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A Bioarchaeological Analysis of Burials at the Weaver Site, Illinois

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ABSTRACT

A collection of skeletal material from the Weaver Site in Fulton County, Illinois, was examined to establish the composition and general health status of a sample of a prehistoric Native American population. The sample consisted of 34 individuals from three cultural periods: the Hopewell, Weaver, and Spoon River Mississippian.

Individuals were evaluated for sex, age, stature, and dental wear. The presence of pathological conditions as indicated by skeletal markers was recorded. The markers assessed were cribra orbitalia and porotic hyperostosis, periosteal infection, enamel hypoplasias, and dental caries, which are used to ascertain the nutritional and disease stress of a population. Evidence was also assessed for cases of unique, individual pathologies, including a case of scurvy—a disease little known in Midwest Native American populations.

While the Weaver sample is too small to derive statistically significant trends, the following conclusions are supported. The Weaver individuals showed lower frequencies of cribra orbitalia, porotic hyperostosis and periostitis than comparative frequencies in contrast populations from the same time period in Illinois. The conditions in the Weaver population were generally of low severity, as well. Mortality age distributions resemble published distributions for this time period. The general good health and resource availability of the Weaver population is supported by its lower frequency and severity of pathological markers, by the fact that 20% in a sample of 34 had an age of 50 years or greater, and by the presence of several very robust males.

Introduction

This study was undertaken as a Senior Honors Thesis in partial completion of the Northern Illinois University Honors Program. The purpose of the study was to establish the composition and general health status of a sample of prehistoric Native Americans from the Illinois River Valley. This information can be used to compare health status between different populations with the ultimate goal of contributing to a better understanding of the quality of life of an ancient population.

Background

A collection of skeletal material from the Weaver Site in Fulton County, Illinois was borrowed by the author from the Illinois State Museum at Springfield. Fulton County is in western Illinois, bordered to the north by Knox and Peoria Counties. The Weaver Site is located roughly ten miles northeast of the Dickson Mounds site, which lies near the intersection of the Illinois River and the Spoon River (Fig. 1).

The Weaver Site is an important archaeological site in the Illinois River Valley that contains the remains of over 2000 years of continuous habitation. The site was inhabited from the Middle Woodland through Mississippian times. The Illinois River Valley was a nearly ideal environment for human habitation, with a dependable water supply as well as numerous food sources. The fertile soil of the valley was conducive to the cultivation of maize and other crops during the Late Woodland and Mississippian periods (Wray and MacNeish, 1961).

Broadly defined, there are three local cultural traditions represented at the Weaver Site: the Hopewell, Weaver, and Spoon River Mississippian foci. The Hopewell cultural period began around 150 BC (Buikstra, 1982), while the Weaver Late Woodland culture dates to AD 300 and continues through the 11th Century AD (Green, 1987). The Spoon River Mississippian culture is first recognized around 1100 AD (Harn, 1994).

The Hopewell period is a subset of the Middle Woodland. Hopewell society was "characterized by status differentiation, specialization in site types, and inter-regional exchange or acquisition networks" (Green, 1987:1). The Weaver focus, once considered a late-Hopewell transition between Hopewell and Late Woodland, is now defined as a Late Woodland focus (Green, 1987). The Late Woodland period bridges the gap between the Hopewell and Mississippian periods.

The Spoon River Mississippian culture developed through a combination of early interaction with Cahokia and Plains Woodland peoples and subsequent exposure to Mississippian lifeways (Harn, 1994). It began to appear around 1100 AD, and quickly diverged from the Cahokian traditions as indicated by changes in material culture. The most important change from previous periods like the Hopewell and Woodland was the intensification of cereal agriculture, primarily maize. There was some continuity of lifeways throughout the process, however, as basic subsistence practices formed by combining Cahokian Mississippian influence with local traditions, continued to persist after the end of the Mississippian period (*ibid*). Mississippian culture was characterized by a high level of social complexity, including "craft specialization, intensive agriculture, rule by politico-religious elites, hierarchically organized settlement systems, and monumental constructions" (Green, 1987:1).

The location and layout of Mississippian sites were probably planned for access to agricultural resources, and as such differ from those of the preceding Late Woodland peoples (*ibid*). The location of Spoon River Mississippian sites in the Illinois River

Valley depended on landform, soil type, vegetation, and water source. All major Spoon River Mississippian sites are located on dry terraces or blufftops near a permanent water source. The sites were frequently located on brownish-yellow-gray silt loam in heavily forested areas. Some sites are also located on loess bluffs with upland or bottomland forest (*ibid).*

Spoon River Mississippian sites tended to be built along a standard plan. All known temple mound centers are located within a 160-kilometer stretch of the Illinois River (Harn, 1994). There are six central towns in the region, composed of platform mounds surrounded by a village area of two to eight hectares (*ibid*). Next in the organization scheme are the numerous primary villages. These villages lacked a central mound plaza, and are thought to have functioned as habitation centers for seasonal activities, located in areas that allowed the exploitation of multiple ecological zones (*ibid*). Intermediate settlements are smaller than villages but are also located for optimal exploitation of resources. Subsidiary sites are the smallest level of organization, and probably reflect seasonal camps for activities like hunting, fishing, and certain kinds of farming (*ibid*). They were frequently positioned near larger, more permanent settlements and some may have been used for daily activities rather than over-night camps.

The Weaver Site was an excellent location for acquiring many types of food. The site was positioned along the bank of Duck Creek (Fig. 2), providing easy access to fish, shellfish, and turtles, as well as waterfowl and aquatic mammals like muskrats (Langford, 1999). Hunting also formed a large part of the diet. Elk was one mainstay of the Weaver diet, and the presence of beaver teeth in burials suggests that they were eaten as well (Wray and MacNeish, 1961). Other animals that could have been hunted include squirrels, foxes, rabbits, raccoons, woodchucks, geese, turkeys, and quail (Langford, 1999).

To supplement their hunting and fishing, the inhabitants of the Weaver site probably gathered wild plants, including hickory nuts and acorns, wild fruits and seeds, and tubers (*ibid*). The domestication of wild plants began before the Middle Woodland, as early as 2000 BC in parts of Illinois (*ibid*). Sumpweed, or Marsh Elder, was commonly eaten by Native Americans in the Illinois River Valley, and was probably one of the first plants to be domesticated in the region (*ibid*). A core group of starchy seed plants was cultivated during the Middle Woodland period, and expanded during the Late Woodland. These included goosefoot, knotweed, maygrass, and little barley (*ibid*). These plants were harvested annually, and provided a rich source of vitamins and minerals, including calcium, phosphorous, thiamin, and niacin. They also provided a source of iron, although game animals probably provided more of this important nutrient (*ibid*).

During the Weaver Late Woodland period, grain horticulture, primarily maize, supplied an increasing amount of the caloric and nutritional needs of the inhabitants. After AD 1000 maize became a significant component of the diet, with a corresponding decline in the use of deer and other terrestrial mammals. Marine resources were increasingly exploited during the Mississippian period, however, providing an important source of iron and protein (*ibid*). This shift was probably related to the increased sedentarism that accompanied the shift to intensive horticulture.

The Weaver Site was principally excavated by the Wray family from 1933 to 1957. Most of the remains from the Weaver Site were excavated by Donald E. Wray in cooperation with Richard S. MacNeish of the University of Chicago. Unfortunately, the Weaver Site has a long history of less systematic excavation prior to this period. The burial mound F^{o}228 was looted extensively before 1900, and again by commercial diggers from 1930-1933. Frank Solomon excavated several Hopewell mounds from the central group in 1927. Highway construction in 1935 partially destroyed several mounds in the central group, and a drainage ditch was cut through the main village site F^{v}229 after World War I (Wray and MacNeish, 1961).

Burial Mounds

The Weaver Site is "a complex aggregate of 55 mounds, 2 cemetery-mounds, 3 cemeteries, and 4 separate village sites" (Wray and MacNeish, 1961:7). It can be divided into five groups of mounds sharing similar features (Fig. 2). The Central group contains the primary village site, F^{v}229, and ten burial mounds from the Hopewell culture. F^{v}229 was inhabited during several successive periods, including both Hopewell and Weaver. No material included in this study is from the Central group.

The West group consists of nine mounds that were used solely for burial purposes. Much of the material in this study is from the West group, mainly burial F^{o}228. Burial F^{o}228 is part of a cemetery-mound identified with the Spoon River Mississippian culture. As noted in the introduction, it was greatly disturbed by looting and excavation prior to the work started by the Wray family in 1933. Other material from the West group included in this study comes from burial F^{o}914, another Spoon River mound, and F^{o}910, a classic Hopewell mound. F^{o}225, also from the West group, was not assigned to a particular cultural horizon in the primary source by Wray and MacNeish (1961).

The South group includes the cemetery F^{c}925 and the burial mound F^{o}205, both assigned to the Weaver focus. It also was used only for burial purposes. Several individuals recovered from these mounds are included in this study.

The North group contains the Maple Mills cemetery F^{c}911, and two Spoon River Mississippian villages. During the Spoon River Mississippian period, habitation of the valley largely shifted from the Central group to the North group, established on a bluff near the river. The Spoon River Mississippian occupation of the North group probably fit the primary village classification proposed by Harn (1994); that of a large village site without a central platform mound. The only material assigned to the North group was from F^{c}911. This consisted only of bone fragments, possibly cremated, and was not included in this study.

The cultural affinity of burials F^{c}904, F^{o}454, F^{o}809, and F^{o}595 was not established by Wray in his 1961 publication, and is not available. The individuals from these mounds were nonetheless included in this study.

Why Study Skeletons?

Archaeological methods can often tell us much about the way a people lived: what they ate, what kind of subsistence method they practiced, how large their population was, and how their society was organized. They can even inform us about a group's religious practices. For demographic information, however, we must turn to analysis of the individuals themselves as preserved in their skeletal remains. Skeletons can tell us a great deal about the health of a population. They can also provide clues to rates and causes of mortality, and even the lives and daily activities of the individuals themselves.

Some diseases leave marks on the skeleton that can be used as diagnostic indicators. Bones respond to disease in two ways: by adding more layers of bone tissue (apposition), or removing existing layers. The skeleton can respond to any individual disease by depositing bone, removing bone, or a combination of the two. Some diseases leave a characteristic pattern of changes to the skeleton, often affecting certain bones and leaving others unaffected; these diseases are relatively easy to diagnose. Many diseases, however, leave only general indicators of their presence. The amount of time that the disease affects the individual also influences its appearance on the skeleton. Many diseases that cause the death of an individual occur quickly and leave no trace on the skeleton; it is the chronic diseases that have time to affect the skeleton that can most readily be identified.

This disparity in the effect of disease on the skeleton and its interpretation for the health of the individual affects all bioarchaeological analyses, and has been referred to as the "Osteological Paradox" (Wood et al., 1992). Wood and colleagues (1992) suggest that individuals with no sign of disease on their skeletons may in fact have been less healthy than individuals whose skeletons show signs of chronic stress, simply because those individuals with signs of chronic stress were healthy enough to combat a disease for a long enough period of time for skeletal lesions to form. Individuals with no lesions may have died before their skeletons had a chance to show signs of the disease.

Another source of bias identified by Wood and colleagues (1992) is associated with changes in population growth rates. In a population with a high growth rate, more children are being born, so a higher number of children will die even when the disease rate is the same. This will be reflected in the archaeological record as an increase in the number of child skeletons. The cause of this increase may not be a decrease in health, however, but in fact the opposite; better health conditions which lead to a higher fertility rate.

Wood and colleagues (1992) suggest the need for future research to clarify the causes and effects of innate differences in frailty, the functioning of disease processes, and the effects of culture on the health of a population in order to better understand and interpret skeletal lesions. Other authors (Cohen 1992 (letter in response to Wood's article)) disagree with the conclusions of the Osteological Paradox (Wood et al., 1992), arguing that evidence from living populations at all levels of social organization suggests that skeletal lesions are best interpreted as directly related to the prevalence of disease in living populations. Ultimately, although the frequency of certain conditions may be suspect in light of mortality and demographic biases, the presence or absence of certain diseases in the skeletal record can be very informative. Many pathological conditions, such as cribra orbitalia and porotic hyperostosis, reflect dietary or disease-based stress. If these conditions are not found in a population, the severity of the stress during life was probably not very high.

Materials and Methods

For the purposes of this study, a selection of osteological measurements and information was collected from each skeleton. This information was used to calculate stature and determine age and sex for each individual. The presence or absence of pathological conditions as indicated by skeletal markers was also recorded. The markers assessed were cribra orbitalia and porotic hyperostosis, periosteal infection, enamel hypoplasias, and dental caries. During the course of the examination of the skeletal material, several other pathologies were identified. The nature of these pathologies makes a precise diagnosis difficult, but a possible identification has been attempted for each case.

Stature was computed for all adult individuals with one or more complete long bones (diaphysis and metaphyses present and unbroken). The presence of all of the long bones (excluding hand and foot bones) in some individuals permitted the use of a more accurate formula. In both cases, Genoves' formulas as published in Human Osteology (Bass, 1987) were used to calculate stature.

Sex estimates were based on features of the skull and pelvis. The pelvis is one of the most dependable indices of sex in an individual (Hoyme and Iscan, 1989). White (2000) notes that skilled osteologists have a 90 percent success rate in determining the sex of an individual when the pelvis is present. Features of the pelvis considered in sex estimation include the ventral arc, pubic symphyseal area, sciatic notch, and preauricular sulcus. Cranial features are also used in determining the sex of an individual, but are generally less reliable than features of the pelvis. When both the skull and pelvis are available for study, however, more accurate determinations can be made if they are both assessed. Traits examined on the cranium include the size and shape of the mastoid process, the external occipital protuberance, projection of glabella, and the contour of the orbital rim. The shape and size of the mental process of the mandible was also considered. In the present study, many individuals were represented only by a skull. The resulting estimates thus have a larger margin of error. These sex indicators and their interpretation are explained in Standards for Data Collection from Human Skeletal Remains (Buikstra and Ubelaker, 1994).

