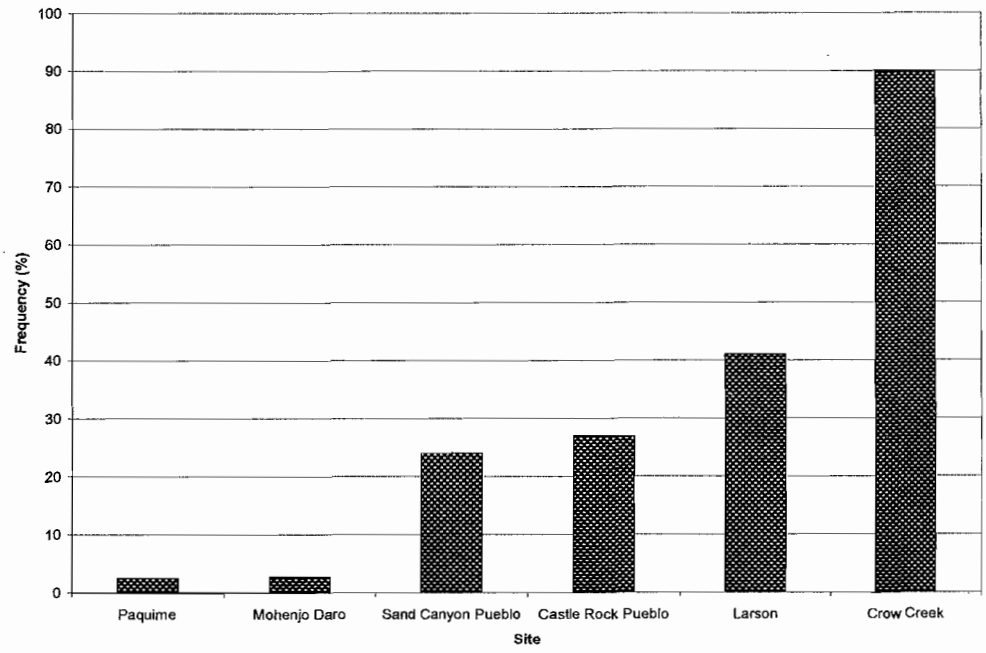
Hypothesis 1: Intergroup Violence Was Endemic in the Casas Grandes Region

Hypothesis 1 is evaluated by observation of skeletal trauma and comparing trauma types and frequencies to other sites where warfare has been confirmed. Low frequencies of ante- and perimortem skeletal trauma were discovered at Paquimé. The frequency of trauma at Paquimé is similar to those from Mohenjo-daro (Kennedy 1984) and Altar de Sacrificios (Saul 1972), two sites where neither warfare nor massacre have been recorded (see Figure 26). These three sites contrast greatly with the Southwest sites of Sand Canyon Pueblo and Castle Rock Pueblo where massacres and cannibalism occurred, the Great Plains sites of Larson and Crow Creek where massacres occurred, and the California Channel Islands where warfare was endemic. Though a small percentage of the population suffered ante- and perimortem trauma, there were no patterned injuries (e.g. multiple healed depressed cranial fractures, parry fractures coupled with cranial fractures on the same individual) that indicate warfare was rampant in the Paquimé region. It is equally likely that these injuries resulted from accidents. This pattern differs from the warfare pattern seen in Table 10 where fractures and scalping are common.

DiPeso supported his warfare theory with the paucity of male burials at Paquimé, believing that warriors were likely lost on distant battlefields and/or buried



a.



b.

Figure 26. Comparison of a). antemortem, and b). perimortem trauma between Paquimé and other selected sites.

in a special warrior cemetery outside the city. Though this could explain part of the female bias in the sex ratio, it does not explain the virtual absence of male warfare survivors. If warfare was necessary to maintain Paquimé's control over its hinterland, a sizeable army would have been needed, and at least some of these men would have survived one or moreinjuries incurred in war. The skeletal record does not reflect this, as healed injuries preserved after death were infrequent. Thus, the osteological data do not support the hypothesis that warfare was endemic to the Casas Grandes region.

Hypothesis 2: The Final Population of Paquimé Was Massacred

Hypothesis 2 is evaluated by comparing trauma frequencies of the IS and NIS. I expected the frequency of trauma would be significantly higher in the NIS. Additionally, the demographics of the NIS should be similar to those of the city's general population. Fluoride and AMS dating, and burial data were used in support as well. The frequency of injury was nearly the same between the NIS and IS (IS=7%, NIS=10%) and only one perimortem fracture was found on a NIS. Comparison of trauma frequencies showed no significant difference (G=.32, d.f. 1, P >.05).

