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NINETEENTH-CENTURY ARROW WOUNDS AND PERCEPTIONS OF PREHISTORIC WARFARE

George R. Milner

In recent years, prehistoric warfare has increasingly attracted the attention of archaeologists in North America, much like other parts of the world. Skeletons with several forms of trauma, including arrow wounds, are often used as evidence of intergroup conflict, although opinion is divided over what these casualties might mean in terms of the effect of warfare on everyday life. Information on 191 patients from the nineteenth-century Indian Wars in the American West indicates that only about one in three arrows damaged bone, and as many as one-half of wounded lived for months or years following their injuries. Arrow wound distributions vary among Indian Wars cases, modern Papua New Guinea patients, and prehistoric skeletons from eastern North America, in large part because of differences in how fighting was conducted. Despite arguments to the contrary, it is reasonable to infer that even low percentages of archaeological skeletons with distinctive conflict-related bone damage indicate that warfare must have had a perceptible impact on ways of life.

En años recientes, el interés de los arqueólogos en Norte América por la guerra prehistórica se ha incrementado gradualmente, al igual que lo ha hecho en otras partes del mundo. Con frecuencia se utilizan esqueletos con diversas formas de trauma, incluyendo heridas de flecha, como evidencia de conflicto intergrupal, aunque se expresan distintas opiniones con respecto a lo que tales víctimas pueden representar en términos del efecto de la guerra en la vida diaria. Información procedente de 191 pacientes de las Guerras Indias del siglo XIX en el Oeste Americano, indica que sólo una de tres flechas llegaba a dañar el hueso y que cerca de la mitad de los heridos sobrevivía a sus lesiones. Las distribuciones de heridas de flecha varían entre los casos de las Guerras Indias, los pacientes de la moderna Papua Nueva Guinea y los esqueletos prehistóricos del este de Norte América, debido en gran parte a la manera en que los enfrentamientos eran conducidos. A pesar de los argumentos que apoyan lo contrario, resulta razonable inferir que incluso bajos porcentajes de esqueletos arqueológicos que presentan daño óseo relacionado a conflicto, indican que la guerra debe haber tenido un impacto sensible en sus modos de vida.

Warfare in prehistoric North America has attracted considerable attention over the past 15 years or so, much like it has elsewhere in the Americas (Haas 1999; Haas and Creamer 1993, 1997; Keeley 1996, 1997, 2001; LeBlanc 1999; Lambert 1997, 2002; Milner 1999; Milner et al. 1991; Rice and LeBlanc 2001; Webster 1993, 2000). This keen interest contrasts strongly with the situation in the preceding several decades when conflicts prior to the unrest that accompanied European expansion into what are now the United States and Canada were rarely acknowledged, let alone systematically studied. Thus, not very long ago it could be said that "[t]here is no very good proof that precontact societies engaged in warfare that was either common or particularly fierce, and the weight of evidence suggests that they were for the most part pacific" (Sale 1990:318). Such statements can no longer be made. It is now widely recognized that conflicts took place among small-scale societies of the distant past, and that there was considerable temporal and spatial variation in the likelihood that fighting would break out. Yet there is still no consensus over what archaeological findings mean in terms of the intensity of conflicts and their effect on local communities. The number of skeletons with conflict-related trauma—an important part of Sale's (1990:318) "weight of evidence"—serves as a fine example of the divergence in how archaeological facts are interpreted.

It has been said recently that when signs of conflict-related injuries, including projectile wounds and mutilations such as scalping, are present in no more than a few percent of skeletons from a cemetery, then fighting among groups rarely broke out (Smith 2003). As Keeley (2001) notes, this view is

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not at all uncommon among archaeologists. If low-mortality warfare occurred only sporadically, one might conclude that conflicts were generally inconsequential and had little, if any, effect on life in the vast majority of local communities. This position is based largely on negative evidence: little or no skeletal evidence means correspondingly negligible conflict. Perhaps that is why prehistoric warfare, particularly its social, economic, and demographic aspects, has not received the attention that some scholars feel it deserves (e.g., Haas 1999; Keeley 1996, 1997, 2001; LeBlanc 1999; Milner 1999; Webster 1993, 2000).

Considering the nature of the archaeological record, the opposite position could also be argued. Even a small proportion of skeletons showing signs of trauma such as projectile wounds, fractures attributable to stone axes, and mutilations involving the removal of body parts are a sure sign that fighting was pervasive and quite conceivably had a noticeable impact on participating communities. Any tendency to underestimate the significance of available evidence would be aggravated by an inclination to hold overly romantic views of life in prehistory, as has been argued by Keeley (1996, 1997, 2001). The critical point is that if a handful of skeletons showing distinctive injuries indicate conflicts were common, then it follows that this aspect of human behavior should be an integral part of studies of ancient ways of life, much more so than is currently done.

A better understanding of how closely skeletons with evidence of wounds mirror the number of people who were actually wounded and killed is essential for evaluating these opposing points of view. There can be no doubt that various weapons produced distinctive marks on archaeological skeletons (e.g., Ingelmark 1939; Lambert 2002; Larsen 1997; Milner et al. 1991; Novak 2000; White 1992). Penetrating spear and arrow injuries, slicing and chopping wounds from sharp metal weapons, fractures from blunt objects such as clubs, and shallow incisions from mutilations including scalping are among the signs of trauma noted in skeletal samples from around the world. The mere identification of injuries, however, does not tell us much about what was happening in past communities unless we also have some idea about the chances that bone might be damaged when an individual was struck and the proportion of victims that might survive. The first issue is related to the recognition of injuries when all we have are skeletons; that is, the sensitivity of what is measured. The second has to do with whether the wounded would immediately enter the mortality sample, some fraction of whom would show skeletal evidence of unhealed injuries.

To begin investigating such issues it is useful to focus on specific kinds of trauma. Arrow wounds, in particular, are amenable to such work. The injuries are distinctive, particularly when stone, antler, or metal points remain embedded in bones. Perimortem fractures, in contrast, can be difficult to distinguish from breaks that took place long after burial. Furthermore, considerable information on arrow wounds can be drawn from records of nineteenth-century casualties during the Indian Wars in the American West. These historical data are not without their faults, but they serve to put interpretations of archaeological skeletons on firmer footing.

Indian Wars Sample

Information on Indian Wars arrow wounds came from several sources, most notably Otis's (1871) lengthy compilation of cases (also Bill 1862; Coues 1866; Jackson 1943; Parker 1883; Pope 1864; Wilson 1901). For the most part, the injuries were described by army surgeons, so it is no surprise that soldiers dominate the sample. Just as explicably, the patients were usually of low rank. Civilians and Indian scouts, however, also came under their care. Most cases dated to the 1860s and 1870s, and they usually originated in the Plains and Southwest. The arrows typically had iron heads, although some were tipped with chipped stone and even sharpened wood.