Age was determined with a combination of pelvic indicators and dental wear. Dental wear can be an extremely effective tool for aging (*ibid*), but requires calibration and can be problematic when teeth are used as tools for working leather and other tasks. Pelvic aging methods are also very useful, but can have a wide age range associated with them. The analysis in this study used the pubic symphysis and auricular surface for age determination when they were available. Pelvic age was calculated for the pubic symphysis by the Suchey-Brooks method, and the auricular surface according to Lovejoy's method (*ibid*). Cranial suture closure was also examined, but the variability found in the sample was so great that the results were not included in the age estimates.

Dental wear was recorded for incisors, canines, and premolars on an eight-part scaled modified from the Murphy system by Smith (Smith, 1984). Molar wear was recorded on a ten-part scale developed by Scott (Scott, 1979). Molar wear is computed by adding the score for each molar quadrant, producing one number that ranges from 4 to 40 for an individual tooth. Dental wear was not recorded for juveniles. These methods are detailed in Standards for Data Collection from Human Skeletal Remains (Buikstra and Ubelaker, 1994).

Children and adolescent individuals are much easier to age than adults using the formation and eruption of the adult and deciduous dentition. Age of tooth eruption in humans is well known, and can be used to estimate age at death in juveniles to within one or two years. To age the Weaver subadults, the development of the dentition was compared to charts developed by Ubelaker (1989) showing tooth formation among Native Americans. The degree of epiphyseal closure of the long bones can also provide an age range, and was used in conjunction with the dental aging. There is some variation in epiphyseal closure between individuals, so ages estimated from the development of the dentition may be more accurate. These methods are also explained in Standards for Data Collection from Human Skeletal Remains (Buikstra and Ubelaker, 1994).

Dental caries are useful indicators of the type of diet a people consumed. Diets rich in carbohydrates lead to more caries formation due to the higher proportion of sugars in these foods compared to those rich in protein (*ibid*). For this reason, hunting and gathering cultures tend to have fewer caries than those practicing horticultural or agricultural subsistence strategies. For this study, dental caries were recorded by tooth type (premolars, molars, etc.), and analyzed as the frequency of affected teeth by number of teeth present. Older individuals would be expected to have more caries, and thus more antemortem tooth loss, as a result of the longer period of exposure to the caries-causing bacteria. This could also be caused by the decreased resistance to caries in teeth with worn enamel.

Cribra orbitalia and porotic hyperostosis are conditions of increased porosity and hypertrophic lesions of the orbit and parietal bones, respectively. They are most often associated with anemia (Roberts, 1995). Anemia is "a reduction in concentration of haemoglobin and/or red blood cells below normal" (*ibid*, 166). Iron deficiency anemia is the most common type of anemia and results from a lack of iron in the body. Iron is necessary for the production of hemoglobin in red blood cells, and its lack causes cells to be undersized, short-lived, and somewhat dysfunctional (*ibid*). In an attempt to compensate for the hemoglobin deficiency, the marrow cavities within the bones enlarge in order to produce more red blood cells. In the bones of the cranial vault, this results in enlargement of the diploë and thinning of the outer table of bone with increased porosity.

The primary cause of iron deficiency is a lack of iron in the diet. Iron is found in large quantities in meat and fish, as well as some plants, but many cereals, such as maize, contain phytates, compounds that inhibit iron absorption (*ibid*). It can be hypothesized that the transition to agriculture, with its emphasis on cereal crops, could lead to an increase in iron deficiency anemia. Several other factors can also contribute to anemia. Both chronic disease and parasitic infection can aggravate existing nutritional deficiencies, and it is posited that one of the body's defensive mechanisms against infectious disease is to withhold iron from the pathogens to deprive them of their nutrients, thereby putting itself into a hypoferric state (Mensforth et al., 1978). This could also contribute to a rise in the frequency of anemia with agriculture, because with the increase in group size and proximity, infectious disease also increases.

Periosteal reactions, also called periostitis, are inflammations of the periosteum, the membranous layer covering the external surface of the bone. This inflammation, caused by a variety of diseases, leaves distinctive lines and marks on the surface of the bone where new bone is being formed. These are caused by increased circulation to the area which causes a buildup of fluid under the periosteum, lifting it away from the bone and stimulating the formation of new bone (Mays, 1998). The presence of the condition is a useful indicator of general disease levels in a population. Periostitis is known to increase in prevalence in response to increases in population density and the development of permanent settlements (Larsen, 1995).

Enamel hypoplasia is a condition caused by a temporary disturbance of the ameloblasts, cells that form tooth enamel. It results in a defect of the smooth surface of the enamel that can take several forms depending on the severity and duration of the disturbance; minor disruptions of enamel secretion result in pitting, while severe, long-lasting disruptions create a linear depression in the enamel (King et al., 2002). Nutritional deficiencies are one of the primary causes of enamel hypoplasias, but they are also linked to episodes of disease and severe stress (*ibid*). Enamel hypoplasias are useful in paleodemographic studies of health because they "provide a permanent record of developmental stress," (*ibid*, 29) as, unlike bone, tooth enamel is not remodeled during life. Disruption of enamel secretion can only occur during the growth of the tooth; this means that enamel hypoplasias are a record of growth disruption during early childhood. The susceptibility to enamel growth disruption seems to differ between different tooth types, thus a different number of hypoplastic episodes may be recorded on different teeth for the same individual. This can also occur as a result of the different tooth formation times if the hypoplastic episode occurs before or after a tooth's enamel is formed. Dental enamel hypoplasias were recorded as a frequency of teeth affected, and the number of lines per tooth.

Data and Discussion

The skeletal material from the Weaver collection is generally well preserved, so few osteological features were obscured by post-mortem damage. Some individuals were represented only by a skull or partial skeleton. Many of the burials contained the remains of multiple individuals.

The Weaver collection contained 34 individuals complete enough to provide some information. There were several more individuals represented by bone fragments or isolated bones of the skeleton, such as a tarsal bone or part of the diaphysis of a long bone. These individuals were not included in the study. Of the individuals included in the study, 14 are juveniles, and 20 are adults. Twenty years of age is viewed as the cut-off for adulthood, with individuals being scored as juveniles up to 19.9 years old. Table 1 provides the age-at-death distribution for all of the individuals studied; the distribution for juveniles of all temporal periods can be seen in Table 2. The age-at-death and sex distribution for all adults is described in Table 3.

Table 1
Weaver Mortality Summary

Age Range (yrs)	# of Individuals	%
<1	2	.06
1-2.9	1	.03
3-4.9	4	.12
5-9.9	3	.09
10-14.9	2	.06
15-19.9	2	.06
20-24.9	2	.06
25-34.9	5	.15
35-49.9	9	.26
>50	4	.12
	34	1

Table 2
Weaver Juvenile Mortality

Age Range (yrs)	# of Individuals	%
<1	2	.14
1-2.9	1	.07
3-4.9	4	.29
5-9.9	3	.21
10-14.9	2	.14
15-19.9	2	.14
	14	1

The distribution of juvenile mortality in the Weaver individuals (Table 2) is very similar to other published distributions of Native Americans from the same time periods (i.e., Blakely, 1971). Among the Weaver children 21% died before the age of 3; this period corresponds to the period of development when children are weakest and most likely to die from disease or dietary stress. The most deaths (29%) occurred between the ages of 3 and 5. This period corresponds to the age of weaning, and is known to be one of the most dangerous times in a child's development (*ibid*). Half of the deaths among the Weaver juveniles clustered between the ages of 0 and 5; the other half were spread over a fifteen-year period.

This distribution suggests that children have a hard time surviving the first several years of life, before three years because of innate frailty, and from three to five years from the stress of weaning. After this period there is no discernable pattern to the deaths until the early 20s when people begin to die of other causes such as disease and violence.

Table 3
Weaver Adult Mortality

Age Range (yrs)	# of Male individuals	# of Female individuals	%
20-24.9		2	.10
25-34.9	4	1	.25
35-49.9	5	3	.45*
>50	2	2	.20
	11	8	1

*n = 8 + 910-A adult (sex undetermined)

Viewing adult mortality as a whole, across the boundaries of cultural periods, several statements can be made about the distribution of patterns of age at death. First, it should be noted that there are 11 males and 8 females in the adult distribution, with one adult of undetermined sex (Table 3). Given the small size of the sample, this is not a statistically significant difference from the roughly 50-50 distribution one might expect

(χ^2=.474, $p > .10$). Another factor to consider is the well-known observation that skeletal populations frequently seem to contain more males than females. Several explanations have been proposed for this, including differential burial patterns (which is less likely), observer bias, and the masculinizing effects of age on female skulls, which are perhaps more likely explanations for this apparent trend.

The age categories used in Table 3 reflect the varying degrees of precision with which skeletal ages can be determined. Few of the skeletons from the Weaver Site examined in this study had both pelvic and dental age information available. As a result, the age categories are broad to accommodate error, and should be taken as relative, not absolute indicators of age.

The Weaver adult age distribution resembles published distributions for this time period in Illinois (Cook, 1982). The majority of adults (80%) died between the ages of 25-50. Within this group, 45% of the deaths were between the ages of 35 and 50. This agrees with the lower life expectancy of pre-modern agricultural peoples when compared to modern peoples with a life expectancy of well over 50. Adults over the age of 45 or 50 are quite difficult to age accurately. However, the fact that four adults, or 20% in a sample of 34 had an age of 50 years or greater indicates that this population was doing well in comparison to others from the same time period.

Table 4
Weaver Juvenile Mortality by Cultural Affiliation

Age Range (yrs)	Hopewell	Weaver	SRM*	Unknown
<1			1	1
1-2.9			1	
3-4.9	1	1	2	
5-9.9	2			1
10-14.9		2		
15-19.9			2	
	3 (.21)	3 (.21)	6 (.43)	2 (.14)

*SRM = Spoon River Mississippian

Table 4 shows the distribution of age at death in juveniles within the three cultural groups at the Weaver Site. The small sample of individuals from the Weaver Site used in this study means that attempts to construct demographic information should be interpreted with caution. These samples become even smaller when they are separated by cultural horizon. There are only three juveniles from the Hopewell period, three from the Weaver, and six from the Spoon River Mississippian periods, reflecting the overall composition of the Weaver Sample. This means that no definite conclusions can be drawn from these samples. It is therefore impossible to say whether the higher number of children from 1 to 4.9 years at death in the SRM sample is due to an increase in mortality, or due to the larger sample size.

Table 5
Weaver Adult Mortality by Cultural Affiliation

	Hopewell		Weaver		SRM		
Age Range (yrs)	Male	Female	Male	Female	Male	Female	Unknown
20-24.9						2	
25-34.9			1		2	1	1
35-49.9		1	2		1	2	2
>50				2	1		1
		2* (.10)	3 (.15)	2 (.10)	4 (.20)	5 (.25)	4(.20)

*n = 1 + 910-A (Hopewell, 35-49.9, sex undetermined)

Table 5 shows the distribution of adult mortality by age and sex divided between the three cultural periods of the Weaver Site. This table shows a more even distribution of individuals between the three periods than found in the juvenile sample. There are two individual from the Hopewell period, five individuals from the Weaver, and nine individuals from the Spoon River Mississippian period.

It is tempting to draw the conclusion that the greater distribution of Weaver individuals in later age groups (>25 years) of 100% compared to 80% of the Spoon River Mississippian sample is related to the increased reliance on maize horticulture in the Mississippian period. Given the small size of the samples, however, this hypothesis is tentative at best, and suggests a possible area for future research if more individuals from the Weaver Site could be obtained for study.

Table 6
Inventory, Age, Sex, and Frequency of Pathologies

		Inventory				Pathologies			
Burial #	Sex/ Age in years	Skull	Pelvis	MNI	# long bones	C.O.	P.H.	Periost -itis	Anomalies
904-62 B	<1				7				
228-63	<1	X							
914-21	1-2.9	X				X slight			
228-72	3-4.9	X		MNI 2	7				Scurvy
205-4 child	3-4.9	X							
228-4	3-4.9	X		MNI 3	13				
910-A 1	3-4.9	X							

904-62 A	5-9.9	X			10				
910-A 2	5-9.9	X							
910-B 2	5-9.9	X Man. Only							
925-2	10-14.9	X							
925-4	10-14.9	X				X mod.			
914-22	15-19.9	X							
228-2* male	M/15-19.9		X		12			X mild	
914-17	F/20-24.9	X				X slight			
228-1	F/20-24.9	X	X		10			X	
228-27	M/25-34.9	X			12			X mild	
914-18	M/25-34.9	X							
809/694	M/25-34.9	X							
925-5	M/25-34.9	X				X healed			
914-24	F/25-34.9	X							Unfused C1
228-47 (box 5)	F/35-49.9		X		12				
225-1	M/35-49.9	X	X		9				
914-25	M/35-49.9	X							
925-1	M/35-49.9		X		12				
925-A+B	M/35-49.9	X			7			X	Treponemal disease
809/595	M/35-49.9	X partial							Auditory exostoses
228-2 female	F/35-49.9	X							
910-A	?/35-49.9								

910-B adult	F/35-49.9	X							Auditory exostoses
205 N half	F/>50	X				X heal-ed			
205-4	F/>50	X				X mod.			TMJ arthritis
914-14	M/ >50	X							Fusion of cervical vertebrae
1985-270	M/ >50	X part-ial							

X = present, blank = absent
*burial F°228-2 contained two individuals, one a male 15-19.9, the other a female 30-49.9

The prevalence of cribra orbitalia and porotic hyperostosis among individuals in the Weaver collection is quite low (see Table 6). Porotic hyperostosis, generally associated with severe anemia, was not detected on any individuals (n=28). Cribra orbitalia was detected on six individuals (p=.21, n=28), with low to moderate severity. Two children showed evidence of cribra orbitalia, as well as three adult females and one adult male. Within the adult sample, 75% of the cases of cribra orbitalia were found on female individuals. The individuals with cribra orbitalia under the age of 25 are evenly distributed between the Weaver and Spoon River Mississippian periods. The other two cases are both females over 50 years assigned to the Weaver Late Woodland period. This may be due to the larger number of individuals in this age group from the Weaver period, or may reflect a higher stress level for these individuals.