When compared to Table 10, the NIS show similarities to massacre sites in some categories. Though the NIS number is over 127 (certainly large enough for a massacre), they show dissimilarities with remains from sites such as Crow Creek and Larson. First, the skeletons are incomplete, not articulated, and highly fragmented. Second, the remains lack evidence of carnivore gnawing, a sign of animal activity on exposed corpses. Third, very few show injuries related to the cause of death. The

NIS did show consistencies with Crow Creek and Larson for evidence of disarticulation (much higher at Paquimé), scalping, and defleshing, and limited cases of burning. However, the NIS were well-preserved, and much more fragmentary and scattered than the assemblages at either Crow Creek or Larson.

The results from both dating methods also argue against a massacre. The relative dating sequence provided by the fluoride analysis shows a pattern of continuous deposition for both the IS and the NIS. If the NIS are the remains of a massacre, they should cluster near the point of lowest fluoride concentration (a horizontal line near the bottom of the graph), while the IS values are continuous throughout the Medio period (a positively-sloped diagonal line) (refer to Figures 23-25 above). The AMS dates also show the IS and NIS to be contemporaneous, and to have been deposited during the Medio period.

A similar pattern of burial has been noted for the site of Galaz Ruin in southwest New Mexico. Anyon and LeBlanc (1984:174) note that at least 25% of burials from Galaz Ruin were extramural (buried outside structures or in room fill) much like the NIS at Paquimé. My statistical analysis of the two Galaz burial groups showed no significant difference between the Galaz age distributions ($G=8.77$ d.f. 5, $P > .05$), thus, the extramural burial demographics were similar to a normal Galaz population. There was a slight tendency to bury people either in or in the fill of or adjacent to rooms suspected as being ceremonial or public in nature (Anyon and LeBlanc 1984:182).

Fifty burials were recovered from post-abandonment fill in Structure 42A, and have fewer than average grave goods in them (182). The authors suggest that the fill in this room would have been soft and a prime place to dig graves (182). Thus, there are numerous similarities between the Paquimé NIS and the Galaz extramural burials, yet LeBlanc (1999:233) sees massacre as the only event that could have produced the Paquimé NIS. Though I do not believe the Galaz burials to be massacre victims, the similarities among these distributions make the Galaz extramural burial group a better candidate for a massacre than the NIS from Paquimé.

The burial data from the NIS do not support their being the remnants of a massacre. This would have been apparent long ago if their distinctiveness had not been obscured by their designation as a single burial type. In fact, the type 2 NIS actually occupy four different burial types. My types 2A and 2C indicate that some bodies were buried whole, while bodies in burial types 2B and 2D were buried in pieces and possibly strewn through different rooms. Some bodies were buried in the fill of abandoned rooms, some were placed on the floor surfaces and covered in fill. Both dating methods argue that these bodies were interred throughout the occupation of the city, which is consistent with the burials taking place as different rooms were abandoned. Hence, a final massacre is not supported.

Hypothesis 3: Human Sacrifice and Cannibalism Were Practiced at Paquimé

Hypothesis 3 is evaluated by comparing the types and patterns of trauma found at Paquimé with those from sites where human sacrifice and cannibalism have been documented. The 1958-1961 excavations recovered ten individuals that DiPeso

and colleagues believed were human sacrifices (DiPeso 1974:2:637; DiPeso et al. 1974:8:361). The notion that some of the individuals were dispatched ceremonially is apparent in the field notes. Referring to burial 39-6, engineer and mapper Eduardo Contreras comments, "Del entierro no. 39, solamente se encontro una parte que fue: la calavera, parte de la columna vertebral y las costillas no apareciendo el resto del esqueleto. Seguramente fue mutilado" [from burial no. 39, only a portion was found: the skull, part of the spinal column and ribs; the rest of the skeleton was not apparent. Certainly it was mutilated] (my translation) (Contreras n.d.:VII:51). Referring to burial 12-6 (IS), Contreras states: "El craneo, como la mayoria de los huesos, estan en mal estado de conservacion y no se encontraron los huesos de las extremidades inferiores solamente las apofisis de los femurs (hip joints are illustrated). Da la impresion de haber sido mutilado antes de ser enterrado" [the skull, like the majority of the bones, is in a poor state of preservation and the bones of the lower extremities were not found, only the joints of the femurs. It gives the impression of having been mutilated before burial] (my translation) (Contreras n.d.:VII:37). Certainly the burial of some people under a ballcourt and around a stone pillar footing are unique among the Casas Grandes burials. The disarticulation and absence of portions of the skeleton as noted by Contreras above, and of one of the females under the ballcourt along with the burial context make a compelling argument for human sacrifice, but the lack of ritual paraphernalia in these burials renders this interpretation speculative.