The Indian Wars sample consists of 248 injuries and 191 victims, although information is not complete for all people. Arrow wounds with recorded locations on the body represent the great majority of the injuries these people experienced. Patient names, ranks, army units and posts, dates of injury, and attending surgeons were compared to prevent duplication of cases since individual patients were sometimes listed in more than one published source.

While more cases are always desirable to identify general trends, what is more worrisome is the

possibility that the sample is biased in some manner. Not all injuries would likely come to an Army surgeon's notice, and not all of them would be regarded as worth reporting. From the distance of over a century, it is impossible to evaluate the representativeness of the sample as a whole. Yet it is reassuring that the cases include individuals who died when attacked, long before a surgeon saw the bodies, and others who received only superficial "flesh wounds" that needed little, if any, medical attention. So whatever its deficiencies, the sample includes injuries ranging from those that were immediately lethal to ones that were little more than scratches. Moreover, many cases came from a surgeon's report that covered all patients who came under his care (Bill 1862), and Otis's (1871) lengthy coverage described a wide variety of wounds, especially the common ones.

Indian Wars Injuries

Roughly three-quarters (70 percent) of the 191 people in the Indian Wars sample survived their wounds. Of 128 individuals for whom information on the number of wounds is available, 81 percent were hit by one arrow; 12 percent and 7 percent of them were struck by either two to four or at least five arrows, respectively. The time of death was reported for 35 people; one-half (49 percent) of them died when injured or soon thereafter, and the remainder (51 percent) survived for as little as six hours to just over seven weeks.

Arrows struck many parts of the body, although there was an uneven distribution of wounds (Table 1). Here the body is divided into the head and neck, the free portions of the upper and lower limbs, the thorax, and the abdomen and buttocks. All but four of the Indian Wars injuries with some location information could be assigned to one of the anatomical units. The four exceptions were either in the thoracic or abdominal regions, so the injuries were divided equally between those two parts of the body.

The classification of wound location conforms to that of VanGurp and colleagues (1990) who summarized records for 90 arrow-wound patients admitted to two hospitals in Papua New Guinea in 1987.[1] The New Guinea and Indian Wars samples differ because the former do not include deaths that took place immediately or minor wounds that did not require hospital attention. Nevertheless, the modern information highlights the variation in wounds that might occur in different cultural settings.

Table 1. Locations of Arrow Injuries in the 19th Century Indian Wars and Modern Papua New Guinea Samples.

	Indian Wars		Papua New Guinea	
Location	N	%	N	%
Head & Neck	29	11.7	16	14.5
Thorax	82	33.1	40	36.4
Abdomen	46	18.5	10	9.1
Upper Limb	66	26.6	7	6.4
Lower Limb	25	10.1	37	33.6

The most remarkable discrepancy between the Indian Wars and Papua New Guinea samples is the relative proportions of injured upper and lower limbs. The Papua New Guinea wound distribution appears to be fairly representative of those receiving attention in hospitals, to judge from an earlier study of arrow wounds where the legs were also several more times as likely to be injured than arms (Sharp 1981).[2] It is difficult to say why a difference in arm and leg injuries might exist—assuming the samples do not badly misrepresent what actually took place—although it must have to do with the attacks themselves. In New Guinea, arrows were often aimed at the popliteal fossa (behind the knee), along with the eye and chest (VanGurp et al. 1990). At least some groups tended to use expendable arrows to cripple victims who were then dispatched with more valued thrusting spears (Heider 1970, 1997). Large shields often used by New Guinea warriors would also protect the body and upper limbs while leaving the legs exposed (Brown 1978; Fingleton 1987; Lennox and Pust 1979; Sharp 1981). During the Indian Wars, the popliteal fossa was unlikely to have been considered a good target because it was not as exposed when on horseback. The larger vulnerable area afforded by the torso must have been preferred when both victims and assailants were often galloping on horses while fighting or fleeing. One army surgeon explained the upper limb injuries, which he also thought seemed high, by noting that "a person can see an arrow darting towards him, and very naturally putting out his arm to ward it off, receives a wound" (Bill 1862:369). This sort of defensive wound is consistent with what would be expected from arrows aimed at the upper body.

Table 2. Indian Wars Wounds with Information on Whether Bones Were Struck (Total) and Those That Actually Damaged Bone (Bone Damaged).

Location	Total N	Bone Damaged N	Bone Damaged %
Head & Neck	25.0	15	60.0
Thorax	32.5	17	52.3
Abdomen	44.5	1	2.2
Upper Limb	39.0	12	30.8
Lower Limb	21.0	4	19.0

Table 3. Bill's (1862) Arrow Wounds by Anatomical Region (Injuries) and the Adjusted Distribution of Bones Damaged by Arrows (Adjusted).

Location	Injuries %	Adjusted %
Head & Neck	8.2	15.7
Thorax	28.8	47.9
Abdomen	25.3	1.8
Upper Limb	31.8	31.0
Lower Limb	5.9	3.6

Information on whether the Indian Wars arrows hit bones is not as complete as the anatomical locations of wounds. Descriptions are sufficient for 162 (65 percent) of the injuries to determine if arrows had splintered bones or buried themselves in them (Table 2). Three arrows hit either the thorax or abdomen, so like before these wounds were split between these two anatomical regions. The chances that bones would be struck varied throughout the body. Bones were least likely to be hit in the lower limb and, especially, the abdomen, while they were frequently struck in the thorax, head, and neck. In the thorax, arrows were most often embedded in vertebrae (59 percent), but scapulae, sterna, and ribs were also damaged. The ribs, in particular, must be underrepresented in the sample—only two cases are reported—considering the fact that the thorax was commonly struck by arrows. Surgeons quite naturally were more intent on treating and reporting injuries to internal organs than fractures of ribs that were of little consequence. On some occasions, however, it was specifically mentioned that arrows passed through intercostal spaces. Even when that happened, arrows often must have chipped the edges of ribs.