Periostitis was found on the long bones of four adult individuals (p=.36, n=11), three males and one female, primarily on the tibia and fibula (Table 6). It was generally more developed on the tibia. The cases of periostitis found in the Weaver sample (with the exception of individual F^c925-A, see pathology section) were all of low severity, and were predominantly (75%) from the Spoon River Mississippian period.

Table 7
Adult Stature

Burial #	Age / Sex	Estimate Stature	Formula
228-2	15-24 / male	160.03 ± 2.81 cm	All long bones
228-27	20-35 / male	167.41 ± 2.61 cm	All long bones
228-1	19-24 / female	168.36 ± 3.81 cm	Femur only
228 '47	30-42 / female	162.86 ± 2.81 cm	All long bones
225-1	31-50 / male	168.30 ± 3.42 cm	Femur only
925-1	35-39 / male	169.75 ± 2.61 cm	All long bones

Stature estimates were only possible for six of the adults in the sample (Table 7), as many individuals are only represented by cranial material. There are several similarities in height distribution among the individuals for whom stature estimates could be made. The estimates of the three males ranged between 167.41 and 169.75 centimeters tall, while the females show a broader range from 162.86 to 168.36 centimeters.

Table 8
Dental Wear, Frequency of Caries, and Antemortem Tooth Loss

Burial #	Estimate Age Range	Sex	Avg. I-P wear	# I-P teeth	Maxillary Molar Wear Scores						Mandibular Molar Wear Scores						# caries	# Teeth lost Ante-mortem
					M1		M2		M3		M1		M2		M3			
					L	R	L	R	L	R	L	R	L	R	L	R		
228-2	35-49.9[d]	F	4.5	20		26	14		10		16	17		16			3	3
228-27	25-34.9[d]	M	4.4	19	22	19	12	13	4	5	18	19				6	5	2
228-1	20-24.9[p]	F	2.1	20	17		12	8	8	8	14	9	12	6	1	1	5	0
225-1	35-49.9[p]	M	6.2	17	38	37	34	36	17	33	35	37	35	36	34	36	1	2
914-22	15-19.9[*]	J	2.3	20	10	10	9	11	NE	NE	13	15	14	10	NE	NE	2	0
914-24	25-34.9[d]	F	3.5	11	13	18	14	13									9	6
914-25	35-49.9[d]	M	5.1	20	21	22	17	17	13		19	21	19	18			4	1
205-N half	>50[d]	F	6.8	7	36	36	32	32	17								1 max. only	3
205-4	>50[d]	F	7.2	14		39		36	36			30	24	32	34		1	6 (min)
914-18	25-34.9[d]	M	3.7	9	15	16	12	14	12	12		19	14	15	15	15	1	0

914-17	20-24.9[d]	F	2.9	16	15		14	10	4			14		12		4			2	0
925-5	25-34.9[d]	M	3.1	20	19	18	14	13		12		19	19	15	17	13	16		0	0
925-4	10-14.9*	J	1.3	20	14	15	5	7	NE	NE		16	14	6	7	NE	NE		0	0
925-B	35-49.9[d]	M	5.8	6	30	30		24		20		31	35	21	27	19	24		2	3
809/694	25-34.9[d]	M	4.2	20	16		15	17		12		16	17	14	15				1	3
910-B	35-49.9[d]	F	5.6	11	33	32	29	30											0	1
910-A[1]	35-49.9[d]	?	6	1									36				16		3	2 (min)
1985-270	>50	M																	No teeth	9 (man only)
914-14	>50[d]	M	7.5	2					16										1	18

p=pelvic age
*=age from development of the dentition
d=age estimated from dental wear
1=F°910-A had only disassociated teeth, so the location of the molars are probable

Dental wear and pathologies

Dental wear was used to estimate the age of individuals without pelvic remains. Precise age estimates from dental wear require that the wear be calibrated to another aging system, preferably pelvic aging. Due to the limited number of individuals with both cranial and pelvic remains, it was not possible to derive a statistically valid calibration for the Weaver individuals. This creates a number of problems for the interpretation of dental wear. Since the wear could not be calibrated, this means that each individual was assigned to a broad age category, rather than the narrow and more specific range that might otherwise have been possible. A more serious problem is the effect that this age estimation had on the data: because ages were estimated from dental wear, any difference in wear between the sexes is somewhat obscured. Concluding that one sex shows more dental wear at a certain age than another would be a case of circular reasoning without the independent corroboration that pelvic ages would provide. Another problem with further refining the age estimates is the disparity in daily life that the individuals might have experienced. We cannot know about an individual's social class, daily work, and other conditions that might have caused a different amount of dental wear than for another individual of the same age.

Although the lack of pelvic ages prevents analysis of differences in dental wear between males and females in a given age group, differences in dental wear at the individual level can be examined. There was some variation in individual dental wear between the left and right sides of the mouth. Many individuals had wear that was within several points between teeth on opposite sides of the mouth, for example, F°225-1's mandibular left and right first molars are 35 and 37, and the second molars 35 and 36, respectively. Other individuals displayed considerably more side-related variation in dental wear, for example, F°228-1 has left first and second molars with nearly twice the wear as those on the right.

There does seem to be a pattern of increased side-related dental wear variation among females compared to males. Some males do display variation in side-related dental wear, but the variation among the females is generally greater. This pattern would be expected for several reasons: Native American females tended to use their teeth for tools (e.g. working leather) more often then men, and they were more likely to include a higher proportion of grains and harder foodstuffs in their diet than men, whose meat intake was higher. There does not seem to be a particular pattern to the side of the mouth with more dental wear.

Some individuals have more dental wear of their anterior teeth than of their posterior teeth, or the reverse, for their age group. Individual F°925-5 has the second to highest wear scores for maxillary first molars in the 25-34.9 age group, with scores of 19 and 18 for left and right first molars, respectively, but the lowest incisor, canine, and premolar (I-P) average, with only 3.1. Conversely, individual F°914-25 has an average I-P score of 5.1, slightly less than many of the scores in the 35-49.9 age bracket, but has by far the lowest maxillary first molar scores of 21 and 22. This might be due to the anatomical differences in tooth size and position within the mouth between the different individuals. It might also reflect a difference in diet, or tooth use (i.e. use of the teeth as tools).

Dental caries are easy to detect in teeth that are in occlusion or were recovered from a burial. What cannot be known is if teeth that are not present had caries. This issue is related to alveolar resorption. Frequently a recovered maxilla or mandible will have several missing teeth. If the tooth sockets are visible and show no signs of resorption, it is impossible to tell if the tooth fell out postmortem due to natural taphonomic processes, or if the tooth had well-developed caries and fell out perimortem. If the tooth fell out some time before death, the alveolar bone would start to resorb, leading to a characteristic pattern that is easily detectable.

Table 9
Caries Distribution by Tooth Type

	Incisors		Canines		Premolars		Molars	
Individ -uals	# Pres- ent	#Affect -ed	#Pres- ent	# Affected	# Present	# Affected	# Present	#Affect -ed
228-27	8	0	4	0	8	1	10	4
228-2	8	0	4	0	8	0	9	3
925-5	7	0	4	0	7	0	10	0
225-1	5	0	4	0	8	0	11	1
228-1	8	0	4	0	8	0	12	5
914-22	8	0	4	0	8	0	8	2
914-25	8	0	4	0	8	0	9	4
914-24	2	0	3	1	6	5	5	3
205-4	4	1	3	0	2	0	6	0
205 n-half	1	0	2	0	4	1	5	0
914-18	3	0	1	0	5	0	11	1
914-17	7	0	2	0	8	0	11	2
925-4	8	0	4	0	8	0	8	0
925-B	0	0	3	1	4	1	10	0
809/ 694	8	0	4	0	8	0	8	1
910-B	5	0	2	0	4	0	4	0
910-A	1	1	0	0	0	0	2	2
914-14	2	0	0	0	0	0	2	1

Most of the Weaver individuals have several resorbed tooth sockets and several caries (Tables 8 and 9). Dental wear was not scored for children or juveniles (with two exceptions for older juveniles), as the stage of tooth eruption is a better indicator of age.

Of the 18 individuals over the age of 15 who could be scored for caries, fifteen of them, or 83% had at least one caries. Seven of these individuals (39%) were male, and six (33%) were female. The youngest individual to have caries, F°914-22, was in the 15-19.9 age group. None of the children or adolescent individuals (less than 15 years of age) in the collection had any caries or resorbed tooth sockets. Many of the individuals with dental caries had antemortem tooth loss as well. Thirteen individuals had at least one tooth lost antemortem out of a sample of 19 individuals (68%). Six males of a sample of 18 had antemortem tooth loss (33%), as did six females (33%). There were two individuals with no caries present who had lost teeth antemortem. When analyzed together, not separated by cultural period, there is no real pattern for caries development relating to age. One of the older individuals, F°225-1, has only one caries and two resorbed tooth sockets, while the much younger F°228-1 has five caries.

Roughly half of the individuals for whom dental wear and dental pathologies could be calculated are from the Spoon River Mississippian period (47%). There are only two Hopewell individual available for comparison, F°910-A and F°910-B. Individuals F°925-5, F°925-B, F°925-4, F°205-4, and F°205-North half are from the Weaver period, and allow a better comparison to be made. All of the Spoon River Mississippian individuals had dental caries, and 56% had antemortem tooth loss. Only 60% of the Weaver individuals had caries; the individuals with caries also had antemortem tooth loss. Both of the Hopewell individuals had antemortem tooth loss, but only one of them had caries. In general, Spoon River Mississippian individuals have more caries (average of 3.6 caries per individual) and resorbed teeth (average of 3.3 per individual) than individuals from the Weaver (.8 caries average per individual, 2.4 teeth lost antemortem average per individual) or Hopewell (1.5 caries and antemortem teeth lost average per individual) periods. Five of the Spoon River Mississippian individuals have no more caries or resorbed teeth than Weaver individuals, but four of them have more, and three of those have considerably more.

One possible explanation for this trend is the increased reliance on carbohydrates (in the form of maize) in the Mississippian diet. An increase in carbohydrates and the associated sugars tends to lead to an increase in caries formation. Although older individuals would be expected to have more caries and resorbed teeth, the Spoon River Mississippian individuals with the highest number of caries and resorbed teeth are actually younger than most of the Weaver and Hopewell individuals, adding support to the dietary hypothesis. This trend is also mentioned by Cook (1982) who notes an increase in caries in Mississippian individuals after the age of 20 compared to earlier populations.

Table 10
Enamel Hypoplasia Prevalence

Individuals with 1 hypoplastic episode	Presence of 2 or more hypoplastic episodes
228-27	X
228-1	X
914-22	
225-1	
914-24	X
925-5	X
914-17	
925-4	
925-B	
205-4	
914-18	
914-25	
p = .48	p = .16

X = present, blank = absent

Table 10 shows the individuals in the Weaver collection that had one or more defined hypoplastic episodes. Some episodes were more severe than others, but individuals with only mild pitting or discoloration were not included in the chart. The number of lines was counted for the incisors and canines only. The frequencies were computed with n = 25 individuals with teeth present, of any age. Four of the twelve individuals with caries (33%) had two or more hypoplastic episodes. None of these individuals had three hypoplastic episodes on more than two or three teeth. Three of the individuals with two hypoplasias (25%) were from the Spoon River Mississippian period. Six of the individuals (50%) were male, four (33%) were female, and two (17%) were juveniles. There is no detectable pattern of hypoplastic episodes by gender.

Pathologies

Individual F°228-27

Individual F°228-27 is a child from the Spoon River Mississippian burial mound F°228. This individual is represented by numerous cranial fragments, including several large pieces of the left and right parietals, the occipital, the temporals, the frontal, the right zygomatic, and the left maxilla. The mandible is also mostly present, though broken in two pieces. The individual's complete mandibular deciduous dentition is in occlusion, and the first adult molars of the mandible are present in their crypts but not yet erupted. Radiographs taken of the mandible show a pattern of dental development consistent with an age of 3 years ±12 months (Buikstra and Ubelaker 1994).

Also included in burial F°228-27 are the post-cranial remains of at least two individuals. One individual is represented by seven long bones, right and left scapulae, and right and left ilia, as well as several ribs and vertebral fragments. A portion of the mandible of a second individual and part of a sternum are the only indications of more than one individual. The length of the long bones suggests an age of 2-4 years for the individual (per Bass, 1987). This age is compatible with the age of the affected cranium and mandible. The second mandibular fragment is slightly smaller than the affected mandible, but of a similar size so that the long bones could conceivably belong to it. Porosity on the scapulae, however, suggests that they belonged to the skull (as well as supporting the diagnosis of scurvy).

Lesions

The affected bones include the frontal, left and right parietals, the occipital, the squamosal portion of the temporals, the maxilla, the zygomatic, the mandible, and the external surface of the greater wing of the sphenoid. The lesions on the frontal bone, parietals, and occipital are hypertrophic or additive in nature, involving the growth of new bone external to the outer table of the cranial vault (Figs. 7 & 8). Those on the maxilla, sphenoid, and mandible are more porous, with much pitting. The hypertrophic lesions vary in the degree of pitting: some are patches of new bone with enlarged pits and holes, such as those covering the parietals and the occipital, and other patches have little pitting, such as on the frontal bone.

