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OSTEOLOGY OF THE CROW CREEK MASSACRE

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

P. Willey

June 1982

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DEDICATION

This work is dedicated to the wanagi
of the Crow Creek villagers.
I hope there are no hard feelings.

ACKNOWLEDGMENTS

The data presented in this dissertation is the product of the discovery, excavation, processing, and data collection and analysis of nearly 500 human skeletons. A project of this magnitude requires the assistance, cooperation, kindness, and interest of many people. The Crow Creek project included many such people at every stage of the operation.

The Crow Creek massacre project was directed by Larry Zimmerman. Tom Emerson was in-charge of the field work with Roberta Neirison, Audhild Schanche, and Ned Hanenberger doing much of the day-to-day supervising. The supervisors and the excavators endured the heat and dust of August and the penetrating cold of December as well as the omnipotent wind. Excavators were Dayton Bard, Pat Big Eagle, Audrey Blackbull, Ann Borel, Dorsey Deloria, Sid Eare, Barb Lass, Jim Sartain, LeRoy "Bear" Thompson, Richard Whitten, Roger Williams, and Tom Wolf. Field work would have been impossible without the cooperation of the Crow Creek Sioux Tribal Council, the Crow Creek Sioux, the National Historic Landmark Board, Robert Alex, and Steve Ruple.

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ABSTRACT

About 1325 AD in south-central South Dakota nearly 500 American Indians were massacred at the Crow Creek Site. They were mutilated, exposed above ground, then buried in the fortification ditch which surrounded the Crow Creek Village. Their remains were discovered, excavated, and cleaned in 1978 and were available for study the first 5 months of 1979. The general purposes of the Crow Creek osteological study were to describe the remains as fully as time permitted and compare these results with those of other samples. This dissertation presents information concerning the Crow Creek bone elements, paleo-demography, cranial affiliations, mutilations, and stature. It emphasizes the unique features of the sample and compares the Crow Creek sample with other skeletal samples from the Plains.

The major findings can be summarized as follows: At least 486 Arikara were buried, that number probably constituting roughly 60 percent of the village inhabitants. Many of the smaller, more distal and more cancellous bone elements are under-represented, and many bones show indications of chewing, snapping, and splintering. There are some indications that some of the elements were preferentially placed in the ditch though these indications are slight. There are fewer young adult females and old adult males present in the sample than expected. A number of explanations for their absence are possible, but the raiders taking captives seems a most likely explanation for the missing young women. There are many mutilations on the bones. Scalping,

skull fractures, evulsions, and decapitations are common. Cranial measurements indicate the Crow Creek sample were Arikara Indians and otherwise most similar to the Pawnee and St. Helena samples. There appear to be no morphologically alien skulls in the sample and no kin-affiliated burial placement of the skulls. The Crow Creek sample was shorter than subsequent Arikara samples, but only the females were significantly shorter. Their stature may indicate dietary insufficiencies and illnesses, but additional testing of this hypothesis is necessary.

PREFACE

The Crow Creek Site is a large, well-preserved, prehistoric Amerindian village in central South Dakota. It is on the registry of National Historic Landmarks. In May 1978 during the annual meeting of the South Dakota Archaeological Society, the site was toured. One of the tour group members went to inspect the outer fortification ditch and the erosion at each end. At the northwest end of the outer ditch, where a large erosional gully had formed, he discovered human bones eroding from the bottom of the ditch about 8 feet below ground surface. The bones exposed indicated that several skeletons might be present. Steps were taken to recover the bones by a University of South Dakota crew working in the area using funding from the Omaha District of the Corps of Engineers. John B. Gregg and Willey were asked to provide osteological advice for the project. Permission was sought and granted by the Crow Creek Sioux Reservation Tribal Council, the Corps of Engineers, and the National Historic Landmark supervisors to excavate and analyze the remains.

While permission was being sought and paperwork processed, the bones at the end of the ditch were looted by a vandal using a mattock or crowbar. A hole, measuring 4.5 feet high, 6 feet wide, and 3 feet deep, was cut into the bank. Nearly 50 individuals were contained in this small volume of earth, and more bones were observed continuing into the back of the hole. The looted material was collected in July, washed, and a preliminary analysis (Willey 1978) made.

Plans were made to conduct a full-scale excavation which began in August and continued into early December when weather made further digging impractical. Though more bones remained in the ditch when excavation ceased, it is believed, based on the slope of the bones, that more than 95 percent of the human material has been excavated (Emerson 1979).

Laboratory processing and preparation of the bones began at the University of South Dakota during the Fall. Skeletal analysis got off to a sputtering start in November and continued at an increasing rate from January until the end of May 1979, when the bones were returned to the Crow Creek Sioux for reburial.

Reburial of the bones occurred August 10, 1981. The bones were placed in six asphalt-coated concrete crypts, and Christian and traditional ceremonies were performed. The bones were buried near the south end of the Crow Creek Village site in an old, filled excavation pit.

Because of the short period the bones were available for study, the work conducted amounted to salvage osteology. The osteological analysis was divided initially between Gregg and Willey: namely, Gregg studying the antemortem paleopathology and Willey the rest. The approach Willey took first was to gather data comparable to that which had been gathered previously from other skeletal material from the same region. Of first priority were cranial measurements and non-metric observations, postcranial measurements, and age and sex assessments. In addition to analyses already precedented in the region, two other approaches were emphasized. An inventory of bone

elements present was performed to determine the number of individuals present and the frequency of the various elements. Also a concerted effort was made to identify paramortem trauma which might indicate cause of death or mutilation. Once these data were collected and other potentially fruitful analyses identified, additional, lower priority analyses were conducted. For the most part, these other studies occurred after Willey returned from South Dakota to Tennessee and were directed and executed by Mark Swegle. There are additional, on-going studies, including an analysis of transverse lines by Steve A. Symes and trace element analysis by M. Pamela Bumsted, not to mention the continuing study of paleopathology by Gregg.

The present study is limited to the data considered to be first priority. The title, "Osteology of the Crow Creek Massacre," then, may be somewhat misleading because it does not include all the areas considered important for a thorough understanding of the Crow Creek massacre. However, it is believed that this work will form a base for other investigations.

Parts of this dissertation have appeared earlier in other places and other forms. Most of Chapter 5, "Crow Creek Cranial Affinities," and parts of Chapter 3, "Count and Context of the Bone Elements," Chapter 4, "Crow Creek Paleodemography," and Chapter 6, "Crow Creek Mutilations," were published in The Crow Creek Site (39BF11) Massacre: A Preliminary Report (Zimmerman et al. 1981). The basis for Chapter 7, "Crow Creek Stature," was presented as "Changing Stature among the Arikara," a paper given on November 6, 1980 at the 38th

Annual Plains Conference, Iowa City, Iowa. All of these chapters have undergone considerable modifications from their original forms.

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CHAPTER 1

INTRODUCTION

In 1978 nearly 500 Indian skeletons were found in the Crow Creek Site fortification ditch in central South Dakota. Remains of men, women, children, and infants were recovered, all indications suggesting they were the fourteenth century inhabitants of the Crow Creek Village. There is conclusive evidence that the people were killed and mutilated, their bodies exposed above ground and chewed by carnivores before being buried in a mass grave (Zimmerman et al. 1981).

The massacre victims from the Crow Creek Site have important implications for skeletal analyses on the Plains and elsewhere. The Crow Creek skeletons are also very important for reconstructing lifeways during the Initial Coalescent period. There are some relatively unique features about the Crow Creek sample and a number of ways in which the Crow Creek material will contribute to our understanding of the past. The unique aspects of the material are the size, period, location, and nature of the sample.

The Crow Creek massacre is the earliest large skeletal sample from the Middle Missouri region. The massacre dates approximately 1325 AD, preceding the other large skeletal samples from the region by about 300 years. It is the only large Initial Coalescent skeletal sample. The Initial Coalescent is the earliest phase in the Middle Missouri region identified on cultural and osteological grounds as leading to the

historic Arikara tribe. The Crow Creek skeletons are, then, important in understanding the origins of the Arikara.

Crow Creek is also the southern-most large skeletal sample in the Middle Missouri region. The closest large sample is from the Sully Site located about 100 miles up-river.

Most importantly, the Crow Creek skeletons are the remains of the largest archaeologically recovered massacre in North America, if not all the Americas. As such, it is valuable for indicating the magnitude of aboriginal warfare and presenting a large sample of victims from which types and frequencies of trauma can be observed.

From a population perspective, the remains are nearly unique among skeletal samples because all of the Crow Creek individuals were members of the same group, and all were alive at one point in time. Most other skeletal samples come from cemeteries and almost always include several, archaeologically inseparable generations. Although several generations are probably present in the Crow Creek sample, unlike cemetery samples, they are separable by age at death. In short, the Crow Creek sample is a deme: a skeletal "population" frozen in time.

This analysis takes these unique features of the Crow Creek sample into consideration, emphasizing some of the major contributions the material has to make in the areas of element taphonomy, paleo-demography, mutilations, craniometric distance, and stature. Each area is considered in a separate chapter in a traditional structure; each chapter has an introduction, methods employed, results found,

and pertinent discussion. All chapters are descriptive, and most are comparative as well. The final chapter summarizes the information gleaned in the chronological order it occurred. But before proceeding to the chapters dealing with the osteological data, it is necessary to review information on the archaeological site, context, and history of the bones.

CHAPTER 2

THE CROW CREEK SITE AND EXCAVATIONS

The Crow Creek Site (39BF11) is a National Historic Landmark located in Buffalo County, central South Dakota, 11 miles north of Chamberlain. It is on the east bank of the Missouri River, immediately north of the mouth of Crow Creek, both of which are impounded by Ft. Randall Dam and are part of Lake Francis Case Reservoir. The site was partially excavated in the 1950's and reported by Kivett and Jensen (1976). The background information concerning the site and excavations comes mostly from these authors, supplemented by Zimmerman et al. (1981).

The site is large, covering approximately 18 acres and rests on prominent terraces (Fig. 1). The west boundary of the site is the steepest edge of the terrace which drops nearly vertically to the former Missouri River flood plain, now the lake, about 80 feet below the terrace surface. The southeast boundary is a less spectacular, but steep, bluff which drops to the old Crow Creek flood plain. The third and final boundary is formed by a well-marked, sinuous, 1250 foot-long fortification ditch. The site is in an excellent defensive position.

There are two components at the Crow Creek site. The earlier component is from the Initial Middle Missouri variant of the Middle Missouri tradition and dates 1100 to 1150 AD. The later component, the one of interest here, is from the Initial Coalescent variant of

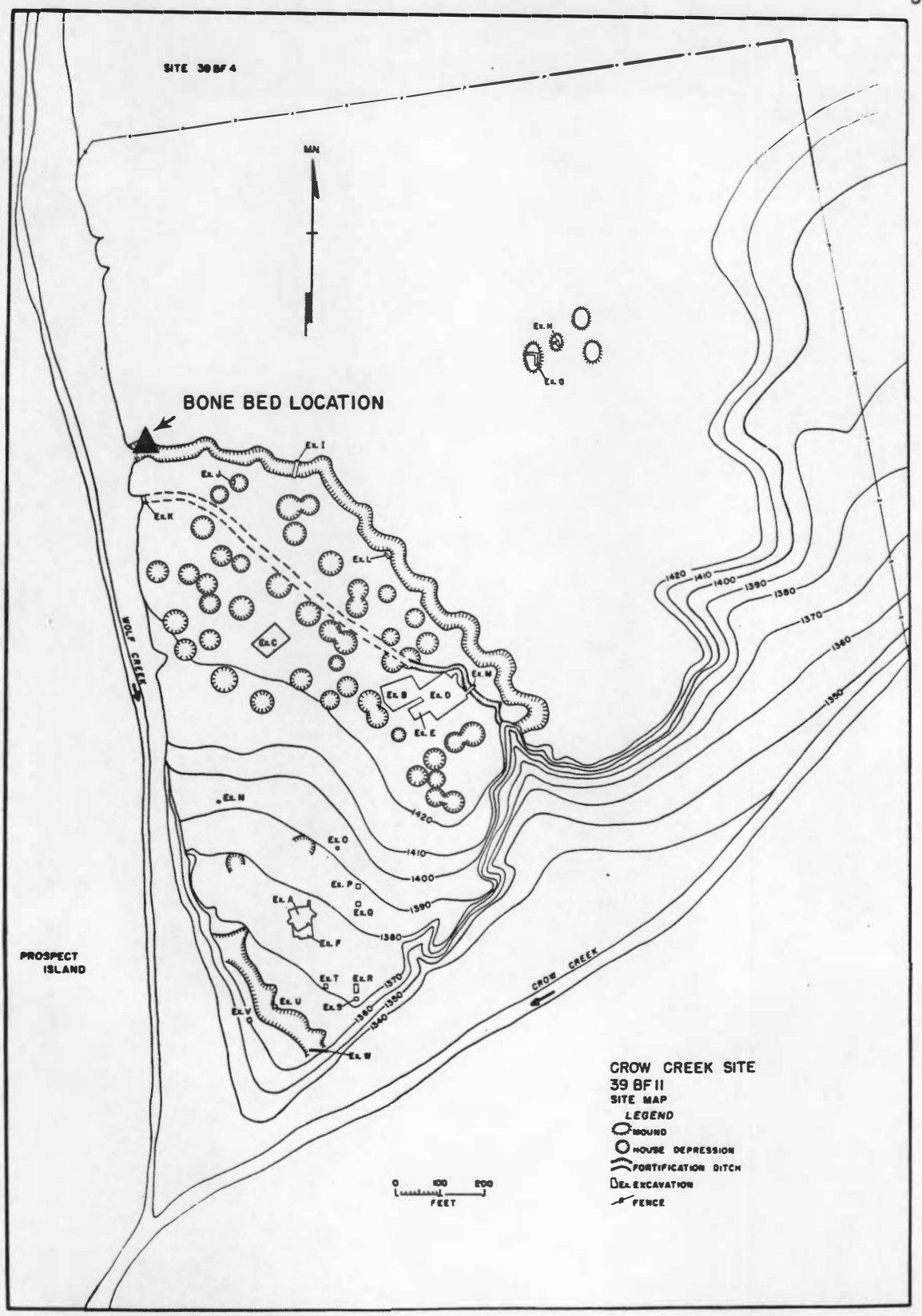


Figure 1. Map of the Crow Creek Site from Kivett and Jensen (1976:2, Fig. 1). Triangle indicates location of the bone bed.

the Coalescent tradition. Based on radiocarbon dates, this component appears to date sometime between 1325 and 1450 AD, probably closer to the earlier date.

The remains of the Initial Coalescent component are impressive. There are at least 50 lodge depressions on the terrace. Two Initial Coalescent fortification ditches surround the village on its most vulnerable side, the more prominent ditch marking the northeast and north village boundary.

The more prominent, outer ditch stretches from the Crow Creek edge of the terrace to the Missouri River side. It is 1250 feet long with 10 bristling bastions. As indicated by the single excavated cross-section, the ditch measured 6 feet deep, more than 4 feet wide, and 12 feet wide at the top. No postholes indicating the presence of a stockade were found in a 10 by 5 foot test trench excavated on the inside of one bastion. Today the ditch is marked by a 2 or 3 foot depression and the greener, higher vegetation which grows there. It was at the extreme northwest end of this ditch where the massacre victims were discovered.

The less prominent inner ditch is visible only near the southeast corner of the village. It apparently had bastions, like the outer ditch. In contrast to the outer ditch, the inner had much cultural debris plus a human mandible and cranium. These were found in the single, small excavation cross-sectioning the ditch. The inner ditch, also in contrast to the outer, has postholes, indicating an associated stockade. Six of the excavated postholes contained human

skull fragments. Like the outer, the inner ditch apparently dates to the Initial Coalescent occupation.

Some archaeologists have interpreted these facts as suggesting that the inner ditch was earlier. As the village expanded beyond the inner ditch, it was used as a refuse dump. With increasing hostilities, fortification was again needed and so the impressive outer ditch was built to include the lodges outside the inner ditch. The skull fragments found in some of the postholes from the stockade of the inner ditch support the idea that the outer ditch had just been dug and that a stockade was being constructed with the posts from the inner ditch, leaving these postholes still open when the massacre happened. Evidence for this hypothesis also comes from the lack of postholes adjacent to at least part of the outer ditch and the relative lack of cultural debris in the outer ditch. In brief, the Crow Creek villagers may have been caught with their stockade down.

Formal archaeological excavations began at Crow Creek in 1954 and continued in 1955 under the direction of Marvin F. Kivett, now museum director of the Nebraska State Historical Society. Results of the excavations and analyses have been reported by Kivett and Jensen (1976). Their excavations exposed more than six structures and sectioned all of the ditches. More than 20 years after the excavations and two years after their report was published, attention was again focused on the site when human bones were discovered eroding from the outer fortification ditch. The principal logistic steps taken have been outlined in the Preface above, but additional information concerning the excavation is needed.

Excavation of the bone bed, which is more fully described by Zimmerman et al. (1981), began with cleaning the end of the fortification ditch for inspection and superimposing a horizontal grid system over the ditch. The horizontal grid was divided into 1 meter squares, numbered in an east-west orientation and lettered north-south. Material collected was identified to the quarter of a meter square, for instance, the Northeast Quarter of Square 8B. In all, 18 meter squares or parts of meter squares (6 meters east-west, 3 meters north-south) were excavated.

Stratigraphically there were two bone beds in the deposit. Bed A was the higher and thinner of the two. Immediately above parts of Bed B was a clay and silt stratum which must have been deposited by humans because clay does not occur naturally on the terrace. The top of Bed B, the lower and much larger of the bone beds, was 1 to 2 feet below Bed A. Bed B was cone-shaped with the apex of the cone against the north wall of the fortification ditch. At the apex the bed was 4.5 feet thick. All of Bed A and the surface of Bed B were photographed and mapped. Articulated bones were given numbers and collected as a unit. In addition to the wealth of human bones, a few cultural and other specimens were found.

Although most of the cultural specimens from the ditch are not diagnostic, those which are (some ceramics, lithics, and a bone point) indicate all materials are from the Initial Coalescent component. There were no diagnostic Middle Missouri artifacts present.

In addition to the cultural materials in the ditch, there were some animal bones (dog?, bison, deer, and smaller mammals) and seeds

of wild plants plus corn and sunflower. The over-whelming volume of material from the ditch was and the focus of this study is the human skeletal material.

Because the Crow Creek Village is so large and exceptionally well preserved and because of the attention recently focused on the site during excavation of the massacre victims, the site is being considered for National Monument status. A preliminary study has been conducted and further feasibility studies are continuing.

CHAPTER 3

COUNT AND CONTEXT OF THE BONE ELEMENTS

The huge bone pile at Crow Creek (Fig. 2) and the shelved bone-filled boxes at the University of South Dakota were alternately an osteologist's dream and nightmare. Any systematic study of the bones had to begin with an element inventory. Once the bone count was complete, more specialized studies could begin. Likewise it is appropriate to begin the osteological part of this report with information concerning and derived from the element count.

There are essentially two general purposes of this chapter. The first deals with the element counts and the second with the archaeological context of the elements. The purpose of the element count is to determine the number of people present as the first step in the demographic analysis, which is more fully presented in the following chapter. The element count is also necessary for determining the proportions of the different elements present. Element proportions differing from the expected ratios may indicate dismemberment by the raiders, consumption by scavengers or omission by the buriers.

The second general purpose of this chapter involves the archaeological context of the elements. Here, the location of the elements in the ditch and their articulation with one another are the matters of concern. The element location is analyzed based on vertical and horizontal placement. The vertical analysis is performed to see if there are differences between the superficial, overlying



Figure 2. Bone Bed B at Crow Creek. More of the bone deposit remains covered at the right margin of the photograph. View is toward the north.

Bed A and the major bone bed, Bed B. Differences between the two bone beds may indicate different origins or treatments. The horizontal analysis is done to see if the elements are randomly scattered through Bed B or if their position is non-random. Non-randomness may indicate special placement of certain elements or the tendency of some elements to roll down slope. The articulated elements are summarized to better understand the degree of decompcsition and dismemberment of the bodies.

A. Methods

Element Count

The bone elements were counted in two ways. First an inventory of each bag was made, listing the maximum number of elements present in each bag. Because parts of the same bone may have been in two or more bags, a summation of this inventory yields a maximum count. To achieve another view of the number of elements present, a minimum count was made of the long bones and the petrous portion of the temporal. Bones from the right and left sides were counted separately in the minimum count. The difference in sides is tested for statistical significance using a binomial Z-test. To use the statistic, it is assumed that the selection of bones for burial was independent of side differences, which they probably are not. Both the minimum and maximum counts were made by Mark Swegle.

Minimum counts were made of the humerus, radius, ulna, femur, tibia, fibula and the petrous portion of the temporal. For each element a single point on the bone was selected, and the count was made of these points. The points chosen for counting were selected

because they were easily identified, easily sided and well preserved. The observer believed that the points selected for counting were at least as well represented as any other points.

The following points were selected for the minimum count. The opening of the internal auditory meatus was used for the petrous portion of the temporal. The middle of the deltoid tuberosity of the humerus was counted. The base of the radial tuberosity of the radius and the base of the coronoid process of the ulna were counted. The base of the lesser trochanter of the femur was counted. The anterior crest at the level of the nutrient foramen of the tibia was selected, and the top of the triangular subcutaneous area near the distal end of the fibula was counted.

Age estimations were recorded for each element in the minimum and maximum counts. The age categories used were child (0-10 years), adolescent (11-17 years), adult (> 18 years), subadult (0-17 years), adult or adolescent (> 11 years), and adult or subadult (> 0 years). No sex determinations were made at this stage of the analysis. Only age estimations were possible due to the disarticulation of most of the skeletons and the often fragmentary condition of the bones. Largely because of these two problems, the last three age categories listed were necessary.

In addition to the minimum element count, a "maximum" number of elements can be estimated. This count was made by summing the inventories made for each bag. During the inventory, bones in each bag were assigned as belonging to different individuals based on repetitions of the same parts of the same elements and differences in

age and sex. In this way the minimum number of elements in each bag was determined. No attempt was made to reassemble elements in different bags so it is certain that this count in most cases is greater than an actual minimum count would have been. It is not, on the other hand, the maximum count because fragments in a bag which did not duplicate others and appeared to be the same sex and approximate age were considered to be from the same individual, though in some instances they probably represent more.

It is likely that the maximum counts of the large and fragile bones are higher than the actual minimum number present. Intuitively it seems likely that the innominates, sacra, vertebrae, scapulae, sterna and to an extent, the clavicles are over-represented by this "maximum" count. It is not possible to determine how excessive the count is.

On the other hand, there are some maximum element counts which are probably fairly accurate. These counts are those of the small and durable bones: the carpals, metacarpals, phalanges, patellae, coccyges, tarsals and metatarsals. At least there should be little fragmentation of these elements.

With these limitations in mind, the maximum count remains the only means of inspecting the relative presence and absence of all the elements. An examination of which elements are more frequently missing will aid the understanding of what happened during the raid and between the time of the raid and the time of the victims' burial.

Archaeological Context

The archaeological context of the bones is analyzed in three ways. The first analysis considers the vertical or stratigraphic distribution of the elements. The second analysis examines the horizontal distribution of the elements. And the third analysis considers the articulations of bones.

The stratigraphic analysis divides the maximum element count into those from Bed A and those from Bed B. All elements having an expected frequency of five or more were used in X^2 analyses. Because there are so few subadult bones from Bed A, no statistical comparison was made by age for the two beds.

To examine the horizontal distribution of both the minimum and maximum element counts, canonical correlations were executed on both counts. Both canonical correlations employ the percentage of each element from each grid square as the basic data. Percentages were calculated by summing all elements (maximum count) or by summing all of the seven elements of the minimum count from all squares and dividing the square sum of each element by the total count. Because the maximum count includes so many element groups, a principal component analysis is performed on the percentages to reduce the number of variables. Principal component scores for each square are calculated using the percentage of each element by square, their unrotated matrix, and those components with an eigenvalue of 1.0 or greater. The principal component scores for each square are used in subsequent statistical manipulations of the maximum element count data. The canonical correlation of the minimum count uses the raw

percentages of the elements by square. Then, using either the raw percentages or the principal component scores and the squares' north-south and east-west axes as location variables, canonical correlations are calculated. All squares are included in the analyses except the material from the looter's hole, which lacks comparability with the rest of the grid system. Both the principal component (FACTOR) and canonical correlation (CANCORR) routines are performed using SAS (SAS Institute 1979).

The third analysis concerns the articulated units found in the field. An articulated unit consists of two or more bones juxtaposed in the same position they take in the complete living body. Most of the more than 700 articulated units were identified and numbered in the field. Although some articulated units were not assigned numbers in the field, they were separated in the field and their apparent association noted in the laboratory. These laboratory-noted articulated units are included in this analysis.

Because an articulated unit could consist of two bones or more than 50 bones, the units were classified into elementary articular groups for analytical purposes. An elementary articular group is an articulation between two bones or two groups of bones. For instance, a head consists of two elements--a skull and mandible. A single articulation might, though, consist of several elementary articular units; for example, a skull, mandible and first two cervical vertebrae. This articulated unit is classified as the following elementary articular groups: head (skull-mandible), skull-neck (skull and C-1) and neck (cervical vertebrae). With the exceptions of the

skull and C-1, and the C-7 and T-1 elementary articular groups, the association of two or more cervicals is noted as just one elementary articular group. For instance, an articulation containing C-1 through C-7 is considered a single elementary articular unit (the neck). The same approach is used with the thoracic and lumbar vertebrae; only when the first or the last vertebra is associated with an adjacent vertebral unit is a separate elementary articular group recorded. Thus, neck-midback (C-7 and T-1), midback-lower back (T-12 and L-1) and lower back-sacrum (L-5 and sacrum) are included as elementary articular groups. Likewise, no attempt is made to count each wrist, wrist-hand, hand, ankle, ankle-foot or foot articulation as an elementary articular group. For a complete list of the elementary articular groups used, see Table 1.

B. Results and Discussion

Element Count

The greatest minimum count, 486, from the right temporal (Table 2) indicates that at least 486 individuals and probably more are represented in the sample taken from the ditch.

At the other extreme, the least minimum count are the 115 right radii (91 left). The differences between the counts of the various elements appears to be a function of size, density and proximity to the torso. In general the larger, denser bones closest to the torso are more frequently present than the smaller, lighter, more distal ones. The proximal limb elements are more fully represented than their distal counterparts. The humerus is more common ($n \geq 213$) than the ulna

Table 1. Elementary articular groups from Bed B by age.[a]

Elements	Adult	Adolescent	Infant or Child	Subadult	Total
Head (Skull-mandible)	128 (128)	15 (15)	24 (24)	0	167 (167)
Skull-neck (Skull-C-1)	126 (126)	13 (13)	24 (24)	3 (3)	166 (166)
Neck (Cervical vertebrae)	118	6	16	2	142
Neck-midback (C-7 and T-1)	56 (56)	0	3 (3)	1 (1)	60 (60)
Midback (Thoracic vertebrae)	204	2	5	4	215
Midback-lower back (T-12 and L-1)	138 (138)	1 (1)	0	3 (3)	142 (142)
Lower back (Lumbar vertebrae)	196	2	1	2	201
Lower back-sacrum (L-5-sacrum)	135 (135)	1 (1)	1 (1)	0	137 (137)
Shoulder (Scapula-humerus)	8 (4)	1 (1)	0	0	9 (5)
Arm (Humerus-ulna or radius)	30 (15)	1 (1)	0	0	31 (16)
Lower arm (Ulna-radius)	52 (26)	1 (1)	0	0	53 (27)
Lower arm-wrist (Ulna or radius-carpal)	2	0	0	0	2
Wrist (Carpals)	4	0	0	0	4
Wrist-hand (Carpal-metacarpal)	3	0	0	0	3
Hand (Metacarpals and/or phalanges)	3	0	0	0	3
Pelvis (Sacrum-innominate)	55	0	1	0	56
Hip (Innominate-femur)	94 (47)	4 (2)	3 (2)	0	101 (51)
Knee (Femur-patella)	7 (4)	0	0	0	7 (4)
Leg (Femur-tibia)	56 (28)	3 (2)	0	0	59 (30)
Lower leg (Tibia-fibula)	122 (62)	5 (3)	1 (1)	0	128 (66)
Lower leg-ankle (Tibia-tarsal)	25 (13)	1 (1)	0	0	26 (14)
Ankle (Tarsals)	29	1	0	0	30
Ankle-foot (Tarsal-metatarsal)	22	0	0	0	22
Foot (Metatarsals and/or phalanges)	20	0	0	0	20
Total	1633	57	79	15	1784
Combination of 2 or more elementary groups	372	15	19	4	410

[a]Minimum number of individuals are in parentheses.