To judge from a simple count of Indian Wars injuries, 30 percent of 162 arrows struck bones. That figure is not the best estimate that can be made because injuries that were interesting from a medical standpoint were no doubt more likely to be reported than ordinary ones with few complications. This problem is handled in Table 3 through the use of the bone-damage estimate from the entire Indian Wars sample (Table 2) and the anatomical distribution of injuries reported by Bill (1862). Bill's findings represent only part of the combined sample, but they are of interest because he reported all cases that came to his attention. Bill's work can be considered as reliable as any primary source on frontier medicine; in fact, his experience and procedures have been cited on a number of occasions as models of medical care and, more recently, as a firsthand account of historical significance (Gross 1866; J. D. Haines 1994; Lundy 1952; Mays et al. 1994; Otis 1871; Parker 1883; Wilson 1901). In Table 3, victims of attacks mentioned by Bill that clearly did not fall under his care were omitted because the intent was to obtain an estimate, however crude, of the range of arrow wounds that a surgeon might be called upon to examine. The first column of percentages gives the wounds Bill reported by anatomical region. The next column shows estimates of the distribution of arrow-damaged bone that take into account the chances that, first, a particular anatomical region would be hit and, second, bone would be struck. So the second column adjusts the total number of damaged bones in Table 2 to take into account the distribution of injuries that might fall under a surgeon's care (Bill's experience) rather than all wounds described for one reason or another (the entire Indian Wars sample, Table 1). Injuries to the skull, for example, were not as common as Table 2 might imply. While the distributions of damaged bones differ, the overall percentage of bones likely to be injured (31 percent) does not.

Most arrowheads did not remain in the bodies of survivors (Bill 1862, 1882). Some arrows glanced off, resulting in only minor wounds, whereas others penetrated deeply with more serious consequences. Some of the latter were cut off arrows that had partly exited the body before the remainder was yanked out in the opposite direction. Others were removed along with shafts when arrows were pulled from wounds. Unfortunately for victims, points often came off when shafts were jerked out.[3]

When arrows lodged tightly, it was noted that

"frantic wrenching at the stick may break off a portion of it inside" (Coues 1866:323). Iron points, in particular, were hard to extract when they bent, a common occurrence.[4] The situation was only that much worse for stone arrowheads. They were liable to break either when the arrow entered the body or shortly thereafter when the shaft was yanked and twisted when removing it. With regard to stone points, it was noted that "[w]hen the head impacts on bone—and it generally transverses soft tissue till halted in this way—the chances of its shivering into bits vastly preponderate over the probability of its becoming fixed or glancing" (Coues 1866:322). Three of six Indian Wars stone arrowheads broke on impact, and two others became detached from their shafts. Treatment was hampered by the fact that one could not pull on stone arrowheads embedded in bone like those fashioned from pieces of iron, at least without the possibility of snapping them.

Despite the surgeons' best efforts, some arrowheads could not be found, even after prolonged and painful probing. This exploration might be repeated if the point was not found the first time around. While the prognosis was not good, the situation was not entirely bleak. Arrowheads were not removed from 9 percent of 134 Indian Wars patients who survived a matter of months to decades following their injuries. Many of these men eventually resumed an active life with no reported disability, often returning to duty in their old units.

Of 45 people whose bones were hit by arrows (49 separate wounds), just over one-half of them (56 percent) lived long enough for a noticeable bony response to have occurred had the points remained in place (the shortest time elapsed between injury and death was almost two months). Because surgeons did their utmost to extract arrowheads, points were left embedded in bone in only 20 percent of the survivors. Overall, points remained embedded in bone long enough for recognizable remodeling to have occurred in 11 percent of the 45 individuals whose skeletons were struck. Other arrowheads were free floating, but undetectable, in soft tissue.

Prehistoric Injuries

Many examples of projectile wounds, mostly embedded stone points, have been reported in the archaeological and osteological literature, as indicated by a survey of skeletons from states bordering the Mississippi River eastward to the Atlantic Ocean, including southern Canada (Milner 1999).[5] To judge from the innumerable chipped stone points found at archaeological sites, virtually all of the projectile injuries from the late prehistoric (ca. A.D. 500 onward) through the early historic periods were caused by arrows, as opposed to spears held by hand or flung with atlatls. Often, enough of these points remained embedded in bone to see they had indeed been parts of arrows. The anatomical distribution of 100 injuries from 93 skeletons from late prehistoric to early historic sites is shown in Table 4.

Table 4. Adjusted Distribution of Bones Damaged by Arrows from Table 3 (Adjusted) Compared with Archaeological Skeletons with Bone Damage from Projectiles, Most Or All of Which Were Arrows (Archaeological Bones).

	Adjusted	Archaeological Bones	
Location	%	N	%
Head & Neck	15.7	16	16.0
Thorax	47.9	40	40.0
Abdomen	1.8	25	25.0
Upper Limb	31.0	9	9.0
Lower Limb	3.6	10	10.0

The archaeological and Indian Wars samples (Table 4) are similar to the extent that some bones, especially those of the thorax, were frequently struck by arrows. There are, however, readily apparent discrepancies between the distributions of injuries. There are at least three reasons for such discrepancies: dissimilar sources of information, reporting bias, and true differences in attacks.

Each source of information—skeletons and patients—has its own set of problems. While osteologists quite naturally focus on what happened to bones in the absence of any soft tissues, not all parts of the skeleton are equally likely to be preserved. Moreover, it is often difficult to identify distinctive arrow damage, particularly if a projectile point only chipped or glanced off a bone. The surgeons, however, cannot be expected to have recorded all such damage because autopsies were only done in a few cases (obviously, they were not performed at all on survivors). They quite naturally would have been more interested in life-threaten-

ing complications, such as injured internal organs or subsequent infections. For example, minor damage to the pelvis caused by arrows skittering across bone after entering the abdomen would have been of little concern when compared with the much more serious laceration of intestines, which typically proved fatal. As far as ribs are concerned, both sources of information probably underestimate damage to bone. When arrows slipped through intercostal spaces, minor nicks on adjacent ribs might be visible on dry bones, but would not have been of any concern to surgeons whose attention was occupied by serious injuries to internal organs. Osteologists, however, must contend with incomplete skeletons, inadequate preservation, and uncertainty over what caused bone damage, so they too will underestimate the number of bones, especially fragile ones like ribs, that were broken, chipped, or scraped by arrows.