The lesions on F°228-27 do not support an interpretation of cribra orbitalia and porotic hyperostosis. The lesions in these conditions are typically focused on the superior surface of the orbits and on the parietals, respectively. Individual F°228-27 has lesions on these areas, but also on many of the other craniofacial bones as well as the mandible.

In order to ascertain the nature of the lesions, several cranial bones and the two pieces of the mandible were x-rayed at the Northern Illinois University Health Services center by Todd Adee, RT, and his assistant. The results (Fig. 9) suggest that the new bone has been added directly to the surface of the cranial vault, rather then being an extension of the diploë through the vault, as would be expected in a case of porotic hyperostosis.

Scurvy

Scurvy develops as a result of dietary deficiency of vitamin C. It affects the composition of the blood vessels (as well as other parts of the body) making them more likely to rupture and bleed profusely. Ortner and colleagues (2001) suggest a set of diagnostic cranial lesions that characterize most cases of scurvy. Increased porosity is the most common type of skeletal lesion caused by scurvy, but hypertrophic lesions can also occur (Ortner et al., 1999). The definitive lesion of scurvy is porosity on the external surface of the greater wing of the sphenoid and the surrounding area (Ortner et al., 2001). These lesions are thought to be related to the action of mastication and pressure on the maxillary artery, which in its weakened state causes it to bleed, leading to an inflammatory response that creates the lesions (Ortner et al., 2001). Other lesions occur on the cranial vault, inner surface of the orbits, the zygomatics, and parts of the maxilla and mandible.

Ortner and colleagues (2001) suggest that lesions on the scapula in scurvy cases reflect the actions of the rotator cuff muscles, principally supraspinatus and infraspinatus. These muscles cause rupturing and bleeding of the blood vessels in the supraspinous and infraspinous fossae. The scapulae associated with burial F°228-72 have pitting in these areas, adding support to the possibility of scurvy as a diagnosis.

Ortner and colleagues (2001) refer to two cases distinguished by increased porosity and hypertrophic lesions of the parietals and orbits, but with no lesions on the sphenoids, which are described as likely cases of scurvy. In F^{o}228-72, parietal lesions are particularly evident, as are lesions of the frontal bone, orbits, maxillae, and mandible.

Hypertrophic lesions caused by scurvy differ from descriptions of marrow hyperplasia (Ortner et al., 2001). In the latter case, expansion of the diploë through the outer table of the cranial vault accounts for the characteristic shape of the lesion. In hypertrophic lesions caused by scurvy, the lesion is described as occurring superficial to the underlying outer table. X-rays of cranial bones from individual F^{o}228-72 (Fig. 9) reveal a pattern similar to the scurvy type of lesion. The lesion extends outward perpendicular to the cranial vault, but does not seem to penetrate into the diploë. In conclusion, the pattern of bones affected and the nature of the bony response suggest a probable case of scurvy.

Individual F^{c}925-A

Individual F^{c}925-A is an adult male, between 35 and 50 years old at death, from the cemetery mound F^{c}925 identified with the Weaver Late Woodland period. This individual is represented by several long bones. A skull identified as F^{c}925-B may belong to the same individual.

Individual F^{c}925-A's long bones consist of seven fragments, including the right and left femora, right and left tibiae, and right and left fibulae. They are all thickened about the diaphysis with multiple layers of coarse appositional bone. The fibulae show a thickening and extension of the interosseus crest as well as growth of the diaphysis. None of the lesions have visible cloacae. Radiographs taken at the NIU Health Center show that the lesions are a continuous appositional layer around the diaphysis, with no gaps between layers. The lesions also do not penetrate into the medullary cavities themselves, which retain their normal shapes.

Individual F^c925-B's cranium has a distinctive "starburst" pattern of lesions on the frontal and parietal bones (Fig. 11). Neither these lesions nor those of the long bones appear to have been active at time of death. The cranial lesions resemble the nodular caries sicca that occur in healed cases of treponemal disease, specifically syphilis (Hackett, 1976). The lesions on the long bones (Fig. 12) closely resemble a healed form of syphilitic lesions with expansion of the cortex and surface rugosity (*ibid*). Figures 13 and 14 show a femur and tibia affected by syphilis. These bones are from the Stanford-Meyer Human Anatomy Skeletal Research Collection at the University of Iowa. The living individual had been diagnosed with syphilis. The pattern of the lesions in Figure 13 is nearly identical to those of the long bones from individual F^c925-A. Taken together, the cranial and long bone lesions suggest a pattern that is characteristic of syphilis.

Though there is some debate about the origins of syphilis, both congenital and acquired (venereal) cases of syphilis in pre-Columbian Native Americans have been described (Ortner, 2003). These individuals have typically come from the Mississippian or equivalent periods from around 1300-1500 AD (*ibid*). If the cranial lesions of individual F^c925-B represent syphilis, they probably indicate a case of venereal syphilis (Hackett, 1976). This disease is not commonly known from Native American populations of the Late Woodland time period, though probable endemic syphilis and yaws have been described in site from the lower Illinois Valley dating to this period

(Cook, 1982). An alternate cause might be a general infection, but there are not many diseases for which these cranial lesions are symptomatic.

Burial F[c]904-28

Burial F[c] 904-28 is a collection of miscellaneous pathologies from the Weaver site. It contains a right femur, right and left humeri (all from individual F[c]904-28), and several cranial fragments (individual F[c]454-4). The cranial fragments include most of the occipital bone of an adult . The occipital shows a large (about 1 inch in diameter) oval-shaped impact wound just beneath the lambda along the lambdoid suture. This impact is visible on the underside of the bone as a large mound-like structure. The impact did not fracture the bone, permitting entry to the cranial cavity, but instead indented the bone. There is evidence of healing on the inner surface of the impact.

The measurements and robusticity of the right femur suggest that it came from a male. The head of the femur is badly misshapen, and displays signs of severe arthritis. Its appearance suggests that this individual suffered from a dislocated hip, probably caused by trauma. The articular condyles of the femur also show signs of arthritis, possibly due to the effect of the dislocated hip on the individual's locomotion.

The humeri are from the same individual and are fairly robust, with marked muscle attachments. The left humerus shows evidence of a fracture around the midshaft beneath the deltoid tuberosity. The fracture is healed, but the amount of distortion to the bone's original shape suggests that the fracture was comminuted. The deltoid tuberosity has been distorted by the fracture. On the posterior surface of the bone superior to the deltoid tuberosity there is a bony growth of uncertain etiology. It may be a remnant of the bony callus caused by the fracture. It may also be a lesion resulting from a disease or infection, possibly osteomyelitis. The fracture may have been severe enough to break through the skin, resulting in the infectious disease osteomyelitis. These are the only cases of obvious physical trauma in the Weaver population.

Individual F°228-57

Individual F°228-57 is only represented by the proximal half of a left femur. The femur's small size and unfused epiphyses indicate it came from a juvenile. The femur has severe appositional lesions along the posterior surface starting at about the proximal quarter of the diaphysis and continuing to just below the midshaft where the bone ends (Fig. 10). This lesion is characterized by large bony growths that project posteriorly away from the surface of the bone. There are numerous holes and crevasses within the lesion. These do not resemble the cloacae found in osteomyelitis, however. The diaphysis is also considerably thickened by multiple layers of appositional bone.

The lesions may represent a periosteal infection of unknown cause. Periosteal infections come in many shapes and sizes, and can be difficult to distinguish from other pathological conditions (Ortner, 2003). The periosteal reaction may have been coupled with a fracture; this cannot be determined since the inferior portion of the bone, as well as part of the lesion, are missing. Tuberculosis is another possible cause for the lesion. Ortner (2003) notes that tuberculosis of the long bones is rarely found, and primarily in juvenile individuals. Cook (1982) notes a high frequency of tuberculosis in Mississippian populations in the lower Illinois Valley in adolescents and young adults. The shape of the lesion does not rule out the possibility of tuberculosis, but as the lesion is not complete, it is impossible to be certain.

Conclusions

Enamel hypoplasias, cribra orbitalia, porotic hyperostosis, and periostitis are general indicators of stress in a population. Enamel hypoplasias are found in 48% of the Weaver individuals. This parallels the frequencies of one or more hypoplastic episodes in Late Woodland populations provided by Goodman and colleagues (1982). Goodman and colleagues (1982) show a reduction in enamel hypoplasias in the Mississippian period not found in the Weaver sample (with far fewer individuals). They also show a trend of increasing severity of hypoplasias in the Mississippian period, with 80% of Mississippian individuals having two or more (*ibid*). This trend is also found in the Weaver population, with a frequency of 43% of two or more hypoplasias in the SRM sample, compared to 20% in non-Mississippian individuals.

Cribra orbitalia, porotic hyperostosis, and periostitis are found infrequently in the Weaver collection. Cribra orbitalia was found on 21% of the Weaver crania, with only two of the cases from children, for a frequency of 20% in individuals under 15 years old. Della Cook (1982) reports a frequency of about 35% for children over the age of 2 years, and over 50% in children between 1 and 2 years old. Periostitis is typically found in about 50% of the individuals from the Illinois River Valley (*ibid*). The Weaver individuals with long bones had a frequency of 36%. The frequencies of these conditions in the Weaver population contrasts with the frequencies of these conditions in other populations from the same time period in Illinois as reported by Cook (1982). It should also be stated that the conditions, when present in the Weaver population, were generally of very low severity.

This could mean that the Weaver population was healthier than other populations in the Lower Illinois River Valley. Alternatively, the Osteological Paradox (Wood et al., 1992) would suggest that this low frequency could mean that the Weaver population was actually less healthy than surrounding populations. These healthier populations would have been able to survive longer during adverse conditions, and would have more individuals with the stress lesions. The Weaver collection is too small to draw any definitive conclusions, but it seems more likely that the Weaver population was healthier rather than more frail. This interpretation is supported by several data points. There are four individuals in the Weaver collection who were probably 50 years or older at the time of death. This indicates a fairly healthy population. The mortality tables (Tables 1-5) suggest that life expectancy at the Weaver site was fairly typical for the period, not significantly shortened. Second, several of the male individuals from the Weaver site were extremely robust. This indicates good resource availability, as no individual can reach their natural potential without proper nutrition during growth. The most convincing reason supporting the interpretation of the overall good health of the Weaver population is that the conditions examined here are indicators of general stress, not fatal diseases. While it is certainly possible to die of anemia and other dietary or disease-related stress conditions, even frail individuals afflicted with these conditions would likely survive long enough to develop changes to the skeleton. Wood's (1992) Osteological Paradox is perhaps more applicable to more virulent conditions like tuberculosis. For this reason, absence of skeletal lesions indicating stress probably means that stress levels were relatively low in the Weaver population relative to other similar groups.

The individual pathologies identified in the Weaver collection suggest a variety of diseases that affected the populations inhabiting the Weaver site. Treponemal disease and osteomyelitis may be tentatively included. Both are well known from the period (Morse, 1969). Also included is scurvy, a disease little known in Midwest Native American populations. The causes of scurvy in this population are not known; none of the other individuals in the Weaver collection showed any indications of the disease, or indeed of any severe nutritional deficiency. This may mean that individual F°228-72 was more frail than other individuals. It is impossible to make firm conclusions about the prevalence of these diseases in the Weaver population, as the sample available for study is a small fraction of all of the skeletons recovered. Some of the individuals in the collection were probably selected because of their interesting pathologies, and may have been unique in the collection.

It is important to remember that the small size of the Weaver collection means that it may not reflect the Weaver population very well. Thus, any conclusions drawn from the skeletal collection are tentative at best.