Table 2. Minimum element counts of major bones from Crow Creek.

Bone	Left	Right	Right Minus Left
Temporals	477	486	9
Humeri	200	213	13
Ulnae	113	131	18
Radii	91	115	24
Femora	367	367	0
Tibiae	262	269	7
Fibulae	156	143	13

($n \geq 131$) or the radius ($n \geq 115$), and the femur ($n \geq 367$) is more common than the tibia ($n \geq 269$) or the fibula ($n \geq 156$).

It is also noteworthy that the minimum count for all elements except the fibula is at least as great for the right side as that for the left. Because seven bones were counted and the likelihood of one side equalling or outnumbering the other side is 0.5, the probability of this distribution happening by chance alone is $(0.5)^6$ or 0.0156. Because the larger, denser bones are more numerous, we might expect their differences between the side counts to be greater than those of the smaller, lighter bones. But this expected difference is just the opposite of the actual side count (Table 2). The side difference is greater in the lighter bones (radius side difference 24) than in the larger, denser bones (femur difference 0). An alternate explanation is that as the greater numbers of the larger, denser elements indicate, they were more likely to be recovered than the smaller, lighter elements. And the larger, denser bones being more likely to be recovered, the frequency of each side is more similar than the frequency of the sides for the smaller bones. But the explanation in terms of taphonomy is unknown.

Now turning to the minimum element count grouped by age, the major discrepancy between the counts of the temporals and the long bones is in the number and proportion of adults represented (Table 3). Several causes may account for these differences. The higher proportion of adult long bones might have been caused by more destruction and scattering of the younger, smaller bodies by scavengers or by differential selection of larger bodies and body parts for burial.

Table 3. Crow Creek minimum element counts by age group.[a]

Elements	Children 0-10	Adolescents 11-17	Subadults 0-17	Adults or Adolescents > 11	Adults > 18	Adults or Subadults	Total
Right temporal	128 (26.3)	40 (8.2)	29 (6.0)	50 (10.3)	237 (48.8)	2 (0.4)	486
Left temporal	132 (27.7)	36 (7.5)	19 (4.0)	10 (2.1)	277 (58.1)	3 (0.6)	477
Left femur	35 (9.5)	41 (11.2)	7 (1.9)	2 (0.5)	282 (76.8)	0	367
Right femur	30 (8.2)	37 (10.1)	7 (1.9)	0	293 (79.8)	0	367
Right tibia	11 (4.1)	27 (10.0)	4 (1.5)	3 (1.1)	224 (83.3)	0	269
Right humerus	11 (5.2)	20 (9.4)	1 (0.5)	9 (4.2)	172 (80.8)	0	213
Left fibula	1 (0.6)	4 (2.6)	3 (1.9)	1 (0.6)	147 (94.2)	0	156
Right ulna	1 (0.8)	4 (3.1)	1 (0.8)	2 (1.5)	123 (93.9)	0	131
Right radius	1 (0.9)	5 (4.3)	0	4 (3.5)	105 (91.3)	0	115

[a]Numbers in parentheses are percentages.

After burial, greater fragmentation of the younger and smaller long bones may have also occurred. The greater number of adult femora compared to adult temporals could be largely explained by the large number of temporals included in the adult-or-adolescent category. Isolated temporals often had to be placed in this category, especially when associated jaws were absent. Few femora, though, were placed in this category; if all observable epiphyses were fused, the bone was considered adult. This may have resulted in some adolescent femora being identified as adult femora. Additional factors that might have had some effect on the discrepancies are the looter's activities and the presence of some unexcavated bones that still remain in the fortification ditch. An increase in the minimum count based on comparisons of the age groupings appears to be unjustified, primarily because of unavoidable imprecision in the age estimations.

It would have been worthwhile to do a minimum count of all elements in addition to the seven which were actually counted. Unfortunately, time and available resources made this approach unfeasible. As a consequence, the maximum element inventory count has to be used for other analyses. The analyses performed with the maximum count are the elements present, differences in the two beds, and differences in the horizontal element distribution through Bed B. We begin with the elements represented in the maximum count, the other two follow in the Archaeological Context section.

Inspecting Table 4, the impression is that generally the torso (vertebral column and hips) is better represented than most of the other parts. The elements seem to become less and less frequent the

Table 4. Crow Creek maximum element counts for adults and subadults.[a]

Elements	Number of Elements			Number/ Individual	Minimum No. of Individuals			Percentage of Expected[b]		
	Adult	Subadult	Total		Adult	Subadult	Total	Adult	Subadult	Total
Innominate	952	203	1155	2	476	102	578	100.0	70.8	100.0
Mandible	309	144	453	1	309	144	453	64.9	100.0	78.4
Femur	706	200	906	2	353	100	453	74.2	69.4	78.4
Sacrum	347	58	405	1	347	58	405	72.9	40.3	70.1
Lumbar vertebrae	1498	173	1671	5	300	35	335	63.0	24.3	58.0
Tibia	505	90	595	2	253	45	298	53.2	31.3	51.6
Thoracic vertebrae	3132	304	3436	12	261	26	287	54.8	18.1	49.7
Scapula	453	56	509	2	227	28	255	47.7	19.4	44.1
Fibula	426	51	477	2	213	26	239	44.7	18.1	41.3
Cervical vertebrae	1318	290	1608	7	189	42	231	39.7	29.2	40.0
Humerus	393	82	475	2	197	41	224	41.4	28.5	38.8
Ulna	251	17	268	2	126	9	135	26.5	6.3	23.8
Radius	234	21	255	2	117	11	128	24.6	7.6	22.1
Ribs	2505	260	2765	24	105	11	116	22.1	7.6	20.1
Clavicle	197	31	228	2	99	16	115	20.8	11.1	19.9
Tarsals	548	10	558	7	79	2	81	16.6	1.4	14.0
Metatarsals	294	3	297	5	59	1	60	12.4	0.7	10.4
Sternum	44	10	54	1	44	10	54	9.2	6.9	9.3
Patella	38	2	40	2	19	1	20	4.0	0.7	3.5
Carpals	93	1	94	8	12	1	13	2.5	0.7	2.2
Coccygeal vertebrae	46	0	46	4	12	0	12	2.5	0	2.1
Metacarpals	51	1	52	5	11	1	12	2.3	0.7	2.1
Hand phalanges	44	0	44	14	4	0	4	0.8	0	0.7
Foot phalanges	11	1	12	14	1	1	2	0.2	0.7	0.3

[a]Elements from Beds A and B are combined.

[b]Percentage of expected individuals based on 476 adults, 144 subadults, 578 total.

more distally they occur, but element size and density are also factors which complicate this generalization. The smaller, less dense bones were less frequently found than the larger, more dense ones. The same generalizations concerning size, density and proximity to the torso can also be made for the hands (Table 5) and the feet (Table 6) when these are considered separately. These results are similar to those found in the minimum count.

There are five factors which may have influenced the elements frequencies observed. Element groups may have been 1) lost due to mutilation and dismemberment by the raiding group, 2) destroyed by scavengers, 3) overlooked when the body parts were picked up for burial, 4) differentially preserved, or 5) lost during excavation, processing or inspection procedures. Differential preservation is probably not an important consideration because all the bones present were well preserved. The large under-representation on the bones of the hands and feet cannot be due solely to loss during excavation, processing and inspection. The events of the raid and between the raid and the burial of the victims probably played the largest role in determining the frequencies observed. These include loss of bones caused by mutilation and dismemberment, loss caused by scavenging, and the omission of some of the body parts while being gathered for burial in the fortification ditch.

Archaeological Context

There are statistically significant differences between the maximum element count in Beds A and B. The maximum element counts by

Table 5. Maximum counts of Crow Creek wrist and hand elements[a] compared with expected numbers.[b]

Bone	Number Observed	Number Expected	% of Expected Observed
Naviculars	20	972	2.1
Capitates	16	972	1.6
Lunates	14	972	1.4
Triquetral	13	972	1.3
Hamate	11	972	1.1
Metacarpals	47	4860	1.0
Greater multangular	9	972	0.9
Lesser multangular	9	972	0.9
Phalanges-proximal row	28	4860	0.6
Pisiforms	5	972	0.5
Phalanges-middle row	10	3888	0.3
Phalanges-distal row	0	4860	0

[a]This count excludes 2 carpals which were not more specifically identified.

[b]Expected number of individuals based on right petrous portion of temporal.

Table 6. Maximum counts of Crow Creek ankle and foot elements[a] compared with expected numbers.[b]

Bone	Observed	Expected	% of Expected Observed
Tali	146	972	15.0
Calcanea	108	972	11.1
Naviculars	71	972	7.3
Third cuneiforms	70	972	7.2
Cuboids	69	972	7.1
First cuneiforms	58	972	6.0
Second cuneiforms	53	972	5.5
Metatarsals	264	4860	5.4
Proximal row phalanges	9	4860	0.2
Distal row phalanges	2	4860	0.0
Middle row phalanges	0	3888	0

[a]This count excludes 2 tarsals which were not more specifically identified.

[b]Expected number of individuals based on right petrous portion of temporal.

bed are presented in Table 7. All elements whose expected frequency was five or greater were included in the X^2 test. The distribution is significant ($X^2 = 73.5$, DF = 9, $P < 0.001$). The over-representation of skull parts and under-representation of cervical and thoracic vertebrae in Bed A and the reverse representations in Bed B appear to contribute most to the difference.

More skull fragments than any other parts are included in Bed A. Assuming that Bed A represents a second, subsequent pick-up of bones and a second burial, the relative frequency of skull fragments might be understandable because skull parts were infrequently chewed and are fairly easily identified. The relative absence of mandibles, femora and some other large, durable bones is more difficult to understand. Some of the meatier bones, such as femora, may have been chewed and splintered by the scavengers and less frequently recovered for burial. But the absence of other elements, especially the mandibles, are difficult to explain in this manner. If more bones were present in Bed A, a more definitive assessment of its origin could be made.

Having considered the vertical distribution of the elements, it is appropriate to examine the results of the horizontal analysis for Bed B. The horizontal distribution of elements is examined using the percentages of the minimum and maximum element counts by grid squares.

Neither of the canonical correlations using the minimum element percentages by square grid is statistically significant at the 0.05 level, although the first one approaches significance. These results are presented below.

Table 7. Crow Creek maximum element count for Beds A and B.[a]

Elements	Bed A		Bed B	
	Number	Percent	Number	Percent
Skull	55	31.4	1097	6.3
Mandible	2	1.1	451	2.6
Cervical vertebrae	7	4.0	1601	9.2
Thoracic vertebrae	22	12.6	3414	19.6
Lumbar vertebrae	15	8.6	1656	9.5
Coccygeal vertebrae	0	0	46	0.3
Sacrum	2	1.1	403	2.3
Scapula	1	0.6	508	2.9
Clavicle	0	0	228	1.3
Sternum	0	0	54	0.3
Ribs	25	14.3	2740	15.8
Humerus	4	2.3	471	2.7
Radius	1	0.6	254	1.5
Ulna	0	0	268	1.5
Carpals	1	0.6	93	0.5
Metacarpals	1	0.6	51	0.3
Hand phalanges	0	0	44	0.3
Innominate	12	6.9	1143	6.6
Femur	0	0	906	5.2
Patella	0	0	40	0.2
Tibia	8	4.6	587	3.4
Fibula	8	4.6	469	2.7
Tarsals	6	3.4	552	3.2
Metatarsals	5	2.9	292	1.7
Foot phalanges	0	0	12	0.1
Total	175	100.2	17380	100.0

[a]Adults and subadults are combined, although categories consisting of both adults and subadults are omitted.

	Canonical Correlation	R-Squared	F-Value	DF	Probability
1	0.80268	0.64430	2.0356	14	0.0784
2	0.76072	0.57870	2.2893	6	0.1184

Wilks' Lambda Value = 0.14986, F = 2.03556, DF = 14, P = 0.07843.

Because the relationship approaches significance and because there are similarities and differences between these results and those of the maximum count, results of both minimum count correlations are presented (Table 8) and the first canonical correlation considered. According to the canonical correlation results, the largest positive coefficients are the humerus and the ulna. These elements tend to be more frequent in the southwest squares and less frequent in the northeast squares. These elements are contrasted with the temporal and radius which have large negative loadings. The temporal and radius are more frequent in the northeast squares, less frequent in the southwest squares.

The other horizontal analysis uses the maximum element count converted to percentages. It will also be recalled that these percentages in turn were used in a principal component (PC) analysis to collapse the element information into orthogonal vectors; then a canonical correlation was executed using the principal component scores for each square and the grid system. In the paragraphs which follow, the principal components are described, then the canonical correlation results are presented.

Three principal components are extracted from the frequencies of the maximum element counts by square (Table 9). These three PC's explain 91.9 percent of the variation.

Table 8. Canonical correlation coefficients of percentages of the Crow Creek Bed B minimum element counts by excavation square.

Variables	V1	V2
Standardized Canonical Coefficients for the Elements		
Temporal	-1.49591	-0.53527
Humerus	0.55710	1.00451
Ulna	0.85831	0.95073
Radius	-0.90157	-0.49749
Femur	0.23486	-0.92322
Tibia	-0.25523	0.05311
Fibula	0.12054	0.70507
Standardized Coefficients for the Spatial Variables		
East-west	0.70402	0.71018
North-south	0.71018	-0.70402

Table 9. Principal component loadings for percentages of Crow Creek Bed B maximum element counts by excavation square.

Elements	PC I	PC II	PC III
Skull	0.87826	-0.22065	0.36900
Mandible	0.85763	-0.19902	0.37445
Cervicals	0.93010	-0.20090	0.23985
Thoracics	0.97519	-0.11059	0.04803
Lumbars	0.98092	-0.14768	0.03869
Coccyx	0.65290	0.30351	0.18992
Sacrum	0.98369	-0.02530	0.04375
Scapula	0.95972	0.16646	0.08953
Clavicle	0.96582	-0.01034	0.01055
Sternum	0.83581	0.29090	0.19563
Ribs	0.97535	-0.09976	0.10297
Humerus	0.98457	-0.02215	-0.07891
Radius	0.92552	-0.20694	-0.14540
Ulna	0.93466	-0.20029	-0.14394
Carpals	0.88176	0.36866	-0.17877
Metacarpals	0.73300	0.59883	-0.07903
Hand Phalanges	0.48786	0.84096	0.05474
Innominate	0.96538	-0.01089	0.19599
Femur	0.97057	-0.08407	0.03199
Patella	0.88962	0.13862	0.05119
Tibia	0.96967	-0.11801	-0.13237
Fibula	0.95886	-0.12949	-0.17675
Tarsals	0.89874	-0.16337	-0.27065
Metatarsals	0.83478	-0.28116	-0.37504
Foot Phalanges	0.78579	0.19132	-0.45326

PC I has high positive loadings on virtually all elements and only four elements have loadings less than 0.8. The elements with low loadings are some of the least common bones. This PC appears to be reflecting the varying depths of the sloped bone deposit. Squares with a large number of one element tend to be the same square with large numbers of other elements. PC I has a variance of 20.08 or 80.3 percent of the total variance.

PC II has high positive loadings on the bones of the hand and wrist as well as the coccyx and low positive or low negative loadings on the others. PC II seems to emphasize many of the elements not emphasized by PC I. It has a variance of 1.86 or 7.4 percent of the total variance.

PC III has high positive loadings on the elements of the head and neck and high negative loadings on the ankle and foot elements. Like PC II, PC III emphasizes some of the elements (the ankle and foot) not emphasized by PC I, but unlike PC II, PC III contrasts these elements with others, in this case, the bones of the head and neck. PC III has a variance of 1.03 or 4.1 percent of the total variance.

Now turning to the canonical correlation of the principal component scores by excavation square, the first of the two roots extracted is statistically significant, but the second is not. These results are presented below.

	Canonical Correlation	R-Squared	F	DF	Probability
1	0.78779	0.62061	4.0273	6	0.0041
2	0.37993	0.14434	1.4339	2	0.2658

Wilks' Lambda Value = 0.32463, F = 4.02729, DF = 6, P = 0.00408.

The PC's contributing most to the significance (Table 10) in descending order of importance are PC II with a positive loading and PC I with a negative loading. PC III has a negative loading but contributes much less than PC II. The first canonical coefficient for PC I indicates there are more elements in the maximum count toward the northeast squares and fewer toward the southwest. The PC II coefficient indicates that there are more wrist, hand, and coccyx bones toward the southwest squares and fewer toward the northeast. Finally PC III, which contributes less to the relationship than the other PC's, has a coefficient indicating that ankle and foot elements are more frequent toward the southwest squares while head and neck elements are more frequent toward the northeast.

There are several similarities between the canonical correlation using the minimum and maximum element frequencies which should be mentioned. First in both analyses, there is only one axis which approaches or reaches significance at the 0.05 level. In both correlations that axis is in a northeast-southwest direction. In neither correlation does the other axis, the northwest-southeast axis, reach significance. In both correlations skulls are found more frequently toward the northeast squares. Besides the similarities between the two correlations, there are differences, but because the two data sets lack comparability, little conclusive can be established.

The last part of this section deals with the articulated units. When the number of articulations from the two bone beds are compared, Bed B has proportionately more articulations than Bed A. Among the 17,380 bones and bone fragments, there were 1784 articulation numbers

Table 10. Canonical correlation coefficients of principal component scores for percent of the Crow Creek Bed B maximum element count by excavation square.

Variables	V1	V2
Standardized Canonical Coefficients for the PC Variables		
PC I	-0.61000	-0.50882
PC II	0.69518	0.02425
PC III	-0.38028	0.86053
Standardized Canonical Coefficients for the Spatial Variables		
East-west	0.55793	-0.82989
North-south	0.82989	0.55793

given in Bed B, while among the 175 elements in Bed A, there were only seven articulations. If the number of articulations is divided by the maximum element count, then Bed B's ratio is 0.1026 compared to Bed A's 0.040. The smaller proportion of articulations in Bed A suggests that the bones in that bed were more dismembered, more exposed or exposed for a longer period than those in Bed B.

Inspecting the distribution of elementary articular groups from Bed B (Table 1, page 18) indicates that generally the larger elements and those located along the midsagittal plane are more frequently articulated than the smaller elements and those located more peripherally. The most frequently articulated elementary articular groups are those along the midline, beginning with the head and continuing through the lower back-sacrum. Next most frequently articulated are the lower leg and hip, followed by the leg, pelvis, lower arm and arm. The articulations suggest that the body parts with more surrounding tissue are those most likely to remain articulated, especially those with substantial ligamentous tissue. It is an interesting exception that the lower arm and lower leg are more frequently articulated than the whole arm or whole leg.

The amount of disarticulation suggests that the bodies were exposed above ground for a considerable time or else much dismemberment occurred before the bodies were interred. It is difficult to estimate the time between death and burial. Because no insect remains were recovered, it seems likely that the bodies were exposed only during cold weather. Adult flies are generally absent in South Dakota between mid-October and late March (Gilbert and Bass 1967).

Although it is possible that the bodies were exposed above ground during the Fall and through scavenging and movement of the bodies the maggots and pupal cases lost, this seems unlikely. Insect remains undoubtedly would have been trapped in cavities and crevasses of the human bodies and included with the bodies when they were buried. It also seems unlikely that the pupal cases were overlooked during excavation. If the bodies were exposed only during cold weather, then they could have been exposed no longer than the five cold months when flies are absent. If the bodies were still exposed in Spring, decomposition and dismemberment may have progressed to the point that flies were not attracted to the bodies, though some other insects which are attracted to more decayed carcasses should have been present (cf. Ubelaker and Willey 1978). It seems likely that the deaths, exposure and burial all occurred within the five months of cold weather and probably happened in fewer than five months, perhaps in a month or less.

Dismemberment probably explains more of the disarticulation than natural decomposition or time of exposure. While some of the dismemberment was apparently done by the raiders, there are so few cuts on the limbs that these explain only a small proportion of the dismemberments, and natural decomposition would have been slow during the cold months. Many of the dismemberments can be attributed to the scavengers based on the chew marks present on the bones. Dismemberment by raiders and by scavengers are discussed further in Chapter 6 which deals with mutilation.

CHAPTER 4

CROW CREEK PALEODEMOGRAPHY

Paleodemography has become a standard part of osteological analyses during the last couple decades. Given its promise of gaining insights concerning mortality, morbidity, environment, and ecology, the inclusion of paleodemography is understandable.

Apparently all but a few paleodemographic studies (e.g. Flinn et al. 1976, Turner and Morris 1970) have used skeletal samples from cemeteries, and apparently all studies have considered the samples mortality data. While it can be argued that the Crow Creek victims reflect mortality from a single cause and should be considered mortality data, Crow Creek is different from most other osteological samples. This view does not, however, deny the utility of using the Crow Creek sample as mortality data if the paleodemography of the region or level of socio-cultural integration were being studied, but the unusual aspects of the Crow Creek sample need to be stressed.

Crow Creek presents a unique paleodemographic opportunity. Some of the unusual aspects of the sample are its large size, relatively early date, and southerly location in the Middle Missouri region. But from a paleodemographic perspective, what makes the Crow Creek sample unique are all of the unusual aspects listed above plus the extremely important context of the victims.

The Crow Creek victims all died at a single point in time and from a single cause. The immediate cause of their deaths--warfare--

froze the population structure of the Crow Creek villagers. And because of this freezing, the Crow Creek paleodemography is in some ways more comparable to a single census of a modern-day, primitive village than the slowly accumulating mortality samples found buried in cemeteries.

The purposes of this chapter are to describe the Crow Creek paleodemography and compare the Crow Creek age distribution with those of other skeletal samples from the same region. Based on the description and comparisons, the nature of the Crow Creek sample as mortality and census data is examined. A final purpose of this chapter is to estimate the number of people living in the Crow Creek Village so that number can be contrasted with the number of individuals recovered by excavation.

A. Methods and Materials

There are two critical assessments, age and sex, which must be made from the skeletons to study paleodemography. The methods used to estimate age and sex are detailed here so they can be compared with those used on other samples (cf. Owsley 1975). Age is estimated using two techniques: dental development for subadults and pubic symphysis morphology for adults.

Subadult age is estimated using dental development because it is generally acknowledged as a more accurate estimator of chronological age than skeletal development. Because the dental standards of Moorrees et al. (1963a, 1963b) are considered the most accurate available (Merchant and Ubelaker 1977), they are employed here.

Both the maxillae and mandibles of subadults and those adults with open third molar roots were X-rayed so that dental development could be assessed. When both sides of the mandible or maxilla were present, the side with the more complete dental set was X-rayed. If both sides had equal dental sets, left maxillae and right mandibles were preferred. To avoid duplication of fragmented jaws, only those pieces containing the second deciduous molar or second adult premolar tooth or crypt were included in the analysis.

All dental X-rays were taken and developed in the Department of Dental Hygiene at the University of South Dakota. Standard DF-58 film was used, employing a paralleling, long cone technique. Shooting and developing was done by Max Schmeling, Mark Swegle, and Jeff Swenson. Swegle scored the dental development using the X-rays and inspected the actual tooth when it could be removed from the alveolus.

Although the Moorrees et al. (1963a, 1963b) standards are almost entirely for mandibular teeth, maxillary teeth were also X-rayed, and age estimations for these were based on the mandibular standards. This approach was taken because there were far more maxillae than mandibles, and there appears to be little difference between dental development of the mandible and maxilla (Owsley 1978). To test for dental development differences between mandible and maxilla, 50 mandible-maxilla pairs were aged independently and tested for statistical significance. A paired t-test was executed and found not significant ($\overline{d} = 0.19$, $t = 1.13$, $DF = 49$, $0.2 < P < 0.5$). Because of their similarities, the mandible and maxilla age estimations are used interchangeably. The subadult age distribution used here employs

the maximum number of either maxilla or mandible, whichever was greater, for each age interval.

Nevertheless, there are problems in aging the maxillae which should be noted. Because the X-ray films were placed at an angle rather than parallel to the maxillary teeth, more distortion is present than in the mandibular X-rays. It is also more difficult to consistently place the film packets on the maxilla than the mandible.

Adult ages were estimated using pubic symphysis morphology following the technique for young adult males by McKern and Stewart (1957), the technique for adult females by Gilbert and McKern (1973), and the phases for the oldest adult males by Todd (1921). When using the techniques of McKern and Stewart or Gilbert and McKern, their written descriptions of the pubic changes and the plastic pubic symphysis casts were employed. Using the Todd method, the written description and an illustration of the male standards were used. Mark Swegle made all assessments.

There has been recent criticism of the Gilbert and McKern standards by Suchey (1979). Swegle found the standards by Gilbert and McKern more difficult to use than those of McKern and Stewart, and though not statistically tested, intraobserver error seems to be substantial. Nevertheless, age estimations based on the Gilbert and McKern technique are retained in this analysis to make them comparable to the techniques used on the Larson Site skeletons.

Both the Gilbert and McKern and McKern and Stewart techniques have a disadvantage when applied to the Crow Creek material. Both techniques present a mean and a range for each score, and the means

sometime skip the 5-year age intervals employed here. Thus, if the means alone were used, no individuals would be included in some of the intervals. Emphasizing the symphyseal age means causes fewer difficulties when parts of the same individual are associated so other age-related features can be used in estimating age. However when skeletons are disarticulated and symphysis change is used as the sole means of age estimation, then modifications must be made.

In applying symphysis age standards to the Crow Creek material, four modifications are made. First, symphysis morphologies intermediate to two of the standards are rated the lower score plus 0.5. Second, assigning a score to an age category is modified so all 5-year age intervals are included. Table 11 shows which symphyseal scores are assigned to each interval. Third, males scoring 14 or 15 in the McKern and Stewart technique are aged using the stages of Todd (1921). This switch in male aging techniques is necessary because the base sample of McKern and Stewart was relatively young while that of Todd was old. Fourth, males scoring X in Todd's technique are arbitrarily divided in half, one-half placed in the 50-54 interval and the other half in the 55-59.

Besides age, the other important variable in a demographic profile is sex. Sex estimation was done only for adults, employed the pubis, and followed the criteria of Phenice (1969), which are regarded as very reliable (Kelley 1978). Using the pubes for sex determination has the advantages of accuracy and usually the association of an ageable symphysis. The proportions of the sexes are compared to determine if

Table 11. Pubic symphysis stages assigned to five-year intervals for estimating the adult Crow Creek ages.

Years	Females	Males
15-19	0 - 1[a]	0 - 2.5[b]
20-24	2 - 4	3 - 8.5
25-29	4.5 - 7	9 - 11.5
30-34	7.5 - 10	12 - 12.5
35 - 39	10.5 - 12	13
40-44	12.5	IX[c]
45-49	13	IX 1/2
50-54	13.5 - 14	X
55-59	14.5 - 15	X

[a]Female standards are from Gilbert and McKern (1973).