Cannibalism in archaeological bone was not widely regarded until after the publication of the Casas Grandes site report. The NIS assemblage was never studied

in earnest during preparation of the site report or by subsequent researchers. Thus, it is not surprising that this type of damage went unreported. Comparison of postmortem modification at Paquimé to that found on non-cannibalized assemblages reveals several disparities, while comparison to Southwest cannibalism sites in Table 7, above, reveals strong similarities. The assemblage from La Quemada (Nelson et al. 1992) shows no evidence of disarticulation, fragmentation, scalping or burning, and the skeletons were relatively complete. This is more typical of secondary burial. The massacre victims from Crow Creek (Willey 1990) and Larson (Owsley et al. 1977) showed evidence of mutilation (dismemberment, decapitation, anterior tooth avulsion, nose and tongue removal, and scalping), but lacked evidence of the extensive bone fragmentation seen at Paquimé. Also note that Crow Creek and Larson showed a good deal of carnivore gnawing to the ends of the longbones, which Paquimé lacked. The Ram Mesa assemblage (Ogilvie and Hilton 2000) interpreted as the remains of murdered witches, showed cranial trauma and cutmarks, anterior tooth avulsion, and a high incidence of burning.

Therefore, the remains from Paquimé most resemble those from Mancos and other sites with remnants of cannibalism (refer to Table 7). It is noteworthy that the time period during which this activity occurred (the Medio period) coincides with an increase in violence and cannibalism in the Four Corners of the United States Southwest.

In summary, Hypotheses 1 and 2 were not supported by these data. The IS assemblage shows only one conclusive case of cranial trauma, which could also be

explained by intragroup hostility. Furthermore, the low incidence of antemortem postcranial fractures, which can be explained as accidental, is not different from other sites lacking warfare. Massacre is also unlikely as an explanation for the NIS assemblage. The low incidence of distinguishable trauma from the NIS and the similarity of trauma occurrence between the IS and NIS argue against a massacre. The fluorine and AMS dates are also inconsistent with a massacre at the terminus of the city's occupation. Hypothesis 3 was validated by the evidence of extreme postmortem modification that is similar to sites where cannibalism occurred. The possibility of ritual sacrifice still remains a viable hypothesis due to the burial provenience of several bodies as DiPeso noted.

CHAPTER VII

DISCUSSION

Warfare

Both warfare and massacre in the Casas Grandes valley are predicated on DiPeso's belief that Toltec *pochteca* were controlling the city and subjugating the region to its power. DiPeso thought that violence was used to subdue the regional polities. Since the dating sequence of the site was revised in 1993, this model was invalidated and an alternative model to explain the motive for this violence has not been offered. Though some Mesoamerican cultural elements were incorporated by Paquime's elite, it does not follow that the city was under the control of a Mesoamerican state. Perhaps there were periodic skirmishes in the area, but this study found no evidence of ongoing warfare.

As mentioned in Chapter 1, LeBlanc (1999:200-203) maintains that Late Period settlement patterns and locations changed in the Southwest due to increased hostility. With the exception of the large apartment cluster, the layout of Paquimé does not fit this model for four reasons: 1) units 1, 11, 15, 18, 20, 21, and 23 are free-standing (refer to Figure 4 above), 2) small Medio period sites are scattered throughout the Casas Grandes and other nearby valleys, 3) the ballcourts and plazas are not enclosed within any walled structures, and 4) Paquimé is located in the middle of a flat floodplain, implying a choice of proximity to agriculture rather than to safety. These attributes make Paquimé a poor candidate for a defensively structured

settlement. However, it could be argued that the hilltop communication station of Cerro de Moctezuma mitigated any offensive threat by providing advance warning of approaching enemies.

The low number of burials and disparate sex ratio at Paquimé are unusual but not unique. Swarts Ruin, a Mimbres site in southwest New Mexico was characterized by a similar burial pattern and low number of observed burials (Cosgrove and Cosgrove 1974). The Cosgrove's (1974:24) note that some rooms contained no burials, while others had between 1 and 32. Eighteen and one half percent of the Late period burials were from outside structural walls or in room fill, which compares to 22% NIS from Paquimé. Nineteen of these bodies were from the fill of rooms that they state "probably had fallen into disuse as the population decreased before the final abandonment of the village...since it was probable that numbers of houses fell into disuse and were left unoccupied during the time necessary to build settlements of the Early and Middle Periods" (Cosgrove and Cosgrove 1974:24). Also, the site had been extensively burned.

The Point of Pines site in southeast New Mexico shows a similar situation (Bennett 1973). The Late period burials (A.D. 1285-1450) from Point of Pines showed a bias of 36% females to 30% males, or 84 males to 100 females, which is comparable to Paquime's 65 males to 100 females. Bennett (1973:53) found no significant difference between these sex ratios using the chi-square test.

Some possibilities to explain the lack of burials are: 1) some people responsible for production in the city lived in other regional hamlets, 2) many of the

men traveled as traders rather than warriors and died while away, 3) some people are buried outside the excavation area as seen at Swarts Ruin, 4) the site experienced population fluctuation throughout the year, which may have been tied to ceremonial and/or trade gatherings, and 5) the population declined over time and all rooms were not used throughout the entire occupation of the city. Additionally, the NIS should be included in the total count of Medio period burials and not treated as a separate population, which would increase the number of burials.