Some differences in wound location would be expected simply because the archaeological sample, which is mainly prehistoric, consisted of people on foot. A large number of the Indian Wars victims, mostly cavalrymen, were on horseback when attacked, and they lacked defensive gear such as shields. It has already been seen that upper limbs were much more likely to have been hit in the nineteenth century than the lower limbs, presumably because the torso presented a better target in fast-paced attacks while riding horses across open country. The numbers of limb injuries in the archaeological sample, however, are not weighted toward the lower limb like they are in Papua New Guinea where the popliteal fossa is targeted. In North America, it is likely that many warriors had shields and body armor, much like they did in the historic period (Taylor 2001, 2003). Yet it does not appear that many of the individuals in the archaeological sample were prepared, hence outfitted, for battle. Taken together, the biological characteristics of victims, the locations of injuries, the numbers of skeletons in graves, and the distributions of graves in cemeteries indicate that most people were ambushed while performing daily chores, and they were often cut down when fleeing (Milner 1999; Milner et al. 1991). It is likely that these people, without the benefit of shields, were for the most part surprised by concealed warriors who from close range attacked with arrows and stone axes. Thus, it is reasonable to suppose that the circumstances of the attacks and cultural preferences contributed to the different wound distributions in modern Papua New Guinea and prehistoric eastern North America.

Descriptions for 90 of the archaeological skeletons were sufficient to determine if bones showed evidence of healing, and 12 percent of them were from people who had lived long enough for noticeable signs of bone reaction to appear at the sites of injury. They were not the only people who survived with points in their bodies, if the Indian Wars sample is any guide to what happened during prehistoric times. In the nineteenth century, 11 percent of all people whose skeletons were struck with arrows survived for lengthy periods with points lodged in bones. While the kinds of points, wound treatments, and data sources were not the same in the two samples, the figures are remarkably close. If more than coincidence, this similarity raises the possibility that overall survivorship from arrow wounds was also reasonably high in distant times.

Injury Recognition

It stands to reason that the chances of recognizing injuries increase through the practice of shooting people more often than necessary to cause death, which is amply documented for the American West and other parts of the world (Keeley 1996; Kelly 2000). One researcher goes further to claim that this tendency—referred to as "pincushioning" where victims were peppered with arrows—means that the victim-underenumeration problem is minimized, if not avoided altogether, because at least one projectile would hit bone (Kelly 2000:151). Here the misleading effect of excessive reliance on noteworthy or classic cases comes into play.

Horrific mutilations did take place during the Indian Wars, and they were a favorite of the sensationalist press; then, like now, lurid stories sold papers. Matter-of-fact surgeons' reports, however, are a better measure of the true situation: most victims were struck by only one arrow apiece. It is reasonable to suppose the surgeons' reports were biased toward people who lived, at least for a time, at the expense of those who were killed at the attack site. The latter would include those whose bodies were "porcupinized," in the words of one surgeon (Coues 1866:323). In fact, one surgeon noted that corpses at the site of attacks often had several arrow

wounds (Bill 1882). If the Indian Wars sample is restricted to 16 people who died more-or-less immediately, the proportion of individuals with multiple arrow wounds increases: one arrow, 56 percent; two to four arrows, 25 percent; and five or more arrows, 19 percent. So, roughly one-half of these individuals were injured by single arrows, as opposed to four-fifths of the entire sample. Turning once again to Papua New Guinea, patients there exhibit the same tendency toward single wounds: 93 percent were hit by one arrow, 6 percent by two to four arrows, and 1 percent by five or more arrows (VanGurp et al. 1990).[6] In short, Kelly's (2000) sanguine view about the high archaeological visibility of prehistoric victims, a result of frequent "pincushioning," does not receive support from the only available evidence.

Most researchers do not question whether counts of damaged bone underestimate the true number of injuries. The problem is estimating how much is missed by looking at dry bones alone. Lambert (1997) has noted that 4 of 16 points were clearly embedded in the bones of one California skeleton. In the virtual absence of any other information, this one-in-four figure is becoming as deeply fixed in the literature as any point might be buried in bone (Ferguson 1997; Keeley 2001; Kelly 2000). Walker (2001), who was interested in the same sort of figure, has estimated that roughly half of the projectiles that might strike a person's front would hit bone. Wounds, however, are not randomly distributed, as shown by the Indian Wars and Papua-New Guinea injuries, as well as those from modern Nigeria (Lennox and Pust 1979; Madziga 2003; Sharp 1981; VanGurp et al. 1990). The simple fact of the matter is that all such estimates, including those based on Indian Wars casualties, are flawed in one way or another. The Indian Wars information, however, has two distinct advantages over the other two osteological estimates: it is based on a sample larger than a single skeleton, and the injuries were acquired under real-life conditions.

The nineteenth-century data show that something like one in three arrows hit bone and, hence, under ideal conditions might be noticed in skeletons. Turning to people instead of wounds, if the Indian Wars victims tell us anything about their prehistoric counterparts, then casualties can also be tripled because most nineteenth-century patients were hit by only one arrow apiece. Such increases, however, would almost certainly underestimate the people who were wounded. That is because skeletons are often incomplete and bone is poorly preserved, making it unlikely that all projectile-point damage would come to the attention of osteologists. Undercounting is especially likely for arrowheads that were not firmly embedded in bone or had been removed during treatment. Broken bones lacking signs of healing, especially minor nicks and scrapes, are difficult to attribute consistently to one cause or another. Arrow injuries among survivors would for the most part be changed sufficiently over time through normal bone remodeling to make projectile trauma difficult to identify as such.

Surgical intervention, when successful, improves the immediate prospects of survival while it reduces the chances modern osteologists would recognize the injuries. The Indian Wars surgeons realized that it was not good to leave arrowheads in the body: "the danger *peculiar* to all arrow wounds is, *that the shaft becoming detached from the head of an implanted arrow, leaves this so deeply imbedded in a bone that it cannot be withdrawn and that, remaining, it kills*" (Bill 1862:367; italics in original). Various techniques were developed to remove arrowheads, both with the shafts and when separated from them (Bill 1862, 1882; Gross 1866; Otis 1871). No doubt Native Americans were equally concerned with such injuries, and at least some groups were skilled at pulling arrowheads out of wounds along with shafts, as described by one admiring surgeon:

> The removal is effected by taking a willow stick and carefully splitting it and rubbing it as smooth as possible; then the pith is carefully cleaned out, and the ends rounded to present as little obstacle as possible in following the wound-track. One stick is introduced very carefully to reach and cover the uppermost fang of the head, and the other to cover the lower fang, and when both are properly adjusted the outer ends are bound to the shaft of the arrow, and all are carefully and slowly withdrawn [Parker 1883:127].

What is abundantly clear is that there is no magic number lurking out there—if only we could find it—that permits a simple transformation from skeletons with recognizable projectile-damaged bone to the number of people who were actually

wounded. At this point, simply tripling the skeletons with detectable arrow wounds, both healed and unhealed, would be as reasonable a way as any to obtain an estimate of victims. One could also take the arrow wounds that were not healed, double it to take into account survivors, then multiply that figure by three as before. This procedure assumes similar survival rates in both prehistory and the nineteenth century. Medical procedures during the Indian Wars were primitive and the hazard of infected wounds was great, much like in prehistory when nature for the most part just took its course. It is likely that the true number of wounded would fall somewhere in the vicinity of the range defined by these two simple procedures, but only under conditions of ideal bone preservation.