[b]Younger male standards are by McKern and Stewart (1957). Males scoring 14 or 15 in the McKern and Stewart standards are aged using the Todd system (1921).

[c]Older male standards are by Todd (1921).

either sex is disproportionately present. A binomial Z-test is calculated assuming a 1:1 sex ratio.

No attempt was made to determine subadult sex because of the difficulties in the assessment and the relative lack of accuracy. Nevertheless to consider the adult sexes separately, life table calculations require subadults to be sexed. This problem is overcome by dividing the number of un-sexed subadults in each age interval in half. If the number of individuals is odd, 0.5 is added to each sex. This artificial division is done for all age intervals 14 years and younger. These data are presented for the benefit of any future researcher who might wish to calculate vital statistics; none are calculated here.

A paleodemographic reconstruction requires that as many individuals as possible be included in the data. It is especially important to have an accurate estimation of subadult vs. adult numbers because such inaccuracies will distort the age distribution at death. These adjusted numbers, as calculated below, are used for comparisons of age and sex distributions of the Crow Creek sample itself.

The total number of aged Crow Creek individuals is 332, a number considerably less than the total minimum count of 486. Under-representation of ageable individuals is understandable given the differential bone preservation. We would expect the more fragile pubic region, used to age and sex adults, to be more prone to damage and loss than the more durable teeth and jaws which were used to age the subadults.

To adjust any possible distortions and make as complete a paleodemographic sample as possible, the number of the most frequent element which could be aged as subadult or adult is used. The petrous portion of the temporal is ageable as adult or subadult and is the most frequent element at Crow Creek. There are 197 subadult right petrous portions (187 lefts) and 278 adult left petrous portions (237 rights). Comparing these numbers with the number of more accurately aged individuals, there are at least 45 subadults and 98 adults not represented in the more precisely aged sample. These extra 143 individuals are added to the 332 more precisely aged individuals to produce a more accurate paleodemographic picture. The ages of the remaining 11 individuals are still in doubt and are omitted from this analysis.

The 143 extra individuals are added to the more precisely aged individuals in the same proportions as the more accurately aged ones. Thus, the extra 45 less precisely aged subadults are added to the count in each of the age intervals from 0-1 through 10-14 based on the proportions of the more accurately aged individuals in each age interval. As an example, the 0-1 age interval contains 6.5 percent of the subadults. The 6.5 percent of 45 is 2.88 which is added to the number in that age interval. Adult numbers are similarly corrected, though the different proportions of the sexes require sex to be considered also. For example, the 20-24 year female interval contains 3.87 percent of all adults; 3.87 percent of the 98 unaged, unsexed adults amounts to 3.71, the number added to the original seven

20-24 year old females. After distributing the grossly aged 143 extra individuals, another manipulation needs to be made.

It is necessary to smooth the age distributions because the age estimation techniques, especially for the older adult ages, are relatively inaccurate and tend to artificially lump individuals in some intervals and exclude them from others. Smoothing also lessens any effect random variation may have on the age distribution of the sample when compared with the age distribution of the entire Crow Creek Village population. While it is impossible to know with certainty, the smoothed age distribution probably more accurately reflects the original Crow Creek population structure than the unsmoothed. The smoothed data are used primarily to compare Crow Creek with other comparably smoothed comparative samples.

Smoothing is executed using the three-mean moving average technique (Weiss 1973:15). Smoothing consists of adding the number of the individuals in an age interval to those in the two adjacent categories, then dividing the sum by three. These calculations produce the smoothed number of individuals for the middle category. The process is repeated using the original and average numbers. There are a number of exceptions which should be noted. Because of the unequal age intervals for the 0-1 and 1-4 categories contrasted with the other 5-year intervals, these shorter categories are not smoothed. The 5-9 year interval is smoothed in the normal way with the exception that 0.2 of the 1-4 year interval number is added to that interval to compensate for the shorter interval. The final age interval (55-59) is not smoothed.

The Crow Creek population structure is described in three separate steps. First, the age distribution for the sexes combined is examined. Then, the sex ratio for the combined adult ages is examined. Finally, the distributions for the sexes separated are examined.

The Crow Creek sexes are combined to be compared with four skeletal samples. The four skeletal samples consist of two each from the Larson and Mobridge sites. These samples are the only large, comparably aged and sexed samples from the Middle Missouri region. Both are located near Mobridge, South Dakota, in the north-central part of the state. The Larson Cemetery sample dates from 1750 to 1780 AD (Owsley and Bass 1979), and the Larson Village sample was apparently massacred about 1780 (Owsley and Bass 1979). There is some recent evidence that Larson may date considerably earlier than the dates given here (Jantz 1982). The Larson Cemetery paleodemographic data are from Owsley and Bass (1979:149, Table 2) and the Larson Village data from Owsley et al. (1977:126, Table 3). The Mobridge samples consist of two cemeteries. One cemetery is located west of the Mobridge Village (Mobridge 1) and is prehistoric, dating from 1600 to 1650 AD (Jantz 1973). The second Mobridge Site cemetery (Mobridge 2) is located south of the village and is protohistoric and possibly dates between 1700 and 1750 AD. The Mobridge mortality data are from Palkovich (1978:148, Table 6; 149, Table 7). The Mobridge data have already been smoothed by Palkovich, but before using the Larson data, they are smoothed using the same technique described above.

To test for statistical differences among the samples, comparisons are made pair-wise between Crow Creek and the comparative samples. The two-tailed Kolmogorov-Smirnov two-sample test (Thomas 1976) is used which requires converting the adjusted and smoothed age distribution to a cumulative percentage distribution. The comparisons which differ significantly with the Kolmogorov-Smirnov test are further examined using a X^2 test applied to the non-cumulative distribution of number of individuals. This additional step permits each age interval pair to be contrasted directly.

B. Results and Discussion

The Crow Creek age distribution counts for the sexes combined are examined first (Table 12). In all three age distributions, unadjusted and unsmoothed, adjusted but unsmoothed, and adjusted and smoothed, there are deviations from the expected consistent decrease in numbers as age increases. The unadjusted and unsmoothed distribution count increases in the 10-14, 15-19, 30-34, 35-39, 45-49, and 55-59 intervals from the immediately preceding intervals. The adjusted but unsmoothed distribution count increases in the 15-19, 30-34, 35-39, 45-49, and 55-59 intervals from the immediately preceding intervals. Finally, the adjusted and smoothed distribution increases in the 40-44, 50-54, and 55-59 intervals from the immediately preceding ones. All of these instances differ from the expected distributions if Crow Creek were a bona fide census sample because a normal census would consistently decrease in numbers as age increases (Jaffe 1982). Based on the age distribution, Crow Creek cannot be considered census data.

Table 12. Adjusting and smoothing the Crow Creek age distribution counts.

Age Interval	Unadjusted and Unsmoothed			Adjusted but Unsmoothed			Adjusted and Smoothed		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-1	0	0	10	6.44	6.44	12.88	6.44	6.44	12.9
1-4	0	0	38	24.47	24.47	48.94	24.47	24.47	48.9
5-9	0	0	76	48.93	48.93	97.86	32.32	32.16	64.3
10-14	0	0	29	18.67	18.67	37.34	34.82	28.51	63.5
15-19	24	12	36	36.86	18.43	55.29	28.24	15.78	44.2
20-24	19	7	26	29.18	10.75	39.93	27.65	11.77	39.4
25-29	11	4	15	16.90	6.14	23.04	20.45	8.70	29.2
30-34	10	6	16	15.36	9.22	24.58	16.39	10.75	27.1
35-39	11	11	22	16.90	16.90	33.80	12.80	10.24	23.0
40-44	4	3	7	6.14	4.61	10.75	10.75	13.84	24.6
45-49	6	13	19	9.22	19.97	29.19	8.70	14.35	23.0
50-54	7	12	19	10.75	18.43	29.18	10.24	19.98	30.2
55-59	7	14	21	10.75	21.50	32.25	10.75	21.50	32.3

The next paleodemographic result considered is the Crow Creek sex ratio for all adult ages combined. Of the 180 adults sexed by pubic morphology, 98 (54.44 percent) were males and 82 (45.56 percent) were female. To test whether there is a disproportionate number of one sex, a binomial Z-test was calculated assuming a 1:1 sex ratio. The result was not significant ($Z = 1.192$, $F(Z) = 0.88$, $P < 0.12$). Although there is some indication that more males than females were present, there is no statistical evidence that the sex ratio deviated from a 1:1 ratio when the adult ages are combined.

However, if the sex ratios are divided by age interval, then differences are observed (Table 12). In the unadjusted and unsmoothed and the adjusted but unsmoothed distributions, males out-number females by almost 2:1 in the 30-34 interval, 2:1 in the 15-19 interval, and almost 3:1 in the 20-24 and 25-29 intervals. In the older age intervals, all three distributions show females out-numbering males by about 2:1 in the 45-49, 50-54, and 55-59 intervals. These distributions show that generally the males out-number females in the younger and middle adult intervals, while the females out-number the males in the older intervals.

These differences in the proportion of each sex based on age probably do not represent the actual sex ratios of the Crow Creek Village at the time of the attack but likely show influences of the events during and following the raid. Rarely if ever does a population have such disproportionate numbers of each sex by age (Jaffe 1982). It is also unlikely that a normal population would have more females in the 55-59 interval than the 15-19 (Jaffe 1982). The differences

appear to be due to events which happened during or following the raid, and these deviations from a normal population rule out the possibility that the Crow Creek sample is a census.

The relative lack of young females may have been caused by them being taken captive by the raiders, escaping from the village and massacre, or being killed but not recovered. Historic accounts occasionally mention Indian battles in which raiders attacked a group of men, women, and children. If the attack occurred in an exposed area or the defending group was out-numbered, the men generally tried to delay the attackers providing the women and children a chance to escape (e.g., Henry in Coues 1897:263). There is also historic mention of raiders killing men but taking at least some women and children captive (Tabeau 1939:150) and presumably returning with them to the camp of the raiders. The last explanation for the absence of the younger females--them being killed but not recovered--remains a possibility, though it is difficult to judge how likely it is.

The relative absence of older males might be explained by them escaping from the village and massacre or being killed but for some reason not recovered in our excavations. It is also possible that the absence of older males is a demographic reality, the males having been subjected to higher mortality than the females. It is difficult to judge the relative likelihood of these possibilities.

Having described and discussed the Crow Creek paleodemography, Crow Creek is not compared with another massacre sample and other cemetery samples from the same region using the percentage of individuals in each age interval (Table 13). When Crow Creek is

Table 13. Adjusted and smoothed age distribution frequencies at Crow Creek for each sex and total sample.

Age Interval	Male	Female	Total
0	2.64	2.95	2.79
1-4	10.03	11.20	10.57
5-9	13.23	14.72	13.90
10-14	14.26	13.05	13.73
15-19	11.57	7.22	9.55
20-24	11.33	5.39	8.52
25-29	8.38	3.98	6.31
30-34	6.72	4.92	5.86
35-39	5.25	4.69	4.97
40-44	4.41	6.33	5.32
45-49	3.57	6.57	4.97
50-54	4.20	9.14	6.53
55-59	4.41	9.84	6.98
	100.00	100.00	100.00

compared with the Larson Village massacre sample (Table 14), no significant differences are observed in the age distributions. This result suggests that massacre age distributions are similar in both prehistoric and protohistoric times.

On the other hand, when Crow Creek is compared with the age distribution at the Mobridge and Larson cemeteries (Table 15), highly significant differences are observed. Chi-square tests (Tables 16, 17, 18) are calculated to determine which cells influence most the significance noted. In all three X^2's, the Crow Creek sample is under-represented in the 0-9 interval and over-represented in nearly all later age intervals. The only exception to the Crow Creek over-representation in age intervals after 0-9 is the 40-49 interval of Mobridge 2, and these expected and observed values are approximately equal. These results suggest that the Crow Creek age distribution is dissimilar from mortality data and cannot be considered a normal mortality sample.

Because of the similarities between the Crow Creek and Larson Village massacre samples, they are combined and compared with the combined cemetery samples used in the previous comparisons. The results are similar to those when Crow Creek alone was compared with the cemeteries. There are highly significant differences between the massacre and cemetery samples (Table 19). When individual cells are examined (Table 20), the massacre samples are under-represented in the 0-9 interval and over-represented in subsequent intervals.

The next question to be answered is, what proportion of the total village population is included in the bone bed? To answer this

Table 14. Smoothed Crow Creek age distribution compared with the Larson Village sample.

Age in Years	Crow Creek Cumulative Percent	Larson Village Cumulative Percent	Difference
0-9	27.26	23.43	3.83
10-19	50.54	47.34	3.20
20-29	65.37	71.87	-6.50
30-39	76.20	88.59	-12.39
40-49	86.49	100.00	-13.51[a]
50-59	100.00	100.00	0
Sample size	463	64	
0.05 critical value			18.14
Conclusion			No difference

[a]Maximum difference is underlined.

Table 15. Smoothed age distribution of Crow Creek compared with those of Middle Missouri region cemetery samples.[a]

Age in Years	Crow Creek Cumulative Percent	Mobridge 1 Cumulative Percent	Mobridge 1 Difference	Mobridge 2 Cumulative Percent	Mobridge 2 Difference	Larson Cemetery Cumulative Percent	Larson Cemetery Difference
0-9	27.26	69.94	-42.68[b]	48.20	-20.94[b]	53.88	-26.62[b]
10-19	50.54	74.54	-24.00	59.71	- 9.17	76.01	-25.47
20-29	65.37	80.29	-14.92	70.81	- 5.44	83.54	-18.17
30-39	76.20	86.53	-10.33	80.18	- 3.98	90.57	-14.37
40-49	86.49	92.61	- 6.12	91.16	- 4.67	96.60	-10.11
50-59	100.00	100.00	0	100.00	0	100.00	0
Sample size	463	203		249		735	
0.05 critical value			11.45		10.69		8.07
0.01 critical value			16.41		15.32		11.57

[a]Maximum differences are underlined.

[b]Significant at 0.01 level of confidence.

Table 16. Comparison of the smcothed age counts of Crow Creek and Mobridge 1.[a]

Age in Years	Crow Creek		Mobridge 1	
	Expected	Observed	Expected	Observed
0-9	186.4	126	81.6	142
10-19	81.4	108	35.6	9
20-29	56.3	69	24.7	12
30-39	43.8	50	19.2	13
40-49	41.7	48	18.3	12
50-59	54.3	63	23.7	15

[a] $\chi^2 = 112.83$, DF = 5, $P < 0.001$.

Table 17. Comparison of the smoothed age counts of Crow Creek and Mobridge 2.[a]

Age in Years	Crow Creek		Mobridge 1	
	Expected	Observed	Expected	Observed
0-9	160.1	126	85.9	120
10-19	89.2	108	47.8	29
20-29	63.1	69	33.9	28
30-39	47.5	50	25.5	23
40-49	48.8	48	26.2	27
50-59	55.3	63	29.7	22

[a] $\chi^2 = 37.22$, DF = 5, $P < 0.001$.

Table 18. Comparison of smoothed age counts of Crow Creek and Larson Cemetery.[a]

Age in Years	Crow Creek		Larson Cemetery	
	Expected	Observed	Expected	Observed
0-9	202.0	126	320.0	396
10-19	104.9	108	166.1	163
20-29	48.0	69	76.0	55
30-39	39.5	50	62.5	52
40-49	35.6	48	56.4	44
50-59	34.1	63	53.9	25

[a] $\chi^2 = 113.37$, DF = 5, $P < 0.001$.

Table 19. Comparison of the smoothed cumulative percentages of the two combined massacre samples with that of the three combined cemetery samples.

Age in Years	Massacres	Cemeteries	Difference
0-9	26.79	55.90	-29.11[a]
10-19	50.15	72.95	-22.80
20-29	66.16	81.00	-14.84
30-39	77.71	88.45	-10.74
40-49	88.14	94.73	- 6.59
50-59	100.01	99.99	- 0.02
Sample size	527	1177	
0.05 critical value			7.13
0.01 critical value			10.22

[a]Maximum difference is underlined. Significant at the 0.01 level of confidence.

Table 20. Comparison of the smoothed age counts of the two combined massacre samples with that of the three combined cemetery samples.[a]

Age in Years	Massacres		Cemeteries	
	Expected	Observed	Expected	Observed
0-9	247.0	141	552.0	658
10-19	100.1	123	223.9	201
20-29	55.3	84	123.7	95
30-39	46.1	61	102.9	88
40-49	39.9	55	89.1	74
50-59	38.6	63	86.4	62

[a] $X^2 = 132.54$, DF = 5, $P < 0.001$.

question, an estimation of the number of people living in the Crow Creek Village is needed to contrast with the number recovered in the bone beds.

An estimation of the number of people living at Crow Creek is possible based on the number of lodges at the site and the number of people living in each lodge. To make the estimation, assumptions must be made that the average number of people living in each lodge was the same as it was during the historic period when the number of individuals and lodges were recorded, the lodges at Crow Creek were all inhabited at the same time, and all lodges at the site were counted.

Given these assumptions, the two critical numbers in estimating the Crow Creek population are the number of lodges at the site and the number of people per lodge. Kivett and Jensen (1976:68) in their report on the Crow Creek Site write that there are at least 50 lodges from the Initial Coalescent component. To estimate the number of individuals per lodge, Roberts (1977:174, Fig. 35) has provided formulae based on historic accounts. His figure for the number of people per lodge for Arikara is 16.62 and for lodges of any tribal affiliation is almost 15 (14.88). These figures indicate that <u>at least</u> 744 (any tribal affiliation) or 831 (Arikara) lived at the site.

That these are minimum figures cannot be stressed enough. One reason these figures must be considered minimal is because the village appears to have been expanding, which suggests that all or nearly all of the lodges were inhabited. The 50 lodge count is also considered

minimal by Kivett and Jensen, and it is entirely possible that there are other, silted-over lodges in the lower, southwestern part of the village.

Having estimated a minimum number of people living at Crow Creek and a minimum number of skeletons represented, it is appropriate to compare the two. Using the estimation of village population (831) and the minimum number of skeletons (486), it seems that only about 60 percent of the village population is represented by the skeletons in the ditch. There are a number of possible explanations why the other 40 percent are missing.

First of all, it is possible that the number of skeletons represented in the ditch or the estimation of the number of people living at Crow Creek are inaccurate. Secondly, we know that there is additional, unrecovered skeletal material continuing east from the rest of the deposit in the fortification ditch, so not all of the material was recovered. There may be additional material present elsewhere in the ditch, the village, or outside the village. Material may also have been destroyed by natural causes and thus not recoverable. Additional possibilities are that some of the village members were absent when the raid occurred, some were able to escape from the village during the raid, or some were taken captive.

CHAPTER 5

CROW CREEK CRANIAL AFFINITIES

On the Northern Plains, cranial measurements and discrete traits have been used to estimate morphological affinities. There have been a variety of interesting results, including studies of microevolutionary changes (Bass 1964; Jantz 1970, 1972, 1973, 1977; Key and Jantz 1981) and ethnic distinctions (Jantz 1974, 1976, 1977; Jantz et al. 1978; Ubelaker and Jantz 1979). Nearly all of these studies employ cranial measurements.

The Crow Creek cranial sample is important because there are no other large Middle Missouri region cranial samples as early or as far south as Crow Creek. Crow Creek is important because it links the earlier Central Plains material with the later Arikara samples both geographically and temporally. Using the Crow Creek morphological distances, three problems are studied. Two problems involve variation among the Crow Creek crania and the third compares the Crow Creek sample with other samples.

There have been relatively few within-site analyses of Middle Missouri region skeletal material (e.g., Owsley and Jantz 1978), and none have dealt solely with a single component within a site. Crow Creek offers an excellent opportunity to study within-site variation for a single component. Looking for variation within the Crow Creek sample, two analyses are performed. Principal component scores from cranial measurements are employed in an outlyer analysis to determine

whether morphologically dissimilar skulls are present in the sample. The other within-site analysis employs the principal component scores to inspect the cranial variation by where the skulls were interred. Cranial variation and burial location are studied to see if placement in the trench is associated with morphology. Both studies employ cranial measurements only.

The third analysis compares Crow Creek cranial measurements and cranial discrete traits with other samples from the Northern and Central Plains. The purpose of this analysis is to determine Crow Creek's morphological similarities with other samples and to suggest tribal affiliation. This study employs both cranial measurements and discrete traits.

A. Methods and Materials

All relatively complete Crow Creek skulls were reconstructed by Mark Swegle and P. Willey during January 1979. Altogether measurements were taken on 104 skulls and 102 were observed. Willey took all measurements and observations.

For the purposes of these cranial analyses, only those skulls with 15 measurements which previously had been taken on other comparable samples are used. The measurements employed are glabella-occipital length (GOL), maximum cranial breadth (XCB), basion-bregma (BBH), basion-prosthion (BPL), minimum frontal breadth (WFB), bizygomatic breadth (ZYB), nasion-alveolare (NPH), external alveolar length (EAL), external alveolar breadth (EAB), nasal height (NLH), nasal breadth (NLB), bifrontal chord (FMB), basion-biporion (BPO), and

auricular height (AUH). These measurements have been fully described elsewhere (Bass 1964, 1971; Jantz 1970), and additional comments have already been published (Zimmerman et al. 1981). All 15 measurements were taken on 30 female and 33 male skulls.

Four additional skulls were added to the analyzed sample. Of these, three were missing one measurement and one was missing two measurements. Skull 11, a female, was missing AUH; Skull 284, a male, was missing FMB; and Skull 368, a male, was missing ZYB. Skull 370, a female, was lacking ZYB and FMB. These missing measurements were estimated using multiple regression formulae which employ all of the other measurements present. The regressions were performed separately for each sex using the GLM routine in SAS (SAS Institute 1979). With these 4 skulls added to the Crow Creek sample, a total of 67 (32 female, 35 male) skulls are analyzed. Descriptive statistics were calculated for each sex using the CONDESCRIPTIVE program in SPSS (Nie et al. 1975) and are presented in Tables 21 and 22. Principal component analyses were performed for each sex using the SPSS program (Nie et al. 1975). The principal component scores are used in the outlyer analysis and to check for cranial heterogeneity in burial location.

The outlyer analysis is performed using the principal component scores of cranial measurements to determine if morphologically dissimilar skulls were present in the ditch. If there are morphologically dissimilar skulls present, it might indicate that some raiders were buried with their victims or that mate-exchange was occurring between groups. All 15 principal component scores of each individual are used

Table 21. Descriptive statistics of female Crow Creek cranial measurements.[a]

Measurements	Mean	Standard Deviation	Minimum	Maximum	Range
GOL	170.22	4.72	160	181	21
XCB	142.31	5.69	129	151	22
BBH	132.53	4.04	125	142	17
BNL	100.50	4.24	91	112	21
BPL	97.38	5.05	86	109	23
WFB	91.56	4.04	83	98	15
ZYB	132.88	4.46	123	139	16
NPH	69.94	3.45	63	77	14
EAL	51.59	2.94	46	57	11
EAB	64.22	3.84	56	71	15
NLH	50.19	2.22	45	54	9
NLB	26.38	1.93	22	31	9
FMB	98.94	3.34	93	105	12
BPO	19.56	3.53	12	28	16
AUH	116.94	4.19	109	130	21

[a]Statistics based on 32 female crania with full complement of measurements. All figures in millimeters.

Table 22. Descriptive statistics of male Crow Creek cranial measurements.[a]

Measurements	Mean	Standard Deviation	Minimum	Maximum	Range
GOL	176.09	6.86	163	190	27
XCB	145.43	6.42	131	162	31
BBH	136.11	4.96	124	145	21
BNL	104.63	4.71	95	116	21
BPL	102.66	4.72	93	112	19
WFB	95.29	4.78	87	105	18
ZYB	140.49	7.12	126	155	29
NPH	73.80	3.72	67	81	14
EAL	54.06	3.10	49	60	11
EAB	67.97	3.04	62	79	17
NLH	53.80	3.11	47	59	12
NLB	27.46	1.80	23	31	8
FMB	103.54	4.00	94	111	17
BPO	20.17	3.29	11	25	14
AUH	120.57	4.25	111	128	17

[a]Statistics based on 35 male crania with full complement of measurements. All figures in millimeters.

to calculate D^2 from the group's centroid for the individual using a program written by William W. Baden. Those crania falling beyond the 0.05 limit are suspect.

The measureable skulls are also tested for morphological heterogeniety based on the location where they were found and the principal component scores. If heterogeneity is present, it would suggest that the skulls and perhaps postcranial skeletons were separated into groups for burial. Such heterogeneity among parts of the bone bed might indicate differing kin affiliations. To examine this possibility, the skulls are separated by excavation units. Because the sample size for each individual square is so small, skulls from all squares with the same number are combined. Thus, for example, the crania from squares 5A, 5B and 5C are lumped together for the analysis. This lumping allows testing of differences among groups of skulls on the east-west orientation but not the north-south. This compromise is necessary because the sample of each individual square is too small for statistical analysis. This compromise is also justified because the north-south placement of the crania is probably largely due to how steep the slope of bones was, and there is better access to the ditch in the east-west direction than the north-south. It seems likely, then, that if cultural distinctions were being made, they would be in an east-west orientation. Another compromise is made. Because of the very small number of skulls from combined Squares 9 and combined Squares 10, these two are also combined (Table 23).

Table 23. Samples from Crow Creek squares combined for analyzing cranial morphology homogeneity among the squares.

Squares	Females	Males
5 A,B,C	11	7
6 A,B,C	4	8
7 A,B,C	6	6
8 A,B,C	7	7
9 and 10 A,B,C	4	7

The male and female skulls are divided by combined squares and analyzed with the discriminant subprogram in SPSS (Nie et al. 1975). The principal component scores for each individual are employed.

Two approaches to establish cranial morphological distances between Crow Creek and other samples from the Central and Northern Plains are used. In the past, cranial measurements have been frequently used to study morphological relationships of Northern Plains samples. The other approach, discrete traits, has been used less frequently. Here cranial measurements are employed to estimate morphological distances and to classify individual crania into groups. The cranial discrete traits are used only to estimate morphological distances.

The cranial measurement morphological distances between Crow Creek and 11 other samples from the Northern and Central Plains are estimated using the canonical variates calculated from the raw measurements and the discriminant subprogram of SPSS (Nie et al. 1975). All crania from the other 11 samples were measured by R. L. Jantz, using the same measurement techniques as those used on the Crow Creek material. Information concerning those samples is presented in Jantz (1972, 1974). For the most part, each sample is made up of skulls from single sites, though sample sizes for Mandan, Omaha, Pawnee, and Ponca are so small that skulls from several sites are combined.

Another way to examine intersite and intergroup differences using craniometrics is classifying individuals into the group with the closest group centroid. Thus, rather than simply examining the placement of group centroids relative to one another, individual

variability is considered by seeing into which groups individuals are misclassified. This statistical manipulation is performed by using an option in the same SPSS program (Nie et al. 1975) which is used to produce the canonical variate values. A hit-miss table results when the individual results are combined. A hit is an individual correctly identified to its group and a miss is incorrectly identified.

In addition to the distances calculated based on craniometric data, discrete traits are used. As many as 20 paired and 9 single cranial and mandibular discrete traits were observed on each of 102 skulls and 49 associated mandibles. For the purposes of this analysis, only 16 of the 29 observations are employed. These 16 traits were selected because Jantz (1970:70, Table 12) found no sex differences in trait frequency in a larger, similar sample, thus allowing the sexes to be combined. The 16 observations used are lambdoidal ossicle (medial and lateral), parietal foramen, coronal ossicle, epiteric bone, ossicle in mastoid suture, anterior condylar canal double, accessory palatine foramen, supraorbital foramen complete, frontal foramen, accessory infraorbital foramen, accessory mental foramen, ossicle at lambda, inca bone, pharangeal fossa, and superior sagittal sinus turns left. All of these observations are recommended by Berry and Berry (1967), except ossicle in mastoid suture, which Jantz noted. Paired observations are combined to get frequencies. Before mentioning the comparative samples and the statistic used, some definitions of terms and method descriptions are necessary.