Massacre

The absence of warfare makes justifying a massacre difficult. Attacking the city in the absence of hostility defies logic. If there were no *pochteca* subduing the region's people, what purpose would invading the richest city in one of the most productive regions in the area be if you abandoned it and a wealth of commodities immediately afterwards? The risk certainly outweighs the reward.

This leaves the difficult task of explaining the differences among and between the IS and NIS groups. DiPeso originally subsumed all NIS (with the exception of three individuals) into the homogenous type 2 burial group. These remains further lost their uniqueness when he assigned all of them to the Diablo phase of the Medio period. In fact, one individual (18-16) was buried so high in room infill that it led DiPeso to comment "it is hard to believe that it belongs with any occupation of the site (except perhaps the modern Mexican occupation)" (DiPeso n.d.: XII:155). In the site report this individual is listed as associated with the Diablo phase of the Medio period (DiPeso et al. 1973:8:404). Deconstructing the type 2 group may add clarity.

I consider the articulated NIS (types 2A, 2C) to have been formal interments post-dating the occupation of the rooms in which they were buried and possibly post-dating the occupation of the city. Uncannibalized individual 26-14 (type 2A) was found with his arms folded across his chest; cannibalized individual 27-14 (type 2C) was found associated with the remains of three turkeys, implying formalized burial. It appears that the fragmentary, disarticulated remains from floor surfaces and mixed in fill above the floors (types 2B, 2D) were either deposited during the occupation of the city, but after the rooms in which they were buried fell into disuse, or after the abandonment of the city. Using their depositional provenience to bolster the massacre hypothesis makes little sense due to their occurrence in room fill *above* the floor surfaces (in some cases as high as 40 cm and with ceiling tiles found in the fill *below* them). Interpretation of the single type 2E burial is difficult due to its recovery from a test trench.

Thus, burial context of the NIS appears consistent with the occupants' use of the crumbling and abandoned rooms and plazas as burial sites. Rather than representing a single depositional episode, the burial data from the NIS favor continuous deposition during and/or after site occupation. The frequency of NIS deposited above floor surfaces in fill (57%) is equal to the amount of NIS cannibalized. The only NIS with evidence of cannibalism were fragmentary, disarticulated skeletons.

Burial types 2A and 2C were simply individuals who were buried in filled-in abandoned houses, where their pits were either dug partially through the soft fill or

until reaching the hard floor surface. They may have all been dug to the floor surface, with the pits of the 2C burials filling partially with back dirt between the time of pit preparation and actual deposition of the body. Therefore, the reason for the abandonment of the city remains unknown.

Human Sacrifice and Cannibalism

Making the leap from a highly integrated ritual system to a system that included human sacrifice and ceremonial cannibalism is difficult. Ritual human sacrifice in Mexico is well known in the archaeological literature and in central Mexico it was often tied to the ballgame. Human sacrifices have been found in Mexico in both apartment compounds and monuments at Teotihuacan (Sugiyama 2005), and at Classic Maya sites (Tiesler and Cucina 2006). Tenth-century sculptures at El Tajín on the east coast of Mexico depict sacrifices by decapitation and disembowelment at the conclusion of ballgames (Wilkerson 1991:63). DiPeso et al. (1974:8) describe ten Paquimé burials that may have been human sacrifices. The burial of a select few under the ceremonial ballcourt makes a compelling argument for ritual human sacrifice tied to the ballgame. It is also possible that some of the cannibalized group were victims of ritual and/or ballgame-related sacrifice.

Like others in the Southwest and northern Mexico, the people of Paquimé were primarily dependent on agriculture for their existence. This period was characterized by unpredictable climatic fluctuation, which likely caused stress on the population. Control over natural events is a primary reason why people seek supernatural assistance (Bailey and Peoples 1999:211). Human sacrifices during

ballgames were often tied to ensuring fertility or adequate precipitation (Wilkerson 1991). At El Tajín, the ballgame and the sacrifice that followed were necessary steps to send mortals to the underworld to confer with the deities (Wilkerson 1991:65). The possibility that the ballgame played a role in perpetuating the sacrifices at Paquimé cannot be ruled out.

My data show that cannibalism was practiced at Paquimé since at least the beginning of the Medio period. Interpretation is complicated due to recovery of cannibalized remains from both interred and non-interred contexts. One can only speculate as to the reasons why the people of Paquimé practiced conspecific consumption. I will offer some possibilities.