Archaeologists are commonly faced with the problem of what to do with projectile points found alongside bones, but not stuck in them. The origin of loose points around skeletons is notoriously difficult to determine. The tendency has been to treat them as either burial offerings or entirely unrelated artifacts that had been moved from their original locations. While it is always better to err on the side of caution, some of the reticence about considering loose points as evidence of injuries can be attributed to a long-standing reluctance to believe prehistoric people engaged in serious fighting.

Army surgeons recognized that stone points frequently broke into pieces, producing a "common and troublesome feature of the wound" (Coues 1866:322).[7] There was also a danger of points being left in the wound when arrows were pulled out. Once separated from shafts, arrowheads were difficult to locate and extract. Because pulling and twisting arrows would likely snap stone points, many of which were quite thin, broken arrowheads can help establish if a skeleton was from a person who was shot. Experiments with points made of chert show that they fracture in several ways when striking a target, but impact fractures of tips and snapped stems often occur (Odell and Cowan 1986; Thompson 2003). For the common triangular (Madison) points, it is not unusual for the wide hafted base to remain intact, while the pointed part in front is shattered into pieces (Thompson 2003). If such a point had penetrated deeply into a body, it is quite possible that the hafted portion might be pulled out with the shaft while the broken pointed end remained in the wound. Thus, one must look carefully at points near bones to identify whether they are broken.

How Many Are Many?

There remains the issue of how to interpret estimates of casualties in terms of conflict's impact on life in prehistoric societies. To put ethnographic and archaeological estimates of conflict-related mortality in a more intelligible context, Keeley (1996, 2001) has cited casualty figures for Gettysburg, among other noteworthy engagements.[8] Regardless of where one stands on the significance of prehistoric warfare, all would agree that Gettysburg and the Civil War are examples of a major battle and war, respectively. At Gettysburg, 4 percent of the Army of the Potomac died in three days of bitter fighting; for the war as a whole, 6 percent of Union soldiers were killed in battle (Anonymous 1989, 2003). Of course, many injured soldiers survived, while others were missing in action, succumbed to disease and accidents, or were captured, so overall casualties were much higher.[9] Yet fatalities in battles, or very shortly thereafter, are what are of interest if we are concerned with prehistoric skeletons showing evidence of unhealed weapon-related trauma. Examples such as those provided by Keeley (1996, 2001) are a useful starting point for turning dry statistics into something more intelligible in terms of societal costs, but a few additional rough estimates pertaining to the Civil War illustrate some of the difficulties in using them.[10]

First, one must be careful about what is represented by such figures; in this instance, viewing combat fatalities relative to combatants is not the same as considering them in terms of the entire living population (men, women, and children) or all deaths that took place in a given year. About .2 percent of the entire population of the United States, the North and South combined, died annually on the battlefield during the Civil War. This estimate is derived from an average of combat fatalities per year (in reality, casualties were unevenly distributed over the course of the war) and the nation's population in the 1860 census (Anonymous 2003; Gauthier 2002). These same fatalities represented somewhere around 7 to 8 percent of the deaths that took place in a single year, to judge from mortal-

ity during the 1860 census year.[11] Note the marked difference in percentages that stems from treating battlefield fatalities relative to the living population as opposed to viewing these fatalities as a fraction of all deaths in a given interval. Neither are the same as deaths among combatants. For archaeological skeletons, the Indian Wars surgeons' experience indicates that more-or-less immediate deaths from arrow wounds in prehistoric cemetery samples would be around three times the observable unhealed wounds—it is the estimate that might be obtained from bones under ideal conditions. That figure, however, should not be misinterpreted as meaning that the same proportion of all community members died from arrow wounds each year.

Second, all cemeteries in use during the Civil War would not have had the same proportion of combat fatalities, even if only burials dating to this narrow window of time are considered. Some burial contexts, such as Confederate mass graves at Shiloh, would have an overabundance of skeletons with unambiguous signs of trauma. Those in sleepy backwaters far from battlefields would have few such casualties, even taking into account the remains that were shipped back home. Unfortunately, as archaeologists we generally have poor control over, or even knowledge about, what is being sampled from any particular time period or geographical area. Directly comparable data require procedures to take into account variation in skeletal completeness and differences in age and sex composition. Yet the problem runs far deeper because of the individualized histories of separate communities, all of which would not have had identical experiences resulting in similar mortality patterns and, hence, samples of skeletons. Because of such difficulties, one must be careful about treating numerical differences, even statistically significant ones, as indicating true cultural differences.

Turning to an archaeological example, Smith (2003) has cautioned against relying on a few high-mortality cases to say that warfare was intense or common in the past. When referring to the percentages of skeletons with signs of trauma, she draws a contrast between "single-digit" and "double-digit" casualties. Because only 3 percent of the skeletons from the late prehistoric Chickamauga, Tennessee, area display trauma attributable to warfare, she concludes that there was "a low risk of intergroup conflict" (two Mississippian components, Dallas and Mouse Creek, are 1 percent and 4 percent, respectively; Smith 2003:311, 314–315).

Smith's (2003) distinction is noteworthy because there are relatively few examples of "double-digit" casualties from prehistoric sites anywhere in the world, even though such high-mortality cases, both ethnographic and archaeological, play a prominent role in Keeley's (1996:90) influential argument that the reality of prehistoric warfare has been ignored, willfully or not, for far too long. If it is indeed true that low percentages of skeletons with combat-related trauma indicate that warfare fatalities were trivial, not nearly enough to have had much of an effect on past communities, then the current heightened interest among archaeologists in intergroup conflict is misplaced. In most instances, evidence for warfare would then be little more than a curiosity because conflicts had little influence on ancient populations. Just such an outcome would be welcome to those who consider the past as fundamentally peaceful, perhaps with the occasional temporary aberration here or there.

The Indian War figures, however, provide support for Keeley's (2001) position that a few unambiguous examples of trauma mean far more people were wounded and often died. Arrows did not always strike bone, and those that failed to do so would leave no direct signs injury. The same holds true of other forms of conflict-related trauma, with scalping being a notable exception because it inevitably results in distinctive marks on bone. For the survivors of wounds that involved bone, subsequent remodeling would often obliterate sure signs of injuries unless points remained embedded in bone. Having only a handful of skeletons damaged by arrows means there were several times as many victims of warfare, and that must be considered a conservative estimate because only rarely are skeletons complete and bones perfectly preserved.

Similar information on other forms of trauma is plainly needed to go from injury identification to a fuller evaluation of the place of violence in prehistoric societies.[12] Nevertheless, to the extent that arrow wounds approximate the visibility of most other forms of conflict-related trauma, then low percentages of skeletons showing any kind of injury, such as those found by Smith (2003) in the Chickamauga area, can be expected to be more significant than they might appear at first glance. After

all, such figures, particularly when considered in light of ambiguities in osteological samples, approach those of battlefield casualties in the Civil War. That particular conflict resulted in great social, political, and economic upheaval, not to mention emotional scars and long-lasting bitterness and animosity. One should not push such an analogy too far, but as Keeley (1996, 2001) has noted it is a useful way to begin to view osteological frequency figures in more human terms.

When considering the possible effects of warfare on daily life in small-scale societies, it is unwise to focus only on the people directly involved in attacks, as is so often done. Individual households in late-prehistoric societies were the primary economic units (for a thorough discussion with specific reference to midwestern and southeastern societies, see Muller 1997). Anything that interfered with the productivity of household members was likely to have dire consequences, especially if essential tasks such as planting and harvesting that could only be performed at certain times were left undone. Warfare-related deaths and steps taken to avoid enemies that lowered task-related efficiency made self-sufficient groups more vulnerable to the many other threats to their existence. Groups in the historic period routinely experienced hunger when stores ran low and wild animals and plants were unavailable, particularly during the late winter and early spring. Periodic shortages, such as crop failure and insufficient game animals, only made things worse, pushing people from hunger to outright starvation.

People suffering from the attacks of their enemies, particularly when precipitous flight disrupted their lives, could have a hard time of it. Two examples from North America highlight these problems, although others from elsewhere in the world could just as easily be used to illustrate this point. The mid-seventeenth-century Huron, harried by their Iroquois enemies, were at one point reduced to "dying skeletons eking out a miserable life, feeding even on the excrements and refuse of nature" (Ragueneau in Thwaites 1899:89). At the start of the nineteenth century, the Shoshone were, in Meriwether Lewis's quaint wording, similarly pressed by "their enemies who were eternally harassing them that they were obliged to remain in the interior of these mountains at least two thirds of the year where the suffered as we then saw great hardships [sic] for the want of food sometimes living for weeks without meat and only a little fish roots and berries" (Moulton 1988:91). Desperate times elicited harsh responses. Lewis "observed that there was but little division or distribution of the meat they [the Shoshone] had taken among themselves. some families had a large stock and others none ... meat was so scarce with them that the men who killed it reserved it for themselves and their own families" (Moulton 1988:149). Hardship in both examples followed forced movement and occupation of less than optimum areas.

In short, it is reasonable to expect that the effects of warfare extended far beyond the immediate loss of life, which in prehistoric eastern North America was for the most part restricted to picking off targets of opportunity (Milner 1999; Milner et al. 1991). The loss of key people, particularly healthy and vigorous adults who did much of the hunting and tending of gardens, would increase the risk of mortality for surviving household members, many of whom were dependents incapable of adequately caring for themselves. The people who were most valuable from the perspective of household survival were precisely those who put themselves in harm's way while performing essential everyday chores some distance from the relative safety of their villages. Thus warfare that targets adults can prove ruinous to self-sufficient villages that in the best of circumstances could only muster a limited workforce. Several people killed at once could easily precipitate a community-wide mortality crisis. Such attacks certainly occurred, as shown by the late prehistoric Norris Farms #36 site in Illinois where small groups, presumably work parties, were occasionally the targets of attacks (Milner et al. 1991).[13]

Conclusion

While the applicability of the Indian Wars experience to prehistoric settings is problematic, more so for some issues than others, some quantification is better than none at all. In aggregate, these case reports represent one of the few reasonably large samples of arrow injuries for any part of the world, past or present. The data are sufficient to say that arrows often do not strike bones, and wounds can be conservatively estimated as being something on the order of three times the number that left indeli-

ble marks on skeletons. Postmortem damage, including the erosion of bone surfaces and the complete loss of skeletal elements, makes it unlikely that all arrow wounds that struck bone can be recognized. It follows that when even a small fraction of a skeletal collection displays arrow wounds, conflicts must have been an important element of life, as Keeley (2001) has previously argued. Such figures are especially noteworthy when coupled with the mortality among survivors whose risk of dying was almost certainly elevated when essential tasks were disrupted by the sudden loss of critical members of self-sufficient households. Thus, cemetery samples with even a few percent of skeletons showing arrow wounds indicate that socially disruptive conflict gripped prehistoric villagers. The relative invisibility of signs of conflict-related trauma, whatever weapon caused it, means that this evidence, when it occurs, should not be dismissed casually.

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References Cited

Anonymous
n.d. Named Campaigns—Civil War. Center of Military History, United States Army, Washington, D.C. Electronic document, www.army.mil/cmh-pg/reference/cwcmp.html, accessed December 23, 2003.

Anonymous
1989 *American Military History*. Center of Military History, United States Army, Washington, D.C. Electonic document, www.army.mil/cmh-pg/BOOKS/amh/amh-toc.html, accessed December 23, 2003.

Anonymous
2003 America's Wars. Office of Public Affairs, Department of Veterans Affairs, Washington, D.C. Electronic document, www1.va.gov/pressrel/amwars.htm, accessed December 23, 2003.

Bill, Joseph H.
1862 Notes on Arrow Wounds. *American Journal of the Medical Sciences* 88:365–387.
1882 Sabre and Bayonet Wounds; Arrow Wounds. In *The International Encyclopedia of Surgery: A Systematic Treatise on the Theory and Practice*, edited by J. Ashhurst, pp. 101–118. W. Wood, New York.

Brown, Paula
1978 *Highland Peoples of New Guinea*. Cambridge University Press, Cambridge.

Coues, Elliott
1866 Some Notes on Arrow-Wounds. *The Medical and Surgical Reporter* 14:321–324.

Ferguson, R. Brian
1997 Violence and War in Prehistory. In *Troubled Times: Violence and Warfare in the Past*, edited by Debra L. Martin and David W. Frayer, pp. 321–355. Gordon and Breach, Amsterdam.

Fingleton, L. J.
1987 Arrow Wounds to the Heart and Mediastinum. *British Journal of Surgery* 74:126–128.

Gat, Azar
1999 The Pattern of Fighting in Simple, Small-Scale, Prestate Societies. *Journal of Anthropological Research* 55:563–583.

Gauthier, Jason G.
2002 *Measuring America: The Decennial Censuses From 1790 to 2000*. U.S. Census Bureau, Department of Commerce, Washington, D.C.

Gross, Samuel D.
1866 *A System of Surgery; Pathological, Diagnostic, Therapeutic and Operative*. Henry C. Lea, Philadelphia.

Haas, Jonathan
1999 The Origins of War and Ethnic Violence. In *Ancient Warfare*, edited by John Carman and Anthony Harding, pp. 11–24. Sutton, Phoenix Mill, Gloucestershire.

Haas, Jonathan, and Winifred Creamer
1993 *Stress and Warfare among the Kayenta Anasazi of the Thirteenth Century A.D.* Fieldiana Anthropology 21. Field Museum of Natural History, Chicago.
1997 Warfare Among the Pueblos: Myth, History, and Ethnography. *Ethnohistory* 44:235–261.

Haines, Joe D.
1994 Treatment of Arrow Wounds in the American Indian-Fighting Army: The Technique of Brevet Lt. Col. Joseph H. Bill. *Journal of the Oklahoma State Medical Association* 87:64–68.

Haines, Michael R.
1994 *Estimated Life Tables for the United States, 1850–1900*. Historical Paper 59. National Bureau of Economic Research, Cambridge, Massachusetts. Electronic document, http://ideas.repec.org/p/nbr/nberhi/0059.html, accessed January 21, 2004.

Heider, Karl G.
1970 *The Dugum Dani: A Papuan Culture in the Highlands of West New Guinea*. Aldine, Chicago.
1997 *Grand Valley Dani: Peaceful Warriors*. 3rd ed. Wadsworth, Belmont, California.

Ingelmark, Bo E.
1939 The Skeletons. In *Armour from the Battle of Wisby 1361*, by Bengt Thordeman, pp. 149–209. Vitterhets Historie och Antikvitets Akademien, Stockholm.

Jackson, A. T.
1943 Indian Arrow and Lance Wounds. *Texas Archeological and Paleontological Society* 15:38–65.

Keeley, Lawrence H.
1996 *War Before Civilization*. Oxford University Press, New York.
1997 Frontier Warfare in the Early Neolithic. In *Troubled Times: Violence and Warfare in the Past*, edited by Debra L. Martin and David W. Frayer, pp. 303–319. Gordon and Breach, Amsterdam.
2001 Giving War a Chance. In *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare*, edited by Glen E. Rice and Steven A. LeBlanc, pp. 331–342. University of Utah Press, Salt Lake City.

Kelly, Raymond C.
2000 *Warless Societies and the Origin of War*. University of Michigan Press, Ann Arbor.

Lambert, Patricia M.
1997 Patterns of Violence in Prehistoric Hunter-Gatherer Societies of Coastal Southern California. In *Troubled Times: Violence and Warfare in the Past*, edited by Debra

L. Martin and David W. Frayer, pp. 77–109. Gordon and Breach, Amsterdam.
2002 The Archaeology of War: A North American Perspective. *Journal of Archaeological Research* 10:207–241.
Larsen, Clark S.
1997 *Bioarchaeology: Interpreting Behavior from the Human Skeleton*. Cambridge University Press, Cambridge.
LeBlanc, Steven A.
1999 *Prehistoric Warfare in the American Southwest*. University of Utah Press, Salt Lake City.
Lennox, C. E., and R. E. Pust
1979 Surgical Experience of Tribal Warfare in Papua New Guinea. *Tropical Doctor* 9:184–188.
Lundy, J. A.
1952 Arrow Wounds. *The New England Journal of Medicine* 246:444–446.
Madziga, A. G.
2003 Arrow Injuries in North East Nigeria. *West African Journal of Medicine* 22:106–109.
Mays, B., A. Parfitt, and M. J. Hershman
1994 Treatment of Arrow Wounds by Nineteenth Century USA Army Surgeons. *Journal of the Royal Society of Medicine* 87:102–103.
Milner, George R.
1999 Warfare in Prehistoric and Early Historic Eastern North America. *Journal of Archaeological Research* 7:105–151.
2000 Palisaded Settlements in Prehistoric Eastern North America. In *City Walls: The Urban Enceinte in Global Perspective*, edited by James D. Tracy, pp. 46–70. Cambridge University Press, Cambridge.
Milner, George R., Eve Anderson, and Virginia G. Smith
1991 Warfare in Late Prehistoric West-Central Illinois. *American Antiquity* 56:581–603.
Moulton, Gary E. (editor)
1988 *The Journals of the Lewis & Clark Expedition: July 28–November 1, 1805*, Vol. 5. University of Nebraska Press, Lincoln.
Muller, Jon
1997 *Mississippian Political Economy*. Plenum, New York.
Novak, Shannon A.
2000 Battle-Related Trauma. In *Blood Red Roses: The Archaeology of a Mass Grave from the Battle of Towton AD 1461*, edited by Veronica Fiorato, Anthea Boylston, and Christopher Knüsel, pp. 90–102. Oxbow Books, Oxford.
Odell, George H., and Frank Cowan
1986 Experiments with Spears and Arrows on Animal Targets. *Journal of Field Archaeology* 13:195–212.
Otis, George A.
1871 *A Report of Surgical Cases Treated in the Army of the United States from 1865–1871*. Circular 3. Surgeon General's Office, War Department, Washington, DC.
Parker, W. Thornton
1883 Concerning Arrow-Wounds. *Philadelphia Medical Times* 14:127–129.
Pope, Charles A.
1864 Two Cases of Ligature of the Common Carotid Artery on Account of Traumatism. *St. Louis Medical and Surgical Journal* 12–17.
Rice, Glen E., and Steven A. LeBlanc (editors)
2001 *Deadly Landscapes: Case Studies in Prehistoric Southwestern Warfare*. University of Utah Press, Salt Lake City.
Sale, Kirkpatrick
1990 *The Conquest of Paradise: Christopher Columbus and the Columbian Legacy*. Plume, New York.
Sharp, Peter T.
1981 "Pierced by the Arrows of this Ghostly World"—A Review of Arrow Wounds in Enga Province. *Papua New Guinea Medical Journal* 24:150–163.
Smith, Maria O.
2003 Beyond Palisades: The Nature and Frequency of Late Prehistoric Deliberate Violent Trauma in the Chickamauga Reservoir of East Tennessee. *American Journal of Physical Anthropology* 121:303–318.
Taylor, Colin F.
2001 *Native American Weapons*. University of Oklahoma Press, Norman.
2003 *Native American Hunting and Fighting Skills*. Lyon's Press, Guilford, Connecticut.
Thompson, Ian
2003 Cutting-Edge Technology. *Missouri Archaeological Society Quarterly* 20:14–18.
Thwaites, Reuben G.
1899 *The Jesuit Relations and Allied Documents*, Vol. 35. Burrows Brothers, Cleveland, Ohio.
VanGurp, Gerald, Timothy J. Hutchinson, and William A. Alto
1990 Arrow Wound Management in Papua New Guinea. *Journal of Trauma* 30:183–188.
Walker, Francis A.
1872 *The Vital Statistics of the United States, Embracing the Tables of Deaths, Births, Sex, and Age, to Which are Added the Statistics of the Blind, the Deaf and Dumb, the Insane, and the Idiotic*. Ninth Census, Vol. 2. Government Printing Office, Washington, DC.
Walker, Phillip L.
2001 A Bioarchaeological Perspective on the History of Violence. *Annual Review of Anthropology* 30:573–596.
Webster, David
1993 The Study of Maya Warfare: What It Tells Us About the Maya and What It Tells Us About Maya Archaeology. In *Lowland Maya Civilization in the Eighth Century A.D.*, edited by Jeremy A. Sabloff and John S. Henderson, pp. 415–444. Dumbarton Oaks Research Library, Washington, DC.
2000 The Not So Peaceful Civilization: A Review of Maya War. *Journal of World Prehistory* 14:65–119.
White, Tim D.
1992 *Prehistoric Cannibalism at Mancos 5MTUMR–2346*. Princeton University Press, Princeton, New Jersey.
Wilson, Thomas
1901 Arrow Wounds. *American Anthropologist* 3:513–531.

Notes

1. There is no information on the precise circumstances of these attacks. As one might expect, little modern comparative material exists on arrow wounds beyond case reports, and it is weighted toward victims who survived long enough to receive treatment, which in modern times usually has a successful outcome. A recent study of Nigerian patients was not used here because figures for various anatomical regions are not consistent with the text where it is stated that multiple parts of the body were injured in 15 of 73 patients (Madziga 2003). Despite the fact that data are not directly comparable, it is clear that the thorax was most often hit by arrows, much like the Indian Wars and Papua New Guinea cases. Only in this instance the predominance of upper body injuries was attributed to the frequent ambush of people who, while riding in the backs of pickup trucks, were partially protected.

2. The ways information in the VanGurp et al. (1990) and Sharp (1981) studies of Papua New Guinea arrow-wounds are reported are not identical, although overall patterns are similar. That is also true of Papua New Guinea patients where all weapons, mostly arrows and spears, are aggregated (Lennox and Pust 1979).

3. It took considerable care and skill to extract loosely attached barbed points along with the rest of an arrow. Surgeons, however, did not always have that opportunity because the "shaft is almost invariably seized and jerked hurriedly out by the patient at the moment of being struck" (Coues 1866:323). So points were often left in wounds.

4. The difficulty experienced in extracting points is evident in one surgeon's experience with a patient who had an iron arrowhead lodged in the proximal head of a humerus. After using forceps to get a firm grip on the point and "bracing my knees against the patient's thorax, I applied all the traction I could muster. Suddenly the arrow-head flew out of its seat, and I would have fallen on the floor, had not the steward caught me" (Bill 1862:371).

5. Citations to descriptions of skeletons can be found in Milner (1999). The dispersed nature of this information, frequently in obscure sources, is one reason why the abundant skeletal evidence for warfare in eastern North America has remained so well hidden for many years. The same can be said about other parts of North America (see Lambert 2002). To be counted here, a skeleton must show unambiguous evidence of projectile-related trauma, typically an arrowhead stuck in a bone. Projectile points in the body cavity, even those with impact fractures, are not included. As might be expected, the spatial coverage is uneven because excavated cemeteries with large and carefully studied collections of well-preserved skeletons have a spotty distribution. At present, there is no reason to believe that the basic pattern of injuries varied much from one place to the next—judging from skeletons and their burial contexts, most victims appear to have died in ambushes—although village palisade strength differed as did, presumably, the nature of personal defensive gear, specifically shields and other body protection (Milner 1999, 2000; Taylor 2001, 2003).

6. These numbers are paralleled in another study of hospitalized Papua New Guinea tribal-fight victims who were hurt by weapons of all kinds: 89 percent of patients were wounded once, 11 percent were struck two to six times, and less than 1 percent had more than six injuries (Lennox and Pust 1979). Arrows struck 67 percent of the 167 patients, with most of the others stabbed by spears.

7. Sometimes the pieces could be found, or would work their way out later, as in one patient where an arrow struck a vertebra: "[t]hree large pieces [were] extracted immediately. Numerous smaller fragments came away in the suppuration" (Coues 1866:322).

8. This is not the only such comparison in the literature; see Gat's (1999) use of such figures, including those from the Civil War.

9. Other particularly bloody battles included Antietam and Shiloh where approximately 3 percent of Union soldiers engaged were killed (Anonymous n.d.). Returning to Gettysburg, the Union combined total for killed, wounded, missing, and captured reached 26 percent (Anonymous 1989). For the northern armies during the entire war, the wounded and killed from all causes was 29 percent (Anonymous 2003). So during the Civil War far more deaths occurred off rather than on the battlefield, with disease being the main killer. In my own family, for example, one survived, while three died of disease and one from an accident (explosion of the *Sultana*) after being released from the notorious Andersonville prison—none died on a battlefield.

10. It really does not matter which major war is selected for illustrative purposes, as noted previously by Keeley (1996) and Gat (1999).

11. It was recognized that deaths were underreported when the 1860 census was being conducted. So in this paper estimates of overall mortality at that time were obtained in two ways: by using an approximation for undercounted deaths proposed for the next census in 1870, and by fitting the 1860 census to a United Nations model life table (M. R. Haines 1994; Walker 1872). Great precision is not necessary here, only a notion of the kinds of mortality figures that characterized this tumultuous period.

12. As this paper focuses on skeletons, other signs of conflict such as palisades, easily defended site locations, no-man's lands, and artwork, among others, are not covered. It must be remembered, however, that nonskeletal evidence for uneasy relations is a critical part of the archaeological record, as discussed by Keeley (1996), LeBlanc (1999), and Milner (2000).

13. At Norris Farms, several pits each contained the remains of a few people, often of one sex, that were in the same state of disarticulation and showed similar patterns of damage from scavenging animals. Thus within single graves, it appears that the time elapsed between death and discovery was the same, with the latter followed by the burial of largely unidentifiable body parts in the village cemetery.

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