Ossicles are isolated pieces of bone in sutures which are large enough (usually greater than or equal to 1cm in diameter) to be

observed without difficulty. Exceptions to this rule are epiteric bones, where even the smallest ossicle is noted as being present. Sometimes it is difficult to judge whether or not an ossicle near the juncture of two sutures is at that point or on one of the other sutures. The major example are bones in the lambdoidal area. Bones near the junctures are called ossicles at those joints if, and only if, the ossicle had a side formed by each of the sutures.

Extra foramina generally have to be larger than a pin-point to be counted. Any foramen near the palatine foramen is recorded as accessory. Recording the supraorbital foramen/notch was somewhat eclectic, and earlier in taking the observations some frontal foramina may have been mistakenly identified as supraorbital foramina. Accessory infraorbital foramina are especially difficult to identify. In some skulls there seems to be a zone ringing the infraorbital region, especially laterally and medially to the orbit, in which the accessory foramina are common. Accessory foramina are identified as accessory infraorbital foramina only if they are present within the distance of the diameter of the infraorbital foramen measured from the nearest edge of the infraorbital foramen. Thus, supernumerary foramina occurring on the frontal process of the maxilla are excluded.

It is frequently hard to judge whether or not a pharangeal fossa is present. In borderline cases, if the depression is large enough to both see and feel, a pharangeal fossa is noted as present.

Usually the turning of the superior sagittal sinus is obvious, but in some instances it is not apparent. In these cases, the sizes

of the transverse sulcii are inspected with the larger sulcus presumed to indicate the direction the sagittal sinus turned.

In brief, these "discrete" nonmetric observations are often indistinct. There seems to be room for observer interpretation, but it is hoped that these definitions and the description of methods are reproducible.

All of the comparative discrete trait samples, except one, are from Jantz (1970). The sample not previously published is the St. Helena (25CD4, 25CD7, 25DK9, 25DK10, and 25DK13) which was kindly made available by Jantz. The Crow Creek sample used is comprised of the same crania used in the metric analysis, except for one male (Skull 294) for which no observations were recorded. A relatively simple statistical procedure is used. Following Grewal (1962) and Berry and Berry (1967), the frequencies of the 16 traits are converted to an angle, expressed in radians (θ), and the distance between samples calculated based on the difference between radians.

B. Results and Discussion

The outlyer analysis was performed to see if morphologically dissimilar skulls were present in the ditch. The presence of different kinds of skulls might mean that some raiders were buried with their victims or mate-exchange occurred. There are, of course, other possible explanations. All 15 components from each individual were employed to calculate Mahalanobis' D^2 from the group's centroid for individual crania. Not one of the 32 female (Table 24) or 35

Table 24. D^2 values of individual Crow Creek female crania from the group centroid.[a]

Skull Number	D^2 Value	Probability
11	12.04	0.50-0.25
21	20.86	0.25-0.10
22	18.69	0.25-0.10
35	20.78	0.25-0.10
57	15.08	0.50-0.25
61	13.09	0.75-0.50
66	13.60	0.75-0.50
76	23.26	0.10-0.05
94	10.98	0.90-0.75
96	9.67	0.90-0.75
98	14.45	0.50-0.25
103	10.39	0.90-0.75
145	18.79	0.25-0.10
156	16.89	0.50-0.25
173	18.82	0.25-0.10
190	16.48	0.25-0.10
195	11.67	0.75-0.50
196	11.02	0.90-0.75
197	10.93	0.90-0.75
207	6.95	0.975-0.95
228	12.46	0.75-0.50
233	16.66	0.50-0.25
308	21.17	0.25-0.10
315	18.06	0.50-0.25
322	9.22	0.90-0.75
323	14.65	0.50-0.25
331	12.38	0.75-0.50
336	9.18	0.90-0.75
361	8.03	0.95-0.90
363	14.43	0.50-0.25
370	15.62	0.50-0.25
377	14.10	0.75-0.50

[a]None is statistically significant. DF = 15.

male (Table 25) crania fell in the 0.05 probability range. Therefore, the null hypothesis--that there are no significantly different skulls present--must be accepted. The measureable skulls all appear to belong to a homogeneous group, presumably the Crow Creek Village inhabitants.

The measureable skulls were tested also for morphological heterogeneity by location in the ditch. Heterogeneity among the excavation squares might indicate kin-aligned burial. The females have four components greater than 1.0. The males have five components with eigenvalues greater than 1.0, but the sixth has an eigenvalue (0.99787) so close to 1.0 that it is included. Thus the males are analyzed using six components. No statistically significant differences are present in either sex. Cranial measurements do not vary with east-west position in the ditch.

Two approaches to estimate cranial morphological distances between Crow Creek and other cranial samples are employed: namely, cranial measurements and cranial discrete traits. The craniometric results are discussed first.

In the craniometric analysis, the first four canonical variates are statistically significant in both sexes. The results in both sexes are so similar that they can be discussed together. The first canonical variate (CV I), which explains 35.7 percent of the female variability and 43.1 percent of the male, primarily separates Crow Creek and to a lesser extent the St. Helena sites (25DK9 and 25DK13) from the Mandan (Fig. 3). CV I arranges the Arikara sites from northern South Dakota (Mobridge, Rygh, Larson, and Leavenworth)

Table 25. D^2 values of individual Crow Creek male crania from the group centroid.[a]

Skull Number	D^2 Value	Probability
1	12.04	0.75-0.50
8	10.22	0.90-0.75
12	17.31	0.50-0.25
18	20.47	0.25-0.10
51	12.27	0.75-0.50
63	12.59	0.75-0.50
83	15.19	0.50-0.25
91	15.14	0.50-0.25
95	21.79	0.25-0.10
100	11.52	0.75-0.50
108	15.78	0.50-0.25
134	13.40	0.75-0.50
135	13.95	0.75-0.50
151	13.02	0.75-0.50
186	11.43	0.75-0.50
216	11.76	0.75-0.50
218	11.10	0.75-0.50
229	13.15	0.75-0.50
236	13.99	0.75-0.50
265	21.13	0.25-0.10
269	13.90	0.75-0.50
284	22.17	0.25-0.10
286	15.37	0.50-0.25
294	16.24	0.50-0.25
301	12.13	0.75-0.50
302	10.84	0.90-0.75
306	21.15	0.25-0.10
307	18.71	0.25-0.10
317	16.35	0.50-0.25
348	9.32	0.90-0.75
356	5.68	0.99-0.975
358	8.81	0.90-0.75
360	21.89	0.25-0.10
368	16.20	0.50-0.25
392	14.00	0.75-0.50

[a]None is statistically significant. DF = 15.

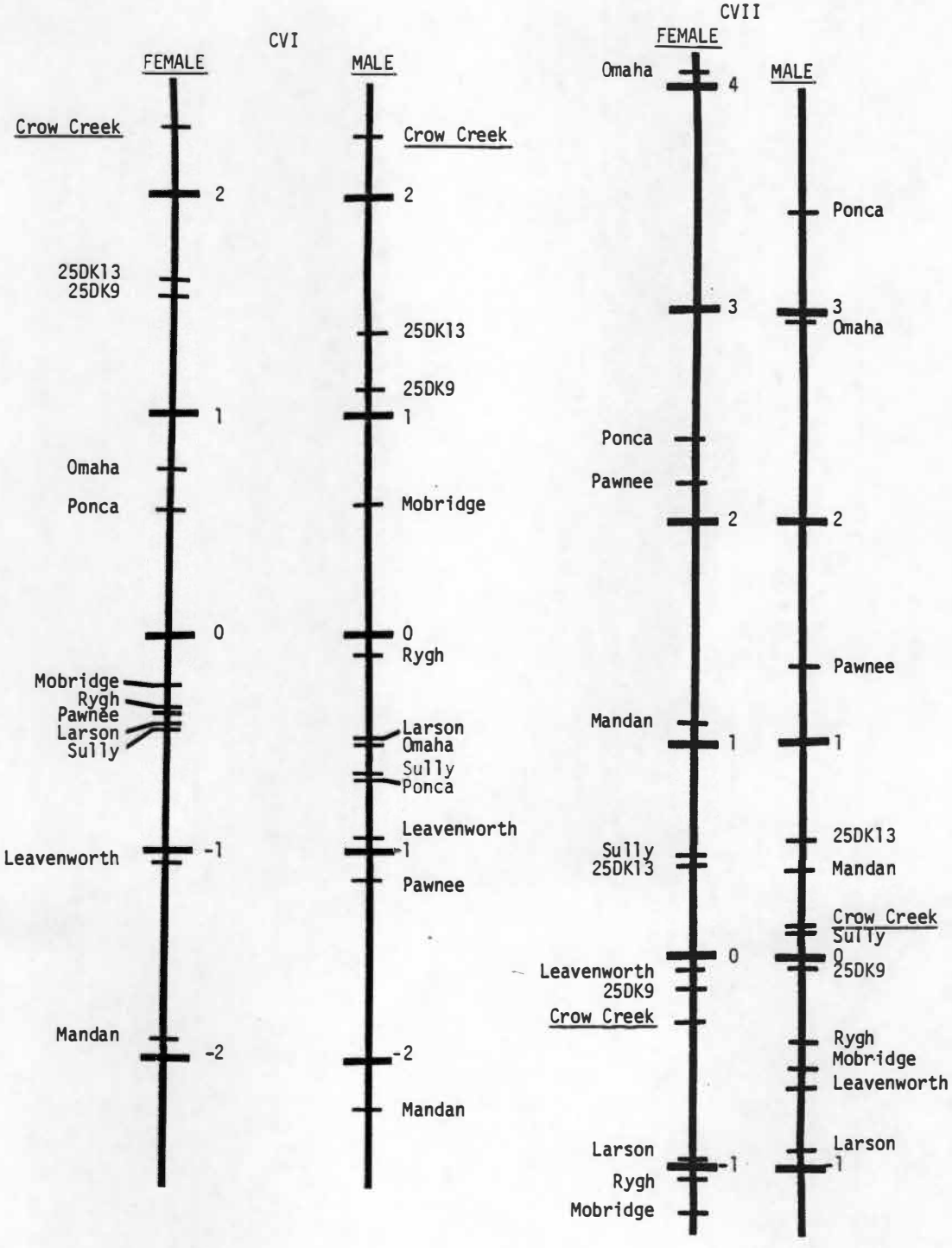


Figure 3. Comparison of Crow Creek and other craniometric samples on canonical variates I and II.

chronologically, and it appears to be doing the same with Crow Creek and possibly the St. Helena sites.

The second canonical variate (CV II) explains 33.3 percent and 24.3 percent of the female and male variability, respectively (Fig. 3). CV II mainly separates the Omaha, Ponca, and to a lesser extent the Pawnee from the other samples, especially the Arikara groups. Generally CV II seems to be geographically influenced, with the southern groups at one end and the northern groups at the other. The Mandan are a notable exception to this generalization. Crow Creek falls near the center of the distribution, near the St. Helena (25DK9 and 25DK13) and near some Arikara samples.

The third canonical variate (CV III), which explains 13.2 percent and 10.7 percent of the female and male variability, respectively, separates the Mandan and St. Helena (25DK9 and 25DK13) samples from the Omaha, Ponca, and at least some of the Arikara samples (Fig. 4). There is no clear patterning to the distribution. Crow Creek again falls near the center of the distribution, near the Pawnee and some of the Arikara samples.

The fourth and final canonical variate (CV IV), which explains 6.0 percent and 7.9 percent of the female and male variability, respectively, is difficult to interpret because the female and male plots are somewhat different (Fig. 4). The female CV IV separates the Ponca, earlier Arikara (Mobridge, Rygh, and Sully), and 25DK9 from the Omaha and later Arikara (Larson and Leavenworth). The female Crow Creek sample falls among the Mandan, Pawnee, and 25DK13. The male CV IV, on the other hand, separates both St. Helena sites (25DK9 and

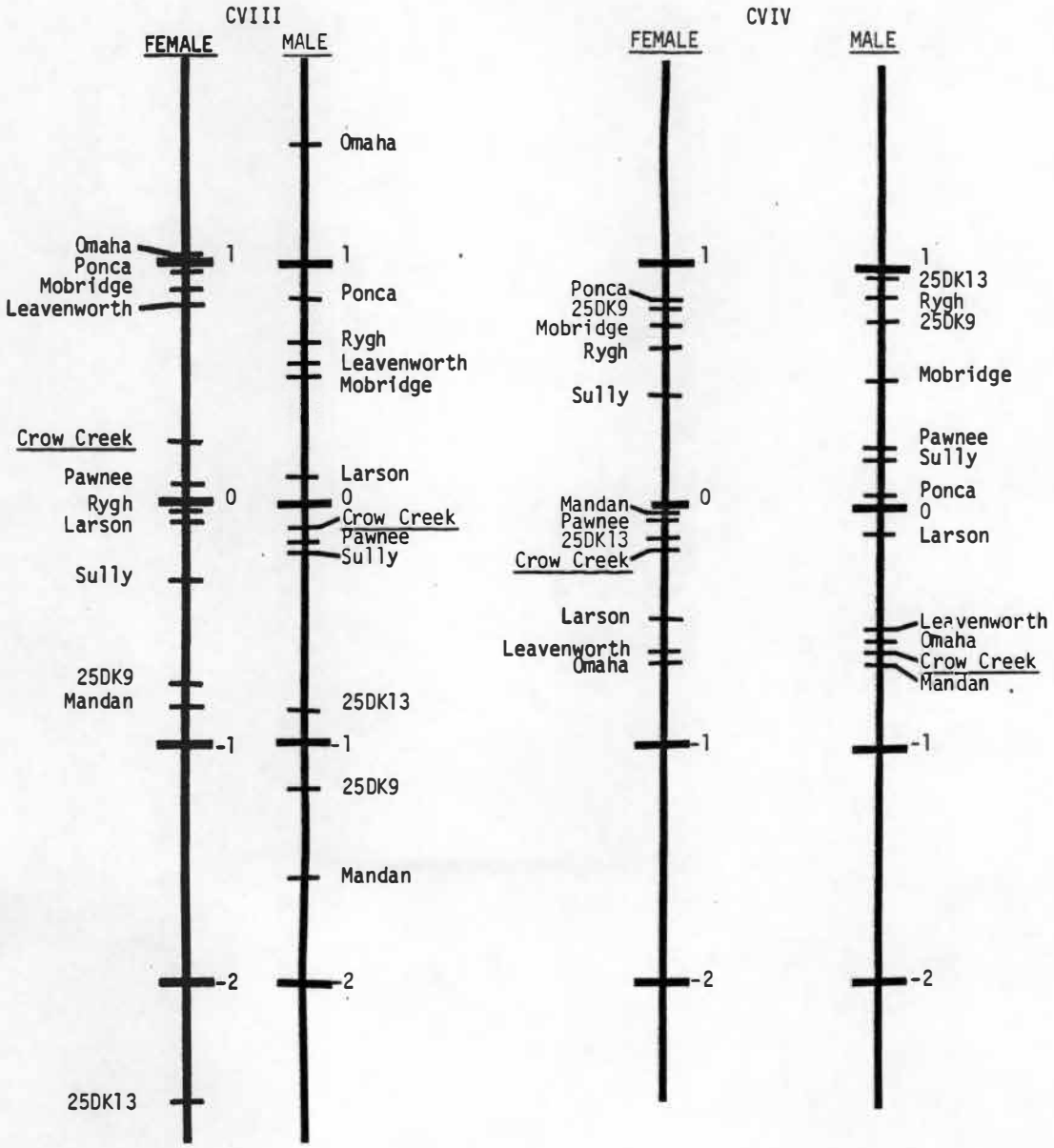


Figure 4. Comparison of Crow Creek and other craniometric samples on canonical variates III and IV.

25DK13) and some earlier Arikara (Mobridge and Rygh) from the Omaha, Mandan, one of the later Arikara (Leavenworth), and Crow Creek.

Each CV is interesting in itself, but discussing them individually makes trends difficult to grasp. CV's can be combined in multi-dimensional plots, thus making patterns more apparent. Simultaneously plotting CV I, II, and III displays the maximum variability on 3 axes--82.2 percent of the female and 78.1 percent of the male variability (Figs. 5 and 6). Both sexes of Crow Creek rest closest to the St. Helena sites (25DK9 and 25DK13); next closest are the earlier Arikara sites.

In addition to examining the group centroids, the hit-miss tables can be inspected to gain an appreciation for variation within the groups (Tables 26 and 27). But before considering the incorrect identifications, a few comments concerning the correct identifications are necessary.

The Crow Creek female and male crania are correctly identified in 78.1 and 65.7 percent of the cases, respectively. This correct identification frequency is better than any of the other groups except the Mandan, Omaha, and Pawnee--the other groups which tend to fall on the extremes of the first three CV's--including the Leavenworth males. Crow Creek's correct identification frequency probably should be expected because it fell on one extreme of CV I, the CV explaining the greatest amount of variability. Although the correct identifications are interesting, the pattern of incorrect identifications are even more useful.

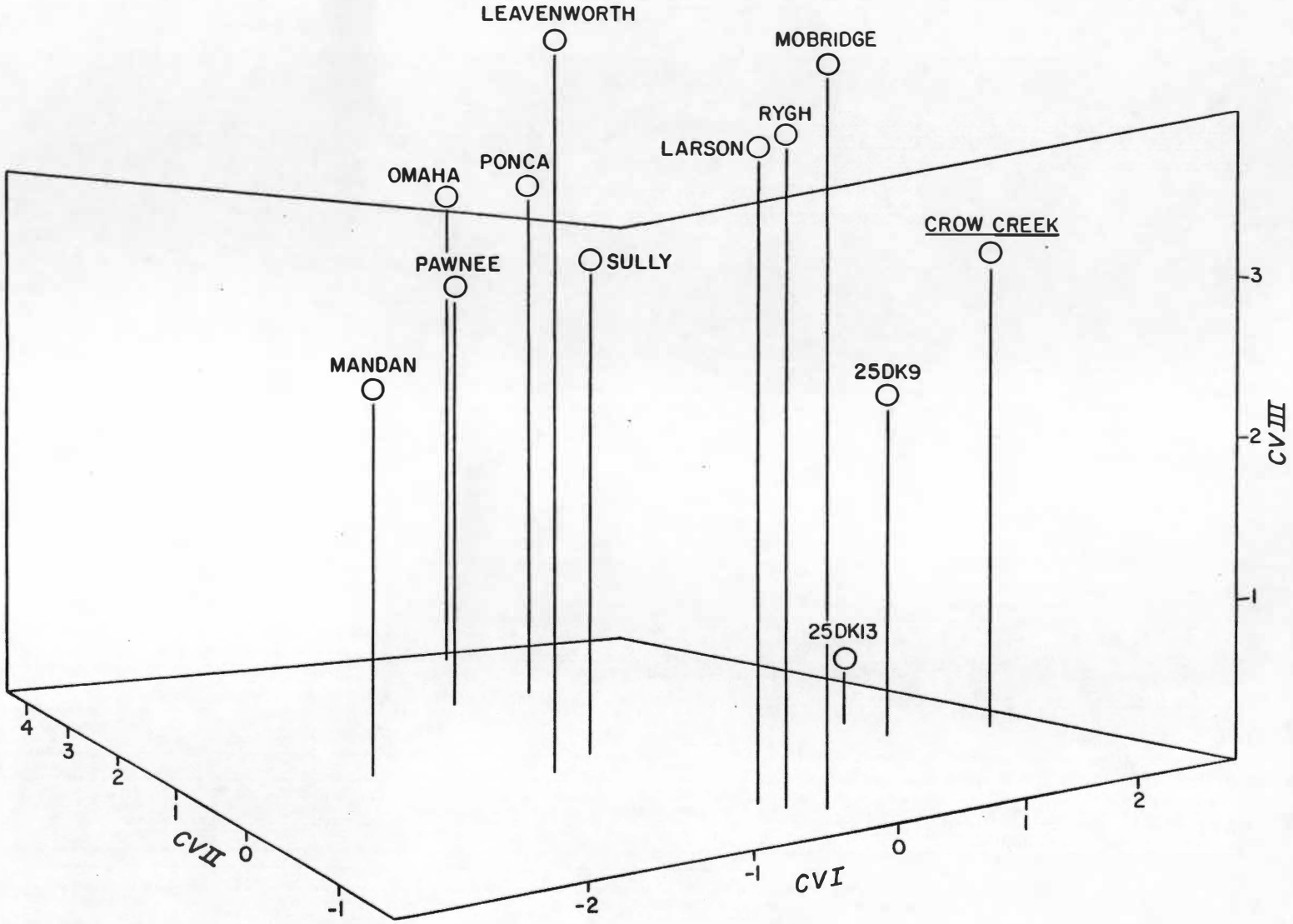


Figure 5. Crow Creek female and other female craniometric group centroids displayed on canonical variates I, II, and III.

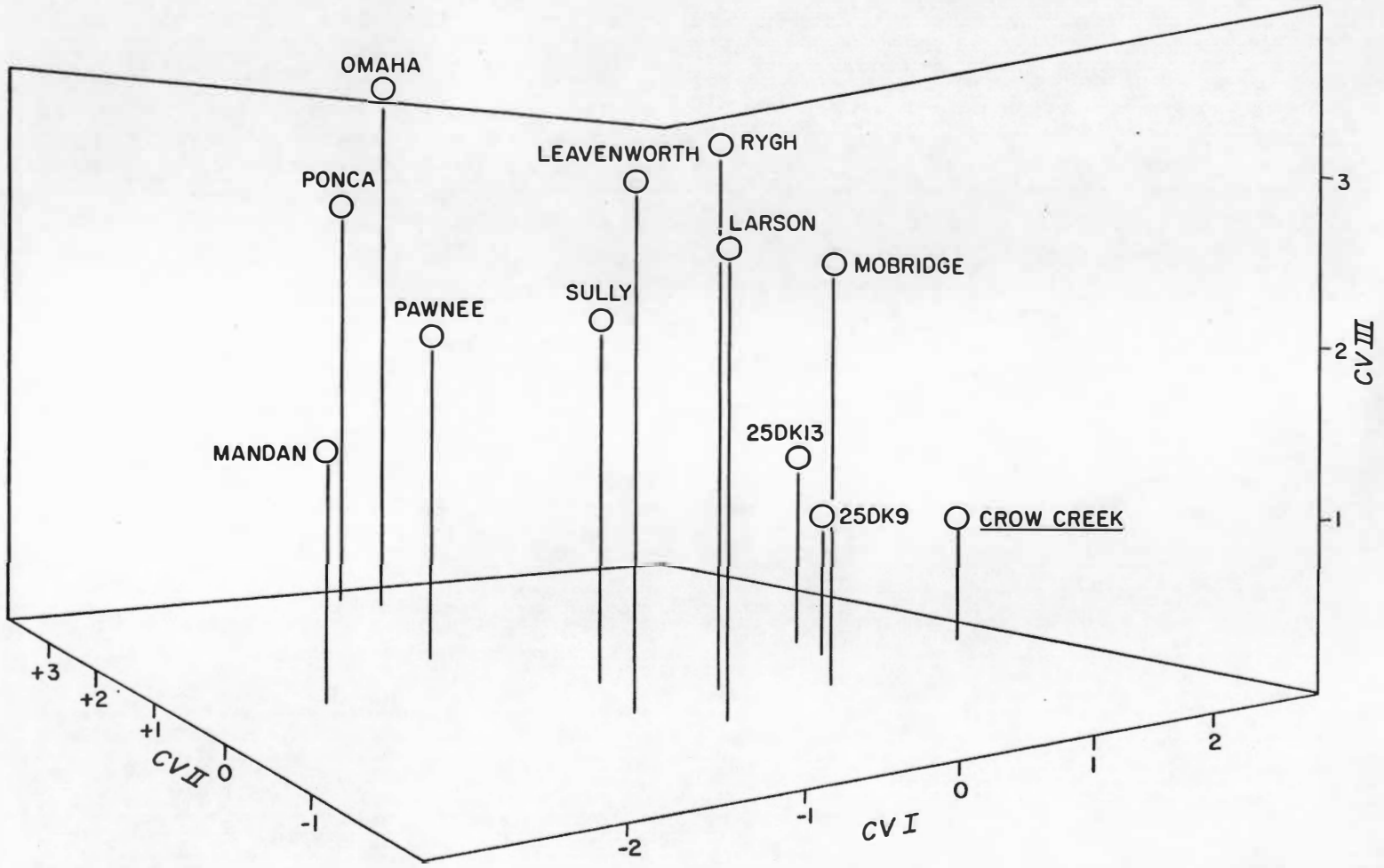


Figure 6. Crow Creek male and other male craniometric group centroids displayed on canonical variates I, II, and III.

Table 26. Hit-miss distribution of female Crow Creek and other female cranial samples.[a]

	Crow Creek	Leaven-worth	Larson	Sully	Mobridge	Rygh	Ponca	Omaha	Mandan	Pawnee	25DK9	25DK13
Crow Creek (39BF11)	25 (78.1)	0	0	0	2 (6.3)	1 (3.1)	0	0	0	0	3 (9.4)	1 (3.1)
Leavenworth (39CO9)	0	12 (63.2)	2 (10.5)	0	2 (10.5)	1 (5.3)	0	0	1 (5.3)	1 (5.3)	0	0
Larson (39WW2)	0	4 (8.5)	27 (57.4)	2 (4.3)	3 (6.4)	8 (17.0)	0	0	0	2 (4.3)	0	1 (2.1)
Sully (39SL4)	1 (3.6)	3 (10.7)	2 (7.1)	8 (28.6)	1 (3.6)	2 (7.1)	1 (3.6)	0	6 (21.4)	2 (7.1)	2 (7.1)	0
Mobridge (39WW1)	1 (5.9)	1 (5.9)	1 (5.9)	0	11 (64.7)	3 (17.6)	0	0	0	0	0	0
Rygh (39CA4)	0	0	3 (17.6)	1 (5.9)	2 (11.8)	7 (41.2)	0	0	1 (5.9)	0	1 (5.9)	2 (11.8)
Ponca	0	0	0	0	0	0	5 (62.5)	1 (12.5)	1 (12.5)	0	1 (12.5)	0
Omaha	0	0	0	0	0	0	1 (14.3)	6 (85.7)	0	0	0	0
Mandan	0	1 (5.6)	1 (5.6)	1 (5.6)	0	0	0	0	15 (83.3)	0	0	0
Pawnee	0	0	0	1 (20.0)	0	0	0	0	0	4 (80.0)	0	0
25DK9	0	0	0	0	0	0	0	0	0	0	2 (50.0)	2 (50.0)
25DK13	0	0	0	0	0	0	0	0	0	0	2 (22.2)	7 (77.8)

[a]Numbers in parentheses are percentages.