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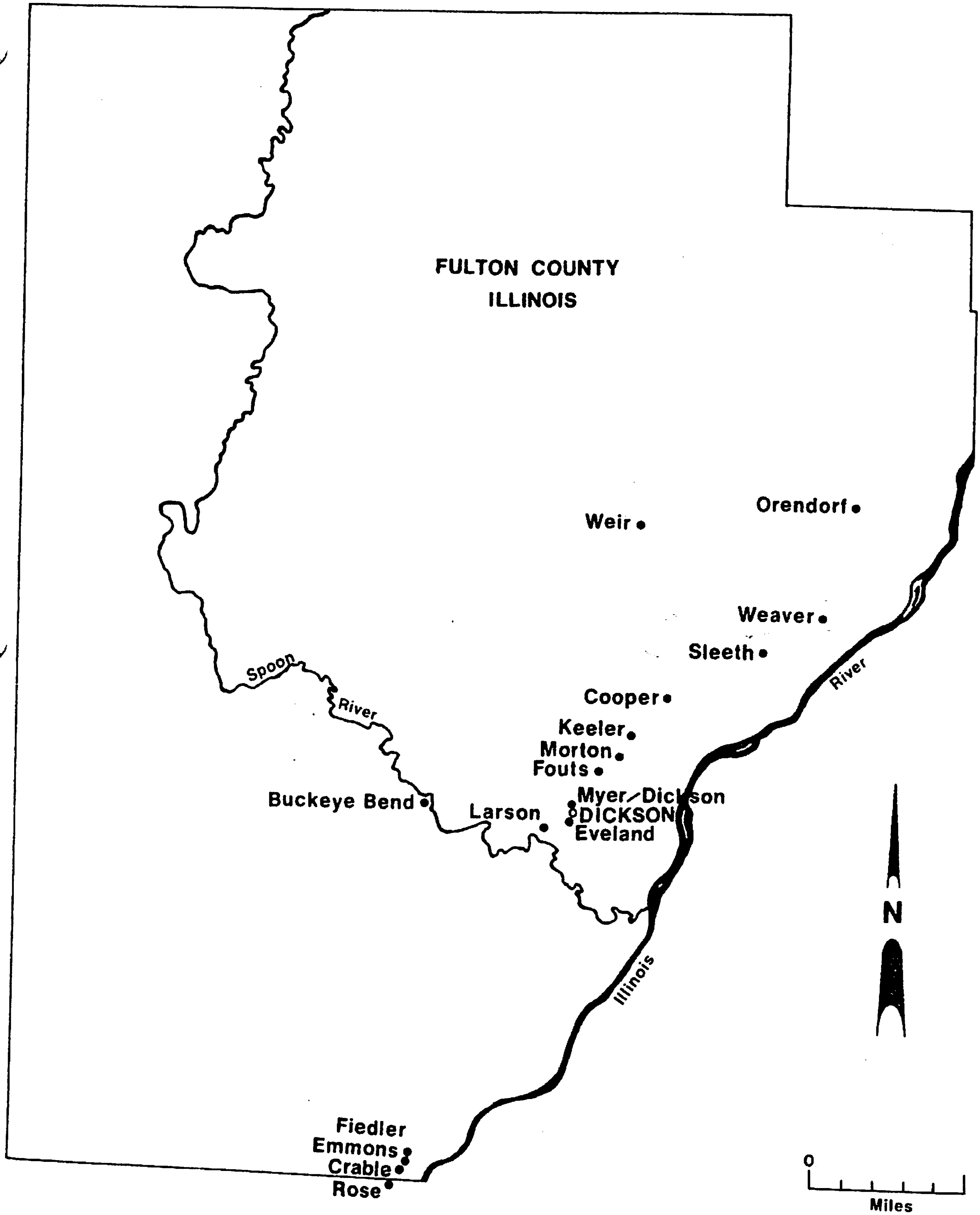
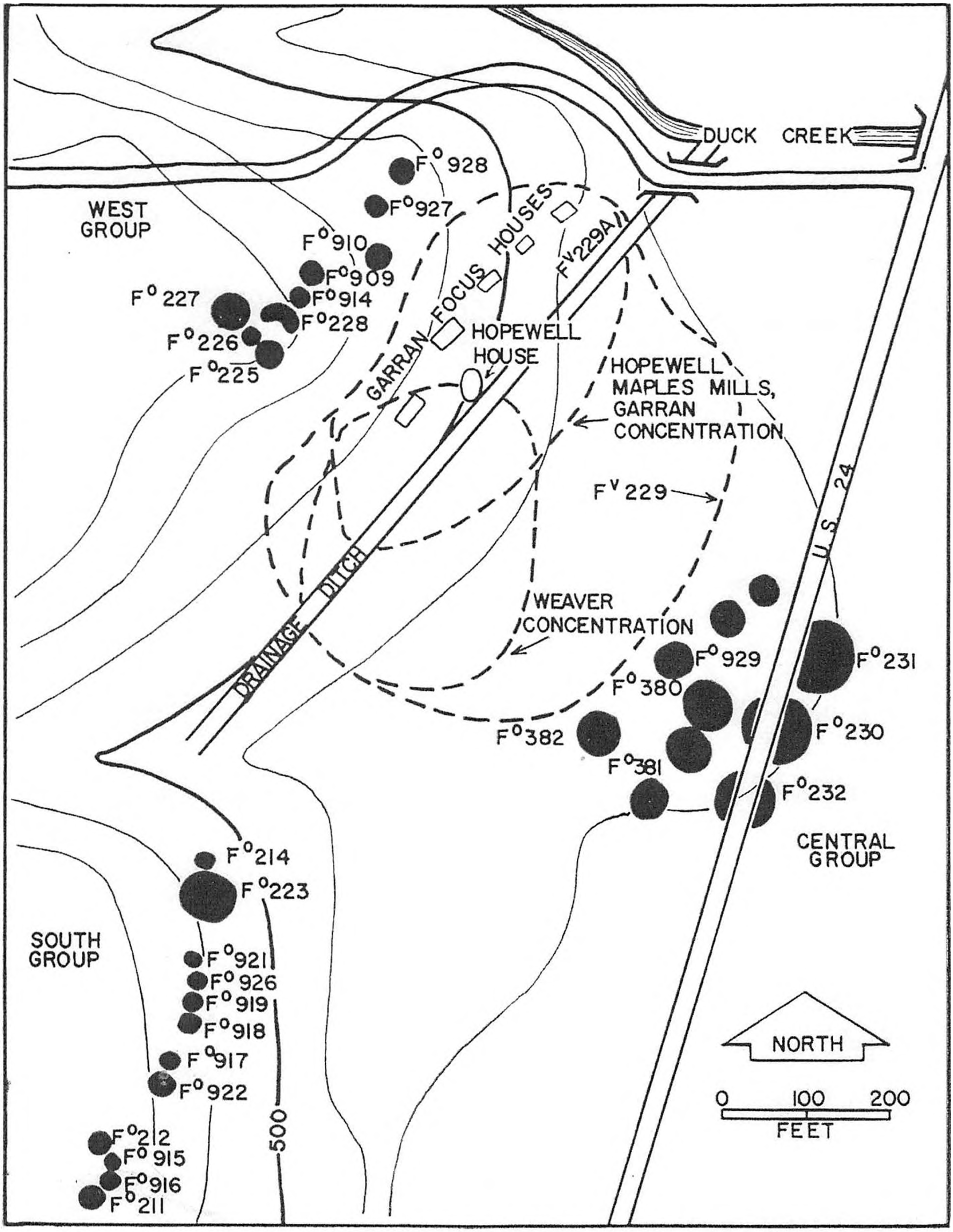


FIGURE 1

Map of Fulton County, Illinois
Cohen 1982



Central and West Groups. Contour interval 20 feet.

FIGURE 2

Map Of Weaver Site
Wray, 1961

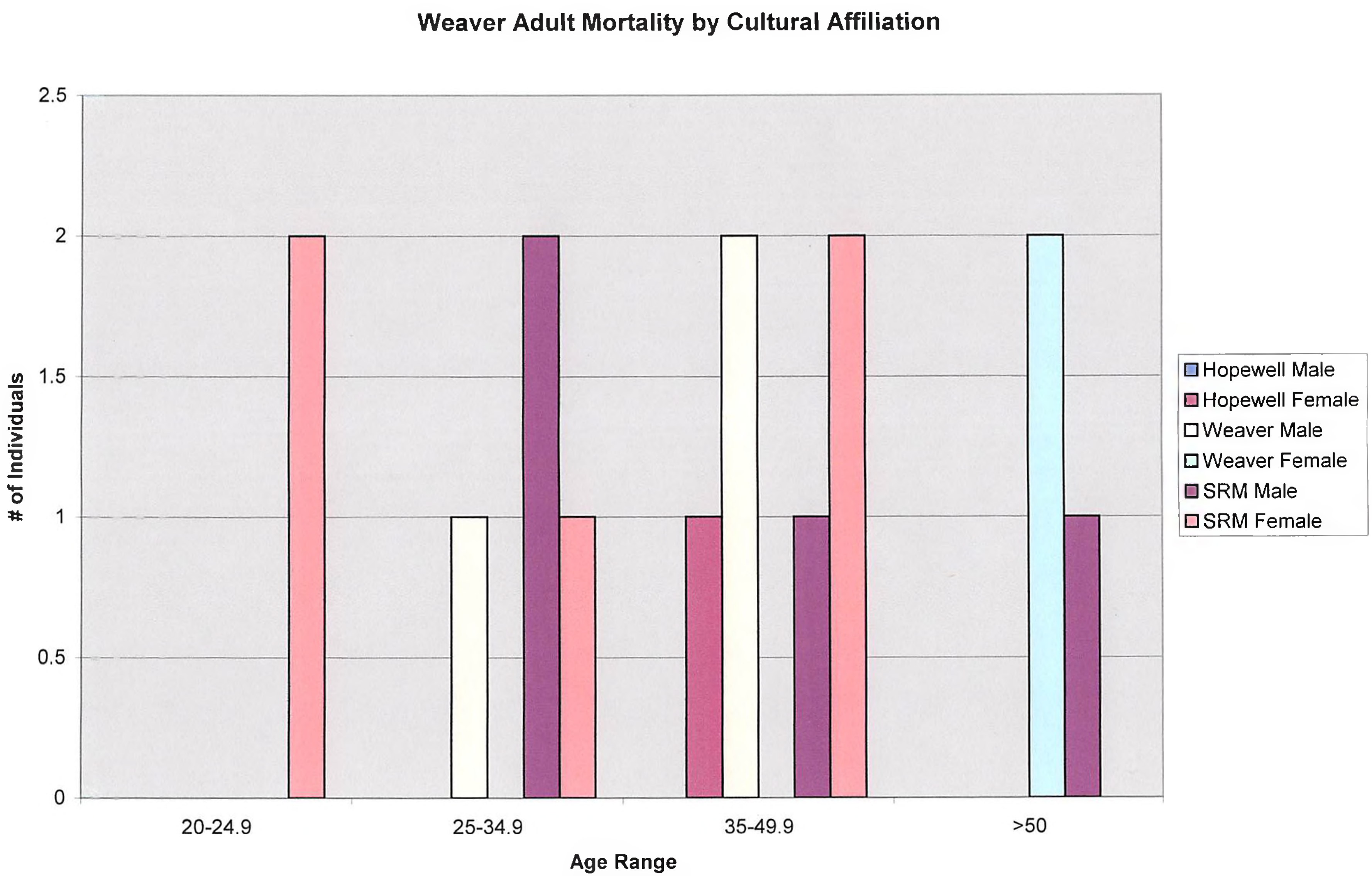

Weaver Adult Mortality by Cultural Affiliation
2.5
2
1.5
1
0.5
0
# of Individuals
20-24.9
25-34.9
35-49.9
>50
Age Range
Hopewell Male
Hopewell Female
Weaver Male
Weaver Female
SRM Male
SRM Female

