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BIOARCHAEOLOGY ON A BATTLEFIELD: THE ABORTIVE CONFEDERATE CAMPAIGN IN NEW MEXICO

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INCEPTION AND OBJECTIVES OF THE STUDY

In July 1989, Thomas A. Livesay, director, Museum of New Mexico, Santa Fe, invited Douglas W. Owsley, curator, Smithsonian Institution, to examine the skeletal remains that had been discovered two years earlier some 20 miles east of Santa Fe at the site of the March 1862 Battle of Glorieta Pass. The bones were found on privately owned land that was being cleared and trenched for the foundation of a house. When the landowner notified the Museum of New Mexico, the Research Section of the Museum's Laboratory of Anthropology immediately undertook the excavation of what proved to be a mass grave and one adjacent burial site. A study of the human remains and related artifacts followed. The skeletons, which represented 31 individuals, were transferred temporarily to the Maxwell Museum of Anthropology, University of New Mexico, Albuquerque, for initial analysis, then returned to the Museum of New Mexico in August 1989. There, in November 1989, Owsley and his colleagues conducted a detailed osteological and dental examination while plans for reburial of the remains were being developed.

As a result of the field and laboratory studies and related archival research, the Museum of New Mexico opened a special exhibition on March 28, 1991, the 129th anniversary of the Battle of Glorieta Pass. Titled "The Civil War in the West: The Confederate Campaign in New Mexico, 1862," the exhibition presented artifacts from the battlefield and information about three of the Confederate soldiers who had been positively identified through both osteological examination and artifacts associated with these burials. Exhibition curator Charles Bennett summarized the significance of the action at Glorieta Pass as follows: "Just as the 1863 Battle of Gettysburg stopped the Confederate thrust into the Federal states, the Battle of Glorieta turned the tide of Confederate intentions in the West" (Mitchell 1991).

Paradoxically, the Confederates initially regarded the battle as a victory, for the Federal troops left the field and evacuated Santa Fe, and the Confederate commander, Lt. Col. William R. Scurry, became governor pro tem of the New Mexico Territory. Scurry described Glorieta as "the hardest contested fight it has ever been my lot to witness" (Alberts 1984:85) and stated, "The battle of Glorietta [sic]--where . . . you steadily drove before you a foe of twice your numbers--over a field chosen by themselves, and deemed impregnable, will take its place upon the roll of your country's triumphs, and serve to excite your children to imitate the brave deeds of their fathers" (Alberts 1984:90). However, while the battle was in progress, a detachment of Federal cavalry discovered the canyon in which the Confederate supply train containing reserve ammunition, medicine, baggage, food, and forage was hidden and destroyed it. A long and arduous retreat by half-starved, ill-clad, exhausted troops was inevitable. Through this study, their comrades who remained behind in that mass grave on the battlefield have revealed much of what the participants suffered during this poorly conceived, inadequately supplied, ineptly conducted campaign--one that wasted the lives of

unseasoned volunteer troops composed mostly of teenagers and men in their early twenties.

Working with Owsley on this study were Richard L. Jantz, Department of Anthropology, University of Tennessee, Knoxville; Steve Ousley, a graduate student of Jantz's at the University of Tennessee; and John Verano, a postdoctoral research fellow in the Smithsonian's Department of Anthropology. The osteological examination and recording of data took place November 5-11, 1989, at the Museum of New Mexico in Santa Fe. Jantz, Verano, and Ousley assisted in the skeletal inventory and collection of data. Jantz and Ousley were primarily concerned with the collection and analysis of cranial osteometric data, and Verano recorded data and photographed selected examples of osteopathology.

The research team was assisted in arrangements for and the conduct of their study by the following members of the Research Section, Laboratory of Anthropology: David A. Phillips, Jr., director; Yvonne Oakes, staff archeologist; Natasha Williamson; and Ann Noble.

The objectives of the investigation were to record data on age, sex, race, and other physical characteristics; antemortem bone and dental pathology; and perimortem trauma and possible cause of death. Through comparison of such data with those contained in military records and descriptive material from diaries and other archival sources, it was hoped that at least some of the individuals could be identified. In addition, data from this Civil War sample were compared with the findings of a similar study of burials associated with the siege of Fort Erie in the War of 1812 (Pfeiffer and Williamson 1991). The physical demands and deprivations of that campaign were in many respects comparable to those experienced by the Confederate troops who participated in the New Mexico Campaign, and the size and characteristics of the two samples were similar. In addition, the data were incorporated into a computerized data base for use in further comparative studies of skeletal series from other historic eras and sites. One such study, a possible follow-on to this one, might compare demographic characteristics and osteopathology of the Glorieta sample with two other Civil War skeletal series: one from the siege of Port Hudson, near Baton Rouge, Louisiana, and one (representing the Irish Brigade) from Antietam, near Sharpsburg, Maryland.

HISTORICAL BACKGROUND

Origin of the New Mexico Campaign

In 1861, shortly after the beginning of the Civil War, Colonel Henry H. Sibley presented to President Jefferson Davis an ambitious plan that would have brought the Confederacy needed supplies and natural resources, had it succeeded, and perhaps even access to Pacific ports in southern California. Sibley proposed to raise a volunteer force in Texas that would supply its own mounts and firearms and live off the land during an invasion of the New Mexico Territory (which included Arizona). He convinced Davis that he could easily defeat the Union forces and gain control of major trade routes and the supply center at Fort Union. Afterward, Sibley also expected to move on to Colorado, with its rich ore deposits and mines, then to Utah, where he thought the Mormons would support the Confederate cause, and eventually to Southern California, thus extending the Confederate domain to the Pacific.

The plan was impractical, but it would cost little and might yield great benefits, so Davis made Sibley a brigadier general in June 1861 and sent him to Texas to recruit and command Confederate forces operating on the upper Rio Grande (Sifakis 1988). Even if the barren land the invaders would traverse had been able to support an army, and the Hispanics had been sympathetic to the Confederate cause, or Colorado, Utah, and California disloyal to the Union, Sibley was not the one to lead such an undertaking. He had a poor record in the Mexican War. He "suffered from an excessive fondness for the bottle which to a large extent denied the Confederacy the full advantages of his West Point (1838) training" (Sifakis 1988:258). And he was indecisive and generally absent when his troops were engaged in battle, resulting in loss of their respect and suspicion of cowardice (Alberts 1984). In contrast, Major General E. R. S. Canby, who commanded the Department of New Mexico and led the Union forces there, was an astute, able, and humane leader, concerned for his own troops and for his prisoners of war (Alberts 1984).

Sibley was enthusiastically received in Texas and soon recruited his brigade. His total force, when combined with troops commanded by Lieutenant Colonel John R. Baylor at Fort Bliss, numbered about 3,200 men (Hall 1978). Sibley's recruits were equipped with what they brought from home and clothing and arms confiscated from former Union posts vacated when Texas seceded from the Union. They trained for a few months near San Antonio, then set out from there in October 1861 on a 630-mile march to Fort Bliss on the border near El Paso. From there, they continued some 300 miles further to Fort Thorn, 70 miles south of the Federal stronghold at Fort Craig. Some 500 men who had contracted smallpox, pneumonia, and other illnesses proceeded no further than Fort Thorn (Shropshire 1990:77).

Although the Confederates reached Fort Thorn in December, Sibley's troops did not advance further toward Fort Craig until February 1862. This long delay gave General Canby ample time to strengthen his fortifications, acquire additional troop support, and lay in supplies. Canby's troops at and near Fort Craig numbered about 3,800 (Alberts 1984). A direct attack on the fort was not feasible, and Canby ignored Confederate attempts to draw him out onto the open plain, where the Confederates camped in alternating snow and sand storms. Alberts (1984:37) describes the situation as follows:

> The Confederate leaders were faced with a dilemma. In their front lay an apparently impregnable fort with a resolute garrison reinforced by large numbers of volunteer soldiers. . . . Behind lay the Mesilla Valley-Fort Bliss region, already stripped of provisions. With only a ten-day supply of food remaining, some decisive move was obviously needed. General Sibley being stricken by an unidentified illness as well as by indecision, Colonel Green decided . . . [to] bypass Fort Craig to the east . . . then return to the river near Valverde, six miles north of the fort. . . . With his lines of supply thus threatened, Canby would have little choice but to leave Fort Craig and fight the Texans on ground chosen by themselves.

On February 21, the Battle of Valverde, the first and largest of the five battles of the New Mexico Campaign, took place. Losses were approximately even: 36 Confederates were killed, 150 were wounded, of whom 43 later died, and one was missing; the Union reported 68 killed, 160 wounded, of whom 17 subsequently died, and 35 missing (Alberts 1984:49). The Confederates also lost many of their pack animals and horses and mules that the troops rode on the march, but not in battle (they were infantry). The Union forces did not abandon Fort Craig as a result of the battle, and the Confederates, short of supplies, pushed on to Albuquerque, slowly and mostly on foot. As Private "Abe" Hanna (1990:67) reported in his notes: "28th Friday we marched 10 miles it being the first traveling we had done on foot there was considerable growling among the Boys.

The Federal troops evacuated Albuquerque after destroying supplies. Therefore, although the Confederates occupied the city early in March, they were soon on the road again, moving north to Santa Fe. There, the Union forces did as they had in Albuquerque, burning supplies, leaving the city, and moving further north to their main military and trade center at Fort Union. On March 26, two weeks after the occupation of Santa Fe, Confederate Major Charles L. Pyron led his battalion and four additional companies along the Santa Fe Trail, on which Federal forces from Fort Union under Colonel John P. Slough and Major John M. Chivington were advancing. Pyron's advance guard was surprised and captured, following which the opposing troops clashed in the Battle of Apache Canyon. Pyron was repeatedly outflanked, then nearly surrounded, but

he managed to retreat with his cannons to his field camp and supply train. This second battle, however, was "the greatest tactical defeat suffered by the Sibley Brigade during the New Mexico campaign" (Alberts 1984:76), for Pyron's losses were 4 dead, 20 wounded, and 70 captured.

Two days later, on February 28, Union and Confederate forces met again at the Battle of Glorieta Pass (Fig. 1). After five hours of heavy fighting in mountainous terrain, the Federal troops withdrew. As at Valverde, casualties were roughly equal: 36 Confederates were killed, 60 wounded, and 25 captured; Federal losses were 38 killed, 64 wounded, and 20 captured. However, while the main fighting was taking place in the valley and at fortified positions on the ridges overlooking it, a detachment of Federal troops led by Major Chivington located and burned the Confederate supply train. Lacking food and ammunition, the Confederates could not push on to their main objective, Fort Union, nor did they remain long at Santa Fe, for Canby attacked the small force the Confederates had left at Albuquerque. More a skirmish than a real battle, the so-called Battle of Albuquerque was largely an exchange of artillery fire, after which the Federal troops withdrew prior to the arrival of the Confederate forces that had fought at Glorieta Pass.

From Albuquerque, the Confederate retreat continued, with Federal troops following but, except for small skirmishes, not attacking. There was, however, one final action, the Battle of Peralta, when Federal troops surprised a Confederate regiment camped near the village of Peralta. A dust storm allowed the Confederates to escape to the other side of the river and join the bulk of their troops. The battle has been described as one of the least bloody combats on record (Alberts 1984): Union losses were 4 killed and 3 wounded; 2 Confederates were wounded and 22 taken prisoner, and a wagon train they could ill afford to lose was taken.

By early May, after jettisoning most of their artillery and what little equipment they had left and climbing though barren, mountainous country, with virtually no food and little water, the Confederates finally arrived back in Texas. At the end of the trek, General Canby returned the Confederate ill and wounded and exchanged other prisoners because he had not sufficient provisions to feed and care for them. So ended a venture that cost the Confederates over 500 lives, more from diseases such as smallpox, measles, and pneumonia than from combat, and accomplished nothing.

Physical Hardships

Two diaries kept during the New Mexico Campaign provide insight into the hardships the Confederate troops endured. Some of these hardships might well have left their mark on the skeletal remains found on the battlefield at Glorieta. Because the campaign began in October, the men were soon subjected to bitter cold, snow, and high

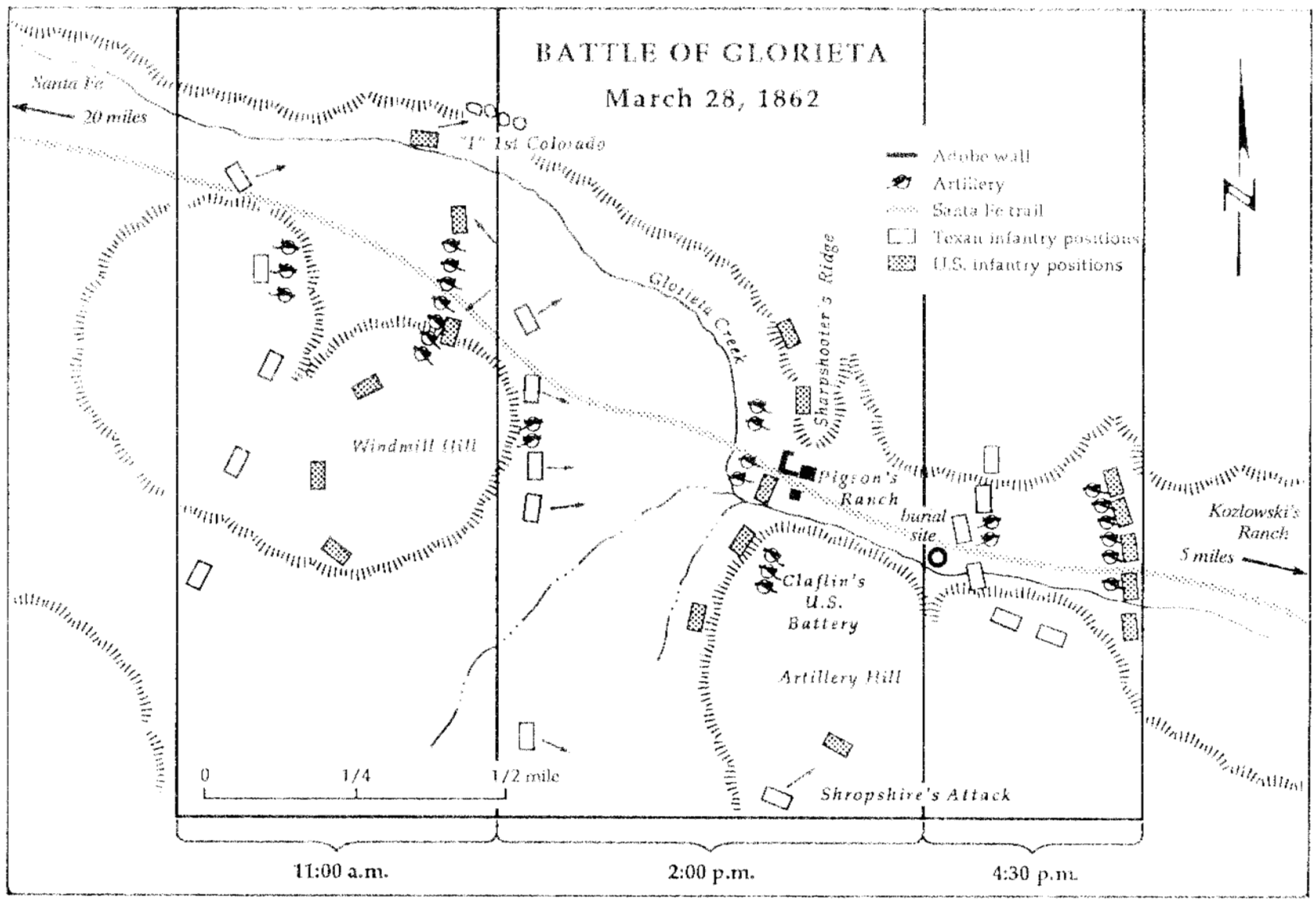

Figure 1. Map of battlefield at Glorieta Pass, New Mexico (after Alberts 1984; redrafted by Terence Arundel).

winds. They typically camped in the open with little or no shelter and frequently in areas where there was no wood to build a fire. Water was a problem throughout most of their several months in New Mexico, as was food. Their diet consisted mainly of a little dried beef and, occasionally, some mutton or beans, but more often only bread and coffee (when there was water enough to make coffee).

Even early in the campaign, when detouring around Fort Craig, and before so many of the animals had been killed at the subsequent Battle of Valverde, the physical demands on the men were extreme.

> Almost a mile in length, the ravine is composed of apparently bottomless sand. The climb was very difficult. . . . For wheeled vehicles . . . the route . . . was almost impossible. Many thin-tired artillery pieces and the heavily laden wagons sank up to their hubs. Drivers double- and tripled-teamed their stuck vehicles. Troopers dismounted to heave on wheels and wagon beds, and together men and animals struggled through the day and until well after dark. (Alberts 1984:38-39)

As they continued further into New Mexico in the midst of winter, conditions became steadily worse, as the following excepts show:

> I had my horse killed in the Battle of Valverde and I am now a foot and I now feel the pleasure of soldiering in New Mexico more plainly than I have ever done before notwithstanding . . . the climate & the hardships of a march of a Thousand miles over mountains such as is seen in no other country than that along the road from San Antonio to Fort Craig without wood or water & but little grass and being in the dead of winter and worse than all the horrors that is witnessed on the Battlefield. (Hanna 1990:66)

> 1st day of March was a cloudy day with cold wind and some snow. We marched 15 miles over a sandy mountainous road. Reached camps at 9 oclock . . . and no wood . . . and as usual no provision. The wind now increased and turned colder and us being out on the level . . . our situation was not very pleasant one. . . . We are now entirely out of everything in the way of provisions and yet thirty miles to Albuquerque. (Hanna 1990:68)

> A few miles further on we crossed a tremendous canion, 500 feet deep, and here the artillery had to be drawn up the hill again by the men. Late in the evening we finished this crossing with cannon, wagons, and all, and then began by a long gradual ascent to gain the summit of a pass in a range of high mountains that run across the course we must take. About sundown, the advance reached the summit of this pass and still the water was six miles off. (Alberts 1984:111)

In light of what these troops had been experiencing for nearly six months prior to the Battle of Glorieta Pass, it was likely that even so small a sample as the 31 who died and were buried on the battlefield would show some after-effects. Thus, in addition to noting osteological evidence of perimortem trauma that could have resulted in death, the investigators were also alert to indications of antemortem stress.

METHODOLOGY

Inventory and Coding Procedures

Each skeleton had been assigned a designation consisting of a number and one or more letters. Documentation developed by the archaeologists and physical anthropologists who had excavated and previously examined the burials provided information on the location and completeness of each of 30 skeletons in the mass grave and 1 buried separately, as well as on associated artifacts. In the mass grave, in which skeletons had been buried three-deep, head to toe, their arms folded (Gullett 1988), some commingling was inevitable; thus, extra bones or teeth were associated with some burials, and other skeletons lacked various skeletal elements. Further sorting and reassignment were necessary. For example, the left foot of Burial 2R showed no unusual characteristics, but the right foot exhibited several discrepancies: (1) right metatarsals 2-5 were shorter and their shafts narrower than those of the left foot; (2) the overall length of the right calcaneus and height of the posterior tubercle were substantially less than those of the left calcaneus; and (3) the right cuboid that articulates with the calcaneus was smaller than the left cuboid. Detailed examination revealed that the posterior subtalar facets of the left and right calcanei differed in shape and size. In addition, a fragmentary left second cuneiform of a size consistent with that of the right foot was present, as well as a left second cuneiform that articulated correctly with, and was apparently part of, the larger left foot. It was evident that the smaller right foot belonged not to Burial 2R but to another of the skeletons (Owsley and Mann 1989).