Table 27. Hit-miss distribution of male Crow Creek and other male cranial samples.[a]

	Crow Creek	Leaven-worth	Larson	Sully	Mobridge	Rygh	Ponca	Omaha	Mandan	Pawnee	25DK9	25DK13
Crow Creek	23 (65.7)	0	0	2 (5.7)	2 (5.7)	3 (8.6)	0	0	0	1 (2.9)	2 (5.7)	2 (5.7)
Leavenworth	0	14 (70.0)	3 (15.0)	2 (10.0)	0	0	0	0	0	1 (5.0)	0	0
Larson	3 (6.7)	7 (15.6)	18 (40.0)	2 (4.4)	8 (17.8)	5 (11.1)	0	0	0	2 (4.4)	0	0
Sully	1 (2.7)	4 (10.8)	6 (16.2)	7 (18.9)	0	7 (18.9)	0	0	5 (13.5)	4 (10.8)	3 (8.1)	0
Mobridge	2 (11.8)	0	3 (17.6)	1 (5.9)	8 (47.1)	2 (11.8)	0	0	0	1 (5.9)	0	0
Rygh	1 (6.7)	1 (6.7)	0	1 (6.7)	2 (13.3)	8 (53.3)	0	0	0	0	0	2 (13.3)
Ponca	0	0	0	0	0	0	4 (67.7)	2 (33.3)	0	0	0	0
Omaha	0	0	0	0	0	0	0	4 (80.0)	0	1 (20.0)	0	0
Mandan	0	0	0	1 (8.3)	0	0	0	0	10 (83.3)	1 (8.3)	0	0
Pawnee	0	0	0	0	1 (11.1)	0	0	0	0	8 (88.9)	0	0
25DK9	1 (25.0)	0	0	0	0	0	0	0	0	0	2 (50.0)	1 (25.0)
25DK13	1 (7.1)	0	0	1 (7.1)	0	0	0	0	0	2 (14.3)	2 (14.3)	8 (57.1)

[a]Numbers in parentheses are percentages.

Crow Creek crania generally misidentify as St. Helena (25DK9 and 25DK13) or early Arikara (Mobridge, Rygh, and Sully). One Crow Creek male, an exception to this generalization, is incorrectly identified as Pawnee. The hit-miss table supports what the CV analysis of the group centroids indicated; namely, Crow Creek is most similar to the St. Helena and early Arikara samples.

These results suggest that Crow Creek's morphological affiliations are closest to the St. Helena and early Arikara samples. It seems probable that the Crow Creek villagers were members of a Caddoan-speaking group. Probably the descendants of the Crow Creek people or their close relatives would have been Arikara.

The discrete trait results are more difficult to interpret. The descriptive statistics, including the number of observations absent and present, the percentage present, and the θ value, are in Table 28. The calculated morphological distances are in Table 29 and are shown in Fig. 7. The discrete traits indicate that Crow Creek is the most distinct of the samples. It is most similar to Leavenworth and Rygh, though these differ greatly from Crow Creek. On the other hand, the St. Helena sample is the most different from Crow Creek, the sample which is the most similar based on metric distances.

If the interpretations about the morphological affiliations are based solely on these results, the Crow Creek sample would be very different from the St. Helena and Arikara samples. Yet, intuitively, the material appears similar to the Arikara crania we have studied. The major problem with the discrete trait distances is they are not as readily interpretable as the metric data.

Table 28. Number of discrete traits absent and present, percent present, and θ-value for the combined sexes of Crow Creek.

Discrete Traits	Number Absent/Present	Percent Present	θ
Lambdoid ossicle-medial	79/31	28.2	.45
Lambdoid ossicle-lateral	88/22	20.0	.64
Parietal foramen	70/51	42.1	.16
Coronal ossicle	124/1	0.8	1.39
Epiteric bone	87/7	7.4	1.02
Ossicle in mastoid suture	82/22	21.2	.61
Anterior condylar canal double	100/26	20.6	.63
Accessory palatine foramen	12/97	89.0	-.89
Supraorbital foramen complete	82/48	36.9	.26
Frontal foramen	63/68	51.9	-.04
Accessory infraorbital foramen	92/22	19.3	.66
Accessory mental foramen	52/7	11.9	.87
Lambdoidal ossicle	52/7	11.9	.87
Inca bone	58/1	1.7	1.31
Pharangeal fossa	45/18	28.6	.44
Superior sagittal sulcus turns left	45/18	28.6	.44

Table 29. Morphological distances based on 16 cranial discrete trait frequencies of Crow Creek and other samples.

	Leavenworth	Larson	Mobridge	Rygh	Sully	St. Helena
Crow Creek	.90	1.23	1.09	0.93	1.50	3.30
Leavenworth		.00	1.36	.00	1.22	0.81
Larson			.00	.00	2.16	0.12
Mobridge				.00	.02	0.16
Rygh					2.74	0.14
Sully						0.33

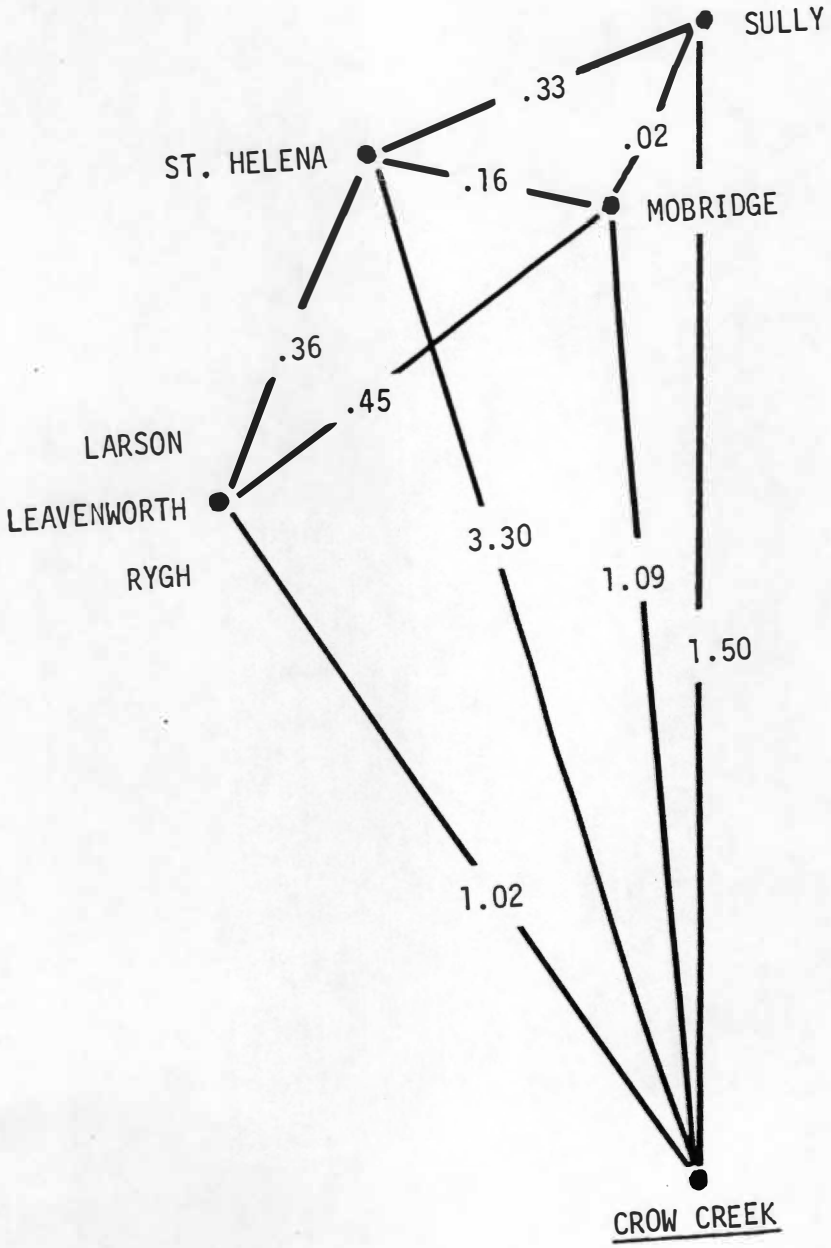


Figure 7. Morphological distances based on non-metric traits between Crow Creek and other cranial samples.

The meaning of discrete traits and their comparability to metrics has been much discussed in the literature recently (e.g., Cheverud et al. 1979, Corruccini 1976, Carpenter 1976). The purpose here is not to detail these discussions but to suggest reasons why the Crow Creek discrete trait and metric distances differ. The first possibility is that the CV's used to determine the metric distances is relatively sophisticated while the discrete trait statistic is fairly simple. Nevertheless it is hard to believe that the difference in statistical sophistication alone would account for these divergent results. Another possible explanation for the differences is that the discrete trait observations may be more susceptible to interobserver error. This error would tend tc make samples artificially more dissimilar than they are in actuality. It is also possible that discrete traits lack the sensitivity of craniometrics, and uninterpretable results should be expected when populations as similar as those studied here are examined.

CHAPTER 6

CROW CREEK MUTILATIONS

There are many historic accounts telling stories of Plains Indian atrocities and mutilations. Many skirmishes and battles were recorded and some describe mutilations, usually done by Indians to Whites, though the reverse is also recorded.

The historic hostilities are often considered aberrant contrasted to the prehistoric conditions. It is frequently thought that historic aggression was caused by depopulation of the Indians, White intrusion forcing many Indian groups to move from their traditional territories, Whites propagating hostilities among Indian groups, and the introduction of new goods--especially horses and guns. In contrast the prehistoric conditions are thought to have been tranquil.

This idea may have been caused by the nature of the ambiguous prehistoric evidence. But deadmen do tell tales, even if their story is abbreviated, obscured by fickle preservation, and cryptic. Perhaps the biggest problem is that there are relatively few prehistoric skeletons available for study. Another problem is that identifying perimortem trauma from bones is difficult in the first place, and attributing trauma to interpersonal aggression is even more tenuous. And even when interpersonal aggression is indicated, determining whether the trauma occurred before and perhaps caused death or was a mere mutilation following death is usually impossible.

Archaeological sites with contexts indicating violence justify careful inspection of their skeletons for perimortem trauma. There are only a few archaeological sites on the Plains which indicate battles were fought there.

Crow Creek is not the only or the earliest massacre archaeologically witnessed on the Northern or Central Plains. There are three other sites whose contexts suggest violent deaths. They are briefly described here in chronological order.

The Fay Tolton site (39ST11) in central South Dakota dates approximately 1000-1100 AD (Wood 1976). Four people (an adult male, two adolescent females?, and a child) in House 1 appear to have been murdered as well as one (an adult male) in House 2 (Butler 1976:28-29). The hands of one of the adolescent females? may have been severed (Butler 1976:29) and one of the adult males may have been decapitated (Lehmer 1971:101). Although the skeletons have been described (Bass and Berryman 1976), no detailed inspection of the bones for mutilations has been made.

The Wright site (25NC3) is in east-central Nebraska and probably dates between 1650 and 1700 AD (O'Shea 1980). The bodies of approximately 50 people were concentrated in a lodge near the entryway, and the lodge was burned (O'Shea 1980). This context has been interpreted as evidence that the people sought refuge in the lodge which was set ablaze, trapping and killing them. Apparently the skeletal remains have not been analyzed.

The Larson Village (39WW2) is in north-central South Dakota and dates approximately 1780 AD (Jantz 1972). The remains of about

75 people were in three lodges, and the lodges were burned. Owsley et al. (1977) find that many of the skeletons were scalped, dismembered, and burned. Material from this site will be compared with the Crow Creek mutilations later in this chapter.

It is apparent from the three examples cited above that the violence at Crow Creek is not unique. There are indications of violence on the Plains predating Crow Creek by several centuries, and some of the same kinds of mutilations found at Crow Creek have also been described from the Larson Village material. What does separate Crow Creek from the others is the enormous number of people killed. The implications of the number killed and the variety and frequency of mutilations are discussed below.

The prehistoric Crow Creek victims offer an excellent opportunity to conservatively identify perimortem trauma which marred their bones. The first purpose of this study is descriptive. A list of the mutilations observed and frequencies of certain kinds of mutilations are presented. The second purpose of this study is comparative. The mutilations on the Crow Creek ditch victims are compared with those found on the bones inside the ditch in the Crow Creek Village, those from the protohistoric Larson Village massacre, and the copious historic accounts from the Northern Plains. These comparisons permit tracing the continuity of some atrocities from the historic documents into the prehistoric period.

A. Material and Methods

About 1700 sacks of Crow Creek material were inspected, although some of the material from the looter's hole may have been omitted. A data collection form was used which listed the elements to be inspected and provided a space for notes. The description of burned bones is based on their study by Mark Swegle (Zimmerman et al. 1981: 182-187) while the other mutilations were examined by Willey.

To obtain a list and an appreciation of the variety of the mutilations present, a preliminary examination of 100 bags of material was made in February of 1979. All fragments in all 100 bags were inspected for perimortem damage, and the damages were noted on the inventory forms. Specifically the bones were inspected for cutting, old but unhealed breaks, and chewing. This procedure was extremely tedious and too time-consuming to complete in the time available for the study, so the process was modified. The rest of the bones were observed for a limited number of traits which were readily observable and could be recorded as present or absent. Other unusual traits not consistently observed were noted, though frequency data for these features (e.g., postcranial cutting and burning) are not recorded. The rest of this description of the methods employed concentrates on those observations amenable to frequency data beginning with the skull and proceeding inferiorly.

Skulls and mandibles were inspected for cuts, fractures, and evulsions. Cutting of the cranial vault was generally interpreted as scalping. The bones which had been cut were noted on the mutilation

inventory sheet. While inspecting the more complete skulls, it became apparent that the deepest cuts on the vaults almost always occur on the frontals, an observation suggested in the historic accounts and previous descriptions of skeletal scalpings. The frequency of scalping is based on the presence/absence of cuts on the frontal. Fragmentary frontals are included in the count only when more than half of the lateral portion of the frontal was present. In addition to the frequency of frontal scalping, note was made of all cranial bones with cuts. This inventory is intended to show the distribution of cuts on the skull vault, not the frequency of presence/absence.

Cuts on the base of the skull (near the foramen magnum, especially the occipital condyles) and the first and second cervical vertebrae are interpreted as decapitation. Occasionally cuts were noticed on the alveolar portions of the mandible and maxilla, and these were recorded but no frequency data were taken.

After more than three-fourths of the bags had been inspected, cuts were found near the nasal aperture, suggesting nose cutting or face slicing; at that point an attempt was made to record the presence/absence of these cuts. Later, when the more complete skulls were removed from their sacks for sexing, their nasal apertures were also inspected for cuts. Thus some frequency data are available for this mutilation. Mandibles, especially the inferior and posterior borders, were inspected for cutting.

Fractures on the cranial vault were also noted. It is difficult with linear fractures to assess whether they happened near the time of death or much later. Because of this uncertainty, linear

breaks are not noted, and only depressed fractures were systematically searched for. One hundred one relatively complete skulls were inspected by Max Schmeling, then a student at the University of South Dakota. The fracture's location, shape, size, and axis were noted.

Evulsions were noted for both the maxilla and mandible. Generally the criteria used to determine the presence of evulsions were an old, stained color on the broken surface or an irregularly broken tooth. In a few cases other criteria were used; if the alveolar portion surrounding a broken tooth root was snapped, the tooth was considered evulsed.

The presence/absence of cutting, fracturing, and evulsion were noted on the forms. In those cases where there was not enough of the specimen present for an assessment of presence/absence, a dash was put beside the appropriate heading. Recording mutilations present on the postcranial remains followed this same format, though the parts present were also noted.

When recording the postcranial mutilations, the part and portion of the long bones present was noted first. The part of the bone is listed as proximal, shaft, distal, or whole. Whole is used when both ends and the shaft were present, proximal when the proximal articular end was present, shaft when neither of the articular ends were present, and distal when the distal articular end was present. The proportion indicated how much of the specimen was present. Proportions were estimated and noted in the following fractions: 1/8's, 1/4's, 1/3's, and 1/2's.

Spaces are provided on the mutilation inventory form for almost all long bones. In all cases, the proportion and part of the bone present are noted, followed by the condition of the ends. The missing ends are listed as being whole, chewed, splintered, or lost postmortem (example, "Dist. chewed").

Because chewing, splintering, and snapping are ambiguous terms, they require definition. Chewing is used to describe small puncture marks which were commonly found near the ends of Crow Creek long bones and the projecting parts of other bones (Fig. 8). This designation is based on the similarities between these marks on the Crow Creek material and marks found on present-day forensic cases in The University of Tennessee, Knoxville, collection. The marks are attributed to dogs chewing the bones. These marks are also similar to those reportedly produced by animal chewing (Miller 1975). While inspecting the Crow Creek material, the use of chewing changed. As the data collection proceeded, broad grooves were noticed near some chewed ends. These grooves appear to have been caused by gnawing with the posterior teeth rather than chewing with the anterior. In these instances chewing is used to describe the grooves even though the characteristic puncture marks are absent.

Snapping is used when it appears that the bone was broken by transverse pressure while the bone was fresh. In many instances a "hinge" fracture was present (Fig. 9). In the earlier stages of data collection, there was a tendency to identify more bones snapped than later. Many of the bones identified as snapped earlier in the data collection would have been identified as splintered after Box 50.



Figure 8. Chewing on left femur head. Scale in centimeters. Specimen 39BF11 70-12.

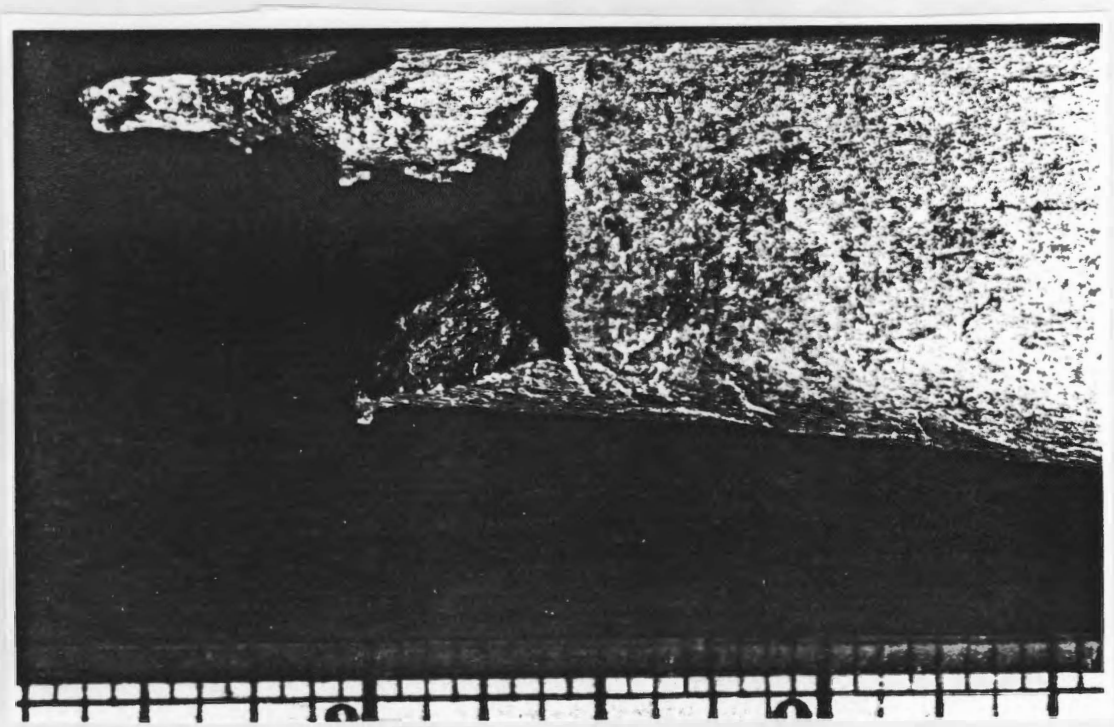


Figure 9. Snapping of left humerus shaft. Scale in inches. Specimen 39WW2-932.

To compensate for this change in methods the snapped and splintered categories are combined for analytical purposes.

Splintering is when the bone end is not chewed or snapped but forms a jagged projection or projections and the cortical surface of the break is smooth, apparently having happened while the bone was fresh (Fig. 10). Splintering may have resulted from direct pressure, especially with some tool or as the bone fell against some hard object. Some bones identified as splintered may actually have been chewed but lack the identifying puncture marks or grooves. Crushing is similar to splintering but seems to result from activity after the bone lost its viability; cortical break surfaces are rough.

In addition to the bones of the skull and neck and the long bones, short and irregular bones were inspected. The bones of the hands and feet were inspected. Each of the few carpals recovered were individually inspected and noted. The tarsals, except the cuneiforms, were individually inspected. Although not individually separated, the cuneiforms were inspected for mutilation.

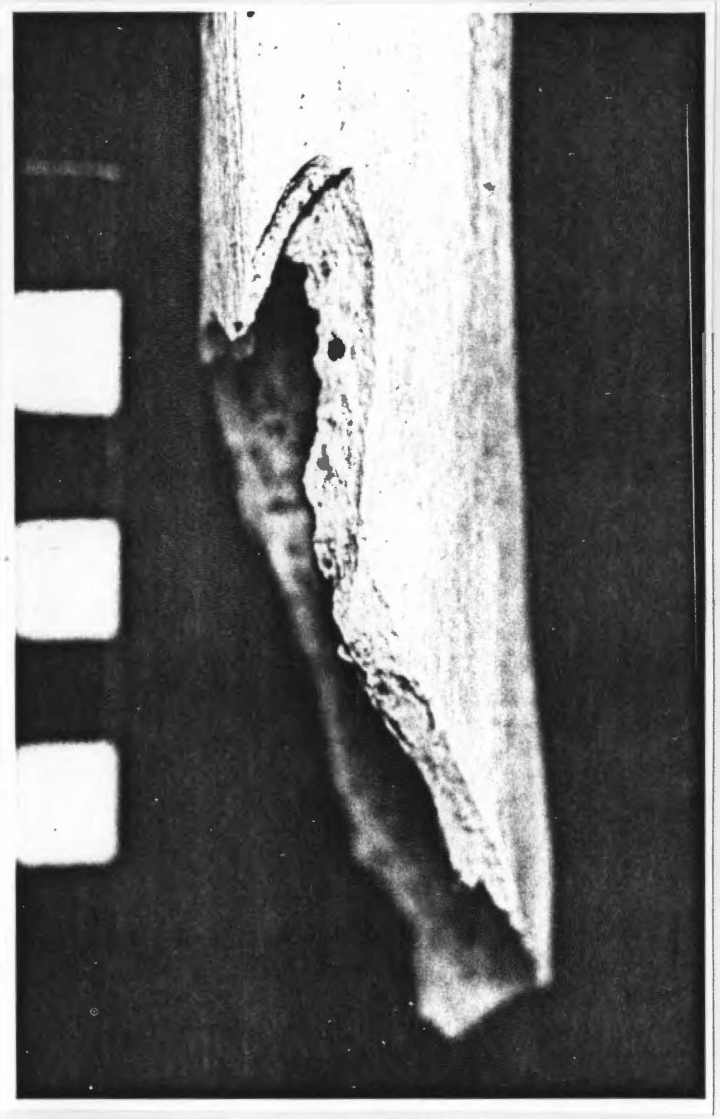
The innominates were inspected for the presence/absence of chewing on the iliac crest and the ischium. In many instances of chewing on the iliac crest, the chewing centered near the anterior superior spine, and this was noted.

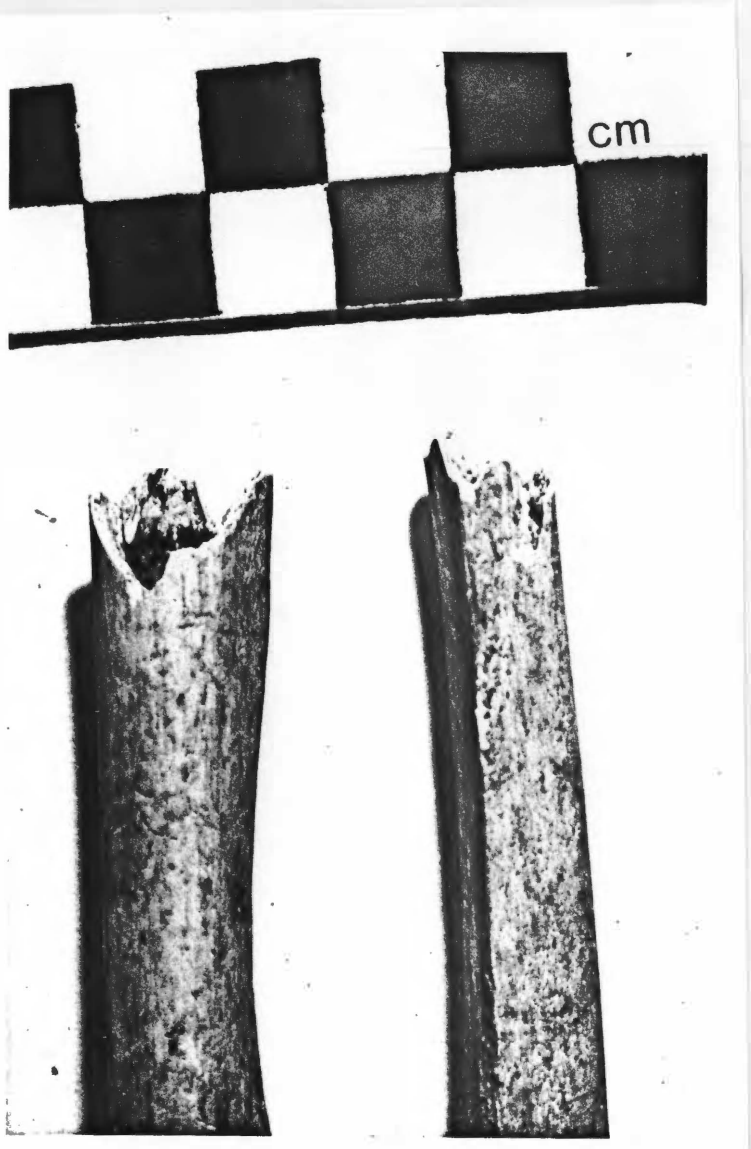
Although there is no space provided on the recording sheets, presence/absence of chewing on patellae was also noted. No space is provided for the scapulae or clavicles, either, but they were inspected, too. On the scapula, only the acromial process was examined, and note made whether the process was whole, chewed, or

Figure 10. Splintering of long bones.

A. Splintered distal radius (above) and ulna (below). Specimens 39BF11 137-7.

B. Splintered distal femur shaft. Scale in centimeters. Specimen 39BF11 53-5.




cm

splintered. Clavicles were examined following the process described for the long bones, although the ends were listed as medial and lateral rather than proximal and distal.

Absences of mutilation were noted by the end of the bone being listed as present but no indication of mutilation being present. This is a potentially confusing, though expeditious, way of noting the lack of mutilation. Small fragments and those fragments lacking definitive modifications were omitted. Questionable assessments were followed by a question mark. Combinations of modifications were noted by listing both mutilations with the first modification listed being the more pronounced or more likely.

To provide a visual record, photographs were taken of examples of each category. Some of the negatives have been lost, and those that remain are at the University of South Dakota. Some of the photographs used in this study are of skeletons from the Nebraska State Historical Society's excavations at the Crow Creek Village site and the River Basin Survey's excavations of the Larson Village.

The methods used on the Crow Creek skeletons were also used to examine those from the Larson Village and the Nebraska State Historical Society's Crow Creek Village skeletons. Both samples were studied in January 1981.

Published historic sources were searched for mutilations. First the sources cited in M. Smith's (1938) article were read. Then sources in the card catalog in The University of Tennessee's Hoskins Library were checked. Most of the references under the card catalog heading North American Indians--Wars dealing with the Northern Plains were

read. While the search was eclectic and undoubtedly many valuable published sources missed, the sample probably includes most historic mutilations.

B. Results and Discussion

Crow Creek Mutilations

The great majority of the Crow Creek frontals show cuts suggesting scalping. Of the frontals in Bed A, 17 (94.4 percent) are cut and one (5.6 percent) may have been (Table 30). In Bed B 354 (89.2 percent) are cut, 24 (8.1 percent) may have been, and 19 (4.8 percent) are not (Table 30). There seems to be no age group or sex exempt from scalping: women and children as well as men display the distinctive cuts.