The evidence suggests there may have been more than one type of cannibalism practiced: endocannibalism, and exocannibalism, ceremonial and profane cannibalism, or a combination of both. Goldman (1999:14) defines endocannibalism as the consumption of a member of one's own group (through kinship or descent); exocannibalism refers to consumption of people from outside one's own group (enemies, for example). Profane or survival cannibalism is the consumption of human flesh in emergency starvation situations, whereas any consumption of human flesh during a ritual or for religious reasons is labeled ceremonial. The IS cannibalized skeletons may have been the remains of endocannibalism, or ceremonial cannibalism (or endo-ceremonial cannibalism), while the cannibalized NIS are those of outsiders or those consumed profanely for nutrition. Most consumed IS were more complete than their NIS counterparts, which suggests the remains of at least some

individuals were important enough to warrant their collection and burial in a single sub-floor grave, which requires more energy expenditure (Ravesloot 1988). This courtesy may have been afforded to certain lineages or group members, or those who were sacrificed ceremonially. Burial 44 A-L-13 serves as an example.

Burial 44-13 was a sub-floor (type 4E) pit sealed with wood planks (Figure 27). The non-permanent sealing with planks implies that it was re-opened to deposit bodies through time. It contained at least 12 individuals (most of them articulated) and the greatest number and quality of artifacts of any burial at Paquimé (DiPeso et al. 1974:8:387-388). The pit had a shelf built into one end and ceremonial ceramic drums among the artifacts. The articulated individuals in this pit were piled on top of one another with the uppermost layer containing the fragmentary remains of four adolescents. The layering of bodies and artifacts was so impressive it led DiPeso to state it was "the most complex burial discovered at Casas Grandes" (DiPeso et al. 1974:8:387). Though I did not personally examine any of the 44-13 material, Sophie Kohn of the University of New Mexico (personal communication 2008) examined the remains from the pit and forwarded digital images to me. We both believe the fragmentary material from the uppermost level of this burial exhibits a similar pattern of cutmarks, burning, and longbone fragmentation to those found at cannibalism sites. This is due to similarities in processing damage between the 44-13 material and the 36 skeletons with PM reported here. I believe this burial is good evidence of the burial of an elite lineage coupled with endo- or ceremonial cannibalism.