FIGURE 6

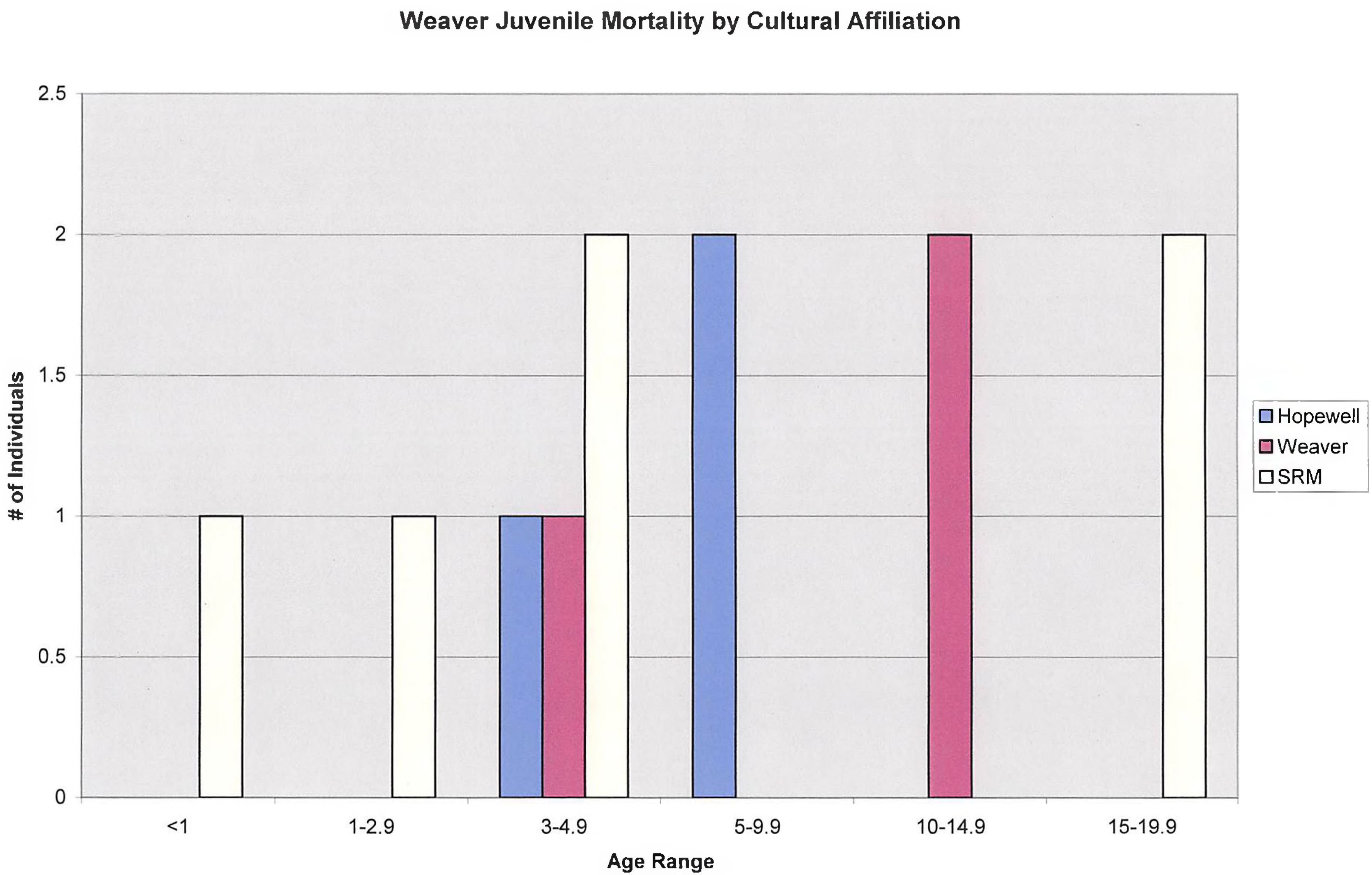
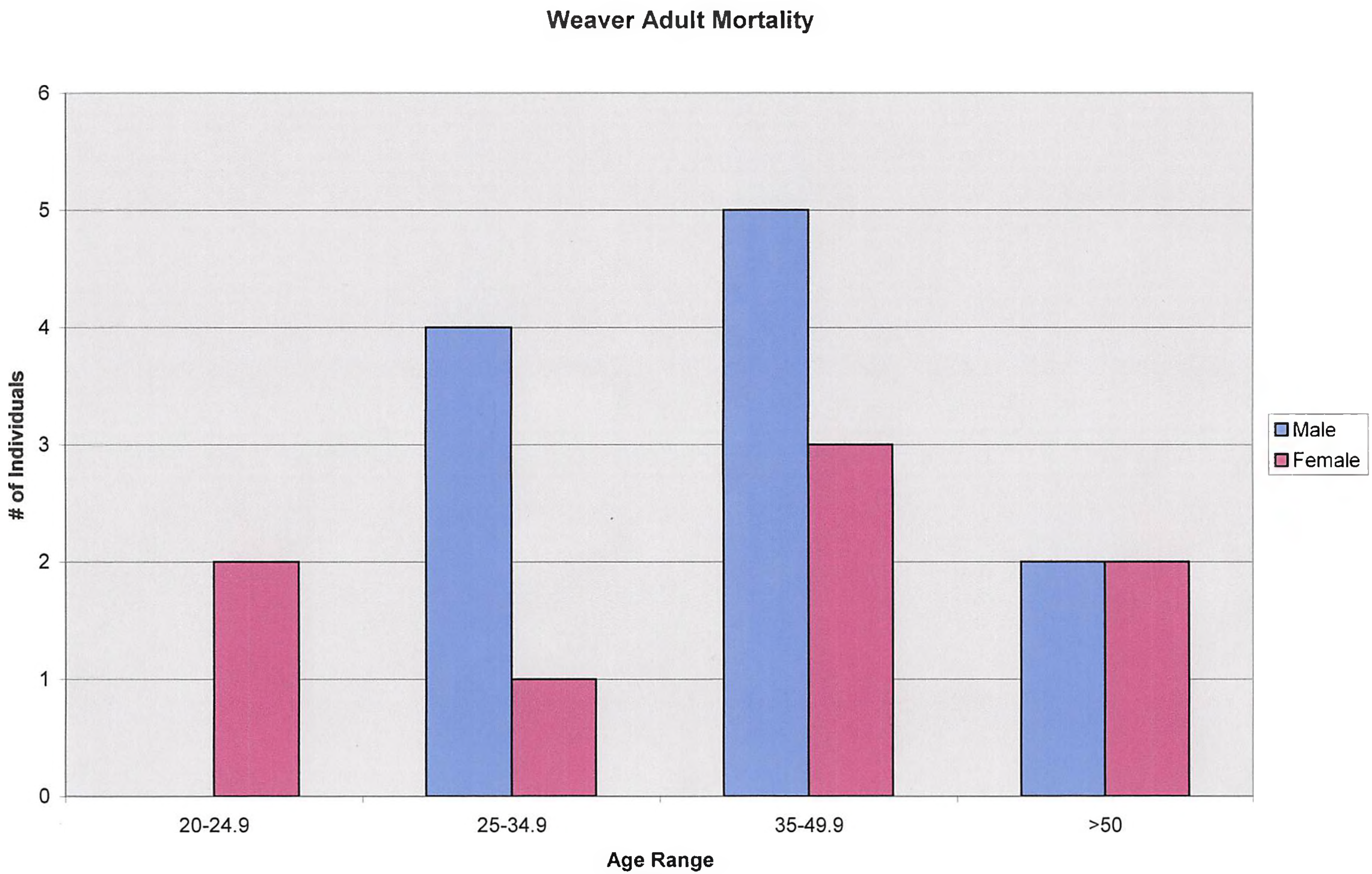

Weaver Juvenile Mortality by Cultural Affiliation
2.5
2
1.5
1
0.5
0
# of Individuals
<1
1-2.9
3-4.9
5-9.9
10-14.9
15-19.9
Age Range
Hopewell
Weaver
SRM

FIGURE 5



Weaver Adult Mortality
6
5
4
3
2
1
0
# of Individuals
Male
Female
20-24.9
25-34.9
35-49.9
>50
Age Range