When the cuts observed on all cranial bones and fragments (Table 31) are tabulated by age (adult, adolescent, and child), there are statistically significant differences among the age groups and the bones cut ($X^2 = 13.57$, DF = 4, $0.05 > P > 0.025$). The largest differences from expected values are found in the lack of cut adult parietals and child temporals and the abundance of cut adult temporals and child parietals.

If it is assumed that no differences in preservation or breakage exist among the age groups, then it appears that more of the scalp of adults and adolescents was taken, while only the top-lock of the scalp of children was removed. This distribution suggests several possible explanations. The hair on the sides of the children's heads may have been undesirable, or perhaps the scalp could be ripped more easily

Table 30. Mutilations of skulls from Crow Creek.[a]

Mutilations	Bone Bed A			Bone Bed B		
	Present	Present?	Absent	Present	Present?	Absent
Scalping	17 (94.4)	1 (5.6)	0	354 (89.2)	24 (4.8)	19 (6.0)
Cut Noses	0	0	0	4 (4.5)	0	85 (95.5)
Evulsions	3 (75.0)	1 (25.0)	0	35 (23.5)	7 (4.7)	107 (71.8)
Decapitation						
Occipital	2 (66.7)	0	1 (33.3)	31 (13.6)	6 (2.6)	191 (83.8)
C-1	1 (100.0)	0	0	56 (24.5)	3 (1.3)	170 (74.2)
C-2	0	0	0	31 (16.5)	4 (2.1)	153 (81.4)

[a]Percentages are in parentheses.

Table 31. The location of cuts on the Crow Creek skulls and skull fragments suggesting scalping by age and sex.[a]

Locations	Female		Female?		?		Male		Male?		Adolescent		Child		Infant		Total	
Frontal	42	(22.0)	35	(26.5)	40	(26.1)	31	(28.2)	24	(32.4)	24	(26.4)	77	(29.3)	8	(38.1)	281	(27.1)
High	0		0		3	(2.0)	4	(3.6)	2	(2.7)	2	(2.2)	8	(3.0)	0		19	(1.8)
Middle	5	(2.6)	7	(5.3)	6	(3.9)	10	(9.1)	6	(8.1)	6	(6.6)	12	(4.6)	0		52	(5.0)
Low	17	(8.9)	11	(8.3)	10	(6.5)	5	(4.5)	1	(1.4)	5	(5.5)	8	(3.0)	1	(4.8)	58	(5.6)
Total	64	(33.5)	53	(40.1)	59	(38.5)	50	(45.4)	33	(44.6)	37	(40.7)	105	(39.9)	9	(42.9)	410	(39.5)
Parietal	1	(0.5)	1	(0.8)	7	(4.6)	1	(0.9)	0		3	(3.3)	26	(9.9)	1	(4.8)	40	(3.9)
Left	40	(20.9)	24	(18.2)	25	(16.3)	17	(15.5)	15	(20.3)	14	(15.4)	45	(17.1)	4	(19.0)	184	(17.8)
Right	37	(19.4)	22	(16.7)	31	(20.3)	18	(16.4)	12	(16.2)	13	(14.3)	47	(17.9)	4	(19.0)	184	(17.8)
Total	78	(40.8)	47	(35.7)	63	(41.2)	36	(32.8)	27	(36.5)	30	(33.0)	118	(44.9)	9	(42.8)	408	(39.5)
Temporal	0		0		2	(1.3)	1	(0.9)	1	(1.4)	1	(1.1)	1	(0.4)	0		6	(0.6)
Left	11	(5.8)	12	(9.1)	8	(5.2)	7	(6.4)	5	(6.8)	8	(8.8)	9	(3.4)	1	(4.8)	61	(5.9)
Right	11	(5.8)	8	(6.1)	9	(5.9)	6	(5.5)	2	(2.7)	4	(4.4)	5	(1.9)	0		45	(4.3)
Total	22	(11.6)	20	(15.2)	19	(12.4)	14	(12.8)	8	(10.9)	13	(14.3)	15	(5.7)	1	(4.8)	112	(10.8)
Occipital	27	(14.1)	12	(9.1)	12	(7.8)	10	(9.1)	6	(8.1)	11	(12.1)	25	(9.5)	2	(9.5)	105	(10.1)
Total	191	(100.0)	132	(100.1)	153	(99.9)	110	(100.1)	74	(100.1)	91	(100.1)	263	(100.0)	21	(100.0)	1035	(99.9)

[a]Both Beds A and B are included. Percentages by column are given in parentheses.

from their heads than that of adolescents and adults. It is also possible that the hair style of the children differed from those of the adolescents and adults; the children's hair may have been in a "Mohawk" style more frequently than their elders.

Using the same data but inspecting just the subadults, a statistically significant difference in distribution of cuts exists between adolescents and children ($X^2 = 9.29$, DF = 3, $0.05 > P > 0.01$). Similar to the differences between adult and child cut locations, the largest differences from expected values are the lack of cut adolescent parietals and child temporals and the abundance of cut adolescent temporals and child parietals.

When the adult scalp marks are divided by bone and sex (female and female? categories are combined as are male and male?), no statistically significant differences are observed ($X^2 = 4.00$, DF = 3, $0.50 > P > 0.25$). Also, there is no statistically significant difference between the side of the temporals and parietals cut when all age categories are lumped ($Z = 0.0001$, $F(Z) = 0.50$).

The typical Crow Creek scalping has two elements: the primary, circling cuts and the secondary, scattered cuts. The circling begins with the deepest, most frequent cuts slicing transversely across the frontal midway between nasion and bregma. Sometimes the circling cuts are single and long, but usually there are several groups of short cuts. As the circling cuts proceed posteriorly, the cuts generally become fewer and shallower on the lateral and posterior parts of the vault. Crests, lines, and processes usually best display the cuts. These cuts, when present, are found on the squamosal portion, temporal

line, and sometimes the mastoid of the temporal and the squamosal portion of the occipital.

In addition to these primary, circling cuts, there are often secondary cuts scattered over the vault. The most likely purpose of the secondary cuts is loosening and skinning the scalp within the boundaries scribed by the circling cuts. Usually these secondary cuts are in a transverse direction, but there is much variability.

Variations from the typical scalping just described were noted while inspecting the Crow Creek remains. One variation is the location of the primary cuts on the frontal. These cuts usually are present midway on the frontal, but sometimes they are located lower on the frontal, in some cases immediately superior to glabella. At the other extreme, some cuts begin near bregma.

A second noteworthy variation is present on some occipitals. Occasionally the circling cuts on the posterior portion of the vault are much inferior to inion. These cuts must have severed the posterior nuccal muscles. Because these cuts are some distance from the foramen magnum, they probably do not indicate decapitation. Although it is assumed here that these cuts are associated with scalping, they might have been intended to mutilate the body otherwise.

A final variation is associated with some depressed fractures. When present the primary cuts occur on the side of the fracture where the majority of the scalp was. This pattern suggests that the scalper was attempting to avoid gashes and holes in the scalp. It also suggests that the fractures--at least in some cases--happened before the scalping.

There are other possible indications of scalping beside the cut marks already discussed. Some historic accounts (e.g., Catlin 1844:238) tell that some people lived through the scalping ordeal. At Crow Creek two skulls (numbers 13 and 264) show remodeling comparable to what has been identified as survival following scalping (Hamperl and Laughlin 1959). Neither of these two skulls retain any cut marks, the marks apparently having been remodeled and destroyed. The importance of these two skulls is that they indicate that violence was not limited to the Crow Creek massacre itself but was more long-lived.

That nearly 90 percent of the skulls show indications of scalping is all the more remarkable when two things are considered. First, the two skulls which appear to have been victims of previous scalpings who survived until the massacre are omitted from the count of those skulls with cut marks and consequently not included with those scalped. Second, Hamperl (1967) demonstrated that it was possible to scalp a person and leave no marks on the bone. If this happened at Crow Creek, then the frequency of scalped frontals is too low. In conclusion, the nearly 90 percent scalped frontals must be considered a minimum figure; the actual figure may well have approached 100 percent.

About 40 percent of the skulls have depressed fractures (Table 32). Most of the skulls had one depressed fracture, though two skulls had as many as five. The majority of the fractures (Table 33) were on the parietals, fewer on the frontals, nearly none on the

Table 32. Skulls with and without depressed fractures from Crow Creek.

Skulls with Fractures Number of Fractures					Skulls without Fractures
1	2	3	4	5	
28	8	2	2	2	
(66.7)[a]	(19.0)	(4.8)	(4.8)	(4.8)	
Total count	42 (41.6)				59 (58.4)

[a]Percentages are in parentheses.

Table 33. Location of depressed fractures on Crow Creek skulls.

Quantity	Frontal	Parietal		Occipital	Temporal
		Left	Right		
Number	20	18	27	3	0
Percent	29.4	26.5	39.7	4.4	

occipital, and none at all on the temporals. Bluntly speaking, the blows seem most common on the top of the vaults.

The outline of the more complete depressions is either round or ellipsoid. Of the 66 depressed fractures classified as round or ellipsoid, 22 (33.3 percent) are round (Fig. 11) and 44 (66.7 percent) are ellipsoid (Fig. 12). There are both large and small round depressed fractures. While in some cases the ellipsoid fractures may have been caused by an instrument with a round diameter obliquely striking the skull, in other instances it is apparent that the tool used had an axe-like cross-section. These ellipsoid depressions, when the depressed bone plug is left intact, have a linear crack running the long axis of the ellipsoid as well as the oval crack forming the outline of the ellipsoid fracture (Fig. 12). No axes with a cross-section like this have been recovered archaeologically from this time period on the Middle Missouri (R. Alex 1979).

Only four (4.5 percent) of the 89 nasal apertures inspected are cut (Table 30, page 102). Those few cuts observed are immediately lateral and parallel to the long axis of the nose, although one cut is present immediately inferior to the nasal sill. It is unfortunate that more cuts were not found so a more definitive pattern could be established.

Evulsion or removal of the teeth occurred fairly frequently among the Crow Creek specimens (Table 30). There are three (75.0 percent) with and one (25.0 percent) possibly without evulsions in Bed A. Bed B showed the reverse proportions: namely, 35 (23.5

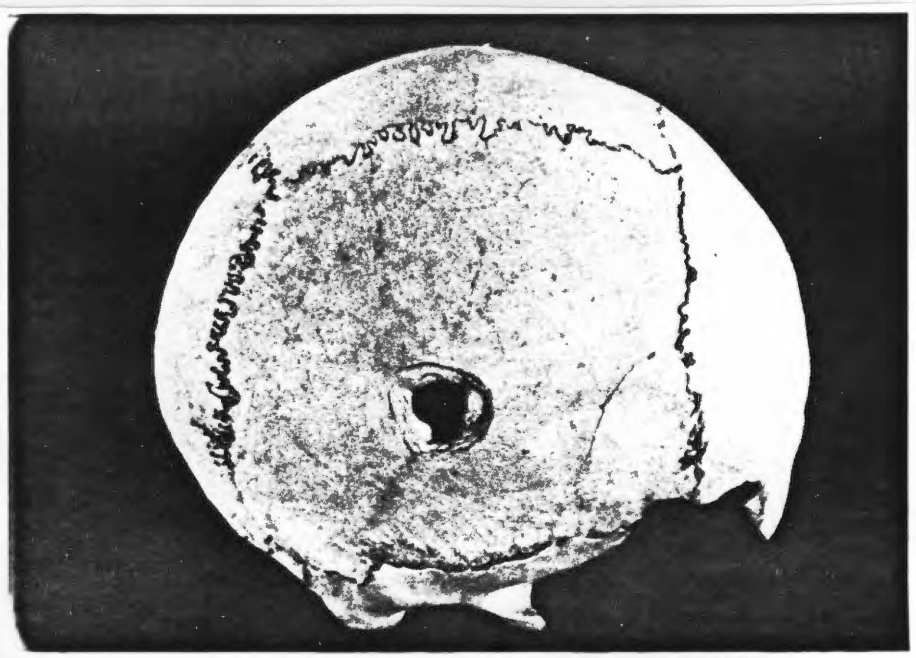


Figure 11. Round depressed fracture on right parietal. Hole diameter 12mm. Specimen 39BF11 98-16 Skull 230.



Figure 12. Ellipsoid depressed fracture on left parietal. Length of fracture 35mm. Specimen 39BF11 96-1 Skull 216.

percent) with, 107 (71.8 percent) without, and the rest (7 or 4.7 percent) are questionable.

Tongues may have been cut from the mouths of the Crow Creek victims. Cuts on the posterior border of the ascending ramus of the mandible may have been incidentally made by a knife during decapitation. But cuts on the inferior border of the corpus are harder to interpret this way. And even more difficult to include as part of beheading are cuts on the medial surface of the mandibular corpus. The most reasonable explanation for these marks is that some tongues are cut loose beginning in the throat under the chin rather than going through the mouth.

Beheading is indicated by cuts around the foramen magnum and cervical vertebrae numbers 1 (C-1) and 2 (C-2). The frequency of these cuts is presented in Table 30 (page 102). Because few observations are possible on material from Bed A, comments are confined to those from Bed B. Cuts are most common on C-1. If this frequency can be taken as an accurate reflection of decapitation attempts, then about a quarter (24.5 percent) were mutilated in this way.

The frequency of cuts varies depending on the bone. Dividing the cuts into those on the occipital, C-1, and C-2 and by presence, presence?, and absence ($X^2 = 10.22$, DF = 4, $P < 0.05$) and by presence and absence alone ($X^2 = 9.17$, DF = 2, $P < 0.05$), both display statistically significant relationships. The cells contributing most to significance are the relative under-representation of occipital cuts and the over-representation of C-1 cuts. This pattern suggests

that the cuts in beheading attempts were centered around C-1, near the base of the skull.

The cuts near the foramen magnum tend to be anterior to the foramen on the condyles or lateral to the foramen magnum on the lateral portions of the occipital. Cuts on C-1 and C-2 tend to be on the anterior surfaces of the transverse processes. This pattern of cutting from anterior to posterior would avoid the problems of getting a blade between the spinous processes on the posterior portion of the vertebrae, but starting the cuts on the anterior surfaces would be difficult because the spaces between the bones would be hard to locate. The anterior to posterior cutting sequence during beheading attempts is similar to the scalping process.

There are other cuts which may indicate beheading. Cuts are present on the posterior border of the mandibular ascending ramus, the gonial angle, and the inferior border of the corpus. These cuts on the mandible may be indications of decapitation attempts. Because of the disarticulation at Crow Creek, no association between the cuts on the mandible, occipital, and first two cervical vertebrae could be established. It is, nevertheless, a possibility.

Beside decapitation, other dismemberments are suggested by cuts on other postcranial bones. This discussion starts with cuts on the bones of the arm, then proceeds to those of the leg. It should be recalled that no specific search was made for these cuts, and those noticed are probably only the most obvious ones.

Cuts are present on all three of the elements of the arm. Starting proximally and proceeding distally, three cuts are located on

the proximal portion of the humerus (Box 41-Bag 6, 117-12, 158-9), a possible cut near midshaft (22-2-D), and two near the distal end of the humerus (60-10, 150-3). All but one of the cuts are on right humeri. There are three ulnae with cuts: two near the proximal end (23-9, 74-7) and one near the distal end (164-14). One radius (71-12-A) has a cut one-third of the bone's length from the distal end on the anterior surface.

There are a number of Crow Creek leg bones which suggest dismemberment. An innominate (29-16) is cut on the lateral surface of the ilium. The only other cuts found near the hip are on the medial surface of the proximal ends of six femora (125-1, 129-5, 134-7, 151-12-C, 156-1-A, 166-12-A-B). All except one of the cuts (125-1) are on right femora. A right tibia (164-3) and a right? fibula (51-6-A-C) are cut on the proximal ends.

When all of the cut long bones are considered together, there is an interesting difference in side incidence (Table 34). Almost four times more rights are cut than lefts. Assuming that cutting is equally probable on each side and the sides are equally represented, the distribution of cuts is statistically significant ($Z = 2.52$, $F(Z) = 0.9941$, $P < 0.01$). But because it has been established from the minimum count presented in a previous chapter that rights ($n = 1737$) are more frequent than lefts ($n = 1653$), the second assumption is violated. Lefts amount to 95.7 percent of the right total, and the probability of randomly drawing a left from the sideable bones of Crow Creek is 0.4876, a right is 0.5124. Using these revised probabilities, the cutting distribution is still significant

Table 34. Number of Crow Creek long bones with cuts.

Elements	Left	Right	Total
Humerus	1	5	6
Ulna	2	1	3
Radius	0	1	1
Femur	1	6	7
Tibia	0	1	1
Fibula	0	1	1
Total	4	15	19

($Z = 2.42$, $F(Z) = 0.9922$, $P < 0.01$), so the distribution is not due to the over-representation of the right side. What this distribution means is problematic.

If, as appears to be the case in the present data, rights are more often cut and rights presumably more frequently severed from the trunk and thus more subject to loss, then we would expect right elements to be less common than the lefts--the reverse of what is observed. It is possible that the right side of the body, having more muscles and tissue, required more cutting than the lefts, thus leaving more cuts on the right. It is of interest that the major left-right differences in cutting frequency are on the more proximal limb bones--the humerus and femur--which have greater muscle mass than the distal limb bones. These results are as would be expected according to the explanation presented. Admittedly this explanation is tenuous.

Besides the presence of cutting, it is possible that some of the splintered and snapped bones may indicate dismemberment. Some of the limb bones may have been smashed, then a cut made through the tissue and shattered bone fragments, severing the distal member from the body. Rather than attempting to locate and cut through the joints, shattering the bone near the appendage to be removed may have sped and facilitated the dismemberment. There is some slight support for this possibility because nearly all limbs are more frequently snapped or splintered at the distal end than the proximal, the humerus being the only exception (Table 35).

If snapping and splintering can indeed be considered caused by shattering blows and part of dismemberment, then toes, as indicated by

Table 35. Crow Creek long bone modifications from Bed B.

Elements	Chewed		Snapped and Splintered		Crushed		Not Modified		Total	
Humerus										
Proximal	50	(4.2)	83	(7.0)	4	(0.3)	214	(18.1)	351	(29.6)
Shaft	1	(0.1)	24	(2.0)	0		384	(32.4)	409	(34.5)
Distal	168	(14.2)	82	(6.9)	4	(0.3)	170	(14.4)	424	(35.8)
Total	219	(18.5)	189	(15.9)	4	(0.6)	768	(64.9)	1184	(99.9)
Radius										
Proximal	27	(5.0)	28	(5.2)	2	(0.4)	129	(24.0)	186	(34.6)
Shaft	0		24	(4.5)	2	(0.4)	158	(29.4)	184	(34.2)
Distal	17	(3.2)	86	(15.9)	0		65	(12.1)	168	(31.2)
Total	44	(8.2)	138	(25.6)	4	(0.8)	352	(65.4)	538	(100.0)
Ulna										
Proximal	75	(12.8)	52	(8.9)	7	(1.2)	86	(14.7)	220	(37.5)
Shaft	2	(0.3)	32	(5.5)	1	(0.2)	176	(30.0)	211	(36.0)
Distal	13	(2.2)	76	(12.9)	1	(0.2)	66	(11.2)	156	(26.5)
Total	90	(15.3)	160	(27.3)	9	(1.6)	328	(55.9)	587	(100.1)
Femur										
Proximal	250	(12.7)	36	(1.8)	11	(0.6)	373	(18.9)	670	(34.0)
Shaft	7	(0.4)	14	(0.7)	0		629	(31.8)	650	(32.9)
Distal	183	(9.3)	169	(8.6)	13	(0.7)	291	(14.7)	656	(33.3)
Total	440	(22.4)	219	(11.1)	24	(1.3)	1293	(65.4)	1976	(100.2)
Tibia										
Proximal	69	(5.1)	102	(7.5)	8	(0.6)	273	(20.0)	452	(33.2)
Shaft	4	(0.3)	49	(3.6)	3	(0.2)	413	(30.3)	469	(34.4)
Distal	87	(6.4)	125	(9.2)	9	(0.7)	222	(16.3)	443	(32.6)
Total	160	(11.8)	276	(20.3)	20	(1.5)	908	(66.6)	1364	(100.2)
Fibula										
Proximal	5	(0.7)	30	(4.5)	0		175	(26.0)	210	(31.2)
Shaft	0		23	(3.4)	1	(0.1)	219	(32.5)	243	(36.0)
Distal	29	(4.3)	62	(9.2)	3	(0.4)	127	(18.8)	221	(32.7)
Total	34	(5.0)	115	(17.1)	4	(0.5)	521	(77.3)	674	(99.9)

[a]Questionable identifications omitted. Numbers in parentheses are percentages for that bone.

snapped or splintered metatarsals, were most frequently severed (Table 36). Arms (acromial processes) were next most frequently dismembered, followed by fingers, hands, ankles, and feet, lower legs, and lower arms (Tables 35 and 36). It would be interesting to compare these observations statistically with cut marks to further test the assumption that some snapping and splintering was involved with dismemberment, but there are so few cuts observed (n = 19) that no reliable conclusions can be established. A major problem is whether all snapping and splintering was caused by shattering blows or caused by other processes.

It is possible that if the bones were thrown into the ditch, impact caused the bones to break, but it is entirely possible that much of the snapping and splintering was produced by scavengers chewing the bones. This possibility is especially likely for some of the small tubular bones, like the metatarsals and metacarpals, and some of the more cortical bones, like the acromial process. The more cancellous bones are more likely to show the definitive tooth marks indicating chewing.

There are many bones which were chewed. The most common bones having puncture marks are the cancellous bones which project and the ends of long bones. Chewing occurs most frequently on the calcaneous, followed by the acromial process, ischium, patella, iliac crest, and talus (Table 36). If some of the snapped or splintered bones were actually chewed, then metacarpals and metatarsals should be added to the list of frequently chewed bones.

Table 36. Modifications of non-long, postcranial bones from Crow Creek.[a]

Locations	Chewed		Snapped and Splintered		Not Modified		Total	
Acromial process	55	(40.1)	47	(34.3)	35	(25.5)	137	(99.9)
Sternum	4	(10.3)	0		35	(89.7)	39	(100.0)
Sacrum	15	(15.3)	0		83	(84.7)	98	(100.0)
Patella	14	(35.0)	0		26	(65.0)	40	(100.0)
Iliac crest	138	(33.7)	1	(0.2)	271	(66.1)	410	(100.0)
Ischium	143	(35.7)	0		258	(64.3)	401	(100.0)
Carpals	2	(2.7)	0		72	(97.3)	74	(100.0)
Metacarpals	3	(6.1)	11	(22.4)	35	(71.4)	49	(99.9)
Hand phalanges								
Proximal row	4	(16.0)	0		21	(84.0)	25	(100.0)
Middle row	0		0		5	(100.0)	5	(100.0)
Distal row	0		0		4	(100.0)	4	(100.0)
Talus	38	(29.0)	0		93	(71.0)	131	(100.0)
Calcaneous	79	(79.8)	0		20	(20.2)	99	(100.0)
Other tarsals	8	(3.2)	0		241	(96.8)	249	(100.0)
Metatarsals	40	(18.3)	110	(50.2)	69	(31.5)	219	(100.0)
Foot phalanges								
Proximal row	1	(14.3)	1	(14.3)	5	(71.4)	7	(100.0)

[a]Questionable identifications omitted. Numbers in parentheses are percentages for that bone or area.

The ends of long bones (Table 35) are commonly chewed, though less frequently than the bones already mentioned. The long bones most frequently chewed are the femur, humerus, ulna, and tibia. Even on these long bones, the shaft is virtually ignored in favor of chewing the ends of the bone. If snapping and splintering can be considered caused by chewing, then a somewhat similar distribution as the tooth marks is observed on the long bones (Table 35). The shafts are at least as frequently snapped or splintered as they are chewed.

It was noted above that the missing hands and feet may have been taken by the raiders, but it is possible that these parts were devoured by the scavengers. The chewing on the bones of the hands, feet, lower arms, and lower legs may testify to this suggestion.

From these observations, it is apparent that there was much chewing of the bodies, even if only the puncture marks are considered. This amount of chewing suggests that the bodies were exposed for some time before interment or that there were many scavengers present. Probably there was both a lapse of time and a great number of scavengers present. The most likely scavengers responsible were the village dogs and the ubiquitous wolves and coyotes. Although no indications were found on the bones, it is also likely that the carrion-feeding birds were involved.

It is entirely possible that as large as the canids were and as small as an infant is that the bodies of some of the infants and small children may have been completely devoured by the scavengers (cf. Miller 1975:213) or dragged elsewhere, scattered, and not recovered for burial. If scavengers did remove the smaller bodies,

then they would have affected the Crow Creek paleodemographic profile presented in Chapter 4.

Present-day field observations of canid scavenging should be mentioned here to flesh-out the picture of the scavenging process. All observations are presented in Miller (1975:212-213). When scavenging a large animal, the coyote first chews off the ear, then tears off the mandible. Next he concentrates on the internal organs. Then the parts of the bones which are readily accessible, especially the relatively cancellous ones, are attacked. These bones include the long bone ends and the calcaneous. Variation among coyotes as well as between episodes involving the same coyote from the ideal presented above are noted. While scavenging practices of other species doubtlessly differ, the fundamentals are probably similar. The Crow Creek bones follow the general pattern just described. The long bone ends and other cancellous, projecting bones were chewed. On the other hand, as might be expected, there are few indications of chewed ears or mandibles present at Crow Creek.

It is interesting that at least some scavengers concentrate on the internal organs before the bones. This suggests that perhaps before many of the Crow Creek bones were chewed that most of the internal organs had been consumed. The consumption of the nearly 500 Crow Creek viscera by scavengers would have required a great number of scavengers or a lengthy period of exposure or both.

The burned human bone was observed and reported by Mark Swegle (in Zimmerman et al. 1981:184-187). He reports that all observed burning was relatively light; the remains were charred but not

calcined. At least seven individuals were charred: three adults, three adolescents, and a child. Of the seven charred skulls, all appear to have been scalped before being burned. Various postcranial bones were charred. Usually when long bones were burned, it was the distal end of the fragment which was charred.

Crow Creek Village Mutilations

In addition to the human bones recovered in the fortification, there are a few bones from Kivett's excavations in the Crow Creek Village. The small number of bones recovered allows only tentative comparisons with those from the fortification ditch. The mutilations on the village bones are presented as counts in Table 37. Although these numbers in some cases differ markedly from those found among the Crow Creek fortification ditch sample, these differences are probably due to the extremely small sample sizes of the Crow Creek Village collection. It is also possible that the village skeletal remains were less accessible both to mutilation and recovery or were mutilated in a manner which precluded recovery for reburial.

Larson Village Mutilations

There are many similarities between the kinds of mutilations observed on the prehistoric Crow Creek massacre victims' bones and the protohistoric Larson Village victims, but the frequencies of occurrence often differs. First the variety of mutilations is considered, then the frequencies.

Virtually all mutilations observed at Crow Creek are also present at Larson (Table 38), like scalping, evulsion, depressed

Table 37. Crow Creek Village postcranial modifications.[a]

Locations	Chewed	Snapped and Splintered	Not Modified	Total
Clavicle				
Medial	0	0	1	1
Shaft	0	0	4	4
Lateral	2	0	2	4
Total	2	0	7	9
Humerus				
Proximal	0	0	1	1
Shaft	0	0	1	1
Distal	0	0	0	0
Total	0	0	2	2
Femur				
Proximal	0	0	3	3
Shaft	0	0	2	2
Distal	0	0	2	2
Total	0	0	7	7
Tibia				
Proximal	0	0	1	1
Shaft	0	0	2	1
Distal	0	0	1	1
Total	0	0	4	3
Fibula				
Proximal	0	0	0	0
Shaft	0	0	2	2
Distal	0	0	1	1
Total	0	0	3	3
Acromial process	0	0	1	1
Patella	1	0	0	1
Iliac crest	1	0	2	3
Ischium	0	0	2	2
Talus	0	0	1	1
Metatarsals	0	3	0	3

[a]Bones from Kivett's excavation in the village proper.