The physical anthropological study began with an inventory of the bones of each of the 31 burials. The inventory form provides a record of the presence or absence of skeletal elements and whether those present are partial or complete. The inventory yields a precise bone element baseline count and makes possible the analysis of bone pathology in relation to, for example, age, sex, side, specific joints, or frequency of occurrence within and between samples (see Owsley et al. 1990).

In addition to the osteological inventory, there is a dental inventory on which to indicate the presence or absence of maxillary and mandibular teeth, as follows: present (tooth only) or present in socket, antemortem or postmortem loss (socket only), antemortem loss with bone resorption, partially erupted or unerupted, or congenitally absent. Sockets are examined for any evidence of abscessing, either antemortem or active at the time of death. Dental caries are scored for location on an affected tooth (e.g., occlusal surface) and severity (ranging from pit or slight fissure to complete crown destruction and root involvement). The presence and degree of calculus deposits and the location and degree of wear are also indicated. Any unusual characteristics such as extra cusps or particular patterns of wear (e.g., pipe facet) are noted, as are the location and number of hypoplastic lines when present. These depressed lines or rows of pits can

occur if an individual experiences episodes of severe nutritional or disease stress during enamel deposition (i.e., before seven years of age). Because the developmental sequence of all permanent teeth is known, measuring the distance of the center of a hypoplastic line from the cementoenamel junction can indicate the approximate age when the stress occurred (Goodman and Armelagos 1985). A helios dial needle-tipped caliper is used, and distance is measured to 0.1 mm.

After completion of the bone and dental inventories, the bones of the Glorieta sample were carefully examined for evidence of disease and trauma. The scoring of pathological changes resulting from infection is based on bone cell response--bone loss, bone increase, or resorption plus addition. These modifications are further rated for severity, extent, condition (whether active, healing, or healed), and location. Codes for degenerative joint disease yield data on the presence and degree of hypertrophic bone formation, porosity, and eburnation. The severity of such conditions can vary on one joint surface, as well as from one joint surface to another.

Traumatic injuries also require a detailed coding format. In regard to fracture of the frontal, occipital, parietals, and temporals, the coding system permits indication of shape, presence of radiating fractures, severity, size, number of separate fractures per bone, and state (e.g., whether any remodeling has occurred). Fractures of the zygomatic bones, maxillae, and mandible are coded only for presence and state. The location and nature of fractures are further documented by drawings on standardized cranial diagrams. The procedure for recording and depicting lesions in postcranial bones is much the same. The result for each skeleton in a sample is a detailed numerical record for computer storage and manipulation, supplemented by anatomical drawings and descriptive notes dealing with anomalies and special observations. Selected bones displaying disease or trauma are x-rayed. The study team also photographed examples of osteological and dental pathology. In addition, a few bone specimens were loaned for more detailed study at the Smithsonian Institution. For example, the posterior surfaces of the patellae of Burial 2P displayed deep circular defects resembling cyst pockets. Owsley borrowed these for radiographic analysis and further detailed examination. He subsequently published a letter report (Owsley and Mann 1990) in the *American Journal of Roentgenology*, "Bilateral Dorsal Defect of the Patella" (a condition found in only about 1 percent of contemporary clinical populations, with an even lower frequency in archaeologic samples).

Craniometry

Besides the development of osteological and dental inventories and data on trauma and disease, craniometric data were recorded for entry into the forensic data bank maintained at the University of Tennessee. Collection of these data made possible a comparison of the Glorieta sample with American Indian and Hispanic samples and with

another Caucasian sample, all of which were drawn from the forensic data bank. The instruments used in obtaining the measurements were spreading and sliding calipers, and the principal measurements recorded were the following: naso-dacryal subtense, zygomaxillary subtense, bregma-lambda subtense, stephanic subtense, nasion radius, zygoorbitale radius, lambda radius, frontomalare radius, zygomaxillare radius, nasion radius, glabello-occipital length, foramen magnum length, malar length inferior, malar length maximum, basion-nasion length, nasio-occipital length, bregma-lambda chord, maximum frontal breadth, bizygomatic breadth, bimaxillary breadth, biauricular breadth, and interorbital breadth (see Key 1983 on the definition and use of these measurements). Of these, four--naso-dacryon subtense, basion-nasion length, nasion radius, and zygoorbitale radius--proved the most useful in distinguishing the Glorieta sample and another Caucasian sample from Amerindian and Hispanic samples.

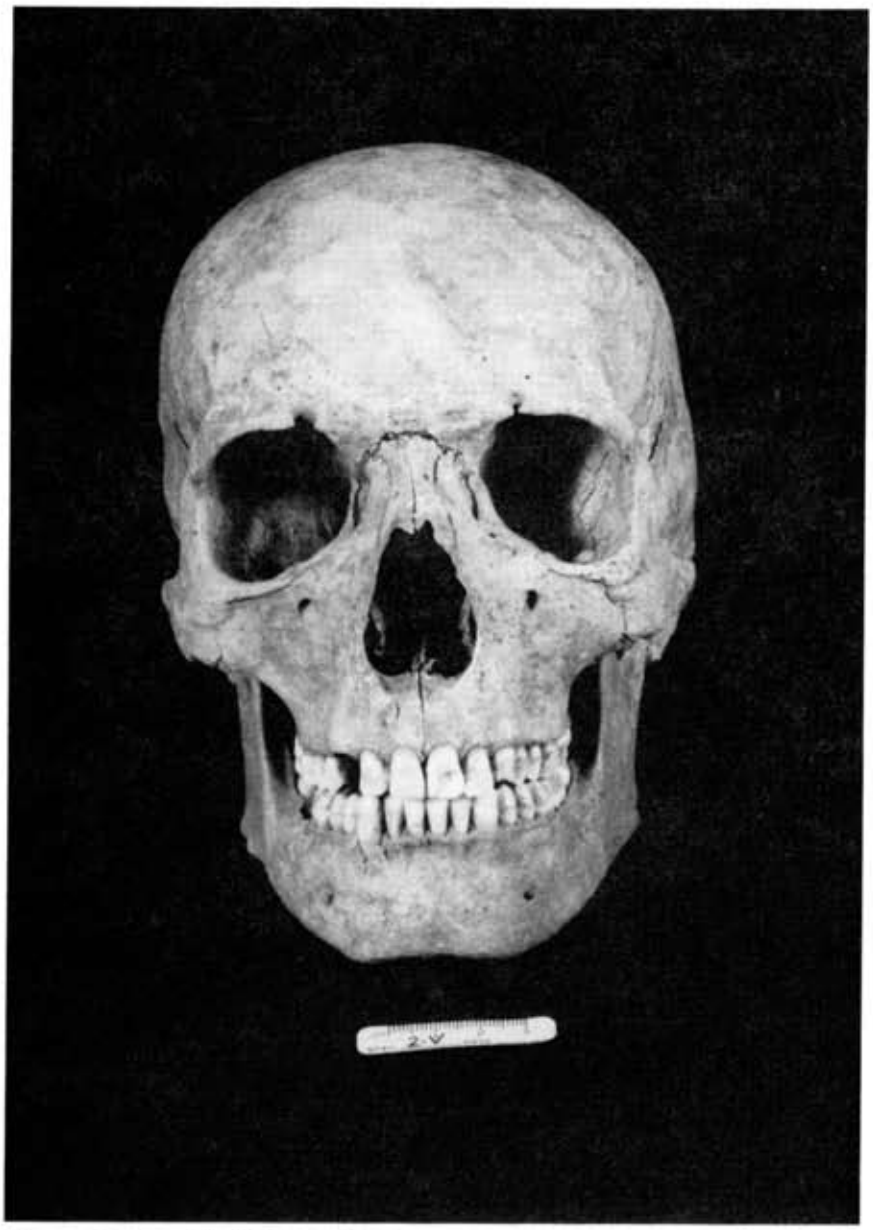

Figure 2. Skull of Burial 2V.

FINDINGS

The Glorieta sample consisted of 30 skeletons from a mass grave and 1 from a grave adjacent to but southeast of the large burial site. The condition of the bones varied from excellent to very poor, and most were in fair to poor condition. Breakage, fragmentation, exfoliation of cortical bone, and warping were characteristic of many of the skeletons. Much of the damage observed was postmortem, some having occurred at the time of excavation, but in many skeletons there was also clear evidence of perimortem trauma.

Degree of completeness of the skeletons varied as greatly as condition of the bones. Thirteen of them were fairly to nearly complete, but many elements of the remaining 18 were missing or severely damaged. Burial 2T, for example, was incomplete and displayed extensive postmortem damage, with the skull fragmentary, all long bones incomplete, articular surfaces of the long bones missing or damaged, the vertebral column pulverized, and only a few fragments of the pelvic girdle present. In contrast, virtually all bones of Burial 2V were present, including the hyoid and the ossicles of the ear (malleus, incus, and stapes); the skull was undamaged (Fig. 2), and the long bones, scapulae, and innominates displayed only slight damage. Table 1 summarizes the information on the condition and completeness of the 31 skeletons of the Glorieta sample.

Nearly all the burials had both maxillary and mandibular teeth present, and in most instances, the sockets were also present. Burial 1A was an exception; there were no teeth present, and the maxillae and mandible were missing. Only the mandibular teeth and sockets of Burials 2E, 2K, and 2M were present.

Stains were apparent on bones of ten of the burials (2C, 2J, 2K, 2L, 2M, 2N, 2R, 2T, 2X, and 2EE). Most of the stains were green as a result of contact with brass or copper artifacts, and most were located on bones of the arm (radii, ulnae, and humeri). The left hand of Burial 2EE was stained greenish black, the left foot of Burial 2C displayed reddish stains, and the left clavicle of Burial 2J was yellow.

Buttons; bits of fabric; pieces of leather, metal, and wood; and a number of other artifacts (e.g., spurs, writing materials) were associated with the burials. The archaeologists of the Museum of New Mexico studied these and displayed many of them in the 1991 exhibition dealing with the Battle of Glorieta Pass. The artifacts of principal interest to the physical anthropologists were the projectiles associated with many of the burials. In some cases there was osteological evidence of perimortem traumatic injury, but in others one or more projectiles associated with a skeleton provided the only indication that death might have resulted from wounds inflicted by small arms (e.g., Minié balls, Colt bullets) or artillery fire (e.g., canister shot). Table 2 presents the data on projectiles and their location in relation to specific burials.

Table 1. Preservation of the Glorieta sample

Burial	Completeness; condition
1A	Incomplete; fair to good
2A	Fairly complete; good to excellent
2B	Fairly complete; fair
2C	Fairly complete; poor
2D	Incomplete; poor
2E	Incomplete; very poor (excavation damage)
2G	Incomplete; very poor (excavation damage)
2H	Nearly complete; fair
2I	Incomplete; fair to poor
2J	Nearly complete; good
2K	Incomplete; vertebrae good, rest fragmented
2L	Incomplete; very poor
2M	Fairly complete; skull poor, posteranial skeleton good
2N	Fairly complete; very poor
2O	Incomplete; poor
2P	Nearly complete; good
2Q	Incomplete; poor
2R	Fairly complete; poor
2S	Fairly complete; fair to poor; root damage to cranium
2T	Incomplete; extremely poor
2U	Fairly complete; fair
2V	Virtually complete; good to excellent
2X	Incomplete; cranium and long bones good, ribs and pelvis fragmented
2Y	Incomplete; poor
2Z	Incomplete; poor
2AA	Nearly complete; poor
2BB	Incomplete; good to poor
2CC	Incomplete; poor
2DD	Incomplete; very poor
2EE	Incomplete; very poor
2FF/GG	Incomplete; very poor

Table 2. Projectiles associated with Glorieta burials

Burial	Type of Projectile and Location
1A	Six .36 cal. Colt bullets in leather pouch; percussion caps in left pocket
2A	Minié ball in pelvic area; percussion caps in leather pouch
2B	Minié ball near right arm
2D	One .31 cal. bullet by left ankle
2E	Minié ball in pelvic area
2J	Minié ball by right innominate near obturator foramen; one .58 cal. bullet in leather pouch by femora
2K	Two Minié balls, one by right femur and one near lower abdomen
2L	One Minié ball by right femur and one in dorsal, lower abdominal area; one .36 cal. bullet in fill
2O	Canister shot in anterior thoracic area
2P	One .36 cal. Colt bullet near skull; one .58 cal. bullet in thoracic area; seven .36 cal. bullets among bones
2Q	One .36 cal. Colt bullet near skull; one Minié ball in fill
2R	One .31 cal. and one .58 cal. bullet in thoracic area; eight .31 cal., one .58 cal., and three .38 cal. bullets in upper thoracic cavity
2T	One .31 cal. bullet near mid right radius; one .31 cal. bullet at back of skull; 11 Minié balls and 16 .31 cal. bullets in pouch in shoulder area
2U	One Minié ball by lower left leg
2V	One Minié ball by lumbar vertebrae
2AA	One .58 cal. bullet near feet
2BB	One Minié ball between femora; one canister shot and one .38 cal. bullet in fill

Demographic Data on the Glorieta Burials

Records of Confederate soldiers participating in the New Mexico Campaign show that 35 were killed at Glorieta Pass and possibly buried on the battlefield. Two officers and some of those who were mortally wounded and died later were buried in Santa Fe and elsewhere. Data on the age and sex of most of these individuals appear in enlistment records and other archival sources. The team of anthropologists based their assessments of the age, sex, and race of the 31 skeletons that were recovered on osteological and

Table 3. Demographic data on the Glorieta sample

Burial	Age	Race	Sex	Stature*
1A	28-33	?	M	185.7 cm ± 3.94 cm (6'1")
2A	20-24	W	M	169.5 cm ± 3.94 cm (5'7")
2B	35-39	W	M	184.5 cm ± 3.94 cm (6'1")
2C	27-33	W	M	174.1 cm ± 3.94 cm (5'9")
2D	19-20	W	M	179.7 cm ± 3.94 cm (5'11")
2E	16-18	?	M	176.4 cm ± 3.94 cm (5'9")
2G	24-27	W	M	176.0 cm ± 3.94 cm (5'9")
2H	24-29	W	M	177.8 cm ± 3.94 cm (5'10")
2I	20-24	W	M	171.5 cm ± 4.0 cm (5'8")
2J	18-22	W	M	180.8 cm ± 3.94 cm (5'11")
2K	17-19	W	M	169.9 cm ± 3.94 cm (5'7")
2L	25-29	?	M	166.7 cm ± 4.0 cm (5'6")
2M	17-19	?	M	173.9 cm ± 4.0 cm (5'8")
2N	16-18	?	M	163.0 cm ± 4.0 cm (5'4")
2O	17-19	W	M	176.4 cm ± 3.94 cm (5'9")
2P	16-19	W	M	177.6 cm ± 4.0 cm (5'10")
2Q	18-21	W	M	No estimate possible**
2R	25-29	W	M	179.7 cm ± 3.94 cm (5'11")
2S	18-22	W	M	173.6 cm ± 3.394 cm (5'8")
2T	25-29	W	M	No estimate possible**
2U	27-33	W	M	176.0 cm ± 3.94 cm (5'9")
2V	18-21	W	M	179.4 cm ± 3.94 cm (5'11")
2X	35-45	W	M	166.7 cm ± 3.04 cm (5'6")
2Y	17-20	W	M	172.25 cm ± 3.94 cm (5'8")
2Z	26-32	W	M	No estimate possible**
2AA	22-25	W	M	174.6 cm ± 3.94 cm (5'9")
2BB	17-19	W	M	173.2 cm ± 3.94 cm (5'8")
2CC	17-21	W	M	183.3 cm ± 3.94 cm (6')
2DD	25-32	W	M	181.2 cm ± 3.94 cm (5'11")
2EE	17-19	W	M	175.0 cm ± 3.94 cm (5'9")
2FF/GG	23-28	W	M	180.6 cm ± 3.94 cm (5'11")

* Long bone measurements and estimates of stature were made by M. London following excavation of the remains and their transfer to the University of New Mexico, Albuquerque.

** No long bones sufficiently complete to measure and use as a basis for estimation of stature (see Trotter and Gleser 1952, 1958).

dental analyses, later comparing their findings with those derived from archival sources in an effort to establish identity. Table 3 summarizes the results of the osteological examination.

As anticipated, the 31 individuals comprising the Glorieta skeletal series were male, and 26 of them were white. In five instances, the bones needed to determine race were not present, so although it was likely, based on archival sources, that these individuals were white, they are not so designated in Table 3. Assessments of age for each individual were based on dental development, degree of closure of cranial sutures, stage of epiphyseal union of long bones, the presence of osteoarthritis or other types of bone pathology, and other osteological observations. The actual ages of 34 of the men buried on the battlefield at Glorieta are known. Their ages ranged from 17 to 42, with a median age of 22, and a mean age of 23. The results of the osteological analysis are consistent with these data. The age range is 17 to more than 40, and the mean and median ages are in the 20-24 category.

Table 4 presents a comparison of the estimated ages of the Glorieta sample based on osteological analysis, the actual ages of Confederates killed at Glorieta (whether buried on the battlefield or elsewhere), and the actual ages of those killed at Valverde, the first and largest of the New Mexico Campaign battles. The age range for those killed at Valverde for whom archival data on age were available (51) was 17-41 years, with a mean age of 25 and a median age of 23. For the 47 who died (either immediately or later in Santa Fe) as a result of action at Glorieta and for whom data on age were available, the range was 17-44 years, with a mean age of 22.6 and a median age of 22. The osteological data on the skeletal remains recovered from the battlefield at Glorieta are consistent with these findings. However, as Table 4 shows, the estimated ages of nearly half (45 percent) of the Glorieta dead who were buried on the battlefield are in the mid to late teens, whereas the data from enlistment records indicate that most of those who died as a result of wounds at Glorieta, as well as at Valverde, were in their early 20s. Few of the Confederate soldiers who participated in the New Mexico Campaign were more than 30 years of age, and most of these were officers, some of whom had fought in the Mexican War.

The osteological age assessments are generally in agreement with the trends apparent in the data on actual ages compiled from the National Archives and other sources, although there is a discrepancy in the 15-19- and 20-24-year-old categories. The estimated ages of 14 individuals were 15-19 years, whereas the records show that only ten of the individuals killed in action were in this age category. Thus, if the written sources are accurate, the ages of four individuals were underestimated.

Age determinations, as previously noted, were based on current standards derived from osteological indicators such as epiphyseal closure in long bones and dental development. Skeletal maturation in contemporary whites probably proceeds at a faster pace than was characteristic of the nineteenth-century population because of differences

in nutrition and health care. Soldiers in the Glorieta sample who displayed active epiphyseal closure were assigned to the age category of 15-19 years, although they could have been slightly older. (Conversely, the discrepancy might also reflect inaccuracy in the reporting of vital statistics at the time of enlistment.)