FIGURE 4

Weaver Mortality Summary

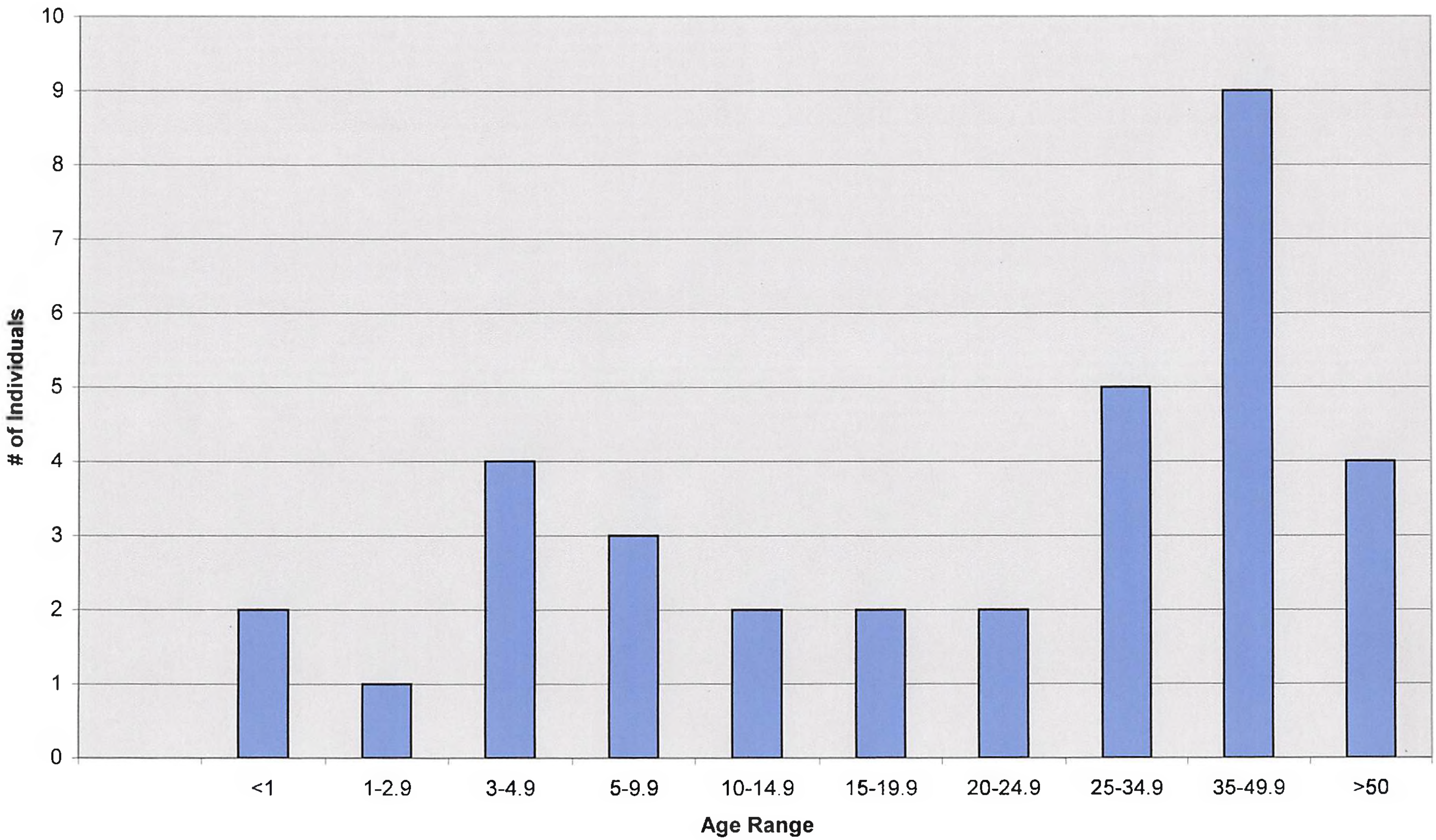


FIGURE 3

FIGURE 7 Possible Evidence of Scurvy—Frontal Bone F° 228-72

FIGURE 8 Possible Evidence of Scurvy—Frontal and Parietals F° 228-72

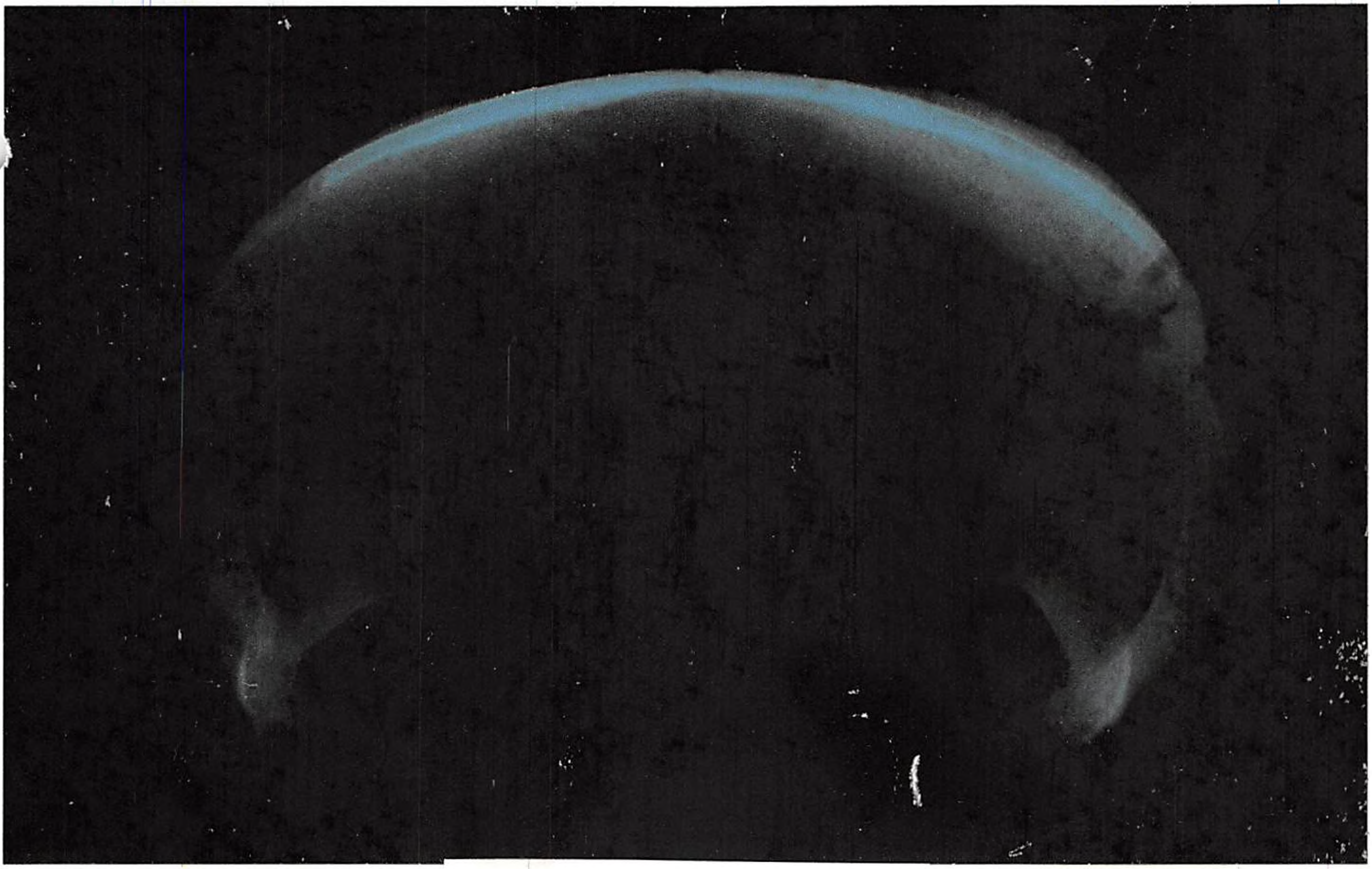


FIGURE 9
Radiograph—Frontal F° 228-72

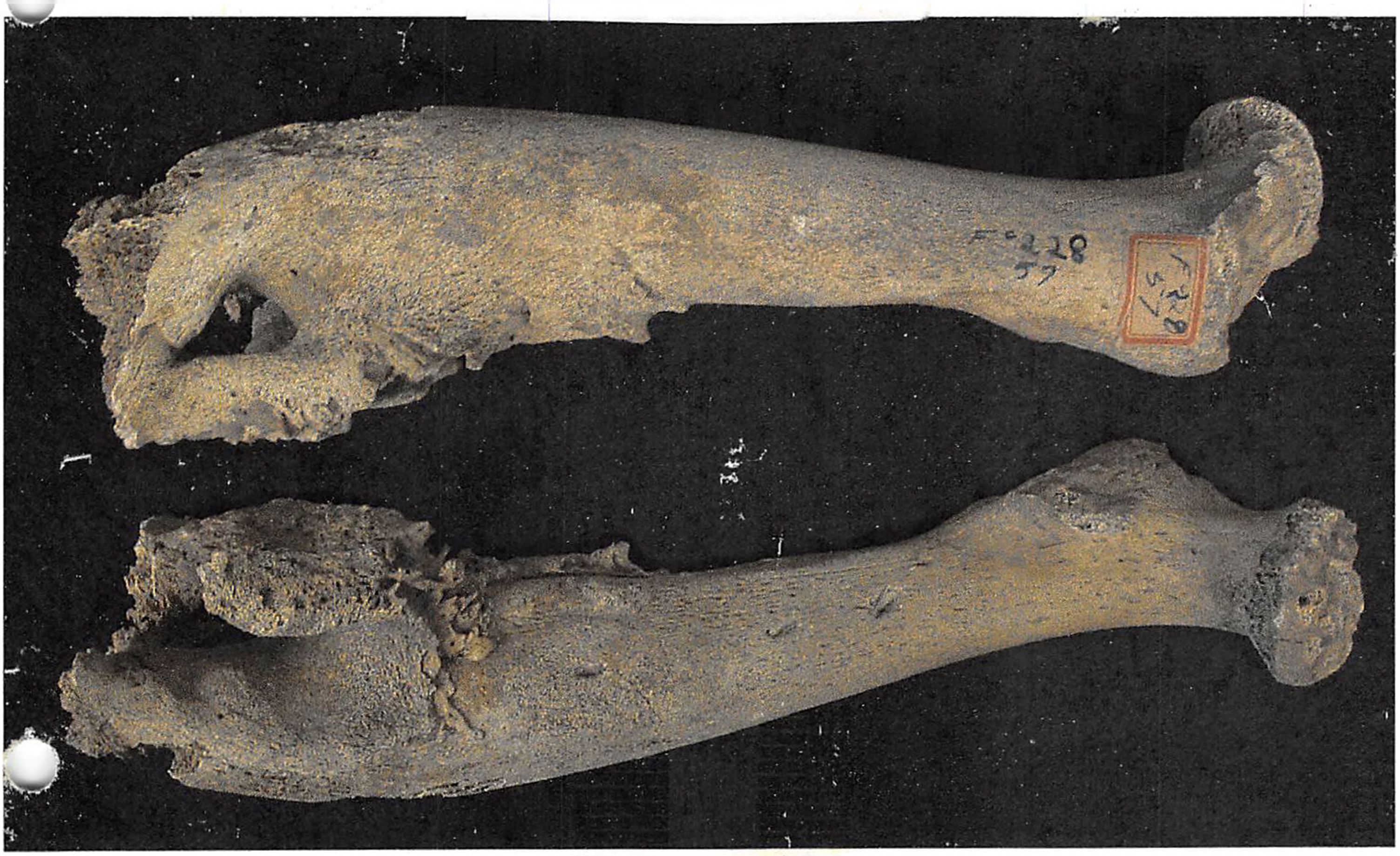


FIGURE 10
Femur F° 228-72

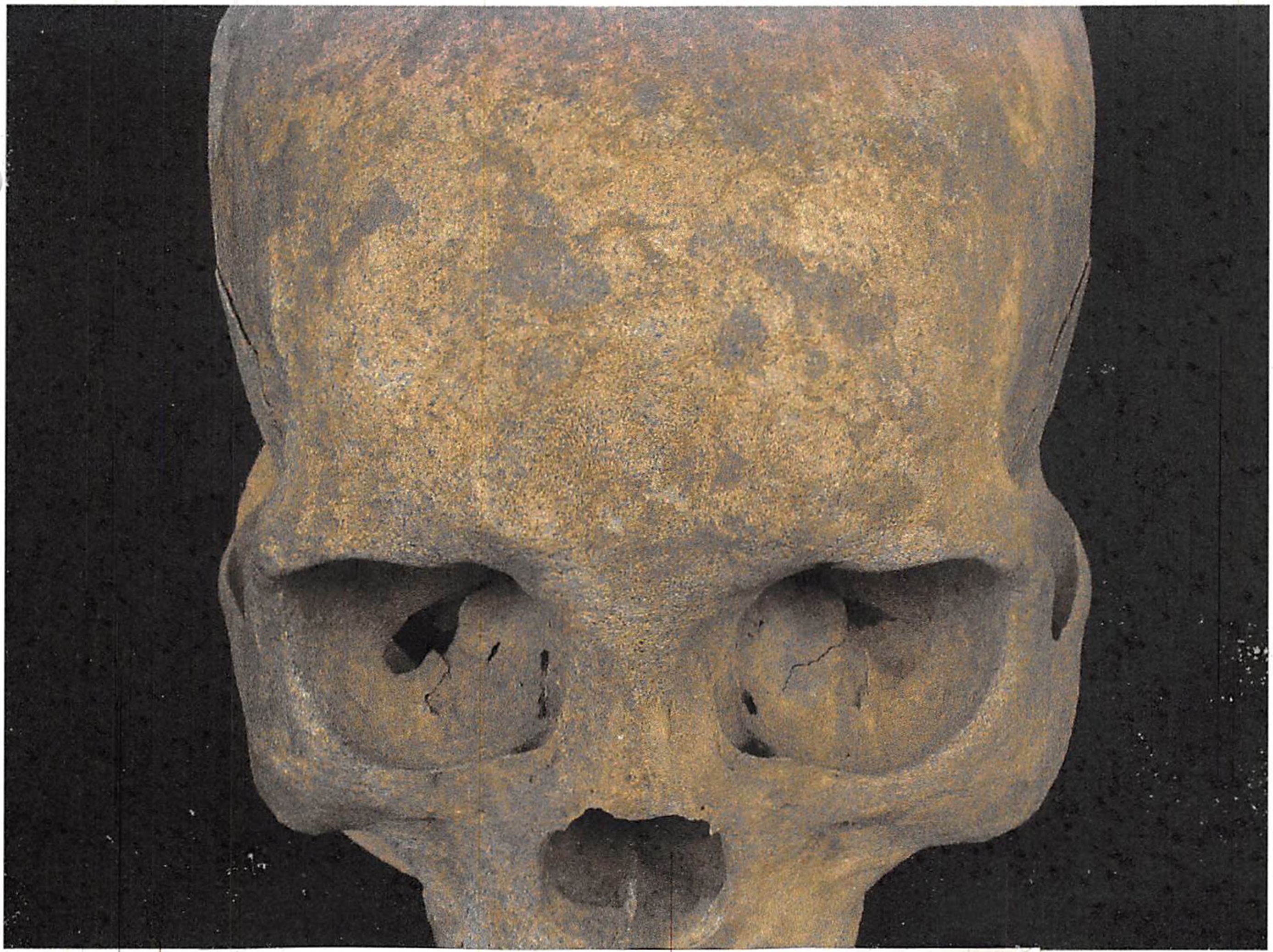


FIGURE 11 Possible Evidence of Syphilis—Cranium F^c 925-B

FIGURE 12 Possible Evidence of Syphilis—Right Femur, Posterior and Anterior F^c 925-A

FIGURE 13
Femur and Tibia of Syphilitic Individual from Stanford-Meyer Skeletal Collection, University of Iowa

FIGURE 14
Closeup of Posterior Femur

APPENDIX

DATA FORMS

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number ____________/____________ Observer ____________

Feature/Burial Number ____________/____________ Date ____________

Burial/Skeleton Number ____________/____________

Present Location of Collection ________________________

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	___	___	Sphenoid	___	___
Parietal	___	___	Zygomatic	___	___
Occipital	___	___	Maxilla	___	___
Temporal	___	___	Palatine	___	___
TMJ	___	___	Mandible	___	___

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	___	___	Os Coxae		
Scapula			Ilium	___	___
Body	___	___	Ischium	___	___
Glenoid f.	___	___	Pubis	___	___
Patella	___	___	Acetabulum	___	___
Sacrum	___	___	Auric. Surface	___	___

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	___	___
C2	___	___
C7	___	___
T10	___	___
T11	___	___
T12	___	___
L1	___	___
L2	___	___
L3	___	___
L4	___	___
L5	___	___

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	___/___	___/___
T1-T9	___/___	___/___

Sternum: Manubrium ___ Body ___

RIBS (individual)

	L	R
1st	___	___
2nd	___	___
11th	___	___
12th	___	___

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	___/___	___/___	___/___

Series/Burial/Skeleton________________

Observer/Date________________

LONG BONES

	Proximal Epiphysis	Diaphysis: Proximal Third	Diaphysis: Middle Third	Diaphysis: Distal Third	Distal Epiphysis
Left Humerus	___	___	___	___	___
Right Humerus	___	___	___	___	___
Left Radius	___	___	___	___	___
Right Radius	___	___	___	___	___
Left Ulna	___	___	___	___	___
Right Ulna	___	___	___	___	___
Left Femur	___	___	___	___	___
Right Femur	___	___	___	___	___
Left Tibia	___	___	___	___	___
Right Tibia	___	___	___	___	___
Left Fibula	___	___	___	___	___
Right Fibula	___	___	___	___	___

Left Talus_____
Right Talus_____
Left Calcaneus_____
Right Calcaneus_____

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	___/___	___/___	___/___
#Metacarpals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	___/___	___/___	___/___
#Metatarsals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

Comments:____

ADULT SEX/AGE RECORDING FORM

Site Name/Number ______________________/______________________ Observer ______________

Feature/Burial Number ______________________/______________________ Date ______________

Burial/Skeleton Number ______________________/______________________

Present Location of Collection ____

SEX

Pelvis	L	R
Ventral Arc (1-3)	___	___
Subpubic Concavity (1-3)	___	___
Ischiopubic Ramus Ridge (1-3)	___	___
Greater Sciatic Notch (1-5)	___	___
Preauricular Sulcus (0-4)	___	___

Skull	L	M	R
Nuchal Crest (1-5)	___	___	___
Mastoid Process (1-5)	___	___	___
Supraorbital Margin (1-5)	___	___	___
Glabella (1-5)	___	___	___
Mental Eminence (1-5)	___	___	___

Estimated Sex, Pelvis (0-5) ______

Estimated Sex, Skull (0-5) ______

Comments:

Series/Burial/Skeleton________________

Observer/Date________________

AGE

Pubic Symphysis	L	R		Auricular Surface (1-8)	L	R
Todd (1-10)	____	____			____	____
Suchey-Brooks (1-6)	____	____				

Suture Closure (blank = unobservable; 0 = open; 1 = minimal; 2 = significant; 3 = complete)

External Cranial Vault	1. Midlambdoid	____	**Palate**	11. Incisive	____
	2. Lambda	____		12. Anterior Median Palatine	____
	3. Obelion	____		13. Posterior Median Palatine	____
	4. Anterior Sagittal	____		14. Transverse Palatine	____
	5. Bregma	____	**Internal Cranial Vault**	15. Sagittal	____
	6. Midcoronal	____		16. Left Lambdoid	____
	7. Pterion	____		17. Left Coronal	____
	8. Sphenofrontal	____			
	9. Inferior Sphenotemporal	____			
	10. Superior Sphenotemporal	____			

Estimated Age: Young Adult (20-35 years) ________

Middle Adult (35-50 years) ________

Old Adult (50+ years) ________

Comments:

Forensic Morphological Observations

COLLECTION ID/CASE #:____________________ I.D. NAME:____________________________

CURATOR/ADDRESS:________________________ RECORDER:__________________ DATE:______

EPIPHYSEAL CLOSURE (Pages 8-9)

Codes: 1 - No Union 2 - Partial Union 3 - Complete Union

38. BASILAR SUTURE:	___	47. LUMB. VERT. RIM:	___	56. PROX. RADIUS:	___
39. MEDIAL CLAVICLE:	___	48. SACRUM (1/2):	___	57. DISTAL RADIUS:	___
40. ATLAS-ANTERIOR:	___	49. SACRUM (S2/3):	___	58. PROX. ULNA:	___
41. ATLAS-POSTERIOR:	___	50. SACRUM (3/4):	___	59. DISTAL ULNA:	___
42. AXIS-ANTERIOR:	___	51. INNOM. PRIM. ELEM.	___	60. FEMUR HEAD:	___
43. AXIS-POSTERIOR:	___	52. ISCH. TUBEROSITY:	___	61. GR. TROCH.	___
44. CERV. VERT. RIM:	___	53. ILIAC CREST (ANT 1/3):	___	62. DIST. FEMUR:	___
45. THOR. VERT. RIM:	___	54. PROX. HUMERUS:	___	63. PROX. TIBIA:	___
46. L5 BODY-ARCH:	___	55. MED. EPIC. HUM.:	___	64. DISTAL TIBIA:	___

CRANIAL SUTURE CLOSURE (Pages 10-12)

Ectocranial
0: open 1: up to 50% 2: >50% 3: obliterated

Endocranial
1: open 2: partial
3: obliterated

	L	R		L	R		
65. MIDLAMBDOID:	___	___	70. MIDCORONAL:	___	___	75. SAGITTAL:	___
66. LAMBDA:		___	71. PTERION:	___	___	76. LAMBDOID(L):	___
67. OBELION:		___	72. SPHENOFRONTAL:	___	___	77. LAMBDOID(R):	___
68. ANTERIOR SAGITTAL:		___	73. INF. SPHENOTEMP:	___	___	78.CORONAL(L):	___
69. BREGMA:		___	74. SUP. SPHENOTEMP:	___	___	79. CORONAL(R):	___

RIB END CHANGES (Pages 13-22)

	Left	Right
80. RIB NO.: _____	Phase: _____	Phase: _____

PELVIC CHANGES (Pages 23-45)

	Left	Right
81. TODD (1920)/(1921):	____________________	____________________
82. SUCHEY-BROOKS (Suchey and Katz 1986):	____________________	____________________
83. McKERN AND STEWART (1957):	I:____ II:____ III:____	I:____ II.____ III.____
84. GILBERT AND McKERN (1973):	I:____ II:____ III:____	I:____ II:____ III.____
85. AURICULAR SURFACE:	____________________	____________________
86. DORSAL PUBIC PITTING:	1. ABSENT: ___ 2. TRACE-SMALL: ___ 3. MODERATE-LARGE:___	1. ABSENT: ___ 2. TRACE-SMALL: ___ 3. MODERATE-LARGE:___