Table 38. Mutilations of skulls from Larson Village.[a]

Mutilations	Present	Absent
Scalping	12 (37.5)	20 (62.5)
Cut noses	0	35 (100.0)
Evulsions	6 (10.0)	54 (90.0)
Decapitations		
Occipital	0	34 (100.0)
C-1	2 (4.8)	40 (95.2)
C-2	3 (7.5)	37 (92.5)
Depressed fractures	5 (22.7)	17 (87.3)

[a]Percentages are in parentheses.

fractures, and cuts on C-1 and C-2. Unlike Crow Creek, there are no cuts on the occipital or around the nose in the Larson Village sample. If the frequency of cut noses is as low as Crow Creek, perhaps the Larson Village sample size is too small to detect it. The absence of cuts on the Larson occipitals, however, is surprising. The Larson sample size seems adequate; perhaps the use of metal knives or a better knowledge of human anatomy enabled the mutilators to avoid the occipital during decapitation. Another possibility is that the focus of decapitation is lower by the protohistoric period. Like the Crow Creek limb bones, the Larson Village bones are frequently chewed, splintered and snapped, crushed, and burned (Tables 39 and 40).

Turning to the frequencies of these mutilations, the two sites vary. With a single exception, the mutilations are more frequent at Crow Creek than Larson Village. The most likely explanation for this difference is that the Larson lodges as they burned collapsed on the bodies and permitted limited access and mutilation. It is also possible that some non-murdered bodies were included in the Larson Village sample, and these would have diminished the frequencies even more. The single exception to the generalization that mutilations are more frequent at Crow Creek than Larson is burning. This fact supports the assertion that the bodies were concealed by the collapsed lodges and unavailable for mutilation.

Nearly all mutilations found at the prehistoric Crow Creek Site are also present in the protohistoric Larson Village material, though less frequent. Absences of mutilations at Larson appear to be due to its small sample size or differing mutilation techniques. The small

Table 39. Larson Village long bone modifications.[a]

Locations	Chewed		Snapped and Splintered		Crushed		Smoked		Not Modified		Total	
Clavicle												
Medial	2	(0.9)	3	(1.3)	0		0		74	(31.9)	79	(34.1)
Shaft	0		0		0		1	(0.4)	82	(35.3)	83	(35.7)
Lateral	9	(3.9)	5	(2.2)	0		2	(0.9)	54	(23.3)	70	(30.3)
Total	11	(4.8)	8	(3.5)	0		3	(1.3)	210	(90.5)	232	(100.1)
Humerus												
Proximal	1	(0.4)	0		0		4	(1.4)	84	(29.6)	89	(31.4)
Shaft	0		3	(1.1)	0		0		101	(35.6)	104	(36.7)
Distal	9	(3.2)	0		0		7	(2.5)	75	(26.4)	91	(32.1)
Total	10	(3.6)	3	(1.1)	0		11	(3.9)	260	(91.6)	284	(100.2)
Radius												
Proximal	1	(0.4)	1	(0.4)	0		0		86	(34.1)	88	(34.9)
Shaft	0		0		0		1	(0.4)	89	(35.3)	90	(35.7)
Distal	0		4	(1.6)	0		3	(1.2)	67	(26.6)	74	(29.4)
Total	1	(0.4)	5	(2.0)	0		4	(1.6)	242	(96.0)	252	(100.0)
Ulna												
Proximal	4	(1.6)	3	(1.2)	0		2	(0.8)	77	(31.4)	86	(35.0)
Shaft	0		1	(0.4)	0		1	(0.4)	85	(34.7)	87	(35.5)
Distal	0		7	(2.9)	0		1	(0.4)	64	(26.1)	72	(29.4)
Total	4	(1.6)	11	(4.5)	0		4	(1.6)	226	(92.2)	245	(99.9)
Femur												
Proximal	12	(3.8)	0		1	(0.3)	1	(0.3)	91	(28.8)	105	(33.2)
Shaft	0		0		0		0		112	(35.4)	112	(35.4)
Distal	8	(2.5)	5	(1.6)	0		4	(1.3)	82	(25.9)	99	(31.3)
Total	20	(6.3)	5	(1.6)	1	(0.3)	5	(1.6)	285	(90.1)	316	(99.9)
Tibia												
Proximal	4	(1.5)	1	(0.4)	0		1	(0.4)	87	(31.9)	93	(34.2)
Shaft	0		1	(0.4)	0		0		93	(34.1)	94	(34.5)
Distal	6	(2.2)	3	(1.1)	0		1	(0.4)	76	(27.8)	86	(31.5)
Total	10	(3.7)	5	(1.9)	0		2	(0.8)	256	(93.8)	273	(100.2)
Fibula												
Proximal	1	(0.4)	7	(2.5)	0		1	(0.4)	79	(28.5)	88	(31.8)
Shaft	0		1	(0.4)	0		0		97	(35.0)	98	(35.4)
Distal	4	(1.4)	11	(4.0)	0		1	(0.4)	75	(27.0)	91	(32.8)
Total	5	(1.8)	19	(6.9)	0		2	(0.8)	251	(90.5)	277	(100.0)

[a]Questionable identifications omitted. Numbers in parentheses are percentages for that bone.

Table 40. Modifications of non-long, postcranial bones from the Larson Village.[a]

Locations	Chewed		Snapped & Splintered		Smoked		Not Modified		Total	
Acromial process	4	(6.6)	4	(6.6)	3	(4.9)	50	(82.0)	61	(100.1)
Sternum	0		0		0		24	(100.0)	24	(100.0)
Sacrum	4	(14.3)	0		0		24	(85.7)	28	(100.0)
Patella	6	(12.5)	0		1	(2.1)	41	(85.4)	48	(100.0)
Iliac crest	13	(16.0)	0		0		68	(84.0)	81	(100.0)
Ischium	7	(9.3)	0		0		68	(90.7)	75	(100.0)
Carpals	1	(0.6)	0		3	(1.7)	174	(97.8)	178	(100.0)
Metacarpals	9	(3.9)	4	(1.7)	6	(2.6)	214	(91.8)	233	(100.0)
Hand phalanges										
Proximal row	2	(1.2)	1	(0.6)	4	(2.3)	164	(95.9)	171	(100.0)
Middle row	0		1	(0.8)	1	(0.8)	117	(98.3)	119	(99.9)
Distal row	0		0		0		76	(100.0)	76	(100.0)
Talus	10	(12.2)	0		1	(1.2)	71	(86.6)	82	(100.0)
Calcaneous	7	(10.8)	0		0		58	(89.2)	65	(100.0)
Other tarsals	1	(0.4)	0		3	(1.2)	252	(98.4)	256	(100.0)
Metatarsals	3	(1.0)	4	(1.3)	5	(1.6)	298	(96.1)	310	(100.0)
Foot phalanges										
Proximal row	0		2	(1.1)	0		175	(98.9)	177	(100.0)
Middle row	0		0		0		63	(100.0)	63	(100.0)
Distal row	0		0		0		59	(100.0)	59	(100.0)

[a]Questionable identifications omitted. Numbers in parentheses are percentages for that bone.

frequencies at Larson Village appear to be caused by the inaccessibility of some bodies and perhaps the inclusion of non-murdered skeletons in the sample. Otherwise there seems to be continuity in mutilation patterns from the prehistoric to the protohistoric periods.

Historic Mutilations

Atrocities are frequently recorded in historic accounts of Indian encounters. Unlike the comparison of Crow Creek with the Larson Village material, comparing the Crow Creek mutilations with historically recorded depredations must deal primarily with a list of mutilations. Frequencies of mutilations are rarely available, and those more fully described atrocities (e.g., surgeons' autopsies) generally involve only a small number of victims. Consequently historic accounts are used to suggest the diversity of mutilations, not the frequencies.

In this analysis the sequence of mutilation presentation follows that used to describe those from Crow Creek: the comparison begins with the head, then proceeds inferiorly. But before presenting the body of descriptions, it is useful to mention some of the additional problems with the historic accounts and some of the accounts not used.

Many of the historic accounts are too vague to be useful in this study. There are many examples. Corpses are described as "butchered" (Coues 1897:262), "mangled" (Boller 1959; Bryant and Murch 1864:115, 415, 498; Coleson 1977:55; Lowie 1935:230; Kane cited in Ewers 1967:135; Palmer 1887:3; Vaughn 1963:97, 98), "cut" (Dorsey 1881:332; Eastman 1849:156; Grinnel 1892:254), "disfigured" (Bryant

and Murch 1864:206), "maimed" (Bryant and Murch 1864:115), or just plain "mutilated" (Bryant and Murch 1864:103, 115, 140, 440; Coleson 1977:22; Boyd 1925:8; David 1937:219; Denig 1928-29:492; Dorsey 1881:313; Coues 1897:260; DeSmet 1904, v. 27:185; Spring 1969:93; Vaughn 1963:94). These statements are interesting because they do indicate mutilations, but for our purposes more specific descriptions are needed.

Of the more specific listings of mutilations, scalping is the best known. It is frequently described in historic accounts of Plains battles. Descriptions of scalpings include Boller (1959:151; 1966: 203-206), Bryant and Murch (1864:206, 219, 251, 253, 328, 363-364, 394), Camp (1976:95, 237, 248), Coleson (1977:22, 23), Coues (1897: 262), David (1937:127, 145, 215, 219), Denig (1928-29:491-492), Eastman (1849:156), Godfrey (1974:112), Luttig (1964:124), Paulding (1974:10-11), Spring (1969:92), and Springer (1971:44, 52). Audubon (1897, v. 2:5) even describes an incident in which a woman was scalped by Arikaras, later buried, then dug up and scalped again!

Scalping was systematic and patterned according to at least some sources. Adair's (1775:387-388) description of scalping in the Southeast is explicit.

> They seize the head of the disabled, or dead person, and placing one of their feet on the neck, they with one hand twist in the hair, extend it as far as they can--with the other hand, the barbarous artists speedily draw their long-pointed scalping knife out of a sheath from their breast, give a slash round the top of the skull and with a few dexterous scoops, soon strip it off. They are so expeditious as to take off a scalp in two minutes.

Larimer (1976:200) and Catlin (1844:238, Plate 101) give similar descriptions of scalping. The description of the procedure, while

somewhat simplified, does describe the marks found on the Crow Creek skulls.

If Adair's statement that a scalp could be removed in two minutes is correct, then the approximately 360 scalps taken at Crow Creek would have required 12 work-hours for removal. Twelve work-hours should be considered a minimum because the number of Crow Creek skulls is a minimum count and probably two minutes to remove a scalp should be considered a minimum amount of time. It is likely that the actual time spent scalping the Crow Creek victims was more than 12 work-hours.

Blows to the head seem to have been a common way of dispatching or mutilating a foe according to the historic records. Bryant and Murch (1864:115, 219, 253, 363-364), Camp (1976:96), Coleson (1977:22), Coues (1897:260), Godfrey (1974:113), Luttig (1964:124), Marquis (1967:15), Palmer (1887:3), Paulding (1974:10-11), U.S. Army (1887:4), and Vaughn (1963:94) all mention head bashing. Whatever instrument was handy was used, but gun butts, clubs, hatchets, and stone hammers are frequently mentioned in the accounts. Certainly the Crow Creek massacre victims were subjected to similar blows judging from the depressed fractures.

Removal of the nose is infrequently recorded. There are two direct references (Bryant and Murch 1864:222; U.S. Army 1887:4), and there is one other possible reference. The possible reference is by Luttig (1964:124) who saw the body of a fort worker who had "his Head Broken, the Brains scattered about[;] his nose and ears cut off, ..." Admittedly this reference is ambiguous and might be edited otherwise to have a different meaning. The low frequency of

cuts near the nasal apertures from Crow Creek and the few historic references to cut noses suggest that the mutilation was less common in prehistoric and historic times than some other mutilations.

In contrast to nose cutting, severing heads from the body seems to have been fairly common in Plains Indian warfare. It is mentioned in many historic accounts (Bryant and Murch 1864:133-134; Denig 1928-29: 491; Fletcher and LaFlesche 1905-06:434; Grinnel 1892:254; Marquis 1967: 15; Mooney 1895-96:260; Wagner 1973:237). It seems that most of the decapitated heads were left on the battlefield. For instance, David (1937:215) writes that a Mexican with a wagon train "had been caught, killed, and scalped by the Sioux, after which his head had been cut off and used for a football." Sometimes, though, the head was taken from the scene. Thompson (Coues 1897:262) observed that "My beau-pere's head was severed from his body even with his shoulders, ... The enemy had . . . taken away the skull of another man for a water dish; . . . ." Perhaps some of the Crow Creek skulls were removed for similar uses.

A couple of historic accounts mention throats being cut (Bryant and Murch 1864:206, 219, 394; Collins 1972:256). No Crow Creek specimens have been interpreted as having their throats cut. But because throat cutting and decapitation attempts might leave similar cuts on the anterior parts of the cervical vertebrae, any throat cuttings at Crow Creek may have been misinterpreted as decapitation attempts. But it is possible, of course, that no cut marks would be left on the bone from throat cutting.

Evulsion, the removal of teeth, occurred in historic times. Luttig (1964:124) mentions that a fort worker, killed in the early 1800's, was mutilated, including having "his teeth Knocked out, ..." There is another reference to evulsions on the Northwestern Plains (U.S. Army 1887:4).

Occasionally severed tongues are mentioned in the historic accounts (Bryant and Murch 1864:219; Vaughn 1963:94).

Although the head and neck appear to be the major focus of defacement, postcranial body parts were also mutilated. Our discussion of postcranial mutilation begins with the dismemberment of the limbs and limb parts, then proceeds to chewing by scavengers.

Some historic accounts specifically mention that arms were severed from the body (Couse 1897:262; Fletcher and LaFlesche 1905-06; Grinnell 1892:254; Marquis 1967:15; Springer 1971:52; U.S. Army 1887:4). Fingers and hands seem to have been popular parts for dismemberment (Bryant and Murch 1864:206, 222, 253; Denig 1928-29: 491-492; Grinnell 1892:254; Marquis 1967:15; Palmer 1887:6; Spring 1969:93; U.S. Army 1887:4; Vaughn 1963:94). Hands and fingers were used as necklaces (Bourke 1887), as offerings (Boller 1959:151), and in games (Kelly 1871:143). Some of the finger and hand bones missing from Crow Creek may have served these purposes.

Some historic accounts specifically mention legs being severed during battles (Bryant and Murch 1864:253; Camp 1976:122; Coues 1897: 262; Fletcher and LaFlesche 1905-06; Grinnell 1892:254; Marquis 1967: 15). Feet and toes were also recorded as being taken (Coues 1897: 262; Denig 1928-29; Grinnell 1892:254; Marquis 1967:15; Palmer 1887:6;

Spring 1969:93; U.S. Army 1887:4; Vaughn 1963:94). No mention is made of what uses were made of the severed feet or toes. It is possible that some of the foot bones missing from the Crow Creek sample were taken as trophies.

Burning is occasionally mentioned in the historic literature (Bryant and Murch 1864:222, 403; Coleson 1977:22; Vaughn 1963:98). For the most part burning the bodies seems to have happened only when fires happened to be burning at the time the person was killed or were set to destroy property. Fires do not appear to have been made specifically to mutilate the bodies. Swegle (in Zimmerman et al. 1981:182-186) comes to many of the same conclusions concerning the Crow Creek burnings.

Historic accounts commonly mention scavengers devouring human bodies (Coleson 1977:22, 23, 55; Boller 1966:141). A few days after a battle between two Indian groups, Alexander Henry (Coues 1897:264) walked over the field noting that wolves and crows "interred" many of the dead; they did their job so thoroughly and so little remained that "I gathered up the remaining bones of my belle-mere in a handkerchief." Few accounts are as graphic as Keim's (1870:143) description of the Washita battlefield a few days after the fight.

> As we moved closer to the immediate site of the village, our approach breaking upon the quiet surroundings of the scene of death, and alarmed from their sense of security and enjoyment, fled innumerable beasts and birds of prey. Suddenly lifting from the ground could be seen thousands of ravens and crows, disturbed in their carrion feast. The dense black mass, evidently gorged, rose heavily, and passing overhead, as if to take revenge for molestation, set up the greatest confusion of noises. The cowardly wolves started from their abundant repast on human flesh, reluctantly left the spot, and while slowly getting out of reach of danger often stopped to take a wishful look behind.

The same sort of scavenging must have taken place at Crow Creek. In addition to birds and wild animals, domestic dogs are also known to eat bodies (Catlin cited in Dunn 1963:187; Thompson 1916). The Crow Creek victims were doubtlessly exposed to scavenging by their own dogs.

There are a number of mutilations listed in the historic accounts which have not been mentioned yet. Their absence may be because they did not occur at Crow Creek, they did occur but were not observed, or they did occur but left no or ambiguous osteological indications. Whatever the case, the variety of these other historically chronicled mutilations are instructive.

One historic reference (Palmer 1887:3) records that a man's whiskers were cut off. Assuming that the Crow Creek men had whiskers, if cuts were present, they might have been missed. It is also possible that the cut whiskers were part of a more general facial mutilation. Several references (Bryant and Murch 1864:206; Paulding 1974:11; U.S. Army 1887:4) mention cuts on the face. And there are a number of Crow Creek specimens with cuts on the face. Skull 51 is cut on the left alveolar process of the mandible, Skull 116 is cut on the middle of the zygomaxillary suture, Skull 197 is cut on the right zygomatic, Box 107-Bag 5 is cut on the right maxilla, and 164-11 is cut on both maxillae and left zygomatic. Perhaps these cuts resulted from their faces being sliced as mentioned in the historic accounts.

A few historic accounts record ears being cut from the head (Boller 1959:151; Bryant and Murch 1864:222; Palmer 1887:6; Paulding 1974:11; Springer 1971:52; U.S. Army 1887:4). While it is possible that these references actually record the ears being taken

with the hair during scalping, it may be that severing ears is a distinct mutilation. If it is a distinct mutilation and did occur at Crow Creek, then cuts on the Crow Creek crania near the ear may have been misinterpreted as scalping marks rather than ear removal.

Many historic accounts mention disembowelings (Bryant and Murch 1864:206, 253; Camp 1976:248; Coleson 1977:23; Coues 1897:262; Custer 1962:255; Godfrey 1974:112-113; Marquis 1967:15; Paulding 1974:11; Roe 1927:10; Spring 1969:93; Vaughn 1963:94; U.S. Army 1887:4). The cuts and breaks associated with evisorating were not specifically searched for during our investigation of the Crow Creek remains. It is unlikely that these mutilaticns would have been fortuitously found. The same is true of genital severing which is mentioned in some historic accounts (Coues 1897:262; Custer 1962:225; Denig 1928-29:124; Dorsey 1881:313; possibly Luttig 1964:124; U.S. Army 1887:4; Wagner 1973:237). Their marks are unlikely to have been left on bone; none were observed at Crow Creek.

Perforating corpses with arrows (Camp 1976:95; Coues 1897:262; Luttig 1964:124; Palmer 1887:3; U.S. Army 1887:4; Vaughn 1963:94), spears (U.S. Army 1887:4; Vaughn 1963:94), bullets (Camp 1976:223), and knives (Coleson 1977:22) are all cited in historic accounts. There were few points associated with the Crow Creek bones and punctures left by points after the points were removed would have been overlooked in all likelihood. The evidence from Crow Creek does indicate, though, that either the historic custom of perforating the body with projectiles was not practiced at Crow Creek or the projectiles fell out or were removed before interment.

CHAPTER 7

CROW CREEK STATURE

The stature of the adult Crow Creek massacre victims is considered for a variety of reasons, including fleshing out this report to make the remains understandable in human as well as skeletal terms. In addition to this goal, Crow Creek stature is considered for what it may indicate about the population and its relationship to the environment. The Crow Creek statures are compared with those of other, similar samples. Before going further it is necessary to consider what variables influence growth and ultimately stature.

Growth and attainment of adult stature is produced by a combination of genetic and environmental influences and their interaction. Genetic influences have been demonstrated by twin studies (Shields 1962, Vandenburg 1962, Wilson 1976), resemblance of same-aged siblings (Garn, Hertzog, and Rohman 1969; Garn and Rohman 1966; Howells 1953; Mather and Jinks 1963; Tanner 1960:43-58), and parent-child correlations (Bielicki and Welon 1966; Howells 1966; Tanner, Goldstein and Whitehouse 1970; Tanner and Israelsohn 1963). In spite of genetic influences, a myriad of environmental conditions affect stature.

These environmental influences affecting stature include nutrition (MacWilliam and Dean 1965, Graham 1968), disease (Prader, Tanner and von Harnack 1963), socio-economic level (Baird 1974,

Clements and Pickett 1952, Gregor 1979, and Thomson 1959), urbanization (Tanner and Eveleth 1976), possibly physical activity (cf. Eveleth and Tanner 1976:257-258), psychosocial stress (MacCarthy and Booth 1970, Widdowson 1951, Friend and Bransby 1947), and secular trend (Charzewski and Bielicki 1978; Tobias 1972; Barett and Brown 1971; Hagen, Paschlau and Paschlau 1961; Takahaski 1966; Vlastovsky 1966). Clearly there are many variables which influence stature.

Even though it is not possible to separate the genetic and environmental influences on Crow Creek stature, it is nevertheless worthwhile considering it as another step toward understanding more about the Crow Creek victims. The purpose of this chapter is to describe the Crow Creek victims' stature, compare it with later morphologically related samples, and discuss differences among Crow Creek stature and the others. Sexual dimorphism is also discussed.

A. Methods and Materials

Because skeletal stature estimation is based on limb bone length and a formula, bone length is a more direct measure of size and not subject to formula assumptions and calculation errors. Of the limb bones, the femur is as accurate an indicator of stature as any other single long bone (Trotter 1970:77, Table 28). An added benefit of using the femur is that it is one of the most sexually dimorphic limb bones (Black 1978, Dwight 1904-05, Pearson 1917-19). For these reasons, femur length is used to describe Crow Creek size and compare it with the other samples. Stature estimations are made only to present an approximation of the victims' heights during life.

Because there are size differences between the sexes, the femora must be separated by sex before any descriptions or comparisons can be made. Innominate morphology is generally considered the most reliable part of the skeleton for visual sex determination (Phenice 1969, Kelley 1978). However, this area cannot be used in an analysis of the Crow Creek femora because few femora were articulated to innominates. To achieve adequately sexed samples, sex determination must be made from the femora alone. Univariate metric methods are frequently used (cf. Dwight 1904-05, Pearson 1917-19, Thieme 1957, Black 1978), but multivariate techniques are generally more reliable.

Multivariate sex estimation of postcranial remains has been used successfully on a variety of samples. Examples of multivariate femur sexing include Pons (1955), Thieme (1957), Thieme and Schull (1957), Hanihara (1958), Howells (1964), Giles (1970), and Kobyliansky et al. (1978). Most studies correctly sex 90 percent of the base samples.

Because of morphological variation among sex and ethnic groups, the more similar the sample on which the discriminant functions are established are to the sample to be sexed, the more accurate the sex determinations will be. Consequently to estimate the sexes of the Crow Creek femora, it is best to calculate a discriminant function on similar, sexable femora. The adult femora from the Larson Site (39WW2) near Mobridge, South Dakota, are used to establish a discriminant. The Larson material has the advantages of being well-preserved, morphologically similar to Crow Creek, and sexed by innominate morphology.

In all cases the Larson Site femora employed in establishing the sex discriminant were sexed by innominate morphology. Phenice's method, the most accurate visual technique (Kelley 1978), was used whenever possible. When Phenice's method was not applicable, other, standard innominate characteristics were used, such as parturitional pitting (Stewart 1970; Houghton 1974, Ullrich 1975), sciatic notch (Bass 1971:159-161), and pubis length (Bass 1971:160). All sex determinations were made by Willey.

Instruments used to measure the Crow Creek material were lent by The University of Tennessee's Department of Anthropology. Length measurements were taken with an osteometric board and diameters with a sliding caliper. All measurements of the Crow Creek femora were taken by Roger Williams, then a student at the University of South Dakota. Willey took all measurements on the Larson material, as well as the other comparative samples.

Femur measurements used to establish the sex discriminant are maximum length, bicondylar length, anterior-posterior and transverse midshaft diameters, and maximum head diameter. These measurements are defined below.

1. Maximum femur length. With either of the distal condyles against the osteometric board's fixed end, the proximal end is rocked in a circular motion against the movable end until maximum length is found (Bass 1971:168).

2. Bicondylar femur length. With both of the distal condyles against the osteometric board's fixed end, the proximal is moved up and down against the movable end to obtain the greatest bicondylar length (Bass 1971:168).

3. Maximum diameter of head. The greatest diameter is found by rotating the calipers in any direction with both caliper arms on the proximal articular surface. Maximum

diameter is usually found near the periphery of the articular surface (Bass 1971:168).

4. Anterior-posterior midshaft diameter. The midpoint on the shaft is located when maximum length is taken and marked with a pencil. Anterior-posterior diameter is taken from the linea aspera to the anterior surface while the caliper is held perpendicularly to the shaft's long axis. The posterior margins of the distal condyles are used to establish the anterior-posterior plane (Bass 1971:168).

5. Transverse midshaft diameter. It is measured in a similar way to anterior-posterior midshaft but at right angles to anterior-posterior (Bass 1971:168).

Only those Larson specimens with all five measurements are used in establishing the sex discriminant; the Larson sample sizes are presented in Table 41. The discriminant function subprogram in the SPSS program (Nie et al. 1975) is used to calculate the following formula using the two best discriminating measurements:

Discriminant score = (Femur head diameter x 0.4314251) +

(Femur anterior-posterior midshaft x 0.1518143) - 23.66658

Male $\overline{X}$ = 1.23477 Female $\overline{X}$ = -1.30336

Sectioning point = -0.034295

The proportion of the Larson femora correctly classified is 90.0 percent. The formula is applied to all Crow Creek femora which have the two required measurements and maximum length.

Once sex is determined for each Crow Creek femur, means and standard deviations are calculated (Table 41) using the CONDESCRIPTIVE routine in SPSS (Nie et al. 1975). From the means, sexual dimorphism is calculated. Sexual dimorphism is defined as

$$\text{Sexual dimorphism} = \frac{\text{Male } \overline{X} - \text{Female } \overline{X}}{\left[\frac{\text{Male } \overline{X} + \text{Female } \overline{X}}{2}\right]} \times 100$$

Table 41. Approximate dates, femur sample sizes, means, standard deviations, and dimorphism of Crow Creek and other sites.

Site	Approximate Date	Males			Females			Dimorphism
		N	Mean	S.D.	N	Mean	S.D.	
Crow Creek 39BF11	1325	44	442.0	23.2	41	407.5	15.5	8.12
Rygh 39CA4	1625	8	449.9	13.7	4	408.8	24.4	9.57
Mobridge 1 39WW1	1650	14	455.1	20.4	16	414.4	17.9	9.36
Mobridge 2 39WW1	1725	10	448.6	13.7	7	412.6	8.2	8.36
Larson 39WW2	1765	59	445.9	16.8	66	417.4	20.4	6.60
Leavenworth 39C09	1817	29	450.5	22.1	25	423.1	17.4	6.27

The Crow Creek femoral lengths by themselves mean relatively little. It is only through comparisons with other, similar samples that an understanding of their meaning is achieved. Samples from five other sites are used in the comparison: namely, Leavenworth (39C09), Larson (39WW2), Mobridge 1 (39WW1), Mobridge 2 (39WW1), and Rygh (39CA4). All samples are currently in the Bass Collection at The University of Tennessee, Knoxville. All samples appear to be Arikara or proto-Arikara based on cranial morphology (Jantz 1972, 1973), and it has been shown here in Chapter 5 that Crow Creek appears to be prehistoric Arikara.

