



A Civil War Surgeon's Pit at Manassas National Battlefield Park, Virginia

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Abstract Human bone fragments were discovered during archaeological monitoring of earth moving on Manassas National Battlefield Park in Virginia. Later mitigation recovered bones in situ—two skeletons and seven amputated limbs. Interdisciplinary research affords an unusually detailed level of interpretation, including identification of the remains as Union soldiers wounded during the Battle of Second Manassas (28–30 August 1862). The reconstructed narrative includes military and personal markers of identity, as well as causes of death and injury, and establishes a window from 1 to 6 September 1862 when the pit

was dug. Records of Union surgeons make future personal identification of the amputated limbs possible and confirm the pit's location as a key treatment center after Second Manassas, a battle that marked an inflection point for combat military medicine by highlighting the urgent need for improved systematic recovery and treatment of the wounded.

Resumen Fragmentos de huesos humanos fueron descubiertos durante el monitoreo arqueológico del movimiento de tierra en el Parque Nacional del Campo de Batalla de Manassas en Virginia. La mitigación posterior recuperó huesos in situ: dos esqueletos y siete miembros amputados. La investigación interdisciplinaria ofrece un nivel de interpretación inusualmente detallado, incluida la identificación de los restos como soldados de la Unión heridos durante la Batalla de la

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Segunda Manassas (28–30 de agosto de 1862). La narración reconstruida incluye marcadores de identidad militares y personales, así como causas de muerte y lesiones, y establece una ventana del 1 al 6 de septiembre de 1862 cuando se excavó el pozo. Los registros de los cirujanos de la Unión hacen posible la futura identificación personal de las extremidades amputadas y confirman la ubicación de la fosa como un centro de tratamiento clave después de la Segunda Manassas, una batalla que marcó un punto de inflexión para la medicina militar de combate al resaltar la necesidad urgente de mejorar la recuperación sistemática y el tratamiento de los heridos.

Résumé Des fragments d'os humains furent découverts pendant la surveillance archéologique d'un déblayage dans le Parc national du champ de bataille de Manassas en Virginie. Des travaux ultérieurs de prévention ont permis la découverte d'os sur site—deux squelettes et sept membres amputés. La recherche interdisciplinaire permet un niveau inhabituellement détaillé d'interprétation notamment l'identification des restes de soldats de l'Union blessés durant la Seconde Bataille de Manassas (28 au 30 août 1862). Le récit reconstitué inclut des marqueurs militaires et individuels d'identité, ainsi que des causes de décès et de blessures, et il définit un intervalle allant du 1er au 6 septembre 1862 lorsque la fosse fut creusée. Les archives des chirurgiens de l'Union rendent possible une identification personnelle ultérieure des membres amputés et confirment le site de la fosse en tant que centre de soins important après la Seconde Manassas, une bataille ayant marqué un point d'inflexion pour la médecine militaire des combats en mettant en exergue le besoin urgent d'une amélioration quant à la récupération et au traitement systématiques des blessés.

Keywords amputation · Civil War · surgeon's pit · military medicine

Introduction

Hundreds of thousands of Americans died or were wounded on Civil War battlefields (Livermore 1900). Because of this, the National Park Service (NPS) maintains these public spaces as tangible monuments to the grim reality of the war that ended slavery in the United States. These historical landscapes, protected

and memorialized, make it possible to visualize and more fully appreciate the experiences of past people and events (Civil War Sites Advisory Commission 1993; Cohn and Silvio 2002). In these places, the acknowledged presence and occasional discovery of the bones of soldiers (Geier and Potter 2000) also command remembrance. Although policies exist to prevent their disturbance, human bones are sometimes exposed by construction, natural processes, or by relic hunters (Potter and Owsley 2000). Such discoveries reveal the human cost of war, but also opportunities to acquire information about a battle, its aftermath, and the individuals who made the space memorable. Therefore, when bones were found on a Virginia battlefield, attention was afforded to lives and limbs lost, battlefield conflict and medical practices, and the humanity of both the soldiers and doctors who treated them. Guided by recent trends in historical bioarchaeology (Muller 2020; Novak and Warner-Smith 2020), multiple analyses were employed to identify not only the corporeal remains, but the people and spaces in relationship to them.

An Unexpected Discovery

In 2014, bone fragments were recovered during archaeological monitoring of sanctioned earth moving on Manassas National Battlefield Park (MNBP) in Prince William County, Virginia (Fig. 1). Established in 1940, MNBP commemorates the 1861 and 1862 Civil War battles of First and Second Manassas, also known as First and Second Bull Run. Fought 13 months apart on similar ground, the battles were Confederate victories and overwhelming Union defeats. Each side suffered large numbers of dead and wounded, exposing the necessity for improved field-hospital and ambulance systems to treat the injured. At Second Manassas, opposing armies sustained over 22,000 casualties, more than at any other battle up to that point in the war.

The displaced human bone fragments found 150 years later represent incomplete left and right arms, legs, and left feet from multiple individuals. The absence of other types of bone and evidence of lower-limb perimortem fracturing, combined with a transverse saw cut on a section of femur characteristic of amputation, suggested a surgeon's pit linked to a field hospital. During both battles, structures on and near