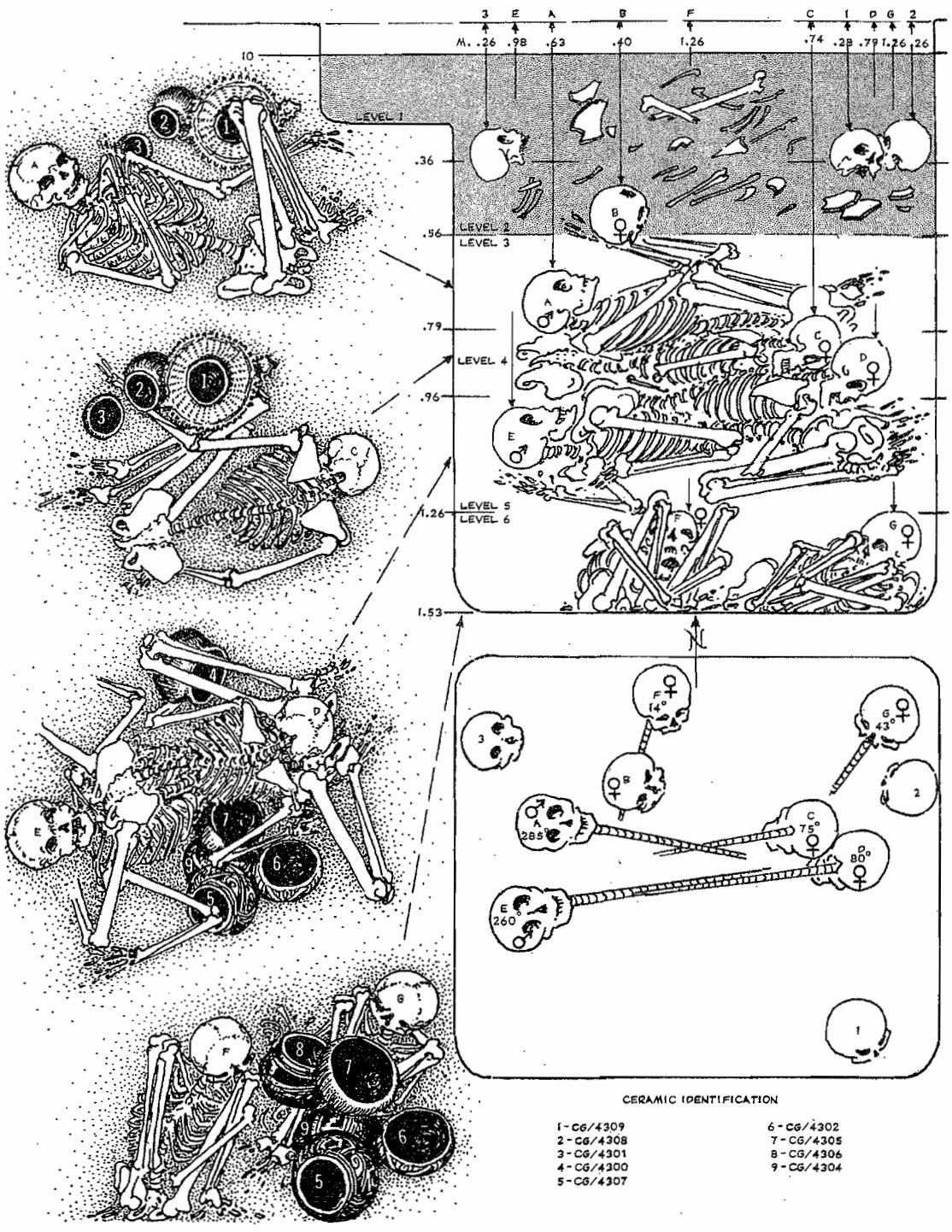


Figure 27. Complex burial 44 A-L-13 (DiPeso et al. 1974:8:Figure 383-8).

The cannibalized NIS were denied sub-floor burial, were less complete, and scattered, and discarded on floors or in fill of unused buildings. This disregard for their final disposition shows the relative unimportance of the persons consumed, inferring their status as an outsider or the consumption as profane in nature. Burial 27-14 is enigmatic in this respect due to its relative incompleteness and placement on a floor surface in association with the remains of three turkeys (a sacred animal associated with death). However, data collection from this skeleton was minimal since only five percent of this individual was recovered.

Element Representation of Fragmented Skeletons

Turner and Turner (1999) cite under-representation of ribs and vertebrae as a characteristic of cannibalized bone assemblages. The Paquimé assemblage did show under-representation of vertebrae, but the observed frequency of ribs was nearly identical to the expected frequency. It is understood that this method of comparison is somewhat hypothetical in that it compares frequencies of highly fragmented archaeological bone to those occurring in an undamaged, complete skeleton. However, it is curious that the two most over-represented categories (cranial and longbone) were the most fragmented, and the most under-represented category (hands and feet) contains some of the smallest bones, and hence the most difficult to recover archaeologically.

The comparison of skeletal element representation showed no significant difference between the expected and observed frequencies of different skeletal elements. The largest pair-wise differences were in the overabundance of cranial and

longbones, and the lack of vertebrae, and hand and foot bones. These differences can be explained by the fact that the crania and longbones were the most highly fragmented parts of the skeleton and that the bones of the hands and feet are the most difficult to recover due to their diminutive size and their susceptibility to the processes of diagenesis. Note that in Table 7, all but one site lists under-representation of vertebrae, and hands and feet as an attribute of cannibalism. This implies that the phenomenon is common and whether or not it is due to loss during the postmortem body preparation or as the result of diagenesis and/or archaeological recovery techniques is difficult to discern. This exercise does show that the crania and longbones were more highly fragmented than expected.

Non-Osteological Evidence: Chronometric Dating and Burned Structures

Relative and absolute dating methods often yield the best information for reconstructing a timeline of past activities. The fluoride and AMS data have been enlightening in the case of Paquimé. It was expected that fluoride ion concentrations between the IS and NIS would be different, when in fact the two were quite similar. The NIS showed no horizontal tendency that would indicate a single depositional episode as would be expected in the case of a massacre.

AMS dating was applied to NIS samples to indicate an absolute date for the proposed massacre. The resulting dates corresponded to the Medio period as expected, and did show a considerable degree of overlap. However, I would feel more comfortable making a massacre assessment with additional dates. A better pattern of deposition may emerge with analysis of more samples.

Burning of structures during prehistory in the Southwest was not unusual. Ritual closure by burning was commonly practiced on ceremonial, communal, and housing structures. According to LeBlanc (1999:74):

> "There should be only a few explanations for a site or a portion of a site to have burned. In general, the logical possibilities for burning sites or portions of sites are (1) accidental fires; (2) deliberate burning of sites that was not related to warfare; (3) deliberate burning of particular structures (such as kivas) while the community continued to be occupied—again, unrelated to warfare—(reasons for this burning might include ceremonial purposes, internal community violence, death of its inhabitants, or pest removal); and (4) burning of all or part of the community due to warfare—including the special case of burning by the resident group to deny the site to the enemy."

However, no one has attempted to explain repeated burning of structures, a phenomenon that was recorded in some rooms at Paquimé.

DiPeso (1974:2:325) argues that the burned room blocks at Paquimé are evidence of the massacre that ended the site's occupation. In his view, invaders stormed the city, murdered the final population, desecrated sacred objects, and burned the buildings. Yet, in his excavation notes on file in the Amerind Foundation archives, he notes that some rooms were burned more than once and many had multiple floor surfaces superimposed on each other. Rooms 4 and 17 of unit 16 were noted to have been burned, re-plastered, then burned a second time (DiPeso n.d.:XII:57, 114). Room 3 in unit 16 contains three superimposed floor surfaces and was also burned, then re-occupied (DiPeso n.d.:XII:45). None of the 8 individuals from unit 16 that I viewed (IS or NIS) showed any evidence of burning, suggesting that the rooms burned before the bodies were deposited there. I conclude that the

fires were more likely tied to ritual closures rather than a site-wide burning that would indicate warfare, massacre, or denial of the site to the enemy.