Forensic Measurements

COLLECTION ID/CASE #: ____________ **RECORDER:** ____________ **DATE:** ______

CRANIAL MEASUREMENTS (Pages 52-60)

			Left	Right
1. MAXIMUM LENGTH (g-op):	___	13. NASAL HEIGHT (n-ns):	___	
2. MAXIMUM BREADTH (eu-eu):	___	14. NASAL BREADTH (al-al):	___	
3. BIZYGOMATIC BREADTH (zy-zy):	___	15. ORBITAL BREADTH (d-ec):	___	
4. BASION-BREGMA (ba-b):	___	16. ORBITAL HEIGHT (OBH):	___	___
5. CRANIAL BASE LENGTH (ba-n):	___	17. BIORBITAL BR. (ec-ec):	___	
6. BASION-PROSTHION L. (ba-pr):	___	18. INTERORBITAL BR. (d-d):	___	
7. MAX.-ALVEOLAR BR. (ecm-ecm):	___	19. FRONTAL CHORD (n-b):	___	
8. MAX.-ALVEOLAR L. (pr-alv):	___	20. PARIETAL CHORD (b-1):	___	
9. BIAURICULAR BREADTH (ALB):	___	21. OCCIPITAL CHORD (l-o):	___	
10. UPPER FACIAL HGT. (n-pr):	___	22. FORAMEN MAGNUM L. (ba-o):	___	
11. MIN. FRONTAL BR. (ft-ft):	___	23. FORAMEN MAGNUM BR (FOB):	___	
12. UPPER FACIAL BR. (fmt-fmt):	___	24. MASTOID LENGTH (MDH):	___	___

MANDIBULAR MEASUREMENTS (Pages 61-63)

	Left	Right		Left	Right
25. CHIN HEIGHT (gn-id):	___		30. MIN. RAMUS BREADTH:	___	___
26. BODY HEIGHT at MENTAL FOR:	___	___	31. MAX. RAMUS BREADTH:	___	___
27. BODY THICKNESS at M. FOR:	___	___	32. MAX. RAMUS HEIGHT:*	___	
28. BIGONIAL DIAMETER (go-go):	___		33. MAND. LENGTH:*	___	
29. BICONDYLAR BR. (cdl-cdl):	___		34. MAND. ANGLE:*	___	

* Record only if mandibulometer is used.

POSTCRANIAL MEASUREMENTS (Pages 64-76)

	Left	Right		Left	Right
CLAVICLE: Epiph. P/A:	**Left**	**Right**	**INNOMINATE: Epiph. P/A:**	**Left**	**Right**
35. MAXIMUM LENGTH:	___	___	56. HEIGHT:	___	___
36. SAGITTAL DIAM. at MIDSH:	___	___	57. ILIAC BREADTH:	___	___
37. VERTICAL DIAM. at MIDSH:	___	___	58. PUBIS LENGTH:	___	___
			59. ISCHIUM LENGTH:	___	___
SCAPULA: Epiph. P/A:	**Left**	**Right**			
38. HEIGHT:	___	___	**FEMUR: Epiph. P/A:**	**Left**	**Right**
39. BREADTH:	___	___	60. MAXIMUM LENGTH:	___	___
			61. BICONDYLAR LENGTH:	___	___
HUMERUS: Epiph. P/A:	**Left**	**Right**	62. EPICONDYLAR BREADTH:	___	___
40. MAXIMUM LENGTH:	___	___	63. MAX. DIAM. of HEAD:	___	___
41. EPICONDYLAR BREADTH:	___	___	64. A-P SUBTROCH. DIAMETER:	___	___
42. MAX. VERT. DIAM. of HEAD:	___	___	65. TRANSV. SUBTROCH. DIAM:	___	___
43. MAX. DIAM. at MIDSHAFT:	___	___	66. A-P DIAM. MIDSH:	___	___
44. MIN. DIAM. at MIDSHAFT:	___	___	67. TRANVS. DIAM. MIDSH:	___	___
			68. CIRCUMFERENCE AT MIDSH:	___	___
RADIUS: Epiph. P/A:	**Left**	**Right**			
45. MAXIMUM LENGTH:	___	___	**TIBIA: Epiph. P/A:**	**Left**	**Right**
46. SAGITTAL DIAM. at MIDSH:	___	___	69. CONDYLO-MALLEOLAR LEN:	___	___
47. TRANSV. DIAM. at MIDSH:	___	___	70. MAX. PROX. EPIPH. BR:	___	___
			71. MAX. DIST. EPIPH. BR:	___	___
ULNA: Epiph. P/A:	**Left**	**Right**	72. MAX. DIAM. NUTRIENT FOR:	___	___
48. MAXIMUM LENGTH:	___	___	73. TRANSV. DIAM. NUTR. FOR:	___	___
49. DORSO-VOLAR DIAMETER:	___	___	74. CIRCUM: AT NUTR. FOR:	___	___
50. TRANSVERSE DIAMETER:	___	___			
51. PHYSIOLOGICAL LENGTH:	___	___	**FIBULA: Epiph. P/A:**	**Left**	**Right**
52. MIN. CIRCUMFERENCE:	___	___	75. MAXIMUM LENGTH:	___	___
			76. MAX. DIAM. at MIDSHAFT:	___	___
SACRUM: No. Segments:	___				
53. ANTERIOR HEIGHT:	___		**CALCANEUS: Epiph. P/A:**	**Left**	**Right**
54. ANTERIOR SURFACE BREADTH:	___		77. MAXIMUM LENGTH:	___	___
55. MAX. BREADTH (S-1)	___		78. MIDDLE BREADTH:	___	___

INVENTORY RECORDING FORM FOR COMMINGLED REMAINS AND ISOLATED BONES

Site Name/Number ______________________/______________________ Observer ______________

Feature/Burial Number ______________________/______________________ Date ______________

Burial/Skeleton Number ______________________/______________________

Present Location of Collection ____

Report all cranial bones separately. Group Cervical Vertebrae 3-6; Thoracic Vertebrae 1-9; Ribs 3-10; Carpals; Metacarpals; Tarsals (other than Talus and Calcaneus); Metatarsals; Hand and Foot Phalanges. Vertebrae other than those grouped above should be reported individually. Identify **bones** by name, indicate **L** (left); **R** (right); **B** (Both); **M** (Midline); **?** (Unsidable). Code articular regions, long bone diaphyses, and vertebrae by **segments: PE** (proximal epiphysis), **P1/3** (proximal third of diaphysis), **M1/3** (middle third of diaphysis), **D1/3** (distal third of diaphysis), **DE** (distal epiphysis); **B** (vertebral body or centrum), **NA** (neural arch). Otherwise, leave this category blank. Code **Completeness** according to the following:**1** = >75% present; **2** = 25% - 75% present; **3** = <25% present. MNI reflects the minimum number of individuals recorded on this line. **Count/Wt** refers to the number/weight of fragmented materials. **Age** and **Sex** determinations should be entered as counts (see text for codes).

Bone	Side	Segment	Completeness	MNI	Ct/Wt	Age	Sex

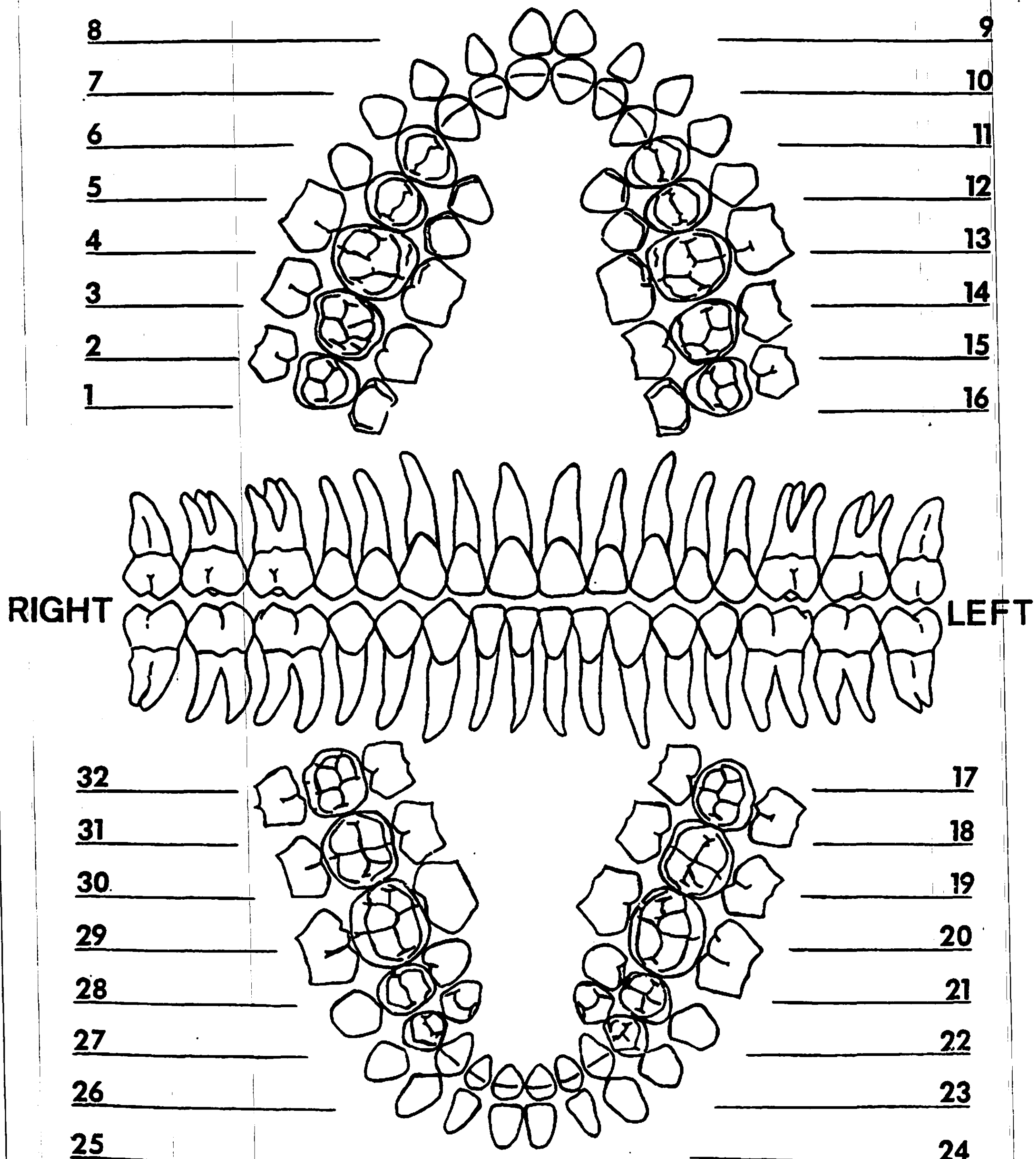
Series/Burial/Skeleton________________________

Observer/Date ________________________

Bone	Side	Segment	Completeness	MNI	Ct/Wt	Age	Sex

DENTAL CHART

Case No.: ________ **Date:** ________



DENTAL INVENTORY RECORDING FORM
DEVELOPMENT, WEAR, AND PATHOLOGY: PERMANENT TEETH

Site Name/Number ____________________/____________________ Observer ____________________

Feature/Burial Number ____________________/____________________ Date ____________________

Burial/Skeleton Number ____________________/____________________

Present Location of Collection ____

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Occlusal surface wear:** use left teeth, following Smith (1984) for anterior teeth (code 1-8) and Scott (1979) for molars (code 0-10). If marked asymmetry is present, record both sides. Record each molar quadrant separate in the spaces provided (+) and the total for all four quadrants under "Total." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

		Tooth Presence	Development	Wear /Total	Caries	Abscess	Calculus/Affected
Maxillary Right	1 M3						
	2 M2						
	3 M1						
	4 P2						
	5 P1						
	6 C						
	7 I2						
	8 I1						
Maxillary Left	9 I1						
	10 I2						
	11 C						
	12 P1						
	13 P2						
	14 M1						
	15 M2						
	16 M3						

Series/Burial/Skeleton_______________

Observer/Date_______________

		Tooth Presence	Development	Wear /Total	Caries	Abscess	Calculus/Affected
Mandibular Left	17 M_3	___	___	___|___ ___	___ ___ ___	___	___ ___
	18 M_2	___	___	___|___ ___	___ ___ ___	___	___ ___
	19 M_1	___	___	___|___ ___	___ ___ ___	___	___ ___
	20 P_2	___	___	___ ___	___ ___ ___	___	___ ___
	21 P_1	___	___	___ ___	___ ___ ___	___	___ ___
	22 C	___	___	___ ___	___ ___ ___	___	___ ___
	23 I_2	___	___	___ ___	___ ___ ___	___	___ ___
	24 I_1	___	___	___ ___	___ ___ ___	___	___ ___
Mandibular Right	25 I_1	___	___	___ ___	___ ___ ___	___	___ ___
	26 I_2	___	___	___ ___	___ ___ ___	___	___ ___
	27 C	___	___	___ ___	___ ___ ___	___	___ ___
	28 P_1	___	___	___ ___	___ ___ ___	___	___ ___
	29 P_2	___	___	___ ___	___ ___ ___	___	___ ___
	30 M_1	___	___	___|___ ___	___ ___ ___	___	___ ___
	31 M_2	___	___	___|___ ___	___ ___ ___	___	___ ___
	32 M_3	___	___	___|___ ___	___ ___ ___	___	___ ___

Estimated dental age (juveniles only)_______________

Supernumerary Teeth:	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)
	___/___	___	___/___	___	___/___	___
	___/___	___	___/___	___	___/___	___

Comments:

____

____

____

____

____

____