To test statistically the femora samples for differences, they were divided by sex and site. First a two-way analysis of variance (ANOVA) was performed using sex and site as independent variables and femur length as the dependent variable. The GLM routine in SAS (SAS Institute 1979) was employed to do the computations. The main purpose of this test is to see if differences in femur length exist between Crow Creek and the other sites. To reveal which sites contained femora significantly different from others, ANOVA's were calculated separately for each sex using the same SAS program (SAS Institute 1979) used to calculate the over-all ANOVA for both sexes. These separate sex ANOVA's were used to inspect for pair-wise differences among the sites employing the Scheffe post hoc test.

Differences between Crow Creek femur lengths and those from other sites were also examined by linear and curvalinear regressions. The regressions were calculated by separating the sexes and using the estimated median date of site occupation as the independent variable

and femur length as the dependent variable. Some dates (Table 41) are more accurate than others. The Leavenworth date, being historic, is accurate; the Crow Creek date is based on a C-14 date (Zimmerman et al. 1981). The other dates are approximations based on the presence or absence of Euroamerican trade goods. The dates for Mobridge 2 and Larson are probably fairly accurate. The dates for Mobridge 1 and Rygh are rough approximations, based on the absence of Euroamerican trade goods. As noted earlier, though, at least the Larson date is questionable (Jantz 1982). The regressions were calculated using the GLM routine in SAS (SAS Institute 1979). The main purpose of the regression analyses is to determine if a significant relationship exists between time and femur length.

To describe how the Crow Creek villagers looked, stature was estimated using Trotter's (1970:77, Table 28) formula for Mongoloid males.

B. Results

The discriminant function calculated for sexing the Crow Creek femora produces reasonable results in terms of the number of each sex represented. There are 44 Crow Creek male (51.8 percent) and 41 female (48.2 percent) femora (Table 41). To test this distribution against that established using pubic morphology (see Chapter 4), a binomial Z-test is calculated. There is no statistically significant difference between the two sex distributions ($Z = 0.48782$, $F(Z) = 0.6879$, $P < 0.35$). Based on the information available, the Crow Creek femora sex estimations are accepted as reasonably accurate.

The femur descriptive statistics (Table 41) indicate that both the Crow Creek male and femur means are smaller than any of the other like-sexed samples. The Crow Creek standard deviations are approximately the same as those of at least some other sites.

To compare the Crow Creek femora with those from the other Arikara sites, it is necessary to examine the ANOVA results. The ANOVA of femur length by site and sex (Table 42) is highly significant ($F = 22.28$; $DF = 11, 311$; $P < 0.0001$), indicating that femur length varies by site and sex. To determine which of the treatments--site or sex--contributes to the relationship, the partial F's are inspected (Table 42). The partials show that both sex and site are highly significant, although the interaction between site and sex is not. It has been established from all these manipulations that there is a statistically significant relationship among the variables, but it is yet to be established which sites have significantly different femora lengths from the other sites.

To reveal which sites' femora lengths are significantly different, ANOVA's of femur length by site are calculated for each sex separately. The ANOVA for the males is not significant by itself (Table 43), but the female ANOVA is. As a consequence of these results, only the female differences justify the subsequent Scheffe post hoc tests. Although the greatest female femur difference (Crow Creek vs. Leavenworth) approaches significance at the 0.05 level, neither this contrast nor any of the other pair-wise differences are significant. The explanation for the lack of pair-wise differences is probably the conservative nature of post hoc tests.

Table 42. Two-way ANOVA for Arikara femur length, site, and sex.

Source	DF	Sums of Squares	F-Value	Probability
Overall				
Model	11	88554.53	22.28	0.0001
Error	311	112378.42		
Total	322	200932.95		
Partial				
Site	5	5617.40	3.11	0.0095
Sex	1	47839.30	132.39	0.0001
Site*Sex	5	1643.08	0.91	0.4763

Table 43. One-way ANOVA's by sex for Arikara femur length and site.

Source	DF	Sums of Squares	F-Value	Probability
Males				
Model	5	2530.55	1.30	0.2656
Error	158	61479.81		
Total	163	64010.36		
Females				
Model	5	4521.29	2.72	0.0220
Error	153	50898.61		
Total	158	55419.90		

When the mean femur length for each site is plotted by sex against the sites' date of occupation, there appears to be a trend for earlier femora to be shorter and the later to be longer. Linear and curvalinear regression models are employed using femur length as the dependent variable and median occupation date as the independent variable. While the male regression (Fig. 13) has a positive slope (i.e., femur length increases with increasing time), the relationship is not statistically significant ($F = 2.72$; $DF = 1, 162$; $P < 0.10$). The female regression (Fig. 13) is also positive, but unlike the males' it is statistically significant ($F = 11.74$; $DF = 1, 157$; $P < 0.0008$). It can be confidently stated that the femur length of the Arikara females increases through time in our sample.

Interpreting these differences of femur length in terms of stature differences, the Crow Creek females average 160.18cm (63 1/3in) and the latest (Leavenworth) average 163.54cm (64 2/3in). The average female stature increases 3.36cm (1 1/3in) during the 500 year period represented by the samples. On the other hand, the Crow Creek males average 167.6cm (66 1/4in) and at the latest site average 169.43cm (67in), an increase of only 1.83cm (3/4in).

Sexual dimorphism employs femur length, not the lengths' conversion into stature estimation. With the exception of Crow Creek, dimorphism consistently decreases through time (Table 41, page 140). The Crow Creek value falls near the mean of all the sites and is most similar to Mobridge 2.

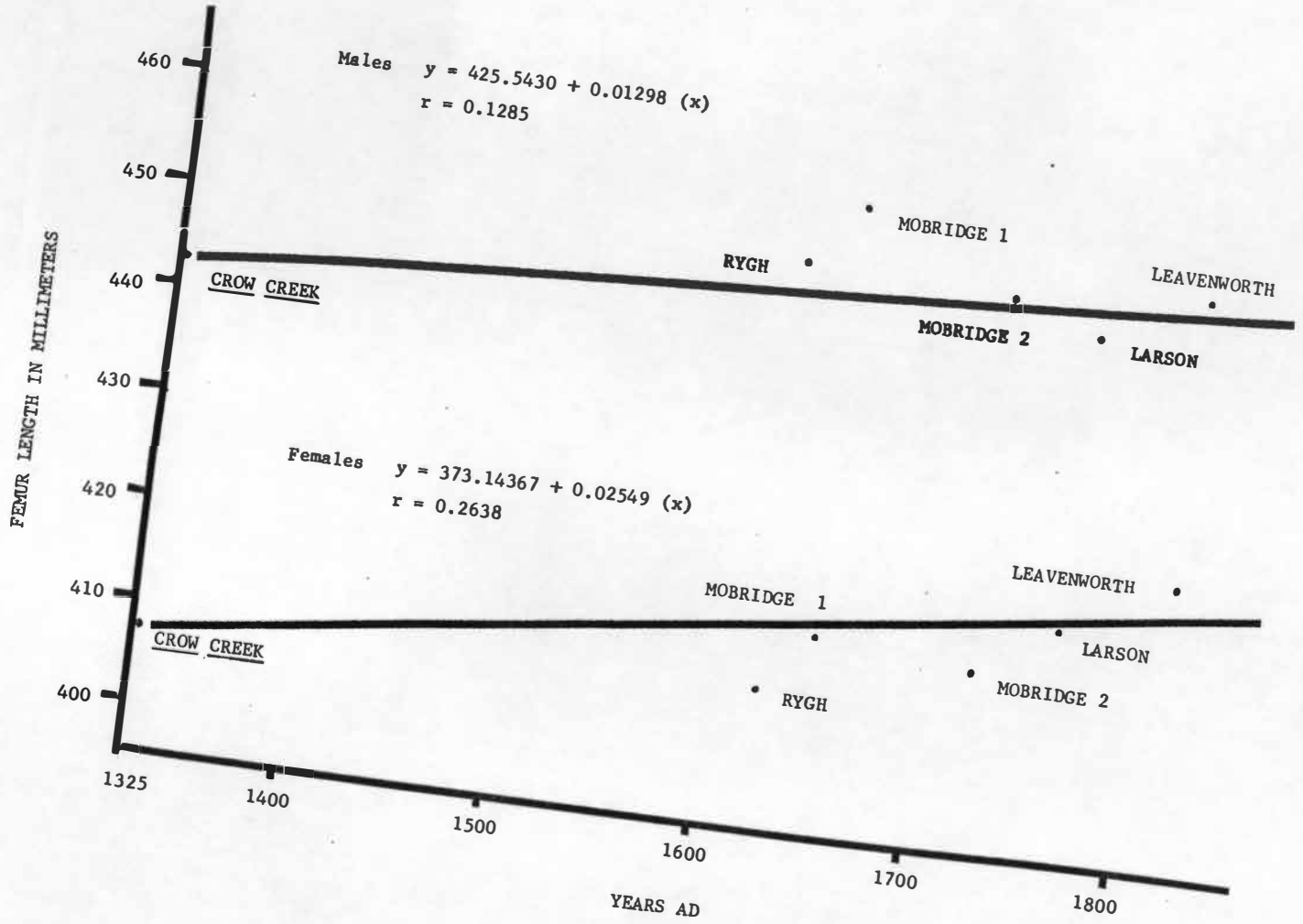


Figure 13. Relationship between time and Arikara femur length by sex.

C. Discussion

As noted in the introduction to this chapter, adult stature is a product of the influences on subadult growth of the environment, genes, and their interaction. Even though it is impossible to separate these influences in this study, it is heuristically useful to divide this discussion into environmental and genetic explanations. First environmental explanations are explored, then genetic causes. Sexual dimorphism is discussed following these discussions.

Environmental Explanations

There are some indications that the Crow Creek villagers were stressed. Data collected by Gregg and Gregg (1979) show numerous traumatic and infectious diseases. Cribra orbitalia appears to be frequent and relatively severe by Middle Missouri region standards (cf. Swegle ms) and suggests nutritional problems. Because of Crow Creek's early date, some may find these indications of stress surprising compared with historic accounts.

Historic accounts chronicle hard lives for the Arikara, including nutritional problems, diseases, depopulation, and social disintegration. Some nutritional problems--like famines--were short-term, though apparently some people starved to death (Tabeau 1939:74, Maximilian 1906:335-336). Protein deficiency, on the other hand, may have been chronic (Trudeau 1914:458, cf. La Verendrye 1914). European diseases, particularly smallpox, ripped through the "virgin soil" populations, perhaps killing over 75 percent of the Arikara in

a single epidemic (Lehmer and Jones 1968:91). Depopulation and social disintegration during the historic period are axiomatic.

There are no indications at Crow Creek that epidemic diseases, depopulation, or social disintegration were present before the raid. Nevertheless Crow Creek statures average less than any other site--even the highly stressed historic Leavenworth site. If stature reflects stress, then Crow Creek was even more stressed than the seemingly down-trodden historic Arikara.

In seeking explanations for these somewhat surprising differences, two related environmental effects are discussed here. The first part of the explanation interprets the Arikara stature change as one instance of a possibly world-wide process involving changing subsistence base and nutritional adequacy. The second part invokes changing climate as the fundamental mover, limiting available resources and producing differences in stature by the limited resources. This explanation views Crow Creek's short stature as due to stress, most probably mal- and/or under-nutrition and related diseases, although any of the environmental stresses mentioned in the introduction to this chapter are possible.

It is possible that the stature increase found through time represents a general process found elsewhere. In an excellent article, Nickens (1976) finds that Mesoamerican stature decreases with the adoption of maize agriculture, bottoms some time later, then gradually increases. These changes he attributes largely to diet and diet-related pathology. It may be that similar processes influenced Arikara stature. If the Arikara follow the Mesoamerican case, then we

would expect stature reduction beginning about 900-1000 AD when agriculture becomes intensive and apparently begins to make a substantial contribution to subsistence (Lehmer 1971:32, 96; Wedel 1961:92). The shortest statures would be a little later. Then, as nutrition improves through time, stature increases.

To test the applicability of Nickens' model to the Arikara, morphologically similar samples are needed from the time periods preceding and following Crow Creek. Especially crucial are the hunter-gatherer samples. Unfortunately, the only large early sample is from 25DK13 in northeast Nebraska. It is an ossuary thought to be slightly earlier or roughly contemporary with Crow Creek (Bass, unpublished notes). Bass kindly made his unpublished 25DK13 femur data available for this analysis.

The 23 25DK13 male femur maximum lengths average 451.4mm and the females average 414.0mm, both greater than those from Crow Creek and approximately the same as some of the later Arikara. These results may support the applicability of Nickens' model to the Arikara, but additional data are needed to test it fully. Before accepting Nickens' model as appropriate, we need to be certain that the suppression of stature at Crow Creek is due to changing subsistence patterns.

There is the additional concern that the observed low point (Crow Creek) may be too late to represent the same process that Nickens describes. In addition even though the female statures are significantly different, it is somewhat disturbing that the Arikara male differences are not statistically different.

There is another part to the environmental explanation which may have influenced the short Crow Creek stature. That influence is the climate.

Lehmer (1970), using the paleoclimatic reconstruction of the Plains by Bryson and coworkers, notes that the Pacific I climatic episode began between 1200 and 1300 AD and ended in the mid-1400's, a period which includes the Crow Creek occupation. This episode is characterized by "Greater amounts of cool dry air, lowered temperatures and decreased precipitation" (Lehmer 1970:121). This climate would have had a marked effect on the natives. As Lehmer (1970:121) notes, these conditions

> would have been unfavorable for corn agriculture, and they may also have diminished the game supply by cutting back the grass cover available for pasturage. They also presumably inhibited tree growth through decreased precipitation and increased evaporative stress.

Following this episode, the climate became milder until the NeoBoreal, beginning about 1550, when the summers were cooler.

It is possible the climatic limitations of the Pacific I episode affected the Crow Creek inhabitants through chronic and short-term nutritional deficiencies and the accompanying synergistic effects of disease. There is also the possibility that the intrusion of the Initial Coalescent groups into the Middle Missouri region, displacing the previously indigenous Middle Missouri tradition, compounded an already critical situation. The additional people living in an area marginal for corn-growing during a period of climatic stress may have made worse a major problem. Perhaps the

cause of the Crow Creek massacre was the Middle Missouri region's total human population approaching the region's carrying capacity during a stressful time. As represented by the adult Crow Creek femur length, increased disease pressure and under- and malnutrition may have triggered the tragedy at Crow Creek.

Warfare at a technological level like Crow Creek would have temporarily reduced the number of people in the area both by those outright killed in the raid and by dispersion of any Crow Creek survivors into other villages in other locations. Warfare also would have spaced hostile groups and presumably the interstices between the groups would have been exploited less, hence allowing it more time to recover between uses.

These environmental interpretations may well be premature, especially in light of the level of statistical significance. But if they are essentially correct, then the stresses indicated by short femur length should be found elsewhere in the skeletons. The data collected dealing with porotic hyperostosis, cribra orbitalia, and lines of arrested growth are being or will be studied to examine this possibility. If these sources fail to support the hypothesis put forward here, alternatives will need to be considered as explanations for the Crow Creek stature, like genetic explanations. Before continuing this discussion with genetic explanations, one problem with the environmental explanations should be noted.

While some of the environmental reasonings make sense, there is a problem using stress as the sole explanation. The major problem is that present-day studies show that stressed males are more stunted

than similarly stressed females (Eveleth and Tanner 1976). But when change in femur length through time is examined, it is the females who improve, not the males. This observation is inconsistent with our expectations.

Genetic Explanations

Another inconsistency with environmental stress as an explanation is that it assumes no genetic change occurred through time, or if there was change, it had no effect on femur length and stature.

At least the first part of this assumption is violated. There is convincing historic evidence that gene flow was occurring between the Arikara and other Indian groups as well as whites (e.g., Tabeau 1939:180-181, Brackenridge 1906:129-130, Bradbury 1904:140, Trudeau 1914:460-461, Luttig 1964:81). Additional evidence supporting the presence of gene flow comes from the changing Arikara cranial measurements, which Jantz (1973) believes demonstrates flow.

It is also likely that selection was occurring. One early trader (Trudeau 1914:459) mentions differential familial survival from smallpox. Osteological support for selection comes from Jantz and Willey's (1977) study of cranial height changes.

It is possible that differential survival explains stature change. According to this explanation, the shorter individuals were less fit for any of a variety of reasons. They tended to die at a younger age and have fewer offspring. The taller people, on the other hand, would have tended to live longer and have more offspring. Depending on how strong and constant this tendency was, the

populations may have become taller fairly quickly. This hypothesis could be tested partially by separating the femur samples into younger and older adult groups divided by site and sex and by applying an ANOVA to the data. At the moment, that additional analysis is beyond the scope of this study.

In addition to gene flow and selection, it is also possible, though unlikely, that gene drift may have happened through group endogamy. This possibility is somewhat feasible for the earlier sites but highly unlikely for the later sites.

Sexual Dimorphism

The femur sexual dimorphism of Crow Creek is less than the other prehistoric sites (Rygh and Mobridge 1), greater than the historic and one of the protohistoric sites (Leavenworth and Larson, respectively), and most closely approximates the other protohistoric site (Mobridge 2). It is noteworthy that, with the exception of Crow Creek, dimorphism consistently decreases through time, from the prehistoric through the protohistoric and into the historic. The meaning of sexual dimorphism at Crow Creek specifically and more generally is uncertain.

Some authors using stature of modern groups (Tobias 1972, Hiernaux 1968) suggest environmental stress decreases sexual dimorphism, while another author (Eveleth 1975) suggests that dimorphism is largely genetic. Still other authors (Gray and Wolfe 1980) conclude both environmental and genetic influences affect dimorphism. Like stature itself, dimorphism appears to be influenced by environment, genes, and their interaction. Unlike Crow Creek stature, Crow Creek

dimorphism is intermediate among the other samples. Little more can be said other than again mentioning that Crow Creek is the one exception to decreasing dimorphism through time. It is also interesting that while stature is increasing through time, suggesting lessening of stress, dimorphism is generally decreasing which some authors would attribute to increasing stress. This apparent contradiction is not resolvable based on the data presently at hand, but perhaps the studies currently being conducted by Owsley dealing with stress and the Arikara will clarify this inconsistency.

CHAPTER 8

INTERPRETATION

The previous chapters have presented either background information or data from specific information sources. Generally the chapters dealing with specific information sources are limited in their scope to those data and inferences from those data. To present a more unified summary, this chapter combines results and conclusions from all chapters in a chronological sequence. It begins with background information, then presents inferences about the major events of the raid, exposure period, burial, and recovery.

A. Background

About 1325 AD in central South Dakota, the Crow Creek Village was destroyed, hundreds of people murdered, and their bodies buried in the fortification ditch which circled the village. The village is large, the principal ditch enclosing nearly 18 acres. The principal ditch stretches 1250 feet from the high bluff overlooking the Missouri River flood plain to a lesser, but still imposing, bluff above Crow Creek. Along its course, there are 10 bastions. There are at least 50 lodge depressions from the Initial Coalescent component of the site. There are some indications that during this period the climate was cooler and drier than before or after the occupation.

The victims are from the Initial Coalescent component and appear most similar to the Arikara tribe. There were probably more

than 800 people living in the village, and at least 486 people were killed and buried in the ditch. The people from Crow Creek, most notably the women, were shorter than later Arikara. Their height may have been caused by an inadequate diet and marginal health which in turn may have been caused by the harsher climate.

B. The Raid

Calling the raid "catastrophic" is an understatement. The raid ended the lives of at least 486 people, and many lodges were burned. The functions of the village as a social unit, a fortress, and a home ended.

Perhaps the most striking osteological evidence of the raid were the mutilations. There are a great variety of mutilations, some of which occur with high frequency. Mutilations included scalping, blows to the head, evulsions, decapitation, burning, and dismemberment. Some noses and tongues were severed. Scalping was the most frequent mutilation; about 90 percent showed indications of scalping. This high incidence is even more remarkable because it has been demonstrated elsewhere that scalping does not always leave marks on the bones. All ages and both sexes showed scalping. Depressed fractures were present on 40 percent of the more complete skulls, and there were as many as five depressions on some skulls. The outlines of the depressions were either round or ellipsoid, the ellipsoid fractures being present twice as often as the round. Indications of decapitation were present in about a quarter of the individuals and were concentrated on the axis (first cervical vertebra). Many of these mutilations would have been

sufficient to cause death. Surprisingly few projectile points were recovered during excavation, suggesting that few were used or they were removed or fell out before burial.

There is evidence that the violence which ended the lives of the Crow Creek victims was not a solo event. Two skulls appeared to be from people who survived scalpings before the raid. A third skull had a healed depressed fracture in the frontal. These three people survived earlier traumas only to die in the massacre.

The killing and mutilating must have happened in and near the village during cold weather. Some mutilated bones were found during the excavation of some of the lodges. It also seems likely that some people may have been slaughtered outside the village. And, if historic sources are any indication, some people probably eluded the raiders altogether. The slayings must have happened during cold weather because the seasonally ubiquitous flies and other insects were absent.

There is evidence that some portions of the Crow Creek population were not buried in the ditch. Young adult females and old adult males are under-represented among the massacre victims. Historic sources often mention raiders taking captive young women, and this is probably what happened to some of the young Crow Creek women. The explanation for the absence of the old men is unknown.

Although the raiders left their marks on the victims, the raiders themselves remain osteologically anonymous. Mutilation patterns seem to lack tribal distinctions, and there appears to be at least a regional mutilation tradition stretching at least from fourteenth century Crow Creek into the protohistoric period and

probably into the historic period. No craniometrically aberant skulls were found at Crow Creek. If skulls of the raiders were included with those of the victims, then they are morphologically identical to the victims. And if that is so, then the raiders, too, are Arikara. But it is possible that no raider skulls were included with the victims.

C. Exposure

The victims were left exposed above ground for some time before being buried. During their exposure, the bodies became a carrion feast. Wolves, coyotes, and village dogs are the most likely to have consumed the flesh, but other mammals and birds are likely culprits as well. These creatures must have been a major cause in disarticulating the bodies and losing the extremities.

Based on the amount of dismemberment, there were either many scavengers, much time, or both. There are too many variables and too little is known about decomposition to accurately estimate the length of exposure. It is likely that the remains were above ground for more than a few days but less than several months. A period of less than several weeks seems to be the most likely, although these estimations are highly speculative.

D. Burial

The exposed bodies were buried at the extreme northwest corner of the village in the fortification ditch, the ditch which was supposed to protect the villagers. The protector became their crypt.

The body parts and bones were picked up probably by returning villagers who had escaped the massacre or by otherwise affiliated people. Recovering all body parts was impeded at least in part by the burned, collapsed lodges. It is also possible that recovery was impeded by drifted snow. Recovery was even further impeded by the scattering by the raiders and the scavengers. Some parts, especially the hands and feet, may have been lost before the recovery effort, and it is possible that many small bones were overlooked by the buriers. Certainly, for one reason or another, bones were left in some of the lodges, as indicated by previous excavations.

The body parts were carried to the extreme northwest part of the site and piled deeply--at one place over 4 feet deep--in the ditch. There apparently was no systematic attempt to align the parts, though this effort may have been impossible given the conditions of the remains. Rather, the parts were piled against the north wall of the ditch, forming a cone against the wall and spilling away from the peak across the ditch to the south wall of the ditch and east and west along the main axis of the ditch. Surprisingly the element distribution showed no slope (north-south) differences in element distribution. What slight differences there are occur mainly along the east-west axis. Skulls seem to be somewhat more frequent toward the northeast part of the deposit; hand and wrist bones are more frequent toward the southwest. No kin distinctions were made in the placement of skulls in the deposit, at least not along the main, east-west axis. But the faces may have been beyond recognition by the time of burial.

Finally, after the bones were in place, they were covered with a thin layer of clay.

Above the principal bone bed and the clay covering was a thin, scattered layer of bones. The reason for this secondary deposit is unclear. The deposit could have been "left-overs" remaining from scavengers which dug to the primary deposit and hauled up parts to consume. An alternate explanation for the secondary deposit is that there was a second recovery of bones after the first was buried. And these bones were placed in the ditch above the primary bone bed. It is unclear which of these explanations is correct.

It is likely that there are other bones at Crow Creek. It is almost certain that bones are still scattered in the village as demonstrated by the earlier excavations of some of the lodges. Certainly at least a few bones remain unexcavated from the primary bone deposit discussed above. It is also possible that there are additional large bone deposits. Because the village is 450 yards long and the excavated bone beds are at the extreme northwest corner of the village, it seems likely that there may be additional burial locations at more convenient spots.

E. Excavation and Reburial

Excavation of the remains began in 1954 and 1955 when Kivett and the Nebraska State Historical Society worked in the Crow Creek Village exposing several lodges and other features. The events which led to the presence of the scattered bones in their excavations and the burned lodges were unclear at that time. With the 1978 discovery of

the bones in the fortification ditch, the nature and magnitude of the events became apparent.

By 1978 a headwardly eating gully had followed the end of the fortification ditch to the west end of the bone bed and exposed parts of several individuals. Before excavations were begun by the University of South Dakota crew, a portion of the bed was looted, the bones broken and strewn down the gully. These remains were recovered, and almost all of the rest of the bone beds were excavated, but because of limited time and money, a few bones remained covered at the east end of the excavation.

The bones were studied at the University of South Dakota beginning in January 1979 and returned in May 1979 to the Crow Creek Sioux Reservation for reburial. Reburial occurred in August 1981 using one of the excavation pits dug by the Nebraska State Historical Society as the grave. Because of the discovery of the bones and the large size and excellent preservation of the village, the site is currently being considered for development as a National Monument.

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VITA

P. Willey was aborted January 18, 1948 on the borders of justice in Durango, Colorado. He attended numerous elementary and secondary schools, always just ahead of the law and graduated in the bottom half of his class from the Lawrence School for Wayward Boys in June 1966. Beginning the following September, he served three years in Leavenworth Federal Penitentiary for armed robbery with an antelope humerus. His rookie year there he was voted the New Meat Most Likely to Succeed. Despite several prior and present convictions, Willey made giant strides during his time in Leavenworth and became a mass murderer and a religious zealot. It was following his conviction for the homosexual slayings of nine boys and alleged assassination attempt of the 1975 TVA-and-I Fair Runner-up Queen that his interests turned toward academic applications of his special knowledge. The Crow Creek massacre victims offered such an opportunity. In spite of his dissertation's hastily written style, poor organization, and half-baked concepts, Willey graduated from The University of Tennessee, Knoxville, in 1982 with a Doctor of Philosophy.

He is a member of Sigma Xi, Phi Kappa Phi, American Association of Physical Anthropologists, Tennessee Anthropological Association, U.S. Volleyball Association, Smoky Mountain Athletic Club, and a token member of the Knoxville Women's Center. He is still waiting for an invitation from Phi Beta Kappa and is certain the invitation must have been misplaced somewhere in the mails.

He is no longer married but hopes to get lucky someday. He has no children that you can speak to in a normal tone of voice. He has asked the writer to convey to the reader that neither his circumcision nor the size of his nose indicates any religious or ethnic affiliations, that green is the color of his true love's hair, and for real value, invest in gold.