CHAPTER VIII

CONCLUSION

The objectives of this dissertation were to determine whether inter-group violence was endemic in the Casas Grandes region, whether the final population was massacred, and whether the people of Paquimé practiced human sacrifice and cannibalism. These questions are tied to the more general objective of explaining the cultural dynamics surrounding violence in Northwest Mexico and why the city was abandoned. Multiple lines of inquiry were used to test these hypotheses. Three conclusions were reached. First, the frequency of skeletal injury characterizes a non-warring population. The antemortem fractures can be more parsimoniously explained as accidental. Second, the osteological and burial data, chronometric dates, and evidence of structural burning do not support the massacre hypothesis. Rather, the data support the following conclusion: the articulated and disarticulated, non-interred skeletons are primary and secondary burials, respectively, made in the soft fill of abandoned structures during and after the occupation of the city. The multiple periods of burning are more characteristic of ritual room closure rather than a single massacre episode.

Finally, very strong evidence for ritual sacrifice and cannibalism among both the non-interred and formally interred assemblages was found. Given the large amount of symbolically-charged Casas Grandes polychrome pottery found at

Paquimé and other regional sites, ritual-religious ceremony was likely a large part of daily life. The strong connections between Mesoamerican ballcourts and ritual are also well-documented. At a minimum, the burials under the ballcourt and the child burial around the post in room 21C of unit 8 should be considered to have been ceremonial in nature. The difference in treatment of certain cannibalized skeletons (the more complete IS) should also be considered to have been surrounded by ceremony. These conclusions should create renewed interest in examination of various aspects of Casas Grandes culture, allowing for a greater understanding of the people who occupied this site for 250 years. The data only discredit the theories of warfare and massacre, but do not offer an explanation for the abandonment of the site. Further research may answer that question.

Contributions of This Research

Though recovered over 40 years ago, this is the first detailed examination of the non-interred Medio period skeletal material. This analysis serves as an example that even fragmentary skeletal remains can be an important data source and should not be neglected in favor of more complete remains with better provenience. This dissertation has contributed 1) an analysis of the non-interred skeletal remains, and their burial provenience, 2) recognition of cannibalism at Paquimé, 3) new fluoride ion and AMS radiocarbon dates from human skeletal remains, and 4) analysis of skeletal element representation in cannibalized assemblages. It has also raised two new questions: 1) is the female sex bias real or introduced, and 2) did Paquimé function as more of a regional gathering place and ceremonial center rather than

simply a manufacturing and distribution center? Certainly, there is much work left to do at Paquimé.

Future Research Directions

The fact that the NIS were highly fragmented and incomplete, suggests the remains may represent fewer individuals that were scattered after disarticulation. The only means of demonstrating this would be to re-assess the number of individuals by conjoining the fragments of the NIS assemblage. I suspect this would produce fewer individuals.

APPENDIX A

INDIVIDUALS INCLUDED IN STUDY SAMPLE

Burial Number	Unit	Burial Type	Percent Complete		Burial Number	Unit	Burial Type	Percent Complete
2	1	1B	25		13	6	1A	25
3	1	1B	25		15	6	1B	50
4	1	1B	25		17	6	1B	20
9	1	1A	20		20	6	1B	50
12	1	1A	30		21	6	1A	90
13	1	1B	10		22	6	1B	90
14	1	2	5		24	6	2	<5
15	1	2	20		27	6	1B	15
16	1	1A	10		28	6	1B	20
20	1	2	<5		29	6	1B	20
23	1	3A	50		31	6	1B	40
28	1	3A	<5		35	6	3A	50
30	1	3D	<5		40	6	3H	15
17A	1	1B	20		43	6	1A	40
17B	1	1B	15		47	6	1A	75
19A	1	2	10		48	6	1A	50
19B	1	2	10		49	6	3B	<5
19C	1	2	<5		23A	6	1B	10
1A	1	2	10		23B	6	1B	<5
21A	1	2	15		23C	6	1B	10
30C	1	3D	<5		37A	6	3A	35
30D	1	3D	<5		37B	6	3A	5
30E	1	3D	<5		5A	6	2	15
30G	1	3D	<5		5B	6	2	<5
1	4	2	80		5	8	1A	35
4	6	2	<5		20	8	3A	10
6	6	3A	50		23	8	8A	90
8	6	1A	25		24	8	1A	90
12	6	1H	5		25	8	1A	50