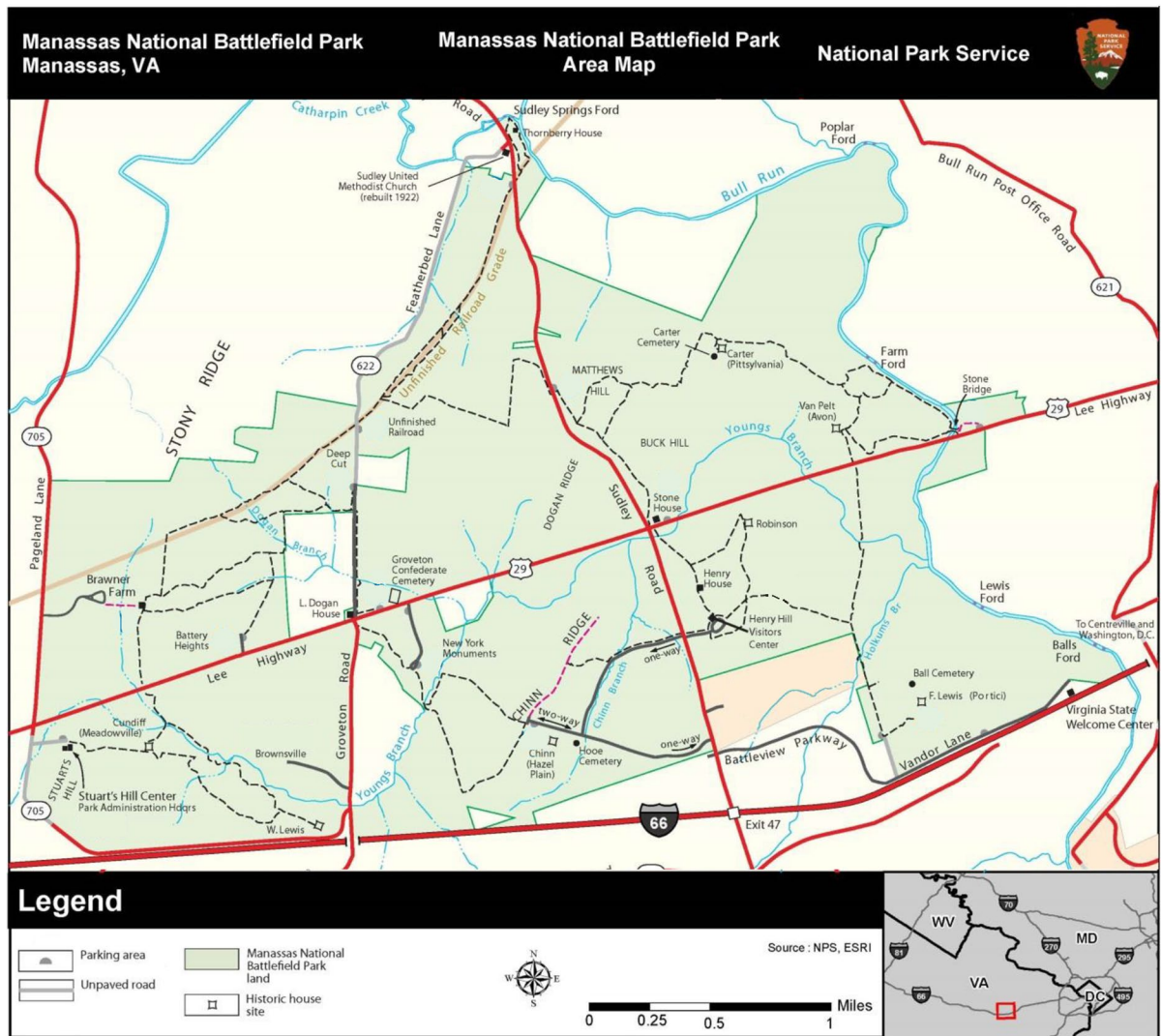
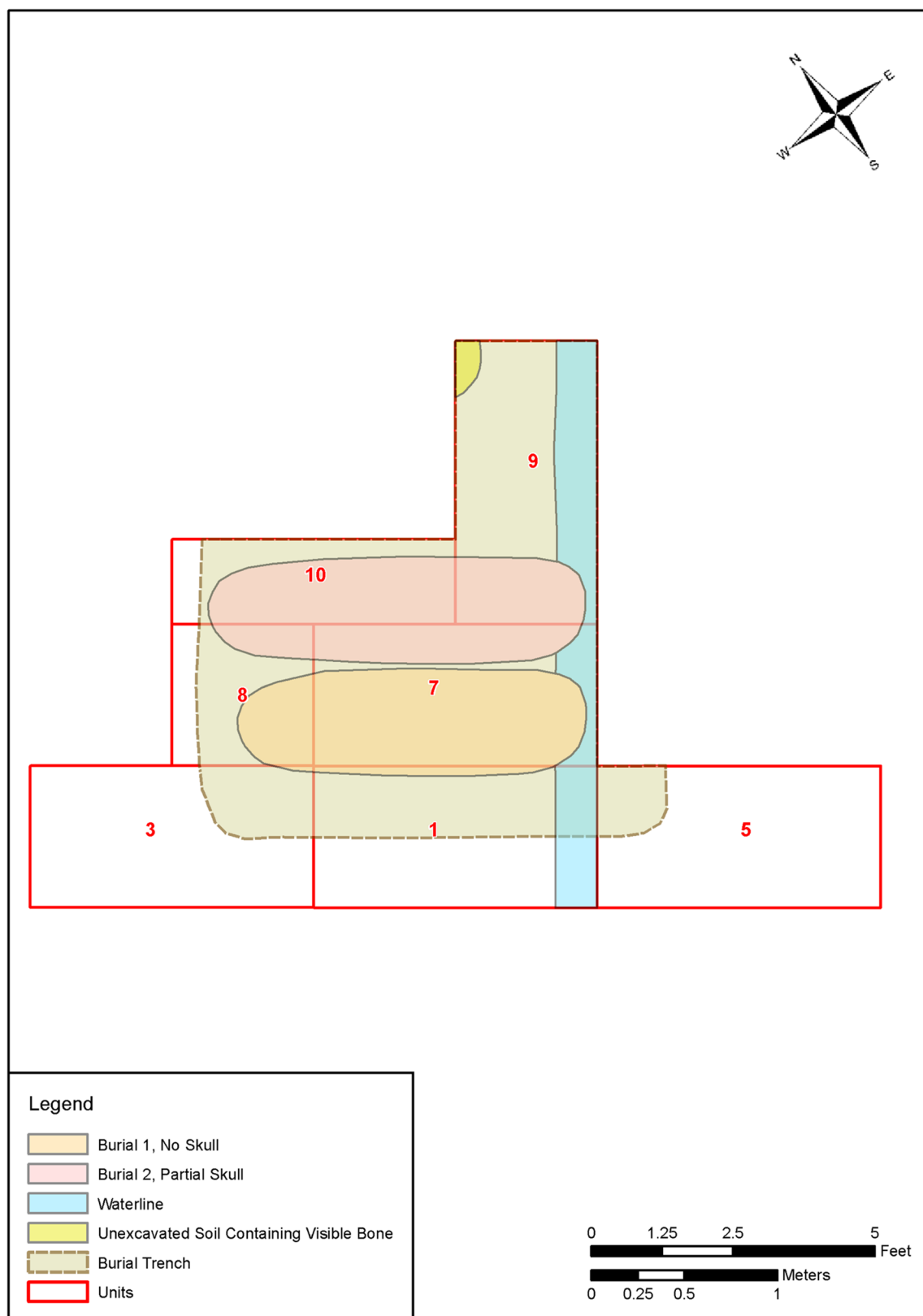


Fig. 1 Manassas National Battlefield Park area map showing its location in Virginia and identifying important sites within. (Map by National Park Service, 2014.)

the battlefield served as makeshift hospitals for sheltering and treating Union and Confederate wounded (Johnson 2013). Requests for reparations filed by landowners after the war describe the detrimental consequences of this activity. The Chinn family, for example, complains that its well was tainted by the disposal of amputated limbs (Johnson 2013).

Though extensive commentary exists on field hospitals and amputations, a Civil War battlefield surgeon's pit has never been professionally excavated or studied, and discard locations of limb amputations are seldom found (Slawson 2017). Amputated limb pits are rarely

documented in formal cemetery contexts, and only occasionally are amputated limbs found buried with the deceased (Ragland 1931; Noël Hume 1963; Bruwelheide, Owsley, and Carlson 2008; Owsley and Bruwelheide 2009). On occasion, cut bones are traced to the work of practicing physicians or to 17th- to 19th-century hospitals and medical schools where surgeons engaged in dissection and training in anatomy and surgery, as well as in performing amputations (Mann et al. 1991; Blakely and Harrington 1997; Bruwelheide, Owsley, Straube et al. 2017; Owsley et al. 2017; Scalise et al. 2018). In this case, bone fragments are



◀**Fig. 2** Excavation units 1, 3, 5, and 7–10, which included portions of the original burial feature (Bedell and Raszick 2016:16).

discovered on a battlefield where combat took place and surgeries occurred. The suspected military burial pit containing multiple limbs showing evidence of trauma and surgery warranted investigation due to the risk of future exposure of intact portions of the shallow feature and to resolve questions about its origin, size, and contents. The MNBP determined that a controlled archaeological excavation and removal of the human remains was the best course of action.

Excavation and Laboratory Methods

Six test units (1–6) along the trench line were excavated. Bone in the wall of Test Unit 1 required the opening of four additional units (7–10) (Fig. 2). The exposed burial feature had a width of about 8 ft. grid west to east (northwest to southeast) by 5 ft. south to north (Bedell and Raszick 2016). The boundary of the pit's northern edge is undefined, although geophysical testing suggests it extends another foot or two beyond the excavation unit wall (Seibert 2018).

The excavated portion of the pit contained multiple lower limbs and the partial skeletons of two individuals laying supine, side by side, with heads to the northwest (Supplementary Fig. 1). The two primary interments were designated Burials 1 (B1) and 2 (B2). Their feet had been disturbed by the mechanical trenching that inadvertently exposed the buried deposit. Bones representing isolated limbs were mostly to the left of B2 and were assigned letter designations A–G.

The battlefield reverted to agriculture after the war. The plow zone extended 0.7 to 1.1 ft. below the surface, well within the area containing human bones. As a result, the skull, cervical vertebrae, right clavicle, and scapula of B1 had been cut through and are missing. Dislodged, loose teeth found in Unit 8 were later matched to B1 in the laboratory. The pubic bones of the pelvis were also damaged by plowing, as was the cranium of B2, which was lying on its left side. The right half of the cranium had been scraped away with only the left half in situ. The upward directed toes of Limb F were similarly removed.

The depositional order of the bodies and limbs, as well as damage from traumatic injuries, were recorded prior to disinterment. The left semi-flexed arm of B1 under the right upper body of B2 confirmed that, of the two men, B1 was placed in the grave first. This skeleton's right femur had a complete fracture, with lateral displacement of the bone's proximal third from its distal two-thirds. The upper right arm of B2, over the left arm of B1, had a comminuted fracture of the proximal humerus with the bone broken into multiple, small fragments (Supplementary Fig. 2). A piece of lead buck shot was recovered near B2's right scapula. Two additional pieces of shot were recovered, one from the individual's pelvic region and one near bones of the lower right leg. A ferrous hook fastener and brass eyelet were under the fractured right humerus. A second eyelet was found nearby. In B2's neck region a paper-backed, tin shirt button was recovered, and four metal Union Eagle buttons from a military sack coat, two positioned face up and two face down, were in rough alignment along this individual's right side. B1 had no associated buttons or fasteners indicating that most, if not all, of this person's clothing had been removed. Neither body appeared to have been bound or wrapped, and no coffins were used. Both individuals were buried in the traditional Christian manner, with their heads in the western end of the pit. The unusual positioning of B2's left arm, tightly flexed at the elbow with the hand directed superiorly and the arm on top of Limb E, indicates not only expedient positioning of the bodies, but also that at least one discarded limb was placed in the pit before B2.

Each isolated leg showed evidence of trauma indicative of battlefield injury and amputation, identifying this feature as not only a grave, but a burial location for surgically removed limbs. No bullets were found with the detached limbs, nor was there evidence of footwear.

Due to poor preservation and extensive fragmentation of the bones, their recovery required supporting pedestals of soil. A preservation treatment of B-72 was applied to some elements to help stabilize the fragile bone during removal and transport. Laboratory cleaning was followed by osteological analysis. Elements were identified, and markers of age, sex, and ancestry were described according to standard methods in bioarcheology and forensic anthropology

(Buikstra and Ubelaker 1994). Evaluations of trauma included techniques of assessing ballistic and sharp-force injuries in bone. Digital radiography determined the presence of metallic particles called “bullet wipe,” or lead spatter (Lukefahr et al. 2021), while stereo-zoom microscopy and digital photography documented the saw cut marks. Photographs taken before and after partial reassembly of the broken limbs facilitated the recording and interpretation of injuries. Additional stereolithography files were generated using a Siemens Somatom Medical CT scanner, enabling virtual reassembly and digital separation of fractured pieces to visualize the fragmentation process and projectile pathway.

Stable-isotope analyses are used to track regional origins, which, in turn, help identify these individuals as Union or Confederate troops. Collagen extraction used a modified Longin (1971) method. Bioapatite (bone mineral) extraction followed Cherkinsky (2009). Isotope values are expressed in standard delta notation where ratios of the heavy to light isotope of interest (i.e., $^{13}\text{C}/^{12}\text{C}$, $^{15}\text{N}/^{14}\text{N}$, $^{18}\text{O}/^{16}\text{O}$) are compared between samples and international standards (i.e., V-PDB for $\delta^{13}\text{C}$, AIR for $\delta^{15}\text{N}$, V-SMOW for $\delta^{18}\text{O}$); units are per mil (‰) and measurement uncertainty is $\pm 0.2\text{‰}$ based on replicate analysis of reference materials.

Finally, comparisons made between the fragmented bone disturbed by initial earth moving and the bones recovered archaeologically determined whether the former represent unique elements from additional individuals or dislodged portions of limbs from the pit.

Results

The feature contained two bodies and seven amputated limbs representing nine individuals. Other than visibly disturbed foot bones of Burials 1 and 2, it is unlikely that any of the bones initially found during archaeological monitoring represent parts of limbs in the excavated pit. No associations can be made by re-articulating fragments or matching partial joints, although this process is complicated by breakage. Comparisons of stable-isotope results detected no clear matches between the burial pit and fragments first found that might imply the same individual was represented in both contexts (Berg et al. 2022).

Elements from the initial disturbance represent four additional limbs (Limbs H–K). Tables 1 and 2 provide details about each set of remains and the stable-isotope data.

Union Soldiers and Limbs

The two skeletons represent males aged 25 to 34 years. Cranial and mandibular structures for B2 and postcranial dimensions recorded for both skeletons, including large femoral heads, are indicative of male sex (Ousley and Jantz 2005). Age-related features include full dental eruption, slight to moderate tooth wear, compact bone density, and no arthritic changes. B2 appears slightly older, based on relative degrees of tooth wear and less compact trabecular bone. Dental metric and nonmetric traits of B1 and B2, along with cranial and mandibular metric and macromorphoscopic traits of the latter are consistent with European ancestry (Ousley and Jantz 2005; Irish and Scott 2015; Hefner and Linde 2018). Statures of the two men are estimated using long-bone lengths and statistical formulas developed specifically for white males (Trotter and Gleser 1952; Ousley and Jantz 2005). B1 was approximately 174 cm (68.5 in.) in height, and B2 was slightly shorter at 170 cm (66.9 in.). Although calculated using regression formulas developed from 20th-century males, and therefore not precisely applicable to 19th-century remains, these stature predictions are reasonable and like the mean stature of 68.5 in. reported for white, male Civil War recruits (Cuff 2005).

Stature cannot be calculated for the isolated leg bones, and determining sex and chronological age from incomplete, single limbs is difficult. Nevertheless, bone robusticity and burial context corresponds with males, while anatomical features of the isolated limbs are consistent with individuals in their 20s or early 30s.

Assessment of stable isotopes to establish region of origin focuses on oxygen and carbon from bioapatite carbonates ($\delta^{18}\text{O}_{\text{ap}}$ and $\delta^{13}\text{C}_{\text{ap}}$, respectively) along with carbon from collagen ($\delta^{13}\text{C}_{\text{col}}$), as these hold the greatest regional predictive power. Oxygen in bioapatite carbonates is routed through body water, which reflects the oxygen-isotope composition of local drinking water (D’Angela and Longinelli 1990; Bryant and Froehlich 1995; Bryant et al. 1996; Chenery et al. 2012). The latter is

Table 1 Age assessments and wound data for remains recovered from Manassas National Battlefield Park

ID	Age (Years)	Injury/Bone Fracture	Wound Description	Amputation	Embedded Bullet/Lead Particles	Type of Projectile ^a	Entrance	Exit	Trajectory of Projectile
Burial 1	25–29	Right femur	Butterfly fracture w/<50% cortical loss and incomplete longitudinal fracturing of proximal third of the shaft from projectile impact	N/a	Transversely embedded bullet	.577 caliber Enfield	Posterior	Did not exit, bullet present	Back to front
Burial 2	30–34	1: Proximal right humerus; 2: Right shoulder; 3: Groin; 4: Right lower leg	1: Round ball passed through the proximal diaphysis of the humerus shattering the bone into multiple pieces (comminuted fracture) with sharp-edged breaks; 2: One buckshot located by anterior humerus and right scapula; 3: Groin based on buckshot recovered in situ; 4: Lower leg based on recovered buckshot	N/a	Radiopaque lead particles in humerus; Three buckshot	Buck-and-ball cartridge .32 caliber buckshot recovered	Undetermined	Undetermined	Undetermined
Limb A	30–39	Undetermined; not recovered; Right lower leg	Wounded lower leg Not excavated	Mid-shaft of right femur	N/a	Undetermined	Undetermined	Undetermined	Undetermined
Limb B	20–24	Left tibia and fibula	Proximal and mid tibia fractured; wound is in left tibia with a partial semi-circular margin; localized damage to the tibia and fibula	Undetermined; not recovered	Two lead particles	Bullet	Antero-medial anterior	Posterior	Front to back and downward
Limb C	25–34	Right femur	Distal third of right femur shattered, circular entrance wound has a diameter of 19 mm	Proximal third of right femur	Six-plus lead particles	Bullet	Antero-lateral	Postero-medial	Right to left with a slight posterior orientation

Table 1 (continued)

ID	Age (Years)	Injury/Bone Fracture	Wound Description	Amputation	Embedded Bullet/Lead Particles	Type of Projectile ^a	Entrance	Exit	Trajectory of Projectile
Limb D	25–34	Right tibia	Proximal third of right tibia shattered; fibula intact	Middle third of right femur	Five-plus lead particles	Bullet	Posterior	Antero-medial	Back to front
Limb E	20–29	Right femur	Proximal femur shattered, irregular circular opening with associated radiating fractures	Proximal third of right femur	One large radiopaque lead particle along margin of entrance wound	Bullet	Anterior	Not defined, but dorsal proximal shaft shows extensive fracturing	Front to back
Limb F	20–24	Left tibia	Mid-shaft of left tibia shattered; fibula nearly complete and unaffected	Middle to lower third of left femur	One large radiopaque metallic particle in defect margin	Bullet	Posterior	Antero-lateral of proximal third of diaphysis	Back to front
Limb G	20–29	Left tibia and fibula	Lower left tibia and fibula; partial semi-circular opening in tibia (~20 mm in diameter) with radiating fractures	Upper third of left tibia	Six-plus metallic particles in several fragments	Bullet	Medial	Lateral	Right to left
Limb H	20–34	Left arm	N/a	N/a	N/a	N/a	N/a	N/a	N/a
Limb I	20–34	Right arm	N/a	N/a	N/a	N/a	N/a	N/a	N/a
Limb J	20–29	Left tibia	Middle third of left tibia	Lower third of left femur	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined
Limb K	20–29	Right tibia	Middle third of right tibia	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined

^a Assessment of projectile based on embedded lead particles and bone breakage.

Table 2 Stable-isotope data

Burial ID	Collagen Yield (%)	Wt %C	Wt %N	Atomic C/N*	$\delta^{13}\text{C}_{\text{collagen}} \text{‰}$	$\delta^{13}\text{C}_{\text{apatite}} \text{‰}$	$\delta^{18}\text{O}_{\text{ap}} \text{‰}$	$\delta^{15}\text{N}_{\text{collagen}} \text{‰}$
Burial 1	5.1	41.1	15.1	3.2	-17.9	-12.0	23.8	11.2
Burial 2	7.1	39.3	14.3	3.2	-20.2	-12.7	24.2	11.3
Limb A	8.4	42.2	15.4	3.2	-17.0	-10.5	24.1	11.3
Limb B	6.4	42.6	15.8	3.2	-17.3	-11.5	23.6	9.9
Limb C	16.3	45.3	17.0	3.1	-17.2	-11.4	24.1	11.0
Limb D	7.3	21.6	6.4	3.9	-17.0	-11.5	23.1	12.6
Limb E	12.4	42.9	16.0	3.1	-18.3	-12.4	24.4	9.9
Limb F	11.4	42.8	15.9	3.1	-17.7	-11.1	23.2	9.7
Limb G	6	40.8	15.2	3.2	-19.0	-10.9	23.1	9.4
Limb H	7.3	42.2	15.7	3.1	-16.1	-10.8	22.8	10.1
Limb I	8.6	42.1	15.5	3.2	-16.0	-10.1	25.4	10.7
Limb J	6.5	44.4	15.8	3.3	-17.2	-11.1	23.6	11.4
Limb K	5.9	43.2	15.7	3.2	-17.1	-11.5	23.5	11.3

Note: C/N ratios in the range of 3.1–3.4 reflect bone collagen unaltered by significant diagenesis (De Niro 1985; Ambrose 1990; McNulty et al. 2002). Limb D falls outside of this range. It also has the lowest weight %C and weight %N. Values ($\delta^{13}\text{C}_{\text{col}}$, $\delta^{13}\text{C}_{\text{ap}}$, $\delta^{18}\text{O}_{\text{ap}}$, and $\delta^{15}\text{N}_{\text{col}}$) for this individual are consistent with assemblage results but may be influenced by poor collagen quality.

controlled by latitude and regional meteorology (Kendall and Coplen 2001; Bowen and Wilkinson 2002; Dutton et al. 2005; Landwehr et al. 2014); therefore, an individual's $\delta^{18}\text{O}_{\text{ap}}$ value indicates regional origin. Carbon-isotope ratios of plants vary by region due to differences in climate and plant carbon-fixation pathways (C3, C4, or CAM) during photosynthesis. Because humans incorporate into their tissues the carbon-isotope values of consumed foods in predictable ways, general diet can be evaluated (Vogel and Van der Merwe 1977; Van der Merwe 1982; Katzenberg and Pfeiffer 1995). Collagen carbon-isotope values largely reflect consumed dietary protein, while bioapatite carbon values represent consumed lipids and carbohydrates (i.e., plant material) (Ambrose and Norr 1993; Jim et al. 2004; Froehle et al. 2010).

The $\delta^{18}\text{O}_{\text{ap}}$ values for each skeleton and limb (Table 2) are consistent with lifetimes spent in northern locales of North America. The $\delta^{18}\text{O}_{\text{ap}}$ value of historical period individuals from this geographic region averages around 24.7‰ (France, Owsley, and Hayek 2014; France, Owsley, Bruwelheide et al. 2020), while southern locales have higher values. All but one of the $\delta^{18}\text{O}_{\text{ap}}$ values from this study range from 22.8‰ to 24.4‰, indicating significant time spent in northern states. Limb I, with a $\delta^{18}\text{O}_{\text{ap}}$ value of 25.4‰, spent time in more southern regions.

The $\delta^{13}\text{C}_{\text{col}}$ and $\delta^{13}\text{C}_{\text{ap}}$ values are also consistent with temperate-region diets of the American Northeast and Midwest. Nineteenth-century protein sources for more southern regions of North America, particularly the lower mid-Atlantic and southeastern United States, are animals foddered predominantly on maize and local C4 grasses, which have relatively higher $\delta^{13}\text{C}$ values. Crops, such as wheat and rye and other local C3 grasses, with relatively lower $\delta^{13}\text{C}$ values predominate in more northern, temperate regions. The human $\delta^{13}\text{C}_{\text{collagen}}$ values from southern states are usually around -12‰ to -9‰, while northern consumers are around -20‰ to -16‰. Likewise, human $\delta^{13}\text{C}_{\text{ap}}$ values from southern states are usually around -10‰ to -5‰, compared to northern values around -13‰ to -8‰ (Ubelaker and Owsley 2003; Raynor and Kennett 2008; France, Owsley, and Hayek 2014; Bruwelheide, Owsley, Barca et al. 2020; France, Owsley, Bruwelheide et al. 2020). No individuals represented in the burial pit have values showing heavy reliance on maize or other C4 plants. This study's mean $\delta^{13}\text{C}_{\text{col}}$ value is -17.3‰ and the mean $\delta^{13}\text{C}_{\text{ap}}$ value is -11.3‰. Limb I is again a slight outlier with the most positive $\delta^{13}\text{C}_{\text{col}}$ (-16.0‰) and $\delta^{13}\text{C}_{\text{ap}}$ (-10.1‰) values.

These limbs and skeletons likely represent Union soldiers.

Injuries

Gunshot wounds are present in each man and all lower limbs. A .577 caliber Enfield bullet was transversely lodged in the posterior proximal shaft of B1's right femur (Supplementary Fig. 3). The distinctly smooth-sided Enfield, or Pritchett, bullet lacks the external grease grooves found on slightly larger, domestic .58 caliber elongated ball ammunition (Minié bullets). However, both bullets have a hollow base, facilitating expansion into the rifling, increasing range, improving accuracy, and causing mortal wounds at greater distances. Since Minié and Enfield lead bullets tend to wobble in the air and deform on impact, they “rapidly dissipate energy into the surrounding body tissues ... causing large wounds” (Kuz and Bengtson 1996:14). The resulting injury is that seen in B1, struck from behind in his right buttock. The bullet's impact reshaped the lead projectile (Fig. 3) and broke the femur into three parts. Based on the impact location, this man initially survived the injury, but died before surgical treatment, for none is noted.

The second soldier (B2) was hit by one or more buck-and-ball discharges based on the recovery of three .32 caliber buckshot. This ammunition has three buckshot (the buck) positioned in front of a large, generally .65 caliber, round ball fired using a .69 caliber musket with a smooth-bore barrel. This ammunition's effectiveness requires close combat distances, generally one hundred yards or less (Hess

2008), due to a comparatively unpredictable spread pattern (Fuller 1958). It therefore had more limited use than rifled muskets during the war (Thomas 1997). The deformed buckshot found with B2 was not accompanied by the larger caliber round ball that passed through and shattered the upper right humerus (Supplementary Fig. 2). The less forceful smaller shot remained embedded in the body. Three widely distributed buckshot found in the region of the right shoulder, lower right leg, and pelvis could have come from the same discharge, although more than one gunshot may be represented. Like B1, this individual shows no evidence of surgical intervention and was either deemed a poor candidate for treatment or died prior to it being administered.

The isolated limbs show severity and patterns of trauma consistent with injuries caused by bullets from gunfire. All but Limb A (Table 1) display complex, comminuted breakage with missing bone displaced from the limb upon impact. No irregular, large-scale wounds from artillery shrapnel or cuts from bayonets and sabers are present. Most limbs show partially defined entrance and exit openings (Supplementary Fig. 4), with radiopaque lead particles embedded near defect margins. Limbs with interpretable trajectory data show that three men were struck from the front, three from the rear, and two from their right side. The fact that these men primarily sustained leg injuries indicates movement and fighting across open terrain that afforded no protection for lower limbs.



Fig. 3 The impact surface of the extracted bullet has well-defined, parallel ridges and the imprinted weave of uniform fabric. The bullet weighs 34.5 g (1.215 oz.), with a mid-bullet diameter of 0.63 in. (Photos by James D. Tiller, 2018.)

Surgical Treatment

Amputations are evident as transverse saw cuts through the bone above impact areas. Of the seven limbs from the pit, six show evidence of amputation, as does the femur section (Limb J) from the initial disturbance (Tables 1, 3). Limb B is missing its amputated thigh portion. Of the represented thigh amputations, two are documented in proximal femora and four are through middle or distal femoral shafts. Limb C's cut was through intact bone high on the thigh immediately below the lesser trochanter. However, the projectile injury fractured this femur's distal shaft, shattering it into two major segments and at least 11 additional pieces (Supplementary Fig. 5). Fragments were reassembled to determine the bullet's entrance and exit just above the knee. Damaged or inflamed tissue must have been a concern as the amputation was performed well above the injury. Another proximal thigh amputation (Limb E) progressed through broken bone just below the lesser trochanter and only 55 mm above the wound (Supplementary Fig. 6). Cutting through compromised bone separated by radiating fractures emanating from the entrance and exit areas was less than optimal. This high-level location was selected out of necessity, the only other surgical alternative being a complicated and riskier disarticulation amputation involving complete removal of the leg at the hip socket. The other represented amputations, through the middle and distal femoral shaft and

the proximal leg (below the knee) were done in response to trauma involving the tibia and fibula.

Documentation of the amputation process includes microscopic examination of well-preserved cut ends. Each cut end represents half of the amputation saw mark, or “kerf”—the bladed tool mark typically composed of two opposing walls and a floor (Symes et al. 2010). Numerous factors affect the cut surface, including the style and design of the sawblade's teeth, tooth width, number of teeth per inch, tooth wear, blade imperfections/damage, blade vibrations, cutting speed, and sawing motion (Baily et al. 2011). Standard Civil War surgical kits are well described with attention given to instruments used for amputations, especially the “capital saw” (Hawk 2017). Characteristics of the cut surfaces were examined to confirm use of a saw vs. another tool and to gain insight into the proficiency of the surgeon, positioning of the patient's leg during the procedure, orientation of the saw blade, sawing motion, and directionality.

Structural features in the cut surfaces reflect saw use and consistency in directionality of the cutting. Four amputated femora have visible striae from blade strokes in the preserved kerf wall that indicate the operation for three femora began on the antero-medial or anterior (front) surface and terminated on the opposing posterior (back) margin. This pattern corresponds with a supine patient on the operating table. Limb A shows a medial (inner thigh) to lateral (side) progression of

Table 3 Amputations

Limb	Location of Amputation (Surgical ^a)	Bone Location	Directionality of Cutting	Terminal Snap ^b
A	Mid-thigh	Middle third of right femur	Medial to lateral	None
C	Proximal thigh	Proximal third of right femur	Anterior-medial to posterior-lateral	Small on posterior-lateral edge
D	Distal thigh	Proximal end of distal third/ Distal end of middle third (at boundary) of right femur	Anterior-medial to posterior-lateral	At linea aspera
E	Proximal thigh	Proximal third of right femur	Unknown—too eroded	None
F	Mid-thigh	Distal end of middle third/ Proximal end of distal third (at boundary) of left femur	Anterior to posterior	At linea aspera
G	Proximal leg	Proximal third of left tibia	Unknown—too eroded	None
J	Lower mid-thigh	Lower middle third of left femur	Unknown—too eroded	None

^a Civil War surgical terminology refers to the femur as the “thigh” and the tibia and fibula as the “leg.”

^b A terminal snap is a protruding bone tag along the margin of an amputation where the edge broke during the final stage of cutting. The linea aspera is a bony ridge along the posterior femoral shaft.

the blade. This thigh was turned outward with the lateral surface of the knee directed downward.

The surgeon's position relative to the patient and his use of the saw is especially evident in the best-preserved cut bone (Supplementary Fig. 7). Limb D's defined striae show the saw's progression from the femur's anterior-medial to posterior-lateral aspects, with the tip of the saw directed slightly downward, indicating the surgeon was on this patient's right side. This was consistently the case on sectioned bone with visible striae, following the standard procedure for the surgeon to be positioned on the right side of the limb during the amputation (S. Smith 1862).

To begin the surgery, which could be performed in less than 10 min., knives were used to cut through skin and muscles prior to sectioning the bones with a saw. No fine nicks or cuts were detected on bone surfaces, indicating the surgeon proceeded with care, likely aided by anesthesia (chloroform or ether), which was commonly administered to patients during the operation. None of the amputated bones show false starts indicated by incomplete or skipped cuts. The blade stroke began with the saw pulled toward the operator, as indicated by exit chipping on the lateral half of Limb D's cut margin. Striation spacing, also visible on Limb D, specifies a pattern of less forceful cutting at the start, followed by more powerful strokes and then lessening the cutting force when approaching the opposing edge of the bone. There are no large breakaway spurs caused by excess force on any of the cut bones. Three femora have small, insignificant terminal snaps; Limb A has no terminal break along the cut margin.

The work reflects the skill of a practiced surgeon.

Discussion

Combining the lines of evidence contextualizes the remains by identifying the pit's origins and revealing the individuals and motives involved in its creation. Better understood is the plight and identity of the wounded and the actions of doctors tasked with their care.

Injury and Amputation

An exceptional resource for interpretation of this burial pit is the *Medical and Surgical History of the War of the Rebellion (1861–1865)*. Prepared by United

States Army medical personnel and published by the Surgeon General's Office (Barnes 1870–1888), this six-volume set contains Civil War case studies, details of troop diseases, observed injuries by type and location on the body, descriptions of surgical procedures, mortality rates, and reports from the battlefield. A revised, systematic method of record keeping for tracking the sick and wounded was not formally introduced until July 1862 and only fully implemented in January 1864 (Barnes 1870–1888[2.1]). Consequently, not every injury or illness was recorded, and information for the first year of the war is especially limited. However, this record provides extensive insight into battlefield injuries as well as military medicine and its evolution during the conflict.

Consistent with observed injuries in the pit, bullets caused most Civil War wounds. Of the more than a quarter of a million gunshot injuries recorded during the war, most involved limbs (71%), followed by the torso (18%), and the head and neck (11%) (Barnes 1870–1888[2.1]:xxv; Adams 1996:115). Limbs were not more susceptible to bullet wounds; their injuries were simply less likely to be fatal and therefore treated and tabulated. In a study of battlefield dead conducted during the war, more than 80% had sustained injuries to the head, neck, and torso. Only 5% of the mortally wounded suffered limb injuries (Adams 1996). Fatality rates documented by Union surgeons for upper- and lower-extremity bullet wounds are 6.5% and 13.8%, respectively (Kuz and Bengston 1996).

Both round and elongated (conoidal) bullet injuries are recorded in the pit remains, but the accuracy, greater range, and destructive nature of the rifled musket and the Minié ball made this weaponry the preferred firearm and ammunition during the Civil War. Its frequent and effective use is noted in the approximately 57% of recorded cases in the *Medical and Surgical History of the War of the Rebellion (1861–1865)* in which the projectile type was identifiable. The Minié ball caused the most wounds—about 108,000 (75%) compared to about 16,000 round ball cases (Adams 1996:114). Surgeons reported that the higher velocity Minié ball caused greater damage than the round ball, although at close range both caused severe injury. Confederate Surgeon E. Lloyd Howard wrote that Minié bullet wounds “are characterized by extensive fissuring and comminution, such as was rarely, if ever, seen when the old smooth-bore

musket was the weapon of the soldier” (Howard 1864:88–89). Another surgeon declared that “[t]he shattering, splintering, and splitting of a long bone by the impact of the Minié or Enfield ball were, in many instances, both remarkable and frightful ... amputation was the only means of saving life” (Cunningham 1958; Kuz and Bengtson 1996:14; Bollet 2002:148).

The detached limbs in the pit have injuries that made them candidates for the life-saving operation of amputation, a common Civil War surgical procedure (Cunningham 1958; Kuz and Bengtson 1996; Bollet 2002; Gabriel 2013). Amputation facilitated hemostasis (halting blood flow) and helped cleanse the wound, as the procedure allowed tying of the severed blood vessels and complete removal of the damaged portion containing debris and bacteria introduced by the traveling projectile (Slawson 2017). Amputation transformed a complicated, dirty wound into a simpler, cleaner wound, albeit the operation itself was unsterile.

A summary of data from the *Medical and Surgical History of the War of the Rebellion (1861–1865)* by medical historian Alfred Bollet (2002:144–154) reports that, out of 174,206 recorded shot wounds to limbs, Union surgeons treated nearly 30,000 by amputation. The patient fatality rate was about 26%. The overall mortality rate for upper-extremity amputations was less than lower-extremity amputations, 12.6% vs. 40.2%, respectively. Fatality rates also varied based on the amputation location, increasing with greater proximity to the torso. Hand and foot amputations had lower patient fatalities, while shoulder and hip joints had the highest rates. Timing of the amputation also influenced patient outcomes. Although knowledge of the microbial cause of infections was not yet understood or incorporated into wound care, surgeons knew that survivorship was more likely when amputations were done within 48 hours of injury. These procedures, termed “primary” amputations, experienced the lowest fatality rate recorded during the war, 24% for upper- and lower-limb amputations combined. “Intermediary” limb amputations, done three days to a month after injury, and secondary procedures, performed more than a month after injury or in response to infection or improper healing, had less optimal patient outcomes, with fatality rates of 35% and 29%, respectively (Barnes 1870–1888[3.2]:879). The importance of conducting amputations as soon

as possible after injury resulted in critical surgeries at field hospitals near combat areas.

In this battlefield pit, amputations are limited to lower limbs. Civil War amputation was more common for lower limbs, especially the thigh, with injuries to the hip and knee joints the most difficult to successfully treat. The fatality rate for thigh amputations was 54%. Amputations involving the hip joint had an 83% fatality rate, the highest of the Civil War (Barnes 1870–1888[3.2]:877). This degree of mortality is likely why B1 exhibited no surgical intervention. Based on the position of the embedded Enfield bullet high in the proximal femur, treatment would have been amputation at the hip—a challenging procedure with little chance of survival even in a controlled surgical environment.

No upper-extremity amputations and the presence of only one leg (below the knee) amputation suggests lower-limb wounds requiring thigh amputations were, in this instance, preferentially treated. Partial upper-limb bones were identified in the trench assemblage, but none had evidence of injury or surgery. Individual B2 has a wounded right humerus, and it is possible that the face-down position of two of his four sack-coat buttons was caused by retraction of the coat front and sleeve to expose the wound and stabilize the injured arm prior to treatment, but no treatment is evident. Amputation of B2’s arm would have involved the scapula joint due to severe breakage of the proximal humerus. Relatively few shoulder amputations were recorded by Union surgeons. The procedure’s fatality rate ranged from 24% (primary surgeries) to 48% (intermediary) (Barnes 1870–1888[3.2]:879). Based on the severity of the injury and battlefield conditions, the surgeon may have opted for conservative treatment, such as cleaning, debriding, and splinting the wound. Individual B2 may also have had additional wounds not visible in the poorly preserved skeleton but indicated/suggested by recovery locations of buckshot. Serious injuries to the head, chest, or abdomen would have excluded amputation as a course of treatment (Kuz and Bengtson 1996).

A lack of upper-limb amputations and only one amputation below the knee is surprising, given these procedures were common during the Civil War; both have equally high numbers recorded by Union surgeons (about 5,500) and are tied for the third-most frequent amputation performed. Of note, however, is the recovery of incomplete, highly fragmented

upper limbs during trenching that disturbed one margin of the pit. The second-most and most common amputations are those of the thigh (6,369 cases) and hands and feet (7,902), respectively (Barnes 1870–1888[3.2]:877). Operations at this field hospital may have been focused on the most life-threatening injuries capable of being addressed on the frontline. Wounds deemed less urgent, or with greater risk to the patient, were perhaps determined to be better treated off the battlefield in more formal hospital settings. This surgically conservative approach may reflect experience. Data from the war showed treating upper-limb shot fractures conservatively favored patient outcomes, while similar injuries to lower limbs benefited from amputation (Hamilton 1866). It may also be the case that the pit represents a surgical station specific to lower-extremity injuries. However, the presence of B2 is inconsistent with this scenario.

Associating the Pit with the Battle of Second Manassas

The remains in this pit were buried during the first 18 months of the Civil War at one of the two battles fought at Manassas. This period is known for the inadequate support provided to injured troops, culminating in two of the worst medical disasters in U.S. military history (Adams 1996; Freeman 1998; Bollet 2002; Rutkow 2005; Schroeder-Lein 2008; Humphreys 2013). Linking data from the pit to information documented for the Civil War provides a more nuanced interpretation of medical care in this case and associates these bones with the Battle of Second Manassas, and, more precisely, its aftermath.

The 21 July 1861 Battle of First Manassas was the first major conflict of the Civil War. Numbers vary, and Union casualties are estimated at nearly 500 killed, over 1,000 wounded, and as many reported missing. Confederate troops had slightly less than 400 killed, about 1,500 wounded, and 12 or 13 missing (Livermore 1900:77; Schroeder-Lein 2008:53). Neither side was prepared for the large number of wounded. Both medical corps lacked trained surgeons, reliable ambulance systems, and organization on the battlefield. This led to what one historian summarized as

a savage military engagement fought by poorly trained troops who received treatment from

inadequately prepared physicians. ... With few available surgical supplies and no plans in place to evacuate casualties, the injured lay for days on the ground where they fell. ... Many received neither medical attention nor so much as a mouthful of water. (Rutkow 2005:5–6)

Second Manassas, fought 13 months later, was a larger conflict. It began on 28 August 1862 and ended two days later with an overnight Union retreat. It is estimated that, of the participating 63,000 Union troops, nearly 1,800 were killed, over 8,000 wounded, and between 4,000 and 6,000 soldiers captured or missing. Of the approximately 54,000 Confederate troops, about 1,500 were killed, over 7,500 wounded, and 89 missing (Livermore 1900:88–89; R. Johnson and Clough Buel 1985:500; Schroeder-Lein 2008:55; D. Johnson 2013:173). This was the largest battle to that point in the war, and, again, the medical departments were grossly unprepared. Despite U.S. Army Medical Corps plans for standardized field-hospital and ambulance systems, they had yet to be fully implemented, and the initially designated main field hospital was too far from the battle, making it ineffective for evacuating Union wounded. In addition, most of the operational ambulances with needed medical supplies were left behind as the Army of the Potomac rushed troops to the Manassas battlefield. Therefore, transporting and treating the wounded surpassed the earlier battle in “inexpediency, ineptitude, and consequent suffering” (Rutkow 2005:182). Instead of hundreds left wounded and dying on the field, in 1862 there were thousands. Union wounded lay unattended for days without food or water.

Unlike the Battle of First Manassas, the Union army secured permission from Confederate commander General Robert E. Lee for a medical party to access the battlefield and collect the wounded. On Monday, 1 September 1862, an ambulance train of civilian drivers, 200 wagons, and about 20 military surgeons with additional staff and civilian volunteers were allowed onto the battlefield under a flag of truce. A central location for assembling and treating the injured was established in an orchard, where “the operation of amputation was performed when necessary” (National Republican 1862:3). Instead of the ambulances making multiple trips to transport wounded to the central location until all were treated, many civilian surgeons and volunteers departed

prematurely after loading only some of the wounded (Barnes 1870–1888[1.1.appended documents]:129). After the first day this left few skilled surgeons, no trained assistants, and no means to transport the wounded from where they fell. In addition, the Union Army retreated from the nearby town, leaving stockpiles of medical supplies, blankets, and food under Confederate control.

The firsthand account of U.S. Army Assistant Surgeon Benjamin Howard provides further insight into the situation. Stranded on the battlefield and operating with only brandy and sugar to sustain him, he estimated that, after three days, 3,000 wounded remained untreated. Despite this, he wrote that, “of those brought to the peach orchard, with few exceptions, all were submitted to the necessary operations” (Barnes 1870–1888[1.1.appended documents]:129). On Thursday, 4 September, a second train of ambulances with food and supplies from Washington was allowed onto the field (Barnes 1870–1888[1.1.appended documents]:126). Removal of the wounded resumed 6 September, and the last of the injured were paroled and transported to Washington area hospitals on 9 September, 10 days after the battle had ended (Duncan 1931). An estimated 4,000 wounded were collected from 21 locations across a 10 × 7 mi. area (Barnes 1870–1888[1.1.appended documents]:126; United States War Department 1887:263).

Evidence of Medical Care

Although the Union wounded from both battles suffered from a lack of medical services on the field, better care was rendered after Second Manassas. Surgical competency had also improved by this time. The U.S. Army began the war with 113 surgeons, 24 of whom joined the Confederacy (Cunningham 1958; Adams 1996; Rutkow 2005). Most volunteer troops initially relied on the services of doctors from local communities, most of whom had little to no knowledge of the unique needs of active military troops and no experience with battlefield trauma and surgery. By 1862, the U.S. Army Medical Department determined that only physicians with the most experience should perform surgeries (Rutkow 2005). That same year, physicians lacking adequate medical skills were discharged, and measures were implemented to test basic knowledge and abilities in physician recruits.

The amputated limbs of this study indicate a skilled, experienced surgeon performed the operations. Marks in the sectioned bones correspond in text-book fashion to surgical procedures of amputation detailed in 19th-century medical guidebooks (S. Smith 1862). The evidence also suggests the surgeon demonstrated sound judgement in assessing what injuries most required treatment, possibly abstaining from surgical intervention when conservative treatment favored patient survival or when risks of operating seemed too great. In the aftermath of Second Manassas at least one surgeon reported refraining from operating after days on the field due to the uncertainty of their departure (Barnes 1870–1888[1.1.appended documents]:129).

Artifacts as Evidence

The few artifacts best align with the 1862 battle. The Enfield bullet lodged in the femur of B1 is significant when combined with accounts of weapons purchased for the Confederacy. Enfield ammunition would have accompanied shipments of Enfield arms because these English rifles and rifle-muskets had slightly smaller bore diameters than American-made counterparts. The first documented import of Enfield arms into the South occurred after the Battle of First Manassas, on 18 September 1861. Prior to that, in early May 1861, 400 Enfield rifles were ordered for infantry companies of South Carolina (United States War Department 1880), but it is unclear when these arms were received. Most sources suggest it was after July 1861; these rifles could have been among the documented September shipment. A Confederate government agent in England made his first purchase of Enfield ammunition on 6 August 1861. This ammunition may have been part of the September cargo (Thomas 1997). Another shipment of 9,620 Enfield rifles arrived in Savannah on 13 November 1861 (Sword 1986). Enfield rifles were in the hands of Confederate troops soon after the Battle of First Manassas and certainly were in use by Second Manassas. This does not, however, completely exclude the use of Enfield ammunition at First Manassas. One U.S. Army regiment of New York volunteers was already armed with Enfield rifles and ammunition (Lewis 1956). The regiment is unnamed and cannot be confirmed as seeing combat at First Manassas, but the information

presents the less likely possibility that B1 may have been a victim of friendly fire at either battle.

The four-button sack coat worn by B2 was more prevalent at Second Manassas and the most common coat worn by Union troops at that time. The U.S. Army adopted this coat for all troops in 1858 (Todd 1974), but initially the U.S. War Department found it challenging to outfit the substantial number of recruits. Many soldiers were supplied uniforms through state or local volunteer militias. This was the case at First Manassas, where most, but not all, Union troops were volunteers and militia wearing state-issued uniforms. Contracts to produce massive quantities of sack coats began in July 1861, and, by June 1862, 367,684 had been commissioned. Based on records of the Civil War Quartermaster department (Crosman 2013), large numbers of sack coats were distributed during the 13 months between the two Manassas battles.

The absence of clothing for B1 also aligns with the aftermath of the 1862 battle. The dead and wounded left on the field were described as partially clothed or stripped of most clothing and usable items. A civilian volunteer who accompanied surgeons onto the field exclaimed: “I saw hardly a decent pair of pantaloons, a blouse, or a pair of shoes on a dead man” (Duncan 1913:11). B1 may have been a victim of such treatment. His clothing may also have been removed by medical staff after the battle since the wounded had lain in soiled garments, some for several days, prior to receiving care. One double amputation survivor left wounded on the field stated that, when doctors came to collect the injured, “[o]ur garments had been cut from our persons for sanitary reasons” (Tanner 1927:126).

Burial

The shallowness of the pit, its contents, and the lack of adherence to standard burial practices reflects an expedient interment after battle by persons not connected to the deceased. There is one account of burial during the 1862 Manassas battle (*National Tribune* 1885), however, this was rarely feasible during conflict, even, and especially, at a field hospital, as all able-bodied military personnel were engaged in fighting or saving lives. Due to the large number of dead, battlefield burials were commonly assigned to a special detail for digging graves, usually near where soldiers died, often burying multiple unidentified men

together. A standard method was often employed to save time and effort:

a shallow grave about a foot deep, [was dug] against the first man in a row and he was then laid down into it; a similar grave was dug where he had lain. The ground thus dug up and served to cover the first man, and the second was laid in a trench, and so on, so the ground was handled only once. (Resnick et al. 1997:13)

On 4 September 1862, the recently mustered 139th Pennsylvania Volunteers arrived to bury Union dead on Manassas battlefield (United States War Department 1887:259–263). They continued for three days, burying about 1,800 individuals. In their desire to complete the unpleasant task of burying bodies exposed for days in the summer sun on enemy-controlled territory, the inexperienced burial crew likely exercised expediency over diligence. On 23 September, a second burial detail was sent because bodies in the shallow graves became exposed in only a month (Cunningham 1958).

The medical party sent onto the battlefield to treat and gather the wounded also dealt with the dead, days before the burial crew arrived. Surgeon Thomas Ellis records that he and other medical staff were accompanied that first day, 1 September 1862, by a Confederate burial crew. Together they buried 85 Union dead in a mass grave (Ellis 1863). The next day Ellis observed medical depots across the battlefield where some were “engaged in burying a number of the dead” (Ellis 1863:236). Burial commencing soon after the medical corps were allowed onto the battlefield is supported by a Confederate cavalryman, who reported: “White flags were flying all over the field today and the Citizens Relief Commission of Washington, with two hundred ambulances, were on the field burying the dead and gathering the wounded” (D. Johnson 2013:174).

Given these accounts, those who dug this shallow pit for the amputated limbs were likely members of the medical party. The pit is assigned to the work of the surgeons, and all remains had similar injuries, unlike the variety of injuries on battlefield dead. The entire pit was dug before remains were placed in it, as B1’s body and the amputated limbs were found in opposing ends of the grave and were deposited before the central body (B2) was laid. Also, at least one more limb was deposited after B2. As operations

were performed and deaths occurred, men and limbs may have been placed in this pit over the short period of time between 1 and 6 September, when surgeons operated on the battlefield.

The John Dogan Farm

The location of the pit is most significant in linking it to the 1862 battle and its aftermath. It also presents the possibility of associating the buried remains with specific events and people. For site integrity and protection, the pit's exact location remains undisclosed, but it resides on the John Dogan property, also known as Rosefield. In 1860, John Dogan farmed 416 ac. of land, centrally located on what became the overlapping battlegrounds of both Manassas conflicts. Dogan's home and associated structures were situated atop a prominent ridge overlooking the Warrenton Turnpike, a thoroughfare during both battles. In addition to the main residence, there was a separate kitchen house, an unknown number of slave dwellings (Dogan's records include 19 enslaved individuals in 1860), at least two other outbuildings, chicken coops, hog pens, and corncribs (White 2012). Nearby were stands of hardwoods, two springs, orchards, and the flowing-water source of Young's Branch.

Like all battlefield residences, John Dogan's house and its related structures could have served as a makeshift field hospital, but no documentation places medical personnel there during the 1861 Battle of First Manassas. After that battle, a Confederate officer seeking shelter at the John Dogan house recounts that the "porch, yard, and stable adjoining the yard, seemed full of the enemy's wounded" (W. Smith 1882:441). However, no comment was made of medical services provided by either Union or Confederate surgeons at that location.

In contrast, sources linked to the 1862 battle cite medical activity at John Dogan's farm. Union forces occupied Dogan Ridge from 28 to 30 August (Roemer 1897; Hennessy 1985, 1999). On the 29th, artillery batteries assumed position on the rise near the Dogan residence, setting up in "a fine orchard" (Roemer 1897:73). At the same time, a Union field hospital was established there by J. A. Peters, assistant surgeon, 21st New York Volunteers. A survivor of the battle reported: "Upon the hill among the guns of the battery, the Dogan House, where Dr. Peters had established his hospital and was caring for the wounded,

just in our rear, we lay the balance of the night" (Mills 1887:261). On 30 August, a "short-lived fight in the Dogan orchard gave the Federals on Dogan Ridge time enough to retreat in safety" as Union commander Pope withdrew his Army (Hennessy 1999:427).

Two full days after the battle, U.S. Army medical personnel and volunteers arrived from Washington, D.C., to gather and care for the injured left behind. They selected a central gathering place, an orchard on the north side of Warrenton Turnpike past the Stone House, a frequently referenced structure located less than a mile east of Dogan's residence. For at least four days, medical care, including amputation, was performed. Medical-party member, Surgeon A. H. Smith, reported that, "[b]etween Monday morning and Thursday night, numerous amputations were performed at the central depot by the surgeons detailed for that purpose" (Barnes 1870–1888[1.1.appended documents]:129). Another surgeon, Thomas T. Ellis, wrote that the central spot was a "depot on the hill" located "about a mile beyond the stone house" (Ellis 1863:234). Surgeons "performed some of the necessary operations" so "all that had been brought to the depot were cared for" (Ellis 1863:236). Volunteer M. Boyd, who had assisted U.S. Army Assistant Surgeon Benjamin Howard, commented that "[t]he headquarters of the ambulance train were established upon a commanding point, on rising ground" (*New York Daily Herald* 1862:1). Dr. Howard himself describes the rendezvous location as "A peach orchard on the right of Warrenton Turnpike Road," where he was "constantly operating" (Barnes 1870–1888[1.1.appended documents]:128–129). U.S. Army Medical Director McParlin reported: "A number of operations were performed at the rendezvous," adding: "Surgeon Page, and Assistant Surgeons Clements, Webster, Jaquette and Howard, USA were occupied at the rendezvous several days" (Barnes 1870–1888[1.1.appended documents]:116).

John Dogan's farm is not explicitly named as the central depot in these first-hand reports, but its location—an orchard on a rise about a mile from the Stone House, north of Warrenton Turnpike—describes this property and no other. Its central and strategic position made it an ideal staging ground for gathering the wounded from surrounding points on the battlefield. It was close to a main thoroughfare for transporting the injured back to Washington and offered shelter, shade, and water, all available on or near a rise from

which to survey the surrounding fields for incoming supply wagons and ambulances.

Nearly 50 years after the battle, a series of articles written by military surgeon Louis C. Duncan and published in the journal the *Military Surgeon* included a review of medical activities at Second Manassas (Duncan 1913). These articles were later published as a book, *The Medical Department of the United States Army in the Civil War* (Duncan 1931). Duncan, who quoted extensively from the original reports in the *Medical and Surgical History of the War of the Rebellion*, added John Dogan's name to the orchard and central gathering location for the wounded, although without providing references for this information.

Identifying the Wounded and the Surgeon(s) Who Treated Them

Knowing what took place at the Dogan property and the names of operators at this location makes identification a possibility, as the amputations may be reported in *The Medical and Surgical History of the War of the Rebellion*. This extensive compilation identifies the type of amputation (primary or intermediary), affected limb, side (left or right), surgical location on the limb (proximal, middle, or distal), injury date, surgery date, operator, and the name, military rank, and regiment of the wounded soldier. These details provide a basis for suggesting identities of the amputations in the excavated pit.

Thirty primary thigh and upper-leg amputations could be compiled for men at Manassas on the dates of the battle (28–30 August 1862), a surprisingly small number. Twenty of the amputations have no named surgeon and none are attributed to Dr. Peters, credited with establishing the field hospital at the Dogan residence. Dr. Peters either did no surgeries, kept no surgical records, or ceded these duties to others. As several regiments were fighting near the John Dogan house, it may have briefly served multiple surgeons as a field hospital or dressing station during the battle.

A comparable list of intermediary amputations, the likely scenario for the remains in the pit, were compiled for surgeries done 1–8 September 1862 for injuries sustained at Manassas on 28, 29, or 30 August. Forty-two thigh and upper-leg amputations were initially identified. Removed from the list were six amputations performed by doctors known to be

elsewhere on the battlefield or at hospitals in or near Washington, D.C. While 36 intermediary amputations remain as possible matches for the study pit (Table 4), side is unknown for 10 amputations, and thigh or leg location is unspecified for 6.

The 36 amputations were performed by 8 named doctors; the surgeon is unnamed in 15 cases. Assistant Surgeon Benjamin Howard is identified 14 times (entries bolded in Table 4). All other names appear only once. Of the handful of surgeons acknowledged at the rendezvous by Medical Director McParlin, only Howard's name appears on the list of doctors who performed amputations, signifying he was a primary operator among the medical party on the battlefield. During the dates he was at Manassas, Howard was also the operator for a middle leg amputation, elbow resection, upper-arm amputation, and excision of the jaw (Barnes 1870–1888[2.2, 2.3]). It is possible that one or more of the other named surgeons were at the rendezvous as well, but no data have been found supporting this. Howard himself comments on the lack of trained assistants.

Of the 14 men who received intermediary amputations by Howard, nearly all were injured 30 August 1862, and they belonged to regiments that fought at disparate locations on the battlefield. The diversity of regiments represented by his patients supports Howard's presence at the central gathering place and the bringing of wounded to that location from areas across the battlefield. Due to the nature of the terrain, under normal circumstances it would be impractical for men wounded at some of these locations to have been treated at the Dogan property, the only known location where Howard worked while on the battlefield. The gathering process continued as late as 5 September, when Drs. Howard and Green traveled with newly arrived ambulances to Mr. Cross's house "to bring in some of the wounded" (*New York Times* 1862). Since amputations credited to Howard end after 6 September, it is presumed he returned to Washington, D.C., as part of the transport carrying wounded to city hospitals. Soon after he is performing surgeries on the battlefield at Antietam in Maryland.

Howard's 14 amputations provide a compelling comparison with the bones from the pit (Table 5). Each study limb has more than one possible match, although six of Howard's entries have incomplete information, making them possible matches for several limbs. Recorded amputations without a named operator done between 1 and 6 September may also

Table 4 Intermediary amputations recorded for Second Manassas from treatment records

Name	Rank	Company	Regiment	Location of Amputation	Surgeon	Side	Injured, Amputated	Location on Field
Marble, J. D.	Pvt	D	7th WI	Upper 1/3 leg	—	Right	Aug. 28, Sept. 1	Brawner Farm
Call, J.	Pvt	E	3rd MI	Lower 1/3 thigh	Mackenzie	Left	Aug. 29, Sept. 2	Sudley Springs
Freyer, W.	Pvt	K	1st MI	Thigh, unspecified	Howard	Right	Aug. 30, Sept. 2	Deep cut
Kehr, C.	Pvt	I	58th NY	Upper 1/3 leg	—	Left	Aug. 30, Sept. 2	Unfinished railroad
McLaughlin, G.	Pvt	A	84th NY	Upper 1/3 thigh	McCall	—	Aug. 29, Sept. 2	Groveton
Whaley, C. H.	Pvt	G	84th NY	Lower 1/3 thigh	—	—	Aug. 30, Sept. 2	Deep cut
Eagan, L. W.	Pvt	—	22nd NY	Upper 1/3