Table 4. Comparison of actual ages with osteologically determined ages

Age Category	Glorieta Sample, Osteologically Estimated Age (N=31)	Glorieta Dead, Actual Age (N=47)	Valverde Dead, Actual Age (N=51)
15-19	14	10	7
20-24	5	21	24
25-29	9	8	11
30-34	1	2	6
35-39	1	4	1
40+	1	2	2

Skeletons of U.S. soldiers who died at the siege of Fort Erie in the War of 1812 were the subject of a detailed study (Pfeiffer and Williamson 1991). Actual data on age were not available for the sample of 33, but based on osteological and dental analysis, the age range for these soldiers was 15-17 though 40+. The mean age was 25, and the median fell in the 22-24 age category. The author notes that the estimates for the Fort Erie sample were consistent with the average ages (24.7 and 25.4 years) of two other companies for whom War of 1812 records were available (Pfeiffer 1991). Thus, in both the Confederate Campaign in New Mexico and at least some of the U.S. engagements of the War of 1812, the men were quite young, often teenagers. Pfeiffer (1991) notes in regard to the War of 1812 that although recruitment of males younger than 14 years was illegal, she found one burial in the Fort Erie sample that might have been as young as 12, though an age of as much as 14 was possible.

The Trotter and Gleser (1952, 1958) formulae for estimation of stature based on long bone measurements were the basis of the data compiled by M. London (Table 3). In three instances (Burials 2Q, 2T, and 2Z), no long bone was sufficiently intact to permit a reliable measurement for estimating stature. Most estimates were based on the left or right femur, whichever was best preserved; however, when undamaged femora were not available, the left or right tibia was used (Burials 2I, 2L, 2M, 2N, 2P, and 2DD). Heights ranged from 5'4" to 6'1", and the average mean and median was 5'9". In the Fort Erie sample from the War of 1812 (Saunders 1991), height ranged from 5'4" to 6'3", with a mean of 5'9". Nearly one-third of that sample was greater than 5'11" tall.

Saunders (1991) compared these findings with data on another War of 1812 sample, Civil War recruits of the 1860s, and modern forensic samples. The mean stature of the Fort Erie sample exceeded that of the comparable War of 1812 regiment and that of the Civil War recruits, being closer to, though slightly less than, the mean height of the twentieth-century forensic sample (5'10"). The author concluded that the Fort Erie sample was biased by likely selection for taller individuals. In terms of stature, the Glorieta sample is similar to the Fort Erie sample.

The craniometric data collected by the University of Tennessee anthropologists for addition to the forensic data bank permitted comparison of the Glorieta skeletons with Amerindian and Hispanic samples and another Caucasian sample. Tests of significance of between-group variations and discriminate function analyses were performed (data on file, Department of Anthropology, University of Tennessee, Knoxville). The results indicated that the Glorieta soldiers and the other Caucasian sample, when compared to the Amerindian sample, had a longer, narrower vault, longer foramen magnum, a more pronounced forehead, less nasal projection from the orbit, a narrower palate, and a smaller minimum cranial breadth. The Glorieta sample, in contrast to the other Caucasian sample, had a significantly smaller nasal width than the Amerindian sample. Comparison of the Glorieta and another Caucasian sample with an Hispanic sample showed fewer significant differences between the Glorieta soldiers and the Hispanics than between the other Caucasian sample and the Hispanics. However, naso-dacryon subtense, basion-nasion length, nasion radius, and zygoorbitale radius revealed consistent and significant differences between (1) the Amerindian and the Hispanic samples and (2) both the Glorieta and Caucasian samples. The analysis revealed no basis for identifying any of the Glorieta crania as Indian; however, a discriminate function analysis of crania of individual soldiers did suggest that Burial 2B might be Hispanic.

Dental Pathology

Of the 31 skeletons in the Glorieta sample, all but one were accompanied by teeth; Burial 1A lacked the mandible, maxillae, and all teeth and is not included in the tabulations that follow. The tooth sockets of 19 (63.3 percent) of the 30 individuals for whom dental data were available showed no evidence of alveolar abscessing. The number of abscesses in the other 11 ranged from one to seven. Table 5 presents the data on the number and types of alveolar abscessing in these individuals. It indicates that at the time of death 9 of the 11 were experiencing active alveolar abscessing, most with periapical perforation of the cortex and bone destruction. Nine of the 11 also had experienced antemortem tooth loss as a result of abscessing, and in most instances the loss occurred long enough prior to death for alveolar bone resorption to have occurred.

Table 5. Incidence of alveolar abscessing by individual

Burial	Periodontal, with alveolar crest destruction	Periapical, with cortex perforation or bone destruction	Abscessed ante mortem, socket remodeling	Abscessed antemortem with bone resorption
2C		3	1	
2G		2	1	2
2H	3	1		1
2R	1		2	1
2S	1	1		
2T				1
2V		1		
2X				4
2Y		1	1	
2Z		5	1	1
2CC		1		3

The total number of tooth sockets available for analysis in this sample of 30 individuals was 833. Of these, only 39 (4.7 percent) displayed evidence of alveolar abscessing. Among the 39, 15 (38.5 percent) were examples of periapical abscessing with perforation of the cortex by a draining sinus, 13 (33.3 percent) represented antemortem tooth loss with bone resorption, six (15.4 percent) showed recent antemortem tooth loss (with the socket still present and in the process of remodeling), and five (12.8 percent) represented periodontal abscessing with alveolar crest destruction.

Molars were the teeth most frequently affected, accounting for 29 (74.4 percent) of the 39 instances of abscessing. Eight (20.5 percent) of the abscessed teeth were premolars, and two were incisors. Table 6 presents the data on abscessing by type of affected tooth. It shows that more mandibular than maxillary teeth had abscessed, and that first and second molars were the most frequently affected.

To summarize, in this skeletal series, the total number of teeth lost or in the process of destruction as a result of alveolar abscessing was less than 5 percent; however, more than one-third (36.7 percent) of the individuals had abscessed teeth at the time of death or had lost teeth antemortem. Two of these individuals accounted for almost one-third (30.8 percent) of the instances of abscessing. In the War of 1812 sample (Sledzik and Moore-Jansen 1991a, 1991b), of 681 sockets available for examination, 1.9 percent revealed periapical abscessing, and 2.1 percent periodontal abscessing at the time of death; 7.9 percent showed that antemortem tooth loss had occurred as a result of

abscessing. The incidence of abscessing was somewhat lower in the Glorieta than the Fort Erie sample, but the percentages in both were low.

Table 6. Tooth sockets showing active or antemortem abscessing in Glorieta sample

Socket	Number Abscessed	Socket	Number Abscessed	Total Number	Percent
Left Maxilla		**Left Mandible**			
1st Incisor		1st Incisor	1	1	2.6
2nd Incisor		2nd Incisor			
Canine		Canine			
1st Premolar	1	1st Premolar		1	2.6
2nd Premolar	2	2nd Premolar		2	5.1
1st Molar	3	1st Molar	2	5	2.8
2nd Molar	4	2nd Molar	3	7	18.0
3rd Molar		3rd Molar	2	2	5.1
Right Maxilla		**Right Mandible**			
1st Incisor	1	1st Incisor	1	2	5.1
2nd Incisor		2nd Incisor			
Canine		Canine			
1st Premolar	1	1st Premolar	1	2	5.1
2nd Premolar		2nd Premolar	3	3	7.7
1st Molar	2	1st Molar	6	8	20.5
2nd Molar		2nd Molar	3	3	7.7
3rd Molar	2	3rd Molar	2	4	10.3
Total	16 (41%)		23 (59%)	39	

Only four (13.3 percent) of the 30 individuals in the Glorieta sample had no carious teeth. The number of carious teeth per individual for the other 26 ranged from 1 to 15, as Table 7 indicates. Not surprisingly, some of those with the greatest number of carious teeth also had lost or were about to lose teeth as a result of alveolar abscessing. They generally displayed the most advanced stages of caries in one or more of their teeth, with virtually complete crown destruction, pulp exposure, and root involvement. For example, Burial 2X, who had 15 carious teeth, had also lost four teeth from abscessing, and 2H, who had 13 carious teeth, had four active periapical abscesses at the time of death and had lost one tooth antemortem.

Table 7. Incidence of dental caries in Glorieta sample

Number of Carious Teeth	Number (%) of Individuals (N=30)
0	4 (13.3)
1	3 (10.0)
2	5 (16.7)
3	2 (6.7)
4	1 (3.3)
5	5 (16.7)
6	2 (6.7)
7	1 (3.3)
8	1 (3.3)
9	2 (6.7)
10	2 (6.7)
11	0
12	0
13	1 (3.3)
14	0
15	1 (3.3)

Table 8 shows the incidence of dental caries in relation to the number of teeth present for each individual in the Glorieta sample and indictes the severity of the lesions, that is, whether carious lesions were (1) beginning or involved less than half a crown surface, or (2) had destroyed from half to all of one or more crown surfaces. The table includes only fully erupted permanent teeth. As Table 9 shows, 16 of the 30 individuals in the Glorieta sample had unerupted, partially erupted, or congenitally absent teeth. In one instance (Burial 2FF/GG), the right mandibular canine was congenitally absent, and the deciduous canine had been retained. The deciduous tooth is not included in the total number of teeth present in Table 8. The number of individuals (11) with unerupted and partially erupted third molars (Table 9) is consistent with the large number of individuals in this sample who were in their mid to late teens.

Table 8. Incidence of dental caries in fully erupted, permanent teeth and severity of carious lesions

Burial	Number Teeth Present	Number (%) with Caries	Less than 1/2 Destruction of Crown Surface	1/2 to Complete Destruction of Crown Surface
2A	29	1 (3.4)	1	
2B	30	10 (33.3)	8	2
2C	29	10 (34.5)	4	6
2D	31	5 (16.1)	5	
2E	12	2 (16.7)	2	
2G	26	6 (23.1)	4	2
2H	30	13 (43.3)	10	3
2I	32	2 (6.3)	2	
2J	29	3 (10.3)	3	
2K	16	0		
2L	30	2 (6.7)		2
2M	12	2 (16.7)	2	
2N	26	1 (3.8)	1	
2O	28	5 (17.9)	5	
2P	27	0		
2Q	32	6 (18.8)	6	
2R	29	9 (31.0)	4	5
2S	30	5 (16.7)	3	2
2T	25	5 (20.0)	5	
2U	32	2 (6.3)	2	
2V	32	4 (12.5)	2	2
2X	25	15 (60.0)	11	4
2Y	28	5 (17.9)	4	1
2Z	27	8 (29.6)	2	6
2AA	28	7 (25.0)	6	1
2BB	30	3 (10.0)	3	
2CC	26	9 (34.6)	5	4
2DD	28	2 (7.1)	2	
2EE	28	0		
2FF/GG	29	0		
Total	816	142 (17.4)	102	42

Table 9. Individuals in Glorieta sample with partially erupted, unerupted, or congenitally absent teeth

Burial	Number Partially Erupted Teeth	Number Unerupted Teeth	Number Congenitally Absent Teeth
2A	L max. 3rd molar R max. 3rd molar	R mand. 3rd molar	
2B			L max. 3rd molar R max. 3rd molar
2E	L mand. 3rd molar		
2J	L max. 3rd molar R max. 3rd molar	R mand. 3rd molar (impacted)	
2M		R mand. 3rd molar	
2N		L and R max. 3rd molars L and R mand. 3rd molars	
2O	L mand. 3rd molar		L max. 3rd molar R max. 3rd molar R mand. 3rd molar
2P	L max. 3rd molar R max. 3rd molar	L mand. 3rd molar R mand. 3rd molar	
2T			R max. 3rd molar
2X	R max. 3rd molar		L mand. 3rd molar R mand. 3rd molar
2Y			L max. 3rd molar
2BB		L mand. 3rd molar	R mand. 3rd molar
2CC		L mand. 3rd molar R mand. 3rd molar	
2DD			L and R max. 3rd molars L and R mand. 3rd molars
2EE	R mand. 3rd molar	R max. 3rd molar L max. 3rd molar L mand. 3rd molar	
2FF/GG			R mand. (deciduous canine retained)

As Table 8 shows, less than one-fifth (17.4 percent) of the 816 teeth present in the Glorieta sample displayed carious lesions. Most (72 percent) of the 142 carious teeth had either slight fissures or lesions that involved less than half of a crown surface. Four individuals had no carious teeth. In eight more, the incidence of dental caries in the teeth present was 10 percent or less. In contrast, in seven individuals dental caries were present in from 20 percent to 60 percent of their teeth. A few individuals were experiencing nearly total destruction of several teeth and active abscessing at the time of death.

Three of the individuals in the sample, including the one (Burial 2X) who had the greatest number of carious teeth and had lost four before death as a result of alveolar abscessing, had received dental care in the past as evidenced by the presence of gold fillings. Burial 2B had two gold fillings, one on the occlusal surface of his right maxillary second molar (Fig. 3), and one on the occlusal surface of his right mandibular second molar. Burial 2H had three gold fillings: on the occlusal surfaces of the right mandibular second molars, and in the buccal pit of the left mandibular first molar. Burial 2X had gold fillings in seven teeth: one on the lingual surface of the right maxillary second incisor; one on the distal interproximal surface of the right maxillary canine; two in the left maxillary second premolar, one on the mesial interproximal surface, and one on the distal interproximal surface; one on the mesial interproximal surface of the right maxillary second premolar; one on the mesial interproximal surface of the left maxillary first molar; two on the occlusal surface of the right maxillary second molar (Fig. 4); and one on the occlusal surface of the right mandibular second molar. This individual, with 15 carious teeth, nine fillings in seven of them, and a history of tooth loss through alveolar abscessing, was the oldest of the Glorieta sample, with an estimated age of between 35 and 45 years at death.

The crown surface on which the greatest number of carious lesions (79) occurred was the occlusal; the interproximal surfaces displayed 62 lesions, and the buccal surface 48. The labial surface was least affected by dental caries.

Of the 142 carious teeth, 52.1 percent were maxillary, and 47.9 percent mandibular. None of the mandibular incisors or premolars was carious, and only one canine was; however, 12 maxillary incisors, 5 maxillary canines, and 12 maxillary premolars displayed dental caries. Most carious teeth of both the mandible and maxillae were molars. Table 10 summarizes the data on dental caries by tooth type for the Glorieta sample.

In the War of 1812 sample (Sledzik and Moore-Jansen 1991a, 1991b), of 599 permanent teeth available for examination, 11.9 percent were carious, compared to 17.4 percent in the Glorieta sample. As in the Glorieta sample, maxillary teeth displayed more carious lesions than did mandibular teeth, and the incidence of caries was higher for maxillary incisors, canines, and premolars than for the corresponding mandibular teeth (mandibular incisors and second premolars displayed no caries), as was also true of the Glorieta sample.

The incidence of caries in the Glorieta sample was closer to, though slightly lower than, that found by Sledzik and Moore-Jansen (1991b) in another Civil War sample representing 49 Union and Confederate soldiers whose average age was 27.1 years. Of the 409 teeth available from that sample, one-fifth (21.7 percent) had carious lesions.

Seven of the individuals in the Glorieta sample (Burials 2C, 2H, 2O, 2T, 2U, 2X, and 2Z) displayed heavy black or brown stains on many of their teeth, probably the result

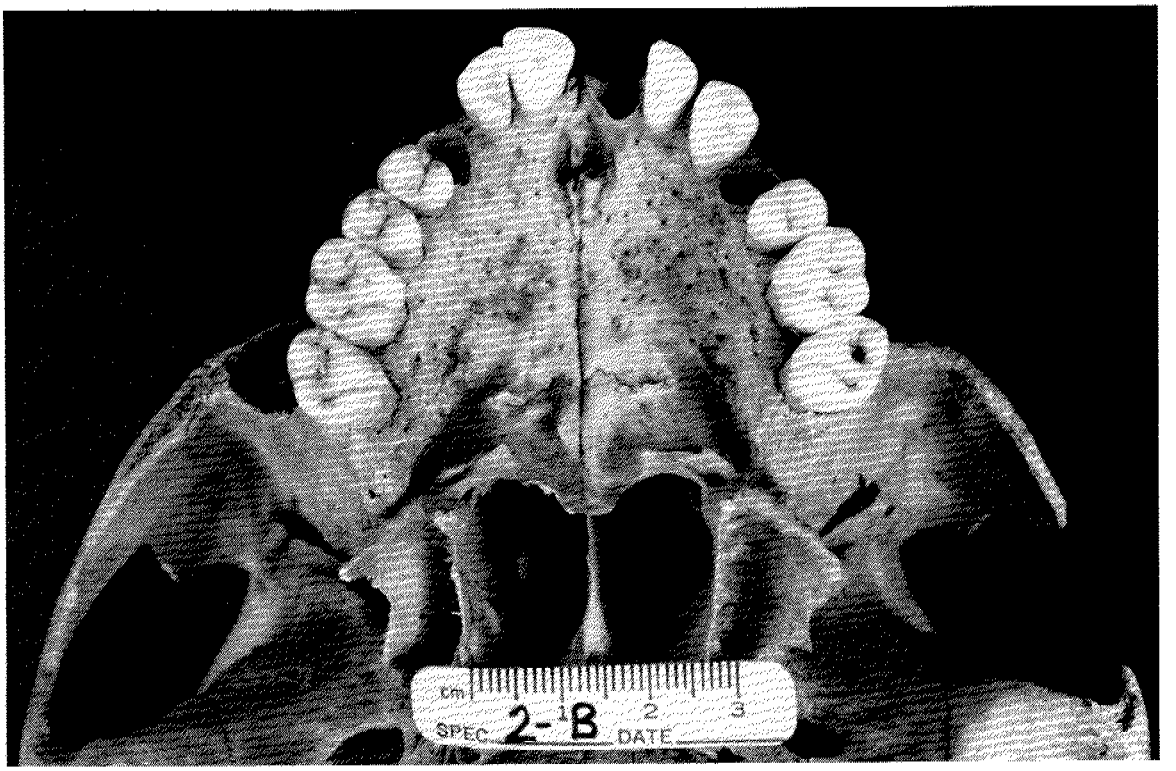

Figure 3. Gold filling on the occlusal surface of the right maxillary second molar of Burial 2B.

Figure 4. Two gold fillings on the right maxillary second molar of Burial 2X. The figure also shows antemortem loss of both maxillary first premolars, possibly from extraction, with alveolar bone remodeling of the tooth sockets.

of smoking or chewing tobacco. One individual (2H) had a pattern of pronounced wear on the right maxillary second incisor and canine that suggested a pipe facet. Campaign diaries (Alberts 1984; Hanna 1990) indicate the heavy consumption of coffee, which could have caused dark staining as well.

The dental inventory form provides for the evaluation of deposits of calculus as follows: none, flecks, moderate, coalesced, heavy, and three-dimensional. As Table 11 shows, there were calculus deposits on at least some of the teeth of all the individuals in the sample, although these were often no more than flecks. Three-fifths (59.5 percent) of the 798 teeth that could be examined for calculus displayed deposits; however, in more than half (58.5 percent) of the 475 teeth with calculus, the deposits were only slight (i.e., flecks). About one-third (35.6 percent) had moderate or coalesced deposits. Of the 28 teeth displaying heavy or three-dimensional deposits, 20 (71.4 percent) were mandibular. Incisors represented more than half (15; 53.6 percent) of the most severely affected teeth, and all these incisors were mandibular. Nine were molars, eight of these maxillary; three were premolars (two mandibular and one maxillary); and one was a mandibular canine.

The teeth in the Glorieta sample were examined macroscopically for evidence of enamel hypoplasia. Episodes of nutritional or disease stress during enamel deposition can be manifested as continuous depressed lines or rows of pits on the labial or buccal surfaces of teeth. In many instances carious destruction or extremely heavy deposits of calculus prevented assessment of enamel hypoplasia in this sample; however, of the 30 individuals who were represented by teeth, 17 (56.7 percent) displayed enamel hypoplasia. In the War of 1812 sample, Sledzik and Moore-Jansen (1991a) observed enamel hypoplasia in the teeth of only one individual. His incisors and canines displayed pronounced lines (see illustrations in Pfeiffer and Williamson 1991:231, 245). Table 12 presents the data on enamel hypoplasia for 17 individuals in the Glorieta sample, showing which teeth were affected and the number of hypoplastic lines these teeth displayed.

The mandibular second molars of one of the individuals in the sample (2T) showed hypocalcification, a condition, like enamel hypoplasia, related to diet or illness that interrupts dental calcification. In this instance, hypocalcification had led to a ring of carious lesions across the buccal surface of the mandibular second molars.

The data on dental pathology for the Glorieta sample indicate that only about a third (36.7 percent) of the individuals had experienced alveolar abscessing and that molars were the teeth most often lost or in the process of destruction as a result of abscessing. Only four individuals were free of dental caries, with the number of carious teeth for the remaining 26 ranging from 1 to 15. Of 816 teeth available for examination, nearly one-fifth (17.4 percent) displayed carious lesions (a slightly lower percentage than that found by Sledzik and Moore-Jansen [1991b] in a Civil War sample of somewhat older average age). The incidence of caries was roughly equal for maxillary (52 percent) and mandibular (48 percent) teeth, and molars were the teeth most frequently affected

Table 10. Incidence of dental caries by tooth type in Glorieta sample

Tooth Type	Maxillae Number Present	Number (%) Carious	Mandible Number Present	No. (%) Carious	Total Teeth Present	Total Number (%) Carious
Incisor	102	12 (11.8)	111	0	213	12 (5.6)
Canine	54	5 (9.2)	57	1 (1.8)	111	6 (5.4)
Premolar	104	12 (11.5)	114	0	218	12 (5.5)
1st Molar	52	16 (32.0)	54	27 (50.0)	104	43 (41.3)
2nd Molar	52	21 (40.4)	54	28 (51.8)	106	49 (46.2)
3rd Molar	30	8 (26.7)	34	12 (35.3)	64	20 (31.2)
Total	392	74 (18.9)	424	68 (16.0)	816	142 (17.4)

Table 11. Incidence of calculus in Glorieta sample

Burial	Teeth Present*	Number (%) with Calculus	Type of Calculus Deposit			
			None	Slight	Moderate	Severe
2A	29	25 (86.2)	4	12	12	1
2B	30	24 (80.0)	6	13	7	4
2C	25	22 (88.0)	3	13	9	
2D	31	27 (87.1)	4	14	13	
2E	13	10 (23.1)	3	10		
2G	25	15 (60.0)	10	7	8	
2H	22	21 (95.5)	1	10	11	
2I	32	7 (28.0)	25	6	1	
2J	29	14 (48.3)	15	7	7	
2K	16	2 (12.5)	14	2		
2L	30	26 (86.7)	4	7	16	3
2M	12	4 (33.3)	8	4		
2N	26	11 (42.3)	15	8	3	
2O	28	8 (28.6)	20	5	3	
2P	27	25 (92.7)	2	12	9	4
2Q	32	14 (43.8)	18	14		
2R	29	13 (44.8)	16	4	5	4
2S	29	22 (75.9)	7	8	11	3

Burial	Teeth Present*	Number (%) with Calculus	Type of Calculus Deposit			
			None	Slight	Moderate	Severe
2U	32	9 (28.1)	23	8	1	
2V	32	28 (87.5)	4	17	7	4
2X	25	24 (96.0)	1	15	6	3
2Y	28	8 (28.6)	20	6	2	
2Z	23	13 (56.5)	10	6	5	2
2AA	28	17 (60.7)	11	10	7	
2BB	30	15 (50.0)	15	9	6	
2CC	25	19 (76.0)	6	10	9	
2DD	28	15 (53.6)	13	13	2	
2EE	28	7 (25.0)	21	3	4	
2FF/GG	29	14 (48.3)	15	13	1	
Total	798	475 (59.5)	323	278	169	28

* The total number of teeth present differs for some individuals from the total shown in Table 8 because in some cases the crown surface of a tooth had been destroyed by dental caries.

Table 12. Incidence of enamel hypoplasia in Glorieta sample

Burial	Number Teeth with Hypoplasia	Teeth Displaying Enamel Hypoplasia	Number of Lines per Tooth
2B	6	max. 1st incisors mand. 1st incisors mand. canines	1 1 1
2D	4	L max. canine R mand. canine L mand. 1st and 2nd premolars	2 2-3 2-3
2E	5	mand. 1st incisors mand. 2nd incisors R max. canine	3 3 1
2G	8	max. 1st incisors mand. 1st incisors mand. 1st and 2nd premolars	1 1 (slight) 1
2H	2	mand. canines	1
2I	1	L max. canine	3
2K	6	mand. 1st and 2nd incisors mand. canines	1 3
2L	1	R mand. 1st incisor	1
2O	8	max. 1st and 2nd incisors mand. 1st and 2nd incisors	2-3 2-3
2P	4	max. canines mand. canines	3 1
2Q	8	max. 1st incisors max. canines mand. 2nd incisors mand. canines	1 1 1 3
2R	14	max. 1st incisors max. 2nd incisors max. canines max. 1st and 2nd premolars mand. 1st incisors mand. canines	2 1 3 2 1 2
2S	2	mand. canines	1
2U	4	max. and mand. 1st incisors	1
2V	10	max. canines mand. 1st incisors mand. canines mand. 1st and 2nd premolars	2 2 2 2
2Y	6	max. 1st incisors max. 2nd incisors max. canines	2 3 1
2BB	8	max. 1st incisors max. canines mand. 1st incisors mand. canines	1 1 1 1

(78.9 percent of the 142 carious teeth were molars). The teeth of all the individuals in the sample displayed deposits of calculus; however, for most, these deposits were only flecks. Of the 28 teeth displaying heavy or three-dimensional deposits, three-fourths (71.4 percent) were mandibular, and 15 of these were incisors. The teeth of slightly more than half the individuals in the Glorieta sample showed that these men had experienced a period of disease or nutritional stress during the period of enamel deposition.

Antemortem Osteopathology

As Owsley et al. (1991) point out in their report on osteopathology in the Fort Erie sample from the War of 1812, a skeletal series from a battlefield offers an opportunity to study the effects of field conditions and physical stress--defined as acute or chronic excessive biomechanical strain on the body--in a specially selected subset of the general population. In such a sample, age, sex, and other physical characteristics are relatively consistent as a result of induction procedures. As this kind of sample is rare in bioarchaeological research, the Glorieta Pass skeletal series represents a valuable resource that will contribute to the development of a diverse osteological data base and pave the way for future comparative studies. In addition, on a more subjective level, determination of the physiological effects of the New Mexico Campaign on its participants enhances our perception of a little-known episode in U.S. history and helps to make it come alive.

Archival sources indicate that the soldiers who fought at Glorieta had endured many months of often extreme physical exertion, hauling heavy equipment through deep sand and up steep inclines in mountainous terrain. Thus it was not surprising to find osteological evidence of biomechanical stress among those who died at Glorieta. The incidence of Schmorl's depressions was one such indication. Herniation and displacement of intervertebral disc tissue can cause the formation of cartilaginous nodes. When these nodes intrude into adjacent vertebral bodies, end-plate lesions called Schmorl's depressions result. Schmorl's depressions are common in the elderly as a result of degenerative disc disease (Mann and Murphy 1990); in younger individuals they can result from trauma, such as a fall from substantial height, heavy lifting, and extreme physical exertion. Schmorl and Junghanns (1971:175) wrote: "Fatigue damage, similar to fatigue fractures in the bone, can be produced in disc tissue when the demand surpassed the functional ability." Schmorl's depressions are most usual in areas of greatest biomechanical strain, specifically the lower thoracic and upper lumbar vertebrae (Owsley et al. 1991:206).

Table 13 presents data on the incidence of Schmorl's depressions in 26 individuals of the Glorieta sample. For four Burials (2X, 2Y, 2BB, and 2FF/GG), no thoracic or lumbar vertebrae were present, so it was not possible to make an assessment. In Burial 2O, the seven thoracic and lumbar vertebrae that were present were only partial, all

Table 13. Incidence of Schmorl's depressions in Glorieta sample

Burial	Number of Affected Vertebrae		
	Thoracic	Lumbar	Total
1A	T7-T10	-	4
2A	T8-T12	L1	6
2B			0
2C	T10-T12	L1-L3	6
2D			0
2E	One thoracic (?)	One lumbar (?)	2
2G			0
2H	T6-T11	L1-L5	11
2I			0
2J	T6, T8		2
2K			0
2L			0
2M		L1, L2, L4, L5	4
2N			0
2P	One of T10-T12	One of L1-L3	2
2Q			0
2R		Two lumbar (?)	2
2S			0
2T			0
2U	T2, T6, T8, T10-T12		6
2V	Four thoracic (?)		4
2Z		One lumbar (?)	1
2AA		Two lumbar (?)	2
2CC			0
2DD			0
2EE			0

lacking the vertebral body; thus, determination of the presence or absence of Schmorl's depressions was not feasible. Thirteen (50 percent) of the remaining 26 individuals displayed vertebral end-plate lesions. Owsley et al. (1991) found evidence of Schmorl's depressions in 48 percent (13 of 27 individuals) of the Fort Erie sample, noting that "The number of individuals and numbers of affected vertebrae seem quite remarkable. . . . This high incidence is particularly dramatic when examined on a per individual basis. Six individuals have five or more affected vertebrae. One soldier had pronounced Schmorl's depressions in 11 vertebrae while another had nine" (Owsley et al. 1991:207). In the Glorieta sample, there also was one individual who had 11 affected vertebrae; Schmorl's depressions were present in six vertebrae of each of three other individuals. The total number of thoracic vertebrae present for the Glorieta sample was 210, with 32 (15.2 percent) displaying Schmorl's depressions; 104 lumbar vertebrae were present, of which 20 (19.2 percent) showed evidence of Schmorl's. Both of these military samples had experienced exceptionally physically demanding schedules and activities; it was not surprising that half of them suffered herniation and displacement of vertebral disc tissue. There was also other related osteological evidence of physiological stress.

Vertebral wedging is a descriptive term that indicates the loss of centrum height along the ventral margin (that is, a wedge-shaped vertebral body). Ankylosis refers to the bony fusion or bridging of two or more contiguous vertebrae, usually along the anterior or lateral margins of the centra. Such pathology can result from the bone loss accompanying old age, from infection, or from physical stress and trauma such as a fall (Mann and Murphy 1990). Compression fractures and loss of vertebral centrum height most frequently result from collapse of the superior end plate. As the intervertebral disc protrudes into the end plates, the bodies collapse.

Six individuals in the Glorieta sample (23.1 percent of those for whom vertebrae were present) displayed vertebral wedging/fusion or compression fractures:

1. Burial 2B. Thoracic vertebrae 9 and 10 were fused laterally and posteriorly at the intervertebral joints. Ligaments along the lateral borders of the vertebral bodies in the area of the costal pits were ossified, and the intervertebral disc was flattened, bringing the bodies of the two vertebrae into direct contact. The superior and inferior surfaces of the centra appeared normal. One of the higher thoracic vertebra also showed wedging, possibly the result of a compression fracture.

2. Burial 2E. The bodies of thoracic vertebrae 11 and 12 showed slight anterior wedging.

3. Burial 2L. One of the lower thoracic vertebrae displayed slight wedging.

4. Burial 2P. One of the lumbar vertebrae (between L1 and L4) had a depressed area on the anterior border of the superior surface of the centrum, approximately 1.5 by 2.0 cm, with remodeling apparent, especially along the borders. Disc herniation and

compression fracture could have caused this defect (Fig. 5).

5. Burial 2Z. Slight wedging and compression fractures were present in two vertebra, the twelfth thoracic and the fourth lumbar.

6. Burial 2CC. The third and fourth thoracic vertebrae were ankylosed. The centra were tightly positioned together, with no disc space between them, and the neural arches were solidly fused with no dividing line.

Osteophytes are bony growths. They frequently occur as small, raised irregularities along the margins or midsections of vertebral centra, but they also occur on and around the joint surfaces of long bones. They typically accompany advancing age but can also result from trauma, heavy physical stress, and obesity (Mann and Murphy 1990). When they occur at muscle attachment sites on long bones, they are referred to as enthesophytes.

The development of osteophytes at the superior and inferior borders of vertebral centra and on and around joint surfaces of long bones is characteristic of osteoarthritis and is generally an indication of advancing age (Bass 1987). In this quite young sample, osteoarthritis, though occasionally present, was not common; however, a number of individuals exhibited osteophytes on vertebrae or long bones or enthesophytes at a muscle attachment site. The following ten individuals (32 percent of the total Glorieta sample) displayed evidence of osteophytosis:

1. Burial 1A (age 28-33). An enthesophyte (tuberosity) was present on the anterior aspect of the left femur in the area of the lesser trochanter and of the attachment site of the iliofemoral ligament. Some type of habitual physical activity such as horseback riding could have caused it.

2. Burial 2B (age 35-39). Slight osteophyte development was apparent at the anterior margin of the right temporomandibular joint, with erosion of the joint surface. The right proximal tibia displayed slight periarticular lipping, and osteophytes were present at the facets and centra of the all thoracic vertebrae. (Note that this individual was one of the two oldest in the Glorieta sample.)

3. Burial 2C (age 27-33). A moderate-sized bony growth was present on the left anterior ala of the first sacral element. The proximal joint surface of the left ulna and all of the lumbar vertebrae also displayed slight osteophyte development.

4. Burial 2H (age 24-29). Slight osteophytic lipping was present between the fifth lumbar vertebra and the first sacral element, as well as on the joint surfaces of the distal left femur and proximal right tibia.

Figure 5. Depressed area on the anterior border of the superior surface of the centrum of a lumbar vertebra (between L1 and L4) of Burial 2P. Disc herniation and compression fracture could have caused this defect.

5. Burial 2R (age 25-29). Osteophytic lipping was present between the third and fourth lumbar vertebra and the fifth lumbar vertebra and first sacral element. (The first element of the sacrum also displayed porosity.) A large bony swelling was also apparent on the left femur near the lesser trochanter and the attachment site of the iliofemoral ligament.

6. Burial 2S (age 18-22). Slight osteophyte development on the left distal ulna had occurred at the site of a healed fracture.

7. Burial 2V (age 18-21). Osteophytosis was pronounced on the centra of the first three lumbar vertebra, and slight on the fourth and fifth lumbar vertebrae. (This degree of lumbar osteophytosis is unusual in one so young.) In addition, Burial 2V had a crescent-shaped area of porosity on the talus at the os trigonum.

8. Burial 2X (age 35-45). Beginning osteoarthritis was evident at the glenoid fossa on the left scapula. (Because no thoracic and lumbar vertebrae were present, it could not be determined whether Burial 2X had spinal osteoarthritis. Note that this individual was the oldest in the Glorieta sample.) The margins of the left scapula also displayed porosity.

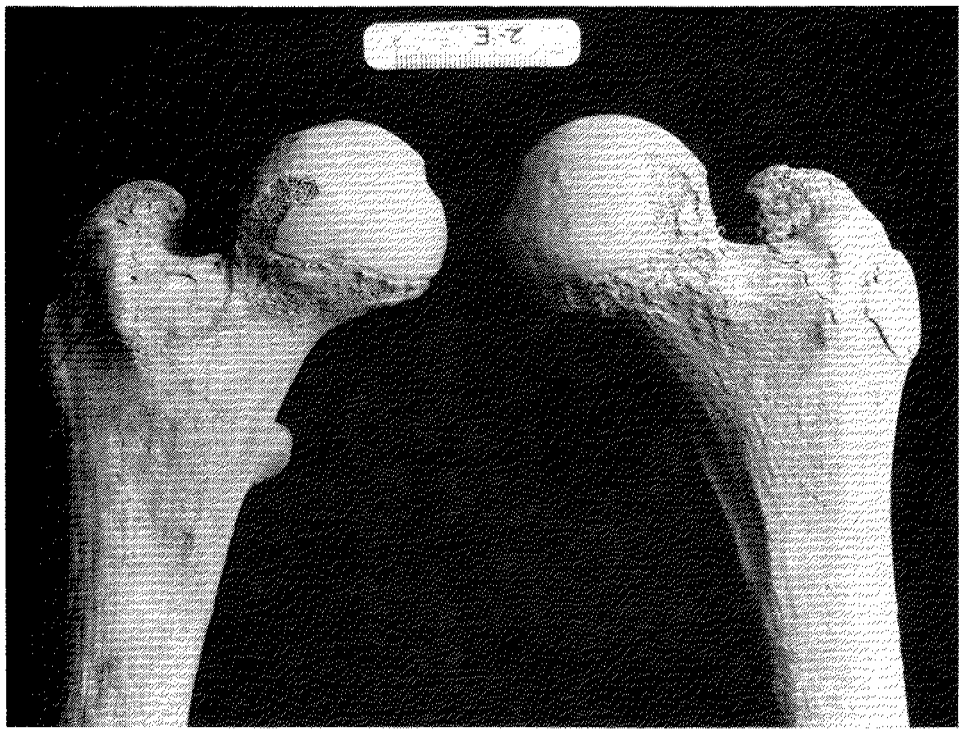

Figure 6. Femur of Burial 2E showing a depression immediately anterior to the lesser trochanter.

Figure 7. Tibiae of Burial 2E showing bilateral depressions on the anterior surface below the unfused proximal epiphyses and near the attachment site of the ligamentum patellae.

9. Burial Z (age 26-32). Slight osteophyte development was present on the left talus at the margin of the tibio-talar articular facet.

10. Burial 2DD (age 25-32). The distal end of the right tibia displayed slight osteophytic lipping, as did the articular facets of all thoracic vertebrae and the centra of the first three lumbar vertebrae.

All but two of these ten individuals were over the mean and median age of the Glorieta sample; the two exceptions were Burial 2S, whose osteophytosis was associated with a healed fracture, and Burial 2V, in his late teens or early twenties, in whom so pronounced a degree of lumbar osteophytic lipping was unexpected and possibly resulted from exceptional biomechanical stress.

Periostitis, inflammation or thickening of cortical bone, generally occurs as a reaction to pathologic changes (e.g., infection, trauma) in the underlying bone, although it may occur by itself (Ortner and Putschar 1981). When deposition occurs over an extended period, the new bone tends to vary in thickness and to be unevenly distributed (Ortner and Putschar 1981). Only two of the individuals in the Glorieta sample showed evidence of periostitis. The middle third of the right ulna of Burial 2E displayed slight but active (at the time of death) periostitis. In the case of Burial 2BB, the distal third of the right femur was affected, with slight periostitis extending up and down the shaft. In contrast to the Glorieta sample, ten individuals in the War of 1812 sample displayed evidence of periostitis. There were 17 occurrences among these ten individuals, seven of which were active at the time of death. Ten of the lesions had healed.

Another type of osteopathology is osteoporosis, that is, diminished bone mass or density resulting from an imbalance between bone resorption and bone formation, usually not occurring before the fifth decade (Ortner and Putschar 1981). Cancellous bone is typically most affected, and the condition is more frequent and severe in females than males. Osteoporosis in the outer table of cranial bone, particularly the parietals, resulting in an "orange peel" texture of the outer vault but no thickening or expansion of the diploë, has been termed ectocranial porosis (Mann and Murphy 1990). An early form or possibly related manifestation is cribra orbitalia, porosity of the upper surface of the orbits, which occurs in childhood, though traces (remnants of pitting) may be apparent in adults (Mann and Murphy 1990). Loss of bone density and porosity can result from metabolic disorders, malnutrition, and vitamin and mineral deficiencies, as well as from extended periods of disuse. Compression fractures and wedging, in addition to porosity, can be manifestations of osteoporosis (Ortner and Putschar 1981).

In view of the near-starvation conditions that the Confederate troops experienced throughout the New Mexico Campaign, it was possible that some evidence of ectocranial porosity and loss of bone mass would be found in the Glorieta sample. Table 14 presents the data on ectocranial porosis, which was present in nine individuals (i.e., 29.0 percent of the 31 crania examined). In each instance the pathological 'condition was active (as

opposed to healed) at the time of death. The orbits of two individuals (Burials 2U and 2BB) suggested cribra orbitalia. In the War of 1812 sample, nearly one-fourth of the individuals displayed ectocranial porosity, but there were no instances of cribra orbitalia.

Table 14. Incidence of ectocranial porosis in the Glorieta sample

Burial	Location	Severity	Involvement
2B	occipital	very slight	localized
2D	parietals	extremely slight	localized
2I	frontal	mild	localized
2Q	parietals and occipital	mild	widespread
2U[1]	parietals and occipital	mild	widespread
2V	frontal, parietals, and occipital	mild	widespread
2X	frontal, parietals, and occipital	mild	widespread
2Z	parietals and occipital	mild	widespread
2BB[1]	occipital	very slight	localized

[1] Evidence of cribra orbitalia also present.

As indicated in the discussion of osteophytosis, one individual (Burial 2S) had suffered a fractured ulna well before death (healing had occurred). There was one other example of antemortem fracture in this sample. Burial 2C displayed a healed, depressed fracture on the frontal bone above the right orbit. The lesion was blunt oval in shape and measured 11 by 6 mm.

Several individuals in the Glorieta sample showed various types of minor osteological anomalies. On each femur of Burial 2E there was a depression immediately anterior to the lesser trochanter (Fig. 6), as well as bilateral depressions on the anterior surface of the tibiae below the unfused epiphyses and near the attachment site of the ligamentum patella (Fig. 7). This individual was in his mid-teens, one of the youngest in the sample. Such cortical depressions near muscle attachment sites in young individuals suggest physical stress. The first element of the sacrum of this same individual had an incompletely fused neural arch, probably a congenital defect, and the first cervical vertebra had double facets.

In Burial 2H, the fifth lumbar vertebra displayed separation of the posterior arch from the vertebral body. The cause of this condition (spondylolysis) is unclear. Although

some researchers consider it congenital, others believe that stress is a major factor--that separation of the neural arch represents a stress or fatigue fracture (Mann and Murphy 1990).

A benign tumor--a button osteoma--was present on the left parietal of Burial 2M.

The second cervical vertebra of Burial 2X had double articular facets and the vertebral arch was incompletely fused. (The fusion defect was too slight to be classified as spina bifida, that is, split or cleft arch.)

Table 15 summarizes the various types of antemortem bone pathology encountered in the 31 Glorieta skeletons. As the table shows, no evidence of antemortem osteopathology was observed in eight (25.8 percent) of the individuals comprising the Glorieta skeletal series. Four of these individuals were in their late teens; the other four were in their late twenties. Older individuals tended to display osteophytosis, particularly osteophytic lipping on thoracic and lumbar vertebra. Nearly two-thirds (61.5 percent) of the 26 individuals for whom thoracic and lumbar vertebrae were present displayed either Schmorl's depressions or ankylosis/compression fractures, a likely result of the physical demands of the campaign. Nine individuals (29.0 percent of the 31) displayed ectocranial porosis, possibly resulting from the malnutrition and dietary mineral deficiencies that characterized the campaign from its inception. Only two individuals showed evidence of periostitis. With the exception of the incidence of periostitis--much lower in the Glorieta than in the Fort Eric sample--the antemortem types of osteopathology observed in the two groups and the percentages affected were similar.

Table 15. Antemortem osteopathology in Glorieta sample

Burial	Antemortem Osteopathology
1A	Schmorl's depressions, thoracic vertebrae; enthesophyte, left femur
2A	Schmorl's depressions, thoracic and lumbar vertebrae
2B	Ankylosis of two thoracic vertebrae; possible compression fracture and wedging of another thoracic; osteophytosis and erosion of right temporomandibular joint; periarticular lipping on right proximal tibia; slight ectocranial porosis
2C	Schmorl's depressions, thoracic and lumbar vertebrae; osteophytosis on centra of all lumbar vertebrae and sacrum, and on left proximal ulna; healed depressed fracture on frontal above right orbit
2D	Slight ectocranial porosis
2E	Schmorl's depressions, one thoracic and one lumbar vertebra; slight anterior wedging of two thoracics; bilateral depressions near muscle attachment sites on femora and tibiae; active periostitis, right ulna; double facets, C1; incompletely fused arch, S1
2G	None observed

Burial	Antemortem Osteopathology
2H	Schmorl's depressions, thoracic and lumbar vertebrae;slight osteophytic lipping between L5 and S1, on distal left femur, and right proximal tibia; spondylolysis, L5
2I	Ectocranial porosis
2J	Schmorl's depressions, thoracic vertebrae
2K	None observed
2L	Ankylosis, lower thoracic vertebrae; slight osteophytic lipping, vertebral centra
2M	Schmorl's depressions, lumbar vertebrae; button osteoma, left parietal
2N	None observed
2O	None observed
2P	Schmorl's depressions, thoracic and lumbar vertebrae; possible compression fracture, one lumbar vertebra; bilateral dorsal defect of patellae
2Q	Ectocranial porosis
2R	Schmorl's depressions, two lumbar vertebrae; osteophytic lipping between L3 and L4, and L5 and S1; enthesophyte, left femur; osteoporosis, S1
2S	Osteophyte development at site of healed fracture on left distal ulna
2T	None observed
2U	Schmorl's depressions, thoracics; ectocranial porosis; cribra orbitalia
2V	Schmorl's depressions, thoracics; pronounced osteophytosis, centra of L1-L3, and slight on centra of L4-L5; ectocranial porosis
2X	Beginning osteoarthritis of glenoid fossae;porosity on margins of left scapula; ectocranial porosis; double articular facets of C2, and incomplete fusion of vertebral arch of C2
2Y	None observed
2Z	Schmorl's depressions, one lumbar vertebra; slight wedging and compression fracture, one thoracic and one lumbar vertebra; slight osteophytosis on left talus; ectocranial porosis
2AA	Schmorl's depressions, lumbar vertebrae
2BB	Slight ectocranial porosis; probable healed cribra orbitalia; active periostitis, left femur
2CC	Ankylosis, two thoracics
2DD	Slight osteophyte development, thoracic and lumbar vertebrae, right distal tibia
2EE	None observed
2FF/GG	None observed

The 31 individuals buried on the battlefield at Glorieta Pass obviously died as a result of traumatic injuries received during the hard-fought, five-hour action that took place there. In many instances, however, the skeletons of these men did not reveal the injury that had caused death. In some cases, projectiles associated with a skeleton were the only indication of the likely cause of death. Fourteen (45.2 percent) of the skeletons revealed clear evidence of penetrating wounds and fractures consistent with injuries inflicted by a projectile, and four others (12.9 percent) showed damage that could have resulted from either a penetrating wound or postmortem damage. Only the projectiles found in association with eight (25.8 percent) of the burials suggested the possible cause of death because there was no osteological evidence of perimortem trauma. In five (16.1 percent) instances, there was no osteological evidence of trauma, nor were projectiles present. Table 16 summarizes the evidence (osteological or associated projectile) of perimortem trauma in the Glorieta sample. It also includes a subjective assessment, based only on the osteological examination and the presence and location of associated projectiles, of the likelihood that perimortem injury was the cause of death. (The assessment is conservative; in several instances, for example, Burials 1A, 2G, 2R, 2Y, and 2AA, survival would have been impossible, even with immediate, expert medical care.)

Table 16. Perimortem trauma and cause of death in Glorieta sample

Burial	Evidence of Perimortem Trauma	Death from Trauma
1A	Radiating fractures and exit wound in the occipital squamous below the lambdoidal suture resulted from a gunshot wound to the face; no projectile associated with burial	Highly probable
2A	No osteological evidence of trauma; Minié ball associated with pelvis	Possible
2B	No evidence of penetrating wound; mandibular fracture resulting from blunt force trauma; Minié ball near right arm	Possible
2C	Likely perimortem fractures of ribs (midshafts of left 7, 9, & 10); no projectile associated with burial	Probable
2D	No osteological evidence of trauma; bullet and canister ball found with burial	Possible
2E	Penetrating wound, left ilium; entry through abdominal aspect; Minié ball near ischial tuberosity	Highly probable
2G	"Keyhole" entry wound, left frontal; trajectory from above, slightly oblique path; exit not visible (occipital missing); no projectile	Highly probable
2H	No osteological evidence of trauma; no associated projectile	Unknown

Burial	Evidence of Perimortem Trauma	Death from Trauma
2I	No osteological evidence of trauma; no associated projectile	Unknown
2J	Entry wound in left temporal near pterion, exit from left temporal/ occipital at asterion; Minié ball and bullet found with burial	Highly probable
2K	Possible perimortem breakage of two left ribs (6 & 7); other broken ribs clearly postmortem damage; Minié ball by right femur, Minié ball in lower abdomen, bullet in fill	Probable
2L	No osteological evidence of trauma; no associated projectile	Unknown
2M	Right tenth rib shows possible perimortem fracture at midshaft; no associated projectile	Possible
2N	Fracture of left ulna at midshaft, force from lateral direction; cortical avulsion, damage posterior to interosseous crest; no projectile	Probable
2O	No osteological evidence of trauma; one ball (canister shot) in thoracic area	Possible
2P	No osteological evidence of trauma; nine associated projectiles, including one near skull, one in thoracic area	Possible
2Q	Penetrating wound, right innominate; entry, medial aspect; traversed pelvic cavity; exited anterior border of greater sciatic notch; bullet near skull, Minié ball in fill	Highly probable
2R	Left femoral head broken at neck, radiating fractures on head; anterior margin of left acetabulum blown out; right ilium fractured and half missing; likely exit through right ilium; 14 projectiles, 10 in thoracic area	Highly probable
2S	Massive damage to pelvis/sacrum; penetrating wounds, left and right ilia, radiating fractures in pubic rami and both ischia; sacrum fractured; no projectiles found with burial	Highly probable
2T	Possible penetrating wound, midshaft of right radius; bullet at back of skull, 11 Minié balls and a bullet in pouch near shoulder	Possible
2U	No osteological evidence of trauma; Minié ball near left leg	Possible
2V	No osteological evidence of trauma; Minié ball in lumbar region	Possible
2X	No osteological evidence of trauma; Minié ball by ischium	Possible
2Y	Entry wound left frontal, exit through right parietal/occipital at lambda; radiating fractures on frontal, parietals, occipital, left temporal; bullet by outer edge of right foot	Highly probable
2Z	Left mandibular ramus fractured at level of P1-P2; radiating fractures on anterior and posterior portions, and internal and external aspects of ramus; no projectile	Highly probable

Burial	Evidence of Perimortem Trauma	Death from Trauma
2AA	Radiating fractures, parietals, occipital, and frontal, and jagged fracture of left mandible; force originating low on left side (temporal region); bullet near feet	Highly probable
2BB	Likely projectile wound, entry through right eye and exit through occipital, no bevelling or radiating fractures visible; Minié ball between femora	Probable
2CC	Entry wound on frontal, exit through right parietal, posterolateral to parietal foramen; radiating fractures on frontal, parietals, temporals, sphenoid, and occipital; no projectile	Highly probable
2DD	No osteological evidence of trauma; no associated projectile	Unknown
2EE	Possible projectile wound, entry on anterior left parietal, exit posterior parietal/occipital area; radiating fracture pattern; no projectile	Probable
2FF/GG	No osteological evidence of trauma; no associated projectile	Unknown

POSITIVE AND TENTATIVE IDENTIFICATIONS

A principal objective of the physical anthropological analysis of the skeletons from the battlefield and of the archaeological study of associated artifacts was to identify at least some of those who died at Glorieta by comparing the findings with what is known from archival sources. In service records, diaries such as *Rebels on the Rio Grande* (Alberts 1984), and archives such as the Moritz Maedgen Papers (Texas Collection, Moody Library, Baylor University, Waco, Texas), there is information about the names, ages, ranks, and military affiliations, and sometimes about place and manner of death and place of burial, of the men who fought and died at Glorieta. The Museum of New Mexico's Office of Archaeological Studies made a careful survey of the archival sources and assembled background information that was not only basic to the organization and presentation of the exhibition on "The Civil War in the West" but also to the attempt to identify the men buried on the battlefield at Glorieta. Comparing the physical anthropological and archaeological data with what was known about the men from archival sources resulted in positive identification of three of them and tentative identification of several others.

Burial 1A

Major John S. Shropshire was killed when he led a charge on the Union Army positions on Artillery Hill (Fig. 8). He received a head wound and possibly also a body wound.

> We charged up a hill with a wide seam of fair open ground to cross on, towards an enemy who were hidden and invisible and who waited patiently for us to approach. Up we went, taking advantage of every bush and tree to shelter us, and before we had crossed the opening, more than 2/3rds of the men had stopped, fearing to go into it, but 35 or 40 brave souls, led on by Col. Scurry, Maj. Shropshire, Capt. Buckholts, and Capt. [James M.] Odell, went. . . . We saw no foe till in twenty yards of them, and then they rose from behind their breast works of rocks and poured into us a deadly volley (Alberts 1984:82).

Shropshire was more than six feet tall and was 28 years old at the time of his death. Other officers who died in the Battle of Glorieta Pass were placed in coffins and taken to Santa Fe for burial, but Shropshire was too tall to fit into his coffin. Still wearing his boots and spurs, he was wrapped in his blankets and buried on the battlefield in a separate grave close to the mass grave in which the other dead were interred, side by side, with arms folded on their chests, and boots sometimes strapped together (Mitchell 1991).

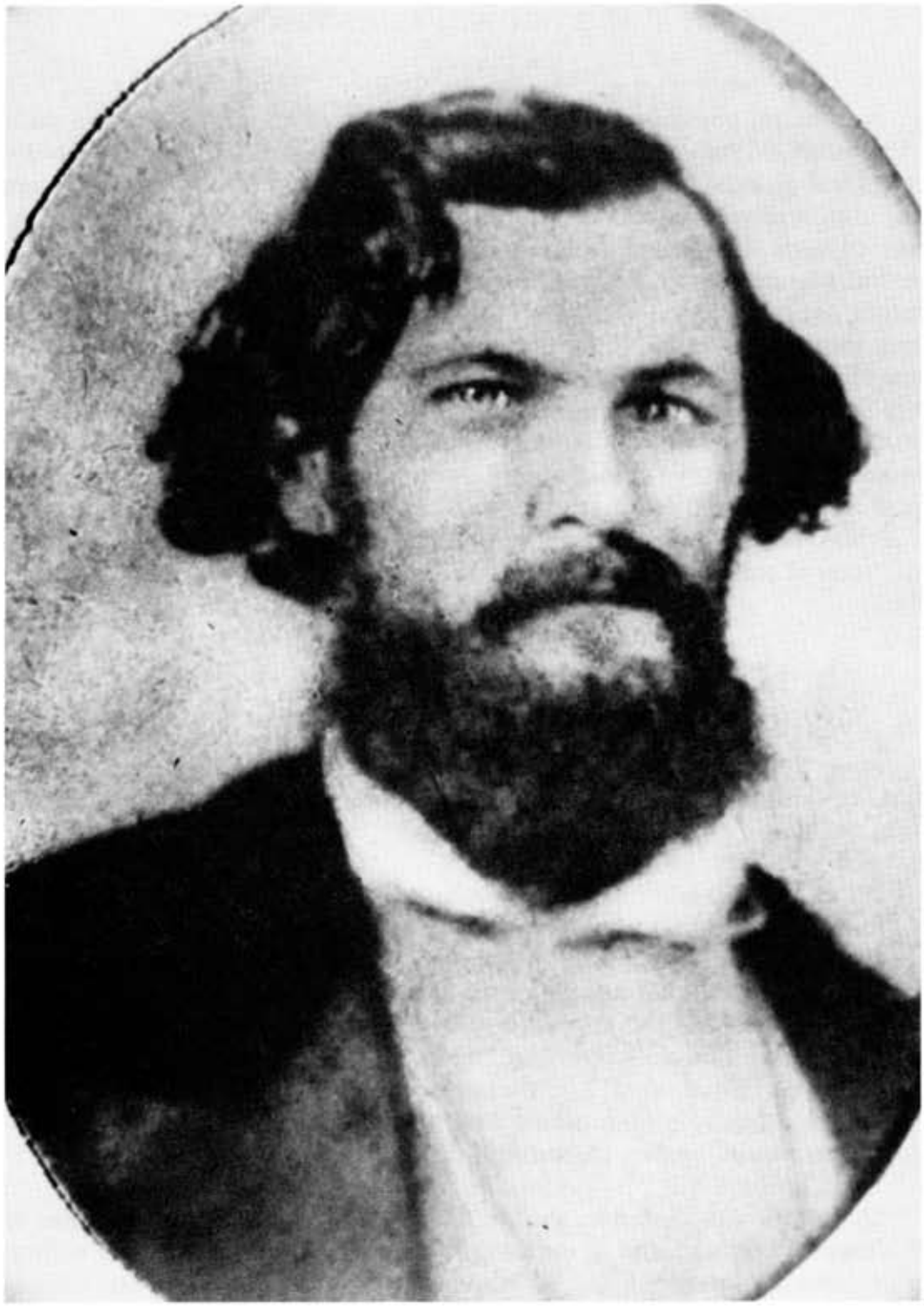

Figure 8. Major John Samuel Shropshire (April 23, 1833-March 28, 1862), 5th Texas Regiment of the Texas Mounted Volunteers, a lawyer of Columbus, Colorado County, Texas, killed leading a charge during the Battle of Glorieta Pass.

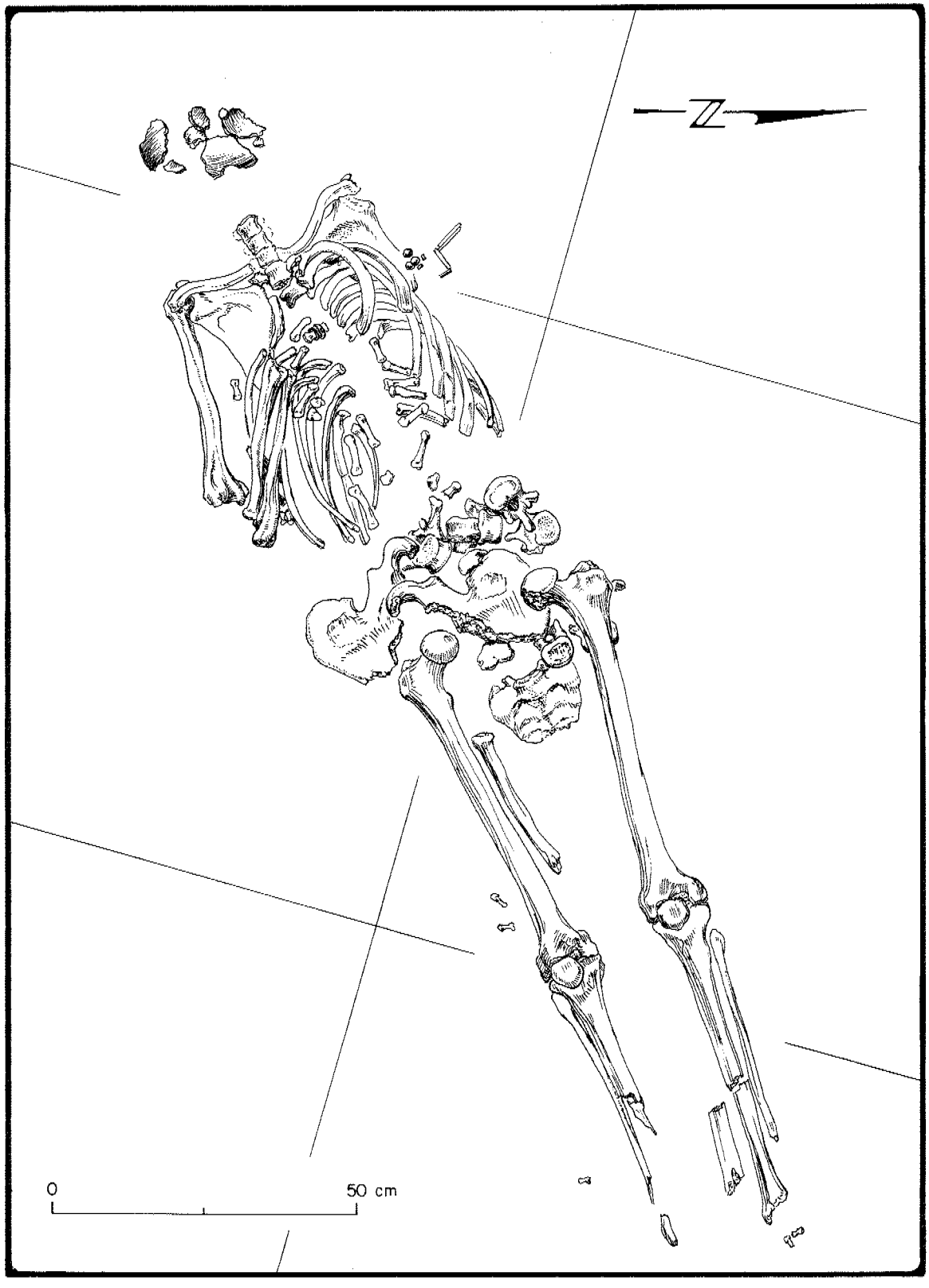

Figure 9. Burial 1A, probably Major John Samuel Shropshire.

Burial 1A in the Glorieta skeletal series was in a grave southeast of the mass grave in which the other 30 men were found (Fig. 9). Based on the osteological examination, Burial 1A was male, approximately six feet one inch tall, and in the 28-33 year age range. Race could not be determined because of the destruction of most of the skull. The squamous portion of the occipital bone displayed multiple radiating fractures (Fig. 10). The fracture pattern suggested that the point of projectile impact was on the front of the skull, from which fractures radiated backward and downward, shattering the occipital along the inferior border of the squamosal suture. This wound to the head, which would have caused death; the correspondence of known physical characteristics to those derived from osteological examination; the separate place of interment; and associated artifacts (e.g., spurs) resulted in the identification of Burial 1A as Major John S. Shropshire. In July 1990, John Shropshire's remains were given to the International Society of Shropshires for reinterment beside his parents in Kentucky, where he was born (Shropshire 1990).

Burial 2E

Private Ebenezer (or Ebineezer) Hanna, called Abe by his comrades-in-arms, had his seventeenth birthday on December 31, 1861. He died three months later of a gunshot wound received in the same charge in which Major Shropshire was killed. Because he could read and write fairly well, Hanna had become the official historian of Company C, 4th Texas Regiment. Ebenezer Hanna's *Memorandum Journal* (Hanna 1990) was begun on February 10; the entries continued though March 28, the day he was killed. A close friend described his wounding and death as follows:

> Abe Hanna was shot down on the left in 30 yards of the enemy. Jake Henson . . . seeing Abe down, went to him, gave him water, and began to pick the stones from under him. While in a kneeling position over his wounded friend, he was shot and killed. . . . Abe Hanna died about an hour in the night very easily. He was shot in the loins and bled inwardly. He said he felt no pain save that his limbs were numb. (Alberts 1984:86.)

The final entry in Hanna's journal, apparently written as he was dying, states, "This is the end of this little Memorandum Journal kept by Ebenezer Hanna who Faught [sic] and Died on the Battle Field of Glorietta [sic]" (Hanna 1990).

Burial 2E was a white male, approximately five feet nine inches tall, and 16 to 18 years of age. He suffered a penetrating wound through the left ilium. An oval-shaped hole with radiating fractures around it indicated entry of a projectile through the internal (abdominal) aspect (Fig. 11); the exit wound was on the external aspect (Fig. 12). Found in association with the body were a Minié ball, near the ischial tuberosity, and writing materials. The depressions near muscle attachment sites on the femora and tibiae of

Burial 2E suggested stress such as would result from continued excessive strain and pulling. One of the last entries in Hanna's journal, a few days before the battle, describes what had by that time become a common occurrence during the campaign: "The horses which draw the artillery was wearied they was not able to draw the artillery to the top of the mountain so they [the guns] were compelled to be taken up by hand and to accomplish this long ropes were fastened to them and we went to work" (Hanna 1990:73).

The age of Burial 2E, the type and location of the fatal wound he received, and the artifacts (small bag of writing implements) buried with him led to his identification as Ebenezer Hanna. Although for a time after his identification there was some discussion of his remains being returned to the Hanna Family Cemetery in Texas, it was decided that he should be buried in New Mexico among those who died with him at Glorieta.

Burial 2S

Private J. S. L. Cotton was 20 years old. He was hit in the lower back or sacrum by a shot fired from a mountain howitzer (small field cannon). Associated with the skeleton were fragments of a ring engraved "S. L. Cot" (Becker 1990).

Burial 2S was a white male, about five feet seven inches tall, and between the ages of 18 and 23 years. This skeleton displayed massive perimortem damage to the pelvis (Fig. 13) and sacrum. A penetrating wound on the left ilium (23 mm in diameter) appeared to be the exit site of a projectile that had passed through the external lateral surface. A similar penetrating wound (diameter 30 mm) was on the right ilium, also with an exit on the external surface. Radiating fractures were present in the pubic rami and both ischia. The sacrum was fractured and partially shattered. The multiple projectile injuries were consistent with wounds resulting from shrapnel or canister shot.

Based on the engraved portion of the ring found with the remains, the age of the individual, and the nature and location of his fatal injuries, Burial 2S was identified as Private J. S. L. Cotton, Company E, 4th Texas Regiment.

Burial 2B

James Manus was a blacksmith in Company I of the 4th Texas Regiment and at 37 years of age next to the oldest of those killed on the battlefield at Glorieta (Fig. 14). (The bugler G. N. Taylor, of the 7th Texas Regiment, Company H, who was 42 years old, was the oldest.)

Burial 2B was a white male, about six feet one inch tall, and between the ages of 36 and 39. He displayed ankylosis of lower thoracic vertebrae and ossification of ligaments along the lateral borders of the vertebral bodies in the area of the costal pits. One higher thoracic vertebra also showed wedging and a possible compression fracture. Osteoarthritis was present at the right temporomandibular joint, which also displayed erosion of the joint surface. A Minié ball was found near the right arm, but there was no osteological evidence of a projectile wound. There was, however, damage to the right mandible consistent with blunt-force trauma. The ascending ramus was fractured just below the condyle. The fracture extended diagonally through the ascending ramus. A blow to the jaw had produced fractures superior and inferior to impact but no damage to underlying bony structures such as would have resulted from penetration by a projectile.

Age, body build, the presence of osteoarthritis, and ankylosis of lower thoracic vertebrae were consistent with the little that is known about James Manus. Thus identification of Burial 2B as James Manus is highly probable.

Burial 2N

Private William Straughn, age 17, of Company D, 4th Texas Regiment, died of a gunshot wound to the head. He and Abe Hanna were the two youngest men killed at Glorieta.

The skeleton represented by Burial 2N was in very poor condition, with the cranium badly damaged. The skull was too fragmented to permit cranial measurements or to determine whether the damage was perimortem or postmortem. The midshaft of the left ulna displayed fracturing that was probably perimortem and the result of a gunshot wound. The assessment of stature was based on a partial tibia, because neither femur was sufficiently intact, and the resulting estimate of height, five feet four inches, was only a rough approximation. None of Burial 2N's third molars had erupted, long bone epiphyses were open, sacral units were ununited, and the elements of the body of the sternum were ununited. All of these characteristics suggested an age of 15 to 18; thus, Burial 2N was one of the youngest men killed at Glorieta. Based on age, he was almost certainly Private William Straughn. Although the cranial damage and postmortem deterioration were too great to determine whether perimortem trauma had been sustained, it is known that Straughn died of a head wound, and the fragmentary cranium was consistent with this fact.

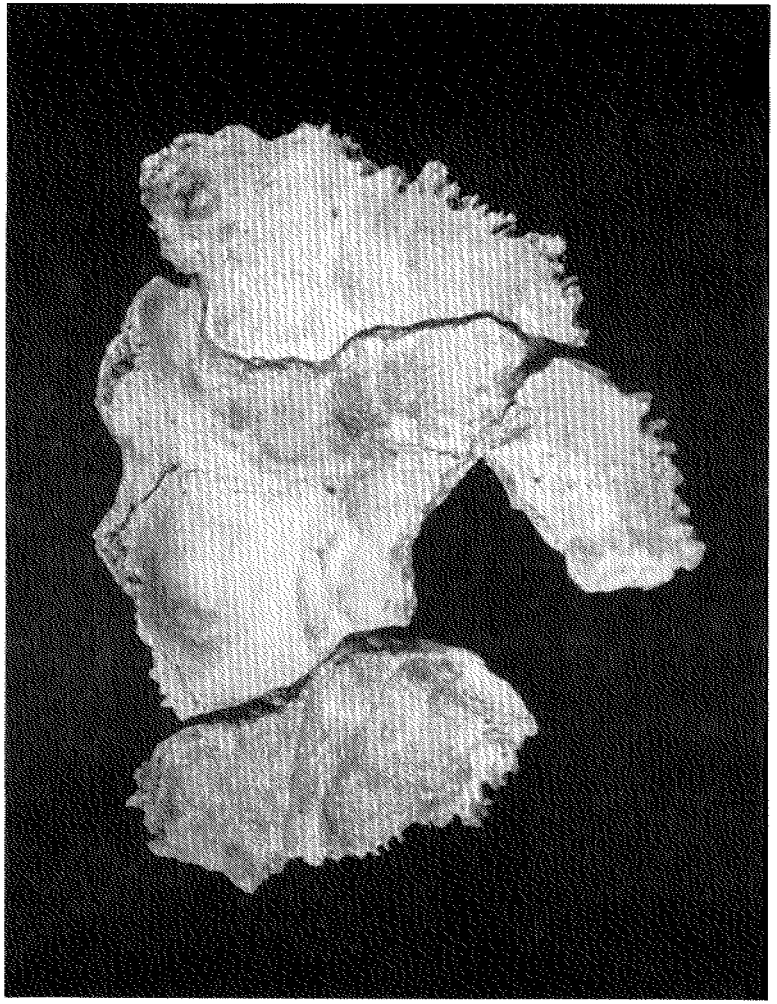

Figure 10. Gunshot exit wound on the occipital of Burial 1A showing multiple radiating fractures (internal view). Fracture pattern suggests that the point of projectile impact was on the front of the skull.

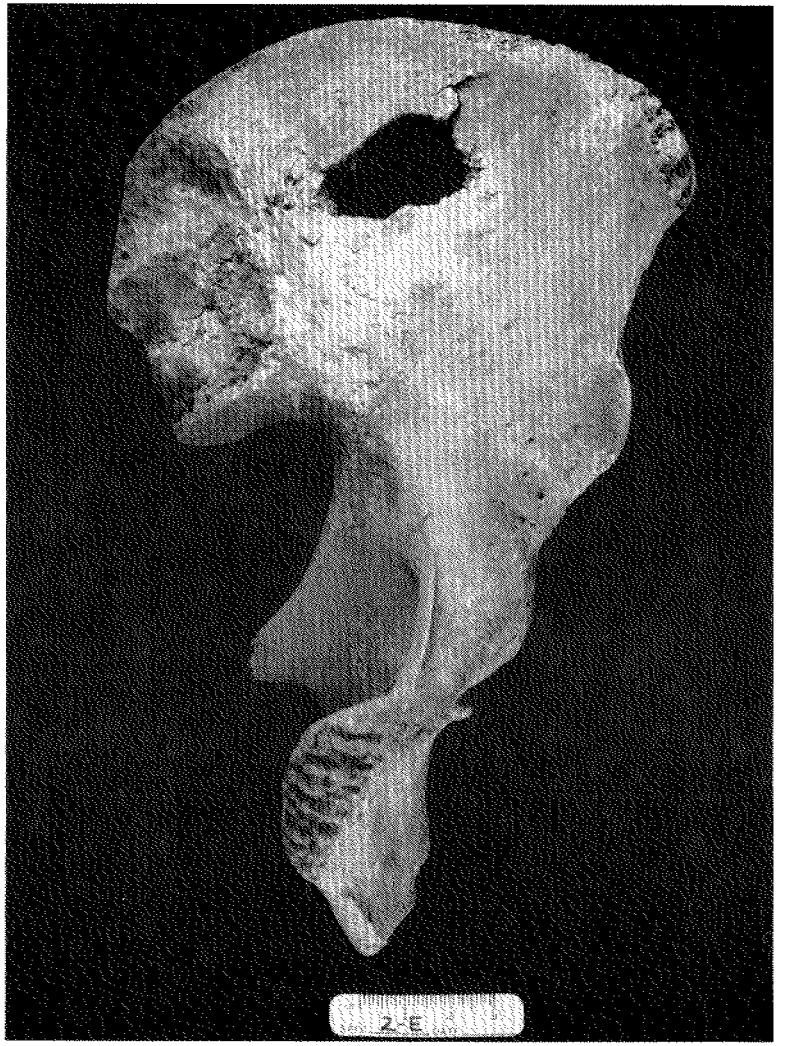

Figure 11. Left ilium of Burial 2E showing oval hole with radiating fractures indicating the entry of a projectile through the internal (visceral) aspect.

Figure 12. Left ilium of Burial 2E showing the projectile exit wound on the external aspect.

Figure 13. The shattered pelvis of Private J. S. L. Cotton (Burial 2S), with multiple penetrating wounds probably caused by canister shot (arrows mark defined projectile injuries).

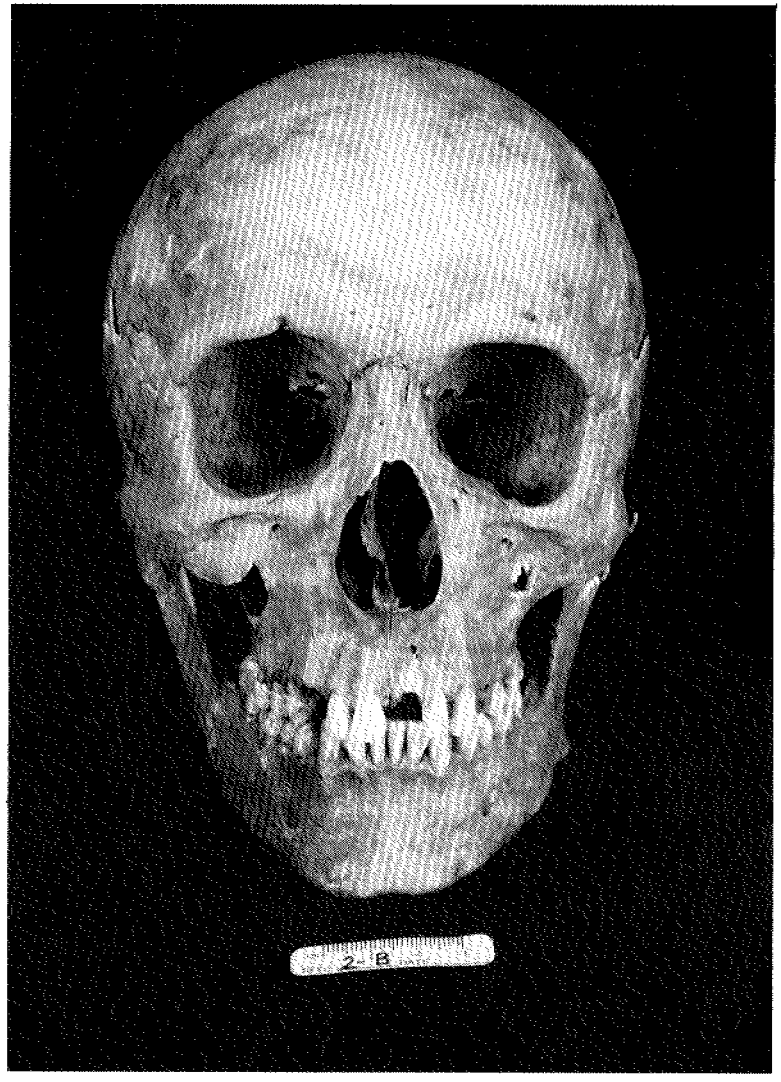

Figure 14. Skull of Burial 2B, probably James Manus, the blacksmith of Company I, 4th Texas Regiment.

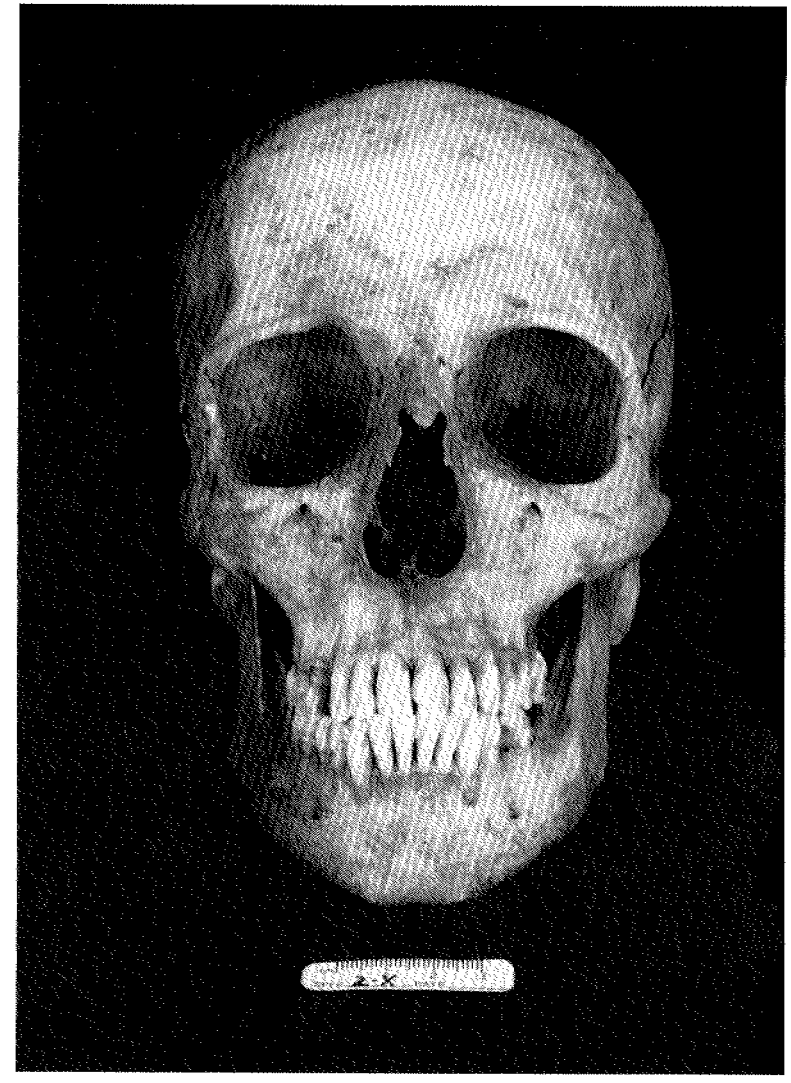

Figure 15. Skull of Burial 2X, probably G. N. Taylor, bugler, Company H, 7th Texas Regiment.

Burial 2X

G. N. Taylor was a bugler in Company H of the 7th Texas Regiment. At 42, he was the oldest of the men killed at Glorieta and buried on the battlefield (Fig. 15).

The estimated age of Burial 2X in the Glorieta skeletal series was between 35 and 45 years. He was a white male, with an estimated height of five feet six inches. Because most of his spinal column was missing, it could not be determined whether arthritic changes were present on the thoracic and lumbar vertebrae, but they were present on the left scapula. The dental pathology associated with Burial 2X was his most distinguishing characteristic. Four of his teeth had abscessed out antemortem; 15 teeth displayed carious lesions; and his teeth were darkly stained, probably from tobacco. That he had received professional dental care was apparent, for he had a total of nine gold fillings distributed among seven teeth. For that era, so many fillings are unusual. If Burial 2X was G. N. Taylor, as the data on age suggest, retention of his teeth may have been critical to his effectiveness as a bugler. No archival reference to the manner in which Taylor died has been found, and there was no osteological evidence of perimortem trauma; however, a Minié ball was found in the pelvic area.

Other Burials

Information on the manner of death of other individuals killed at Glorieta might have been helpful in identifying them. However, the nature of the wounds received by only four of the other men have been indicated in archival sources: Jacob Henson was shot in the shoulder while kneeling beside the fallen Abe Hanna, Enos R. Slaughter died of a gunshot wound to the head, Burton R. Stone died of a gunshot wound to the abdomen, and Edward T. Burrowes died of a gunshot wound to the heart. The death of James R. Stevens is mentioned but not the nature of his wound. In the Glorieta skeletal series, in addition to the six who were have been positively or tentatively identified, there were eight individuals displaying head wounds (Burials 2G, 2J, 2Y [Figs. 16 and 17]; 2Z, 2AA, 2BB, 2CC [Figs. 18 and 19], and 2EE); three displaying fractures of ribs (Burials 2C, 2K, and 2M); two with trauma to the pelvis (Burials 2O and 2R), in one case (Burial 2R) involving the proximal femur as well (Fig. 20); and one who had a possibly perimortem fracture of the radius and a bullet found in association with the back of his skull (Burial 2T). Five (Burials 2A, 2D, 2O, 2P, and 2V) showed no osteological evidence of gunshot wounds, but the number or location of projectiles associated with these skeletons suggested perimortem trauma. For example, in Burial 2P, one .36 caliber bullet from a Colt pistol was found near the skull, one .58 caliber bullet was found in the thoracic area, and seven .36 caliber Colt pistol bullets were among and around the bones.

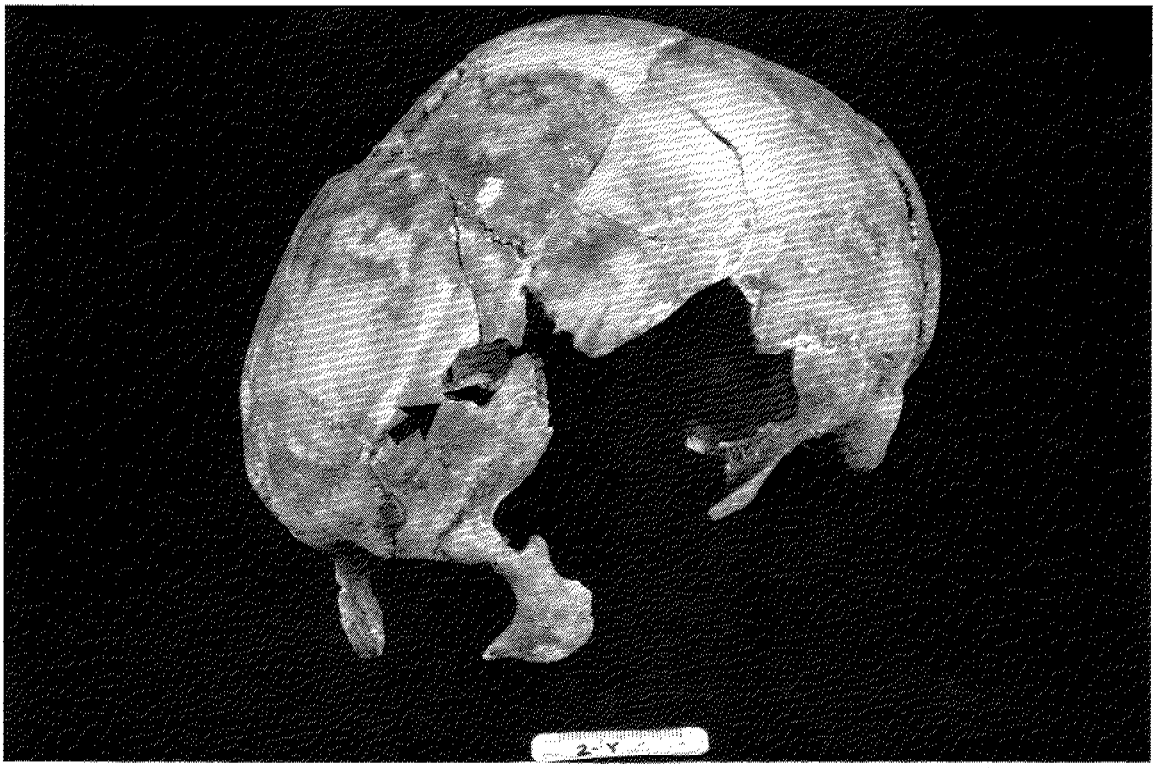

Figure 16. Entry wound (arrow) on the left frontal of Burial 2Y.

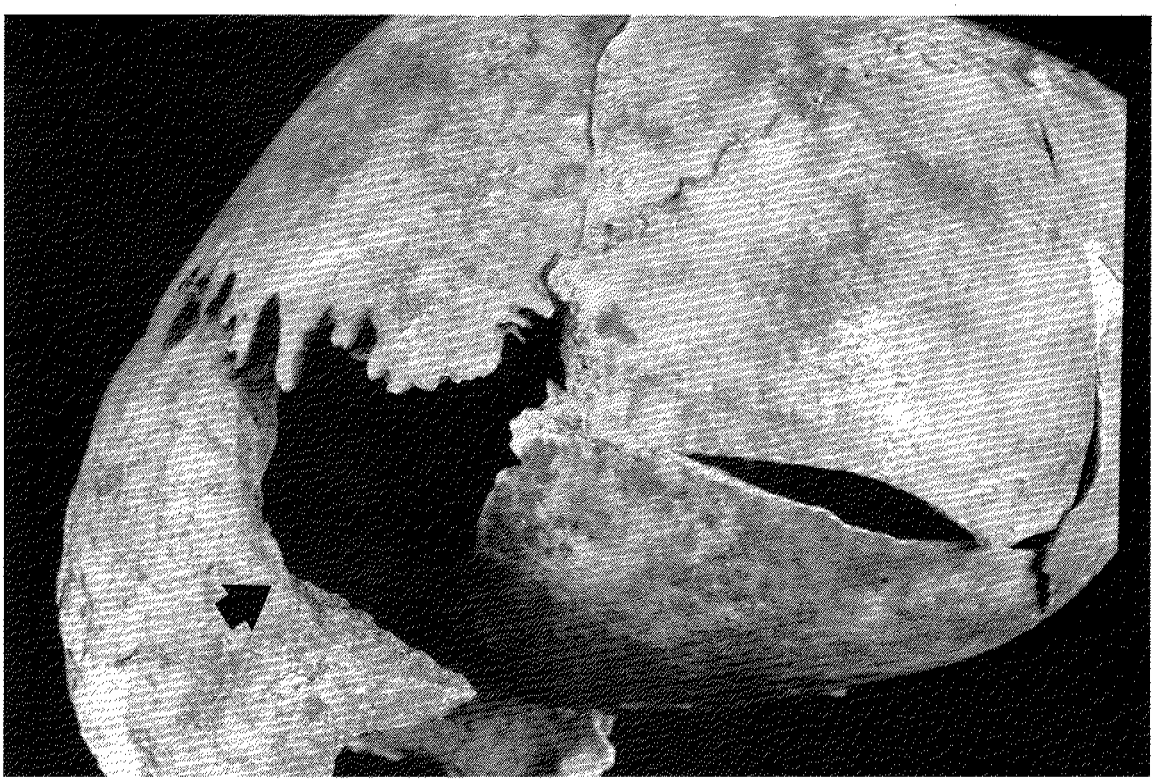

Figure 17. Exit wound (arrow) on the right parietal and occipital of Burial 2Y.

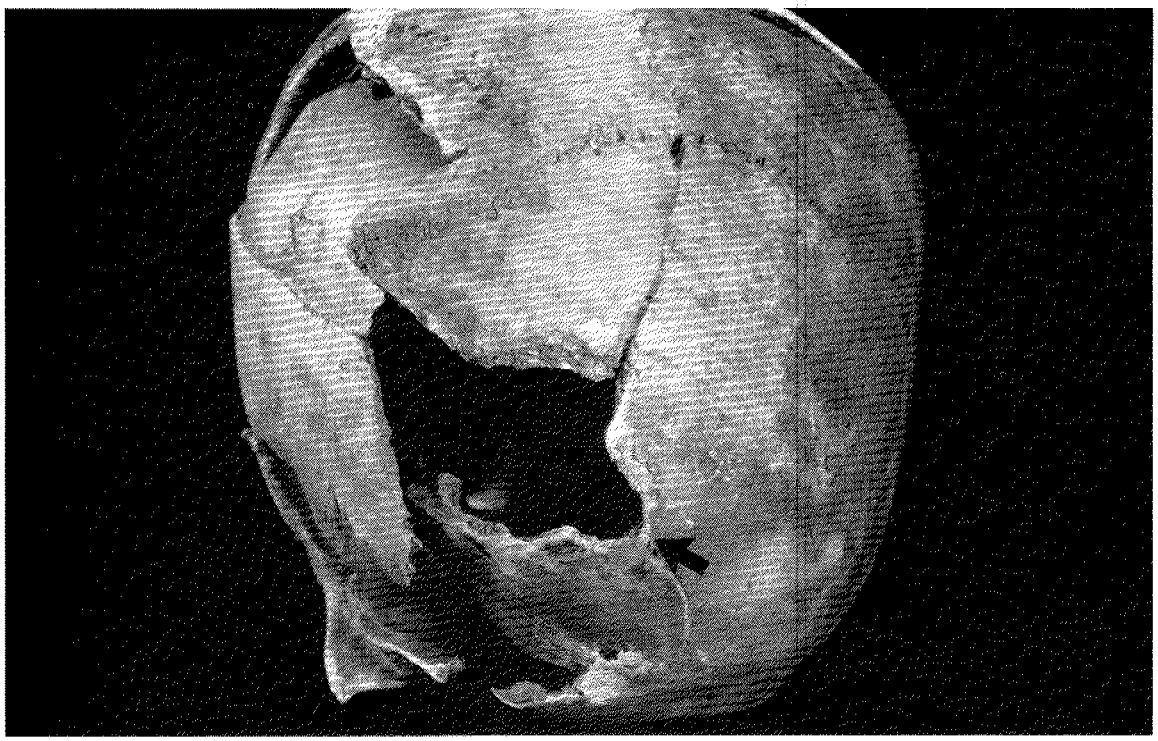

Figure 18. Skull of burial 2CC, with a gunshot entry wound (arrow) on the right frontal.

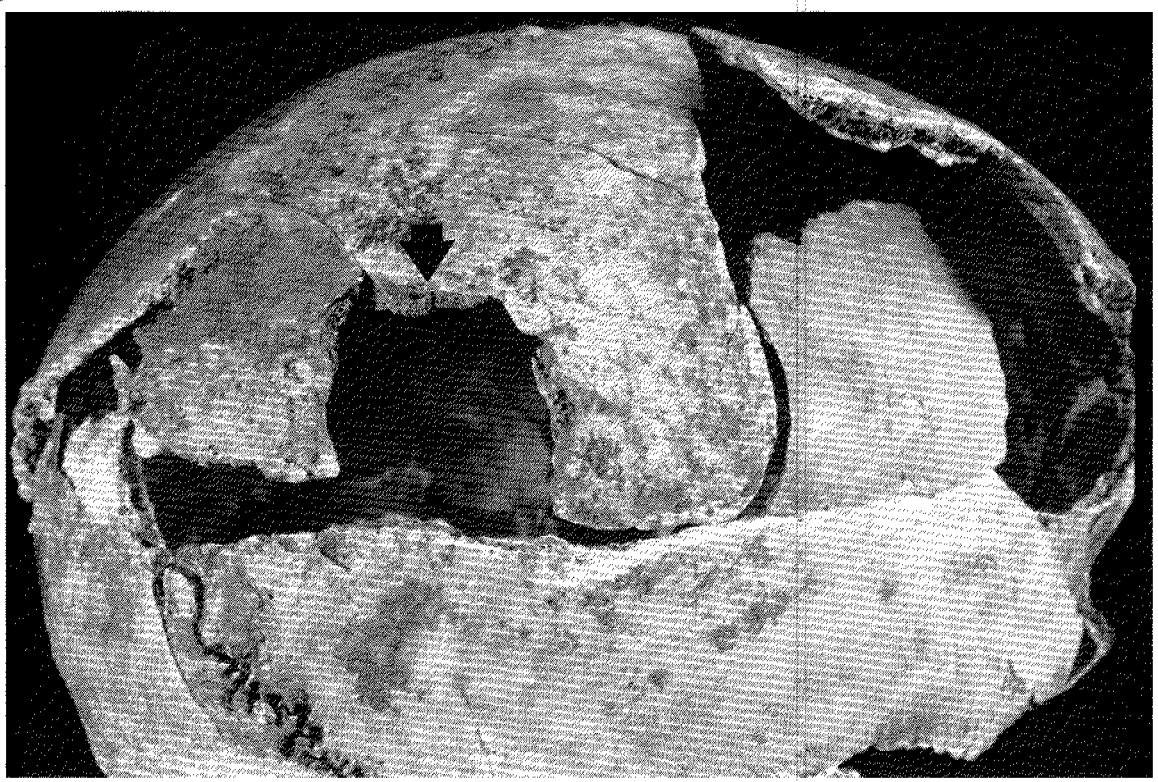

Figure 19. Exit wound (arrow) on the right parietal of Burial 2CC.

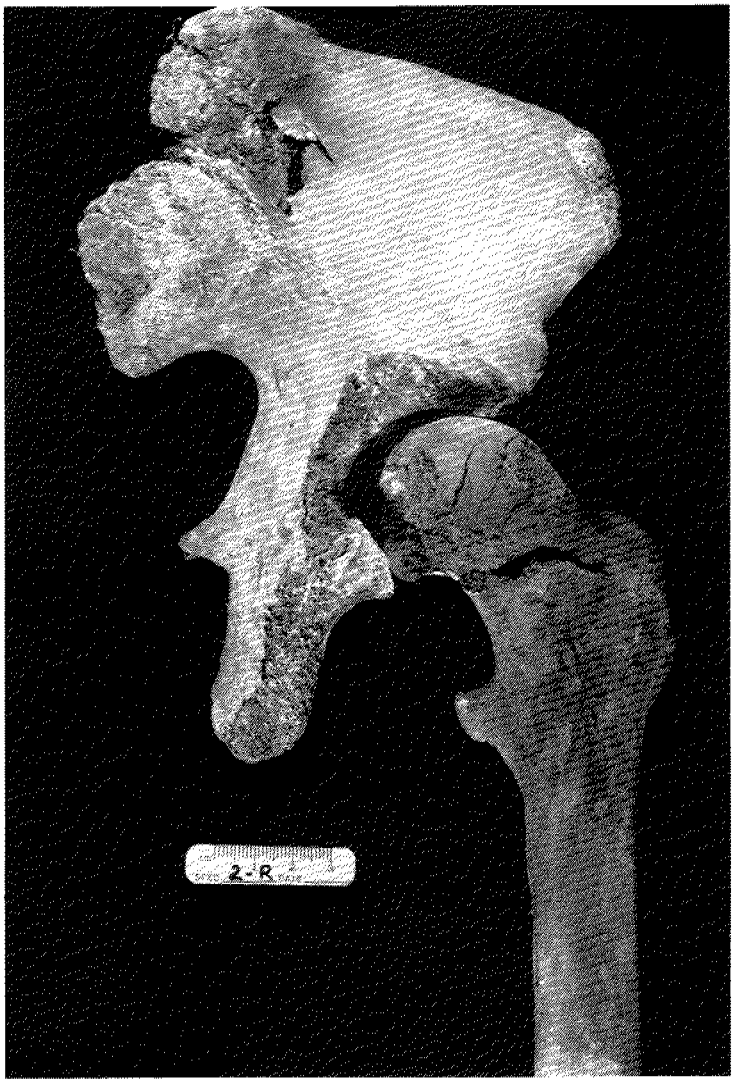

Figure 20. Gunshot wound to the pelvis of Burial 2R, also showing fracturing of the head and neck of the left femur. The projectile struck the inferior portion of the femoral head and continued through the acetabulum into the lower abdomen.

Private Enos R. Slaughter

Private Enos R. Slaughter, killed by a gunshot to the head, was 26 years old. Among the burials displaying head wounds, there were three whose age would be consistent with Slaughter's: Burial 2G, 24-27 years of age; Burial 2Z, 26-32; and Burial 2AA, whose estimated age range, 22-25, though slightly below Slaughter's, was close enough to merit consideration.

Burial 2G displayed a "keyhole" entry wound on the left frontal (Fig. 21). The anterior-posterior length was 30 mm; the maximum lateral dimension was 15 mm. On the anterior half of the defect, the inner table showed beveling; the border of the posterior half showed irregular breakage along both the inner and outer tables. The characteristics of the wound suggested a slightly oblique entry of a projectile from above, about 20 to 30 degrees to the right of the mid-sagittal plane. Radiating fractures extended

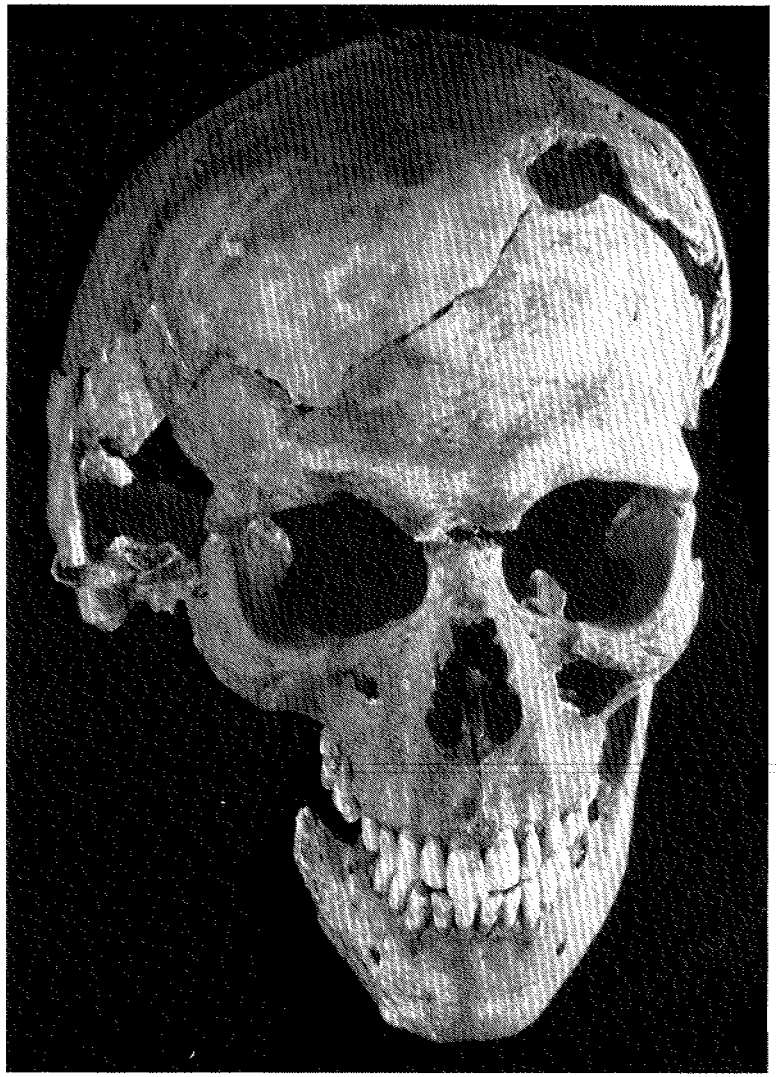

Figure 21. Keyhole entry wound of a projectile on left frontal of Burial 2G.

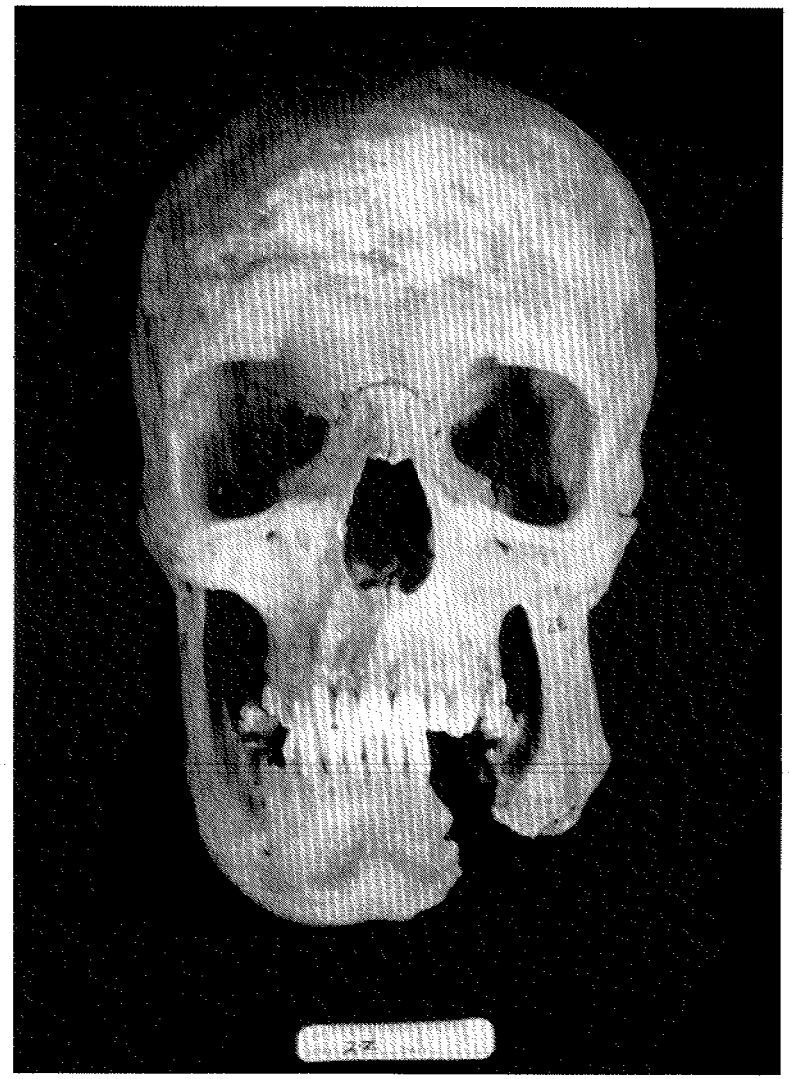

Figure 22. The cranium and fractured mandible of Burial 2Z.

from the entry wound in three directions. No exit wound was visible, but the occipital, where it could well have been, was absent.

Burial 2Z had sustained a perimortem injury to the left mandible (Fig. 22). The ramus had been fractured. Part of the bone was missing, but radiating fractures were present on both the interior and posterior portions and on both the internal and external aspects. A "best estimate" of the age of 2Z was late 20s or very early 30s. Probably, 2Z was older than Slaughter.

The cranium of Burial 2AA included the frontal, left and right parietals, and occipital; the left and right temporals were missing. Radiating fractures were present on the left and right parietals and occipital. The basioccipital was sheared off at the approximate location of the basilar suture, with a radiating fracture extending from the sheared edge almost to the anterior border of the foramen magnum. The basioccipital was also broken off posterior to the occipital condyle on each side. In addition, the left mandible displayed jagged fractures. The fracture pattern on the mandible suggested that the force came from the left side and from about the level of the temporal, delivering a crushing blow to the skull. A .58 caliber bullet was recovered from this Burial, but it was in the area of the feet. Burial 2AA could well have been as much as 26 years of age, as the long bone epiphyses were fused, though the epiphyseal lines were still visible on the proximal tibiae, and the sagittal and coronal sutures were beginning to fuse endocranially. All teeth were fully erupted, and alveolar resorption was evident. Therefore, Enos Slaughter can be tentatively identified as Burial 2G or Burial 2AA.

Private Jacob Henson

Private Jacob Henson was 20 years old. While kneeling beside and bending over Hanna to give him water and pull stones from under him, Henson was hit in the upper thoracic or shoulder area ("the ball going in at the shoulder and ranging towards the heart" [Alberts 1984:86]). None of the skeletal series showed evidence of a shoulder wound. Of the three burials with possible perimortem trauma to the ribs (thoracic area), Burial 2C's estimated age range was 27-33. Burials 2K and 2M, with an estimated age of 17-19, might be possible candidates for identification as Jake Henson. The assessment of possible perimortem trauma to the right tenth rib (well below the shoulder) in Burial 2M was uncertain. The fracture occurred at about midshaft, and a 30-mm-long section of the cortex of the outer surface had been stripped away. The skeleton had sustained substantial postmortem damage, which complicated assessment of perimortem trauma. Burial 2K displayed midshaft fractures of the left sixth and seventh ribs that were probably perimortem. Twisting and warping had occurred postmortem. Projectiles were also associated with 2K, though not in the thoracic area. There was no persuasive evidence that either Burial 2K or Burial 2M was Henson.

Four other burials whose age suggested possible identification as Henson did not display wounds that corresponded to the description of his death. Burial 2Q was 18 to 21 years of age, but he had sustained perimortem damage to the right innominate. A bullet had entered through the medial aspect, traveling through the pelvic cavity and exiting in the area of the greater sciatic notch. Three radiating fractures were present: (1) a complete fracture through the ilium from the greater sciatic notch upward and ventrally toward the anterior superior iliac spine; (2) a 34-mm fracture extending downward along the medial aspect of the ischium toward the ischial tuberosity; and (3) a fracture extending 27 mm from the rim obliquely across the acetabulum (Fig. 23).

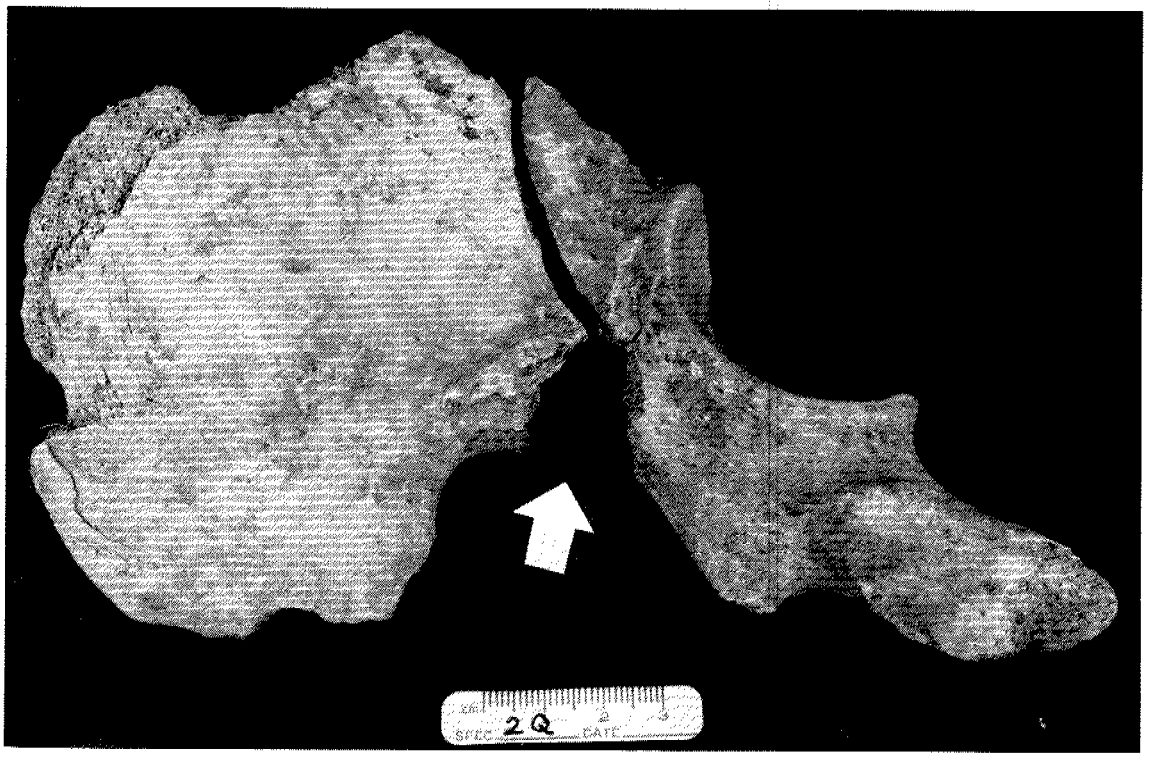

Figure 23. Gunshot exit wound (arrow) through the right innominate of Burial 2Q. One radiating fracture caused complete separation of the ilium.

The three other burials showing perimortem trauma whose estimated age corresponded approximately to that of Henson--Burials 2J (18-22 years), 2Y (17-20 years), and 2CC (17-21 years)--had received head wounds, which eliminated them from consideration.

It is possible that Henson received a wound to the heart that did not involve any

osteological damage. Burial 2D, who was 19-20 years old, showed no osteological evidence of perimortem injury, but two projectiles were found with the skeleton. One canister shot was located to the right of the vertebral column, and one .31 caliber bullet was in the area of the left ankle. The location of the bullet was not consistent with Henson's injury, and descriptions of the charge on the Union line suggest small-arms fire from short range rather than from small artillery. The ages of Burial 2A (20-24 years) and 2V (18-21 years) were also consistent with Henson's. Neither of them displayed osteological evidence of perimortem injury; a Minié ball was associated with the pelvis of Burial 2A and with the lumbar region of Burial 2V.

The data are not sufficient to provide a convincing, or even a highly tentative, identification of Jacob Henson with any of the Glorieta skeletal series.

Private Burton R. Stone

Private Burton R. Stone was shot in the abdomen. The osteological data derived from the skeletal series do not provide any clear evidence of this trauma. Burial 2R, judged to be in his upper twenties (estimated age range 25-29), or possibly as old as 30 or 31, suffered extensive damage from a gunshot wound that entered his left hip and perhaps could have caused abdominal injury. The point of entry is so low, at the femoral head, it is doubtful that anyone would have described the wound as a gunshot to the abdomen; however, 14 projectiles were associated with this burial, 10 of which were in the thoracic cavity. Quite possibly an observer would have described someone hit by such a barrage as wounded in the abdomen. A principal obstacle to a tentative identification of Burial 2R as Stone is age. Stone was only 22 years old, thus considerably younger than the estimated age of Burial 2R. Based on age, Stone might be identified with Burials 2A or 2I (20-24), or 2V (18-21), none of which showed osteological evidence of perimortem trauma. As with Henson, the data are not sufficient to suggest even a highly tentative identification.

Private James R. Stevens and Joseph G. H. Able

The third oldest man killed at Glorieta and buried on the battlefield was 30-year-old Private James R. Stevens, Company D, 4th Texas Regiment. Archival records report his death but not its manner. Based on age, two burials with whom he might be identified are 2C (estimated age between 27 and 33) and 2DD (estimated age between 25 and 32). Burial 2C displayed osteophytic lipping on the lumbar vertebrae, a cupping of rib ends that is typical of early middle age, and moderate wear on his anterior teeth. He had suffered perimortem damage to the left ninth and tenth ribs, and possibly to the seventh as well. Burial 2DD also displayed slight vertebral osteophytosis, as well as osteoarthritis on the right tibia and a pleated appearance of the ventral surface of the body of the scapula, which is a sign of early middle age. His incisors showed dentin exposure, but

there was little wear on the other teeth. The face of Burial 2DD was small, and the superior margins of the orbits were sharp--a female trait--but the postcranial bones were heavy and large, and the muscle attachment sites were well marked. Estimation of age was difficult. Although many features of the skeleton were consistent with designation as a young adult, others--the osteopathology and pronounced muscle-attachment sites--suggested more advanced age. No evidence of perimortem trauma was present, nor were projectiles associated with the burial.

It is possible that Burial 2C was Private Stevens and that Burial 2DD was Joseph G. H. Able of Company E, 4th Texas Regiment. Able's age was only 24, but he was a farrier--one who shod horses--and he did much of the same kind of heavy work as James Manus, the blacksmith. His bones could well reflect his occupation and suggest an older age than his facial and cranial features indicated. Both these identifications are obviously extremely tentative, yet not unlikely.

Private Edward T. Burrowes

Private Edward T. Burrowes served in the artillery of the 5th Texas Regiment. He was 19 when he was killed at Glorieta by a gunshot wound to the heart. Burial 2M was 17-19 years old, and as mentioned in the discussion of those who might be identified with Jacob Henson, there was some uncertain evidence of perimortem trauma to a rib. Burial 2K, also 17-19 years old, had sustained likely perimortem trauma to two left ribs, and one of the projectiles found with him, a Minié ball, was in the lower abdomen. Burial 2O, 17-19 years of age, displayed no osteological evidence of trauma, but canister shot were found in the thoracic cavity. Internal injury sustained during an exchange of small artillery fire is a possibility. Burial 2D, who was 19 to 20 years old, showed no osteological trace of gunshot wounds causing death; however, canister shot was present along the right side of the vertebral column. As in the case of Burial 2O, he could have been wounded in the chest in an exchange of artillery fire without osteological evidence of injury. Because the condition of the skeleton was poor and there was some commingling with the bones of another individual, it was not possible to reach any definite conclusion. Burial 2P, 18-23 years of age, displayed no osteological evidence of perimortem trauma, but nine projectiles were present, one of which was near the skull, and another in the thoracic area. Solely on the basis of age, Artilleryman Burrowes can be tentatively identified as Burial 2K, 2M, 2O, or 2P.

Further Identifications

The data are insufficient to justify further speculation on identity. Should additional documentation of manner of death be found, it is quite likely that several more of the soldiers who died at Glorieta could be identified, particularly those who sustained head wounds.

CONCLUSION

The principal objectives of the study of the Glorieta skeletal series were to record demographic data, data on antemortem osteological and dental pathology, and evidence of perimortem trauma and possible cause of death. Through comparison of this information with the archival material and artifacts assembled by the archaeologists of the Museum of New Mexico, it was hoped that some of the individuals could be identified. Three positive identifications were achieved, and three more that were highly probable. Four very tentative, speculative associations of Glorieta burials with men known to have died in the battle were also suggested. For two of the men for whom there was limited information about the circumstances of their deaths, no convincing association with the burials based on osteological analysis was possible. Should additional records and archival descriptive material become available, some of the suggested identifications might become less tentative, and some of the other 19 burials might be identified.

A skeletal series from a battlefield is somewhat rare in bioarchaeological research and presents an opportunity to study the effects of field conditions and physical stress in a special subset of the general population in which physical characteristics are relatively consistent and controlled as result of induction criteria. The Glorieta Pass skeletal series represents a valuable contribution to osteological and forensic data bases. Future comparative studies with other military and historic samples can augment understanding of health, disease, trauma and their treatment, demography, socioeconomic conditions and lifestyle, and past history. As an example of the sorts of comparisons that are possible, findings from the analysis of the Glorieta series were considered in relation to those from a sample of men who fought in the siege of Fort Erie in the War of 1812, nearly half a century before the Civil War. A possible follow-on might be comparison of the Glorieta findings with those from two other Civil War samples from the siege of Port Hudson and Antietam.

In addition to augmenting physical anthropological data bases and thereby contributing to ongoing and future research, the information resulting from this study provided a better understanding of the physical demands and deprivations of the New Mexico Campaign and its physiological effects on those who took part in it. In so doing, it helped to illuminate an episode in U.S. history that has been generally ignored. It also draws attention to the human cost, and often negligible results, that too often characterize military endeavors.

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