Burial Number	Unit	Burial Type	Percent Complete		Burial Number	Unit	Burial Type	Percent Complete
27	8	1A	60		25	12	12A	25
28	8	2	15		31	12	2	10
29	8	2	<5		34	12	11B	60
31	8	2	10		29A	12	2	25
33	8	1A	10		6A	12	1B	15
44	8	1B	25		6B	12	1B	25
45	8	1B	5		1	13	2	15
26A	8	1A	40		4	13	2	5
26B	8	1A	5		5	13	2	5
1	11	2	15		12	13	1B	50
2	11	1A	40		13	13	4A	40
3	11	1E	10		14	13	11D	10
8	11	2	10		15	13	11D	10
9	11	2	20		16	13	11D	<5
32	11	1B	40		19	13	3A	15
33	11	1B	30		23	13	1B	25
35	11	7A	25		24	13	1A	60
36	11	1B	25		25	13	3A	20
37	11	1A	30		26	13	1B	50
43	11	1A	20		45	13	11B	<5
45	11	7A	10		46	13	11B	10
52	11	9	<5		72	13	3B	50
54	11	7A	25		73	13	3B	35
18/19	11	2	<5		74	13	3A	50
53A	11	7B	90		76	13	1A	35
4	12	1A	<5		77	13	1A	30
4	12	1A	30		78	13	3A	35
15	12	1A	<5		81	13	3A	35
16	12	1A	<5		82	13	3A	25
24	12	12A	20		86	13	3A	50

Burial Number	Unit	Burial Type	Percent Complete		Burial Number	Unit	Burial Type	Percent Complete
87	13	3A	40		9B	15	1D	10
88	13	3A	40		1	16	2	50
48B	13	11B	25		8	16	9	10
62A	13	1B	15		14	16	2	5
66A	13	1G	30		18	16	2	<5
66B	13	1G	40		20	16	1A	30
1	14	8B	40		21	16	1A	60
2	14	8B	50		23	16	4B	40
19	14	2	10		25	16	1A	15
23	14	2	<5		3	19	1E	<5
25	14	2	5		6	19	11A	25
26	14	2	25		7	19	1A	20
27	14	2	5		8	19	2	<5
28	14	2	<5		1	20	1H	40
31	14	1B	40		2	20	1A	25
32	14	1B	40		1	21	1A	10
39	14	7B	40		4	21	3B	<5
44	14	1B	5		1	22	3A	30
45	14	1B	10		2	22	3A	20
46	14	1B	50		1	23	3B	<5
48	14	1D	50		4	23	3A	15
49	14	1D	75		3	CP	3B	20
51	14	12A	30		4	CP	3B	10
53	14	11A	25		5	CP	3B	<5
54	14	11A	20		11	CP	3A	50
2	15	2	30		21A	CP	3D	<5
3	15	2	5		21B	CP	3D	<5
3	15	2	5		21D	CP	3D	<5
4	15	2	5		10-900874 0/4	TROPHY	SKULL	<5
5	15	2	<5					
9A	15	1D	20					

APPENDIX B

DETAILS OF FLUORINE ANALYSIS

Sample ID	% Fluoride	Average % Fluoride	Standard Deviation	Coefficient of Variation
19C-1	0.730			
19C-1	0.797			
19C-1	0.828	0.785	0.050	6.4
24-6	0.557			
24-6	0.566			
24-6	0.569	0.564	0.006	1.1
18/19-11	0.460			
18/19-11	0.510			
18/19-11	0.487	0.486	0.025	5.2
21D-CP	0.870			
21D-CP	0.864			
21D-CP	0.850	0.861	0.010	1.2
21B-CP	0.774			
21B-CP	0.733			
21B-CP	0.696	0.735	0.039	5.3
25-14	0.949			
25-14	0.960			
25-14	0.940	0.950	0.010	1.1
27-14	1.060			
27-14	1.065			
27-14	1.101	1.076	0.023	2.1
30-1	0.336			
30-1	0.416			
30-1	0.288	0.347	0.065	18.6
11-8	1.036			
11-8	1.049			
11-8	1.020	1.035	0.014	1.4
44-8	0.584			

44-8	0.557			
44-8	0.560	0.567	0.015	2.6
19-13	0.962			
19-13	0.917			
19-13	0.966	0.949	0.027	2.9
19A-1	0.266			
19A-1	0.278			
19A-1	0.221	0.255	0.030	11.8
21-1	0.375			
21-1	0.387			
21-1	0.381	0.381	0.006	1.5
9A-15	0.410			
9A-15	0.378			
9A-15	0.353	0.380	0.029	7.5
1-11	0.482			
1-11	0.514			
1-11	0.505	0.501	0.017	3.3
31-12	0.740			
31-12	0.726			
31-12	0.832	0.766	0.058	7.5
17-6	0.225			
17-6	0.194			
17-6	0.176	0.198	0.025	12.7
5-6	0.385			
5-6	0.371			
5-6	0.293	0.350	0.050	14.2
30-1	0.337			
30-1	0.276			
30-1	0.325	0.313	0.033	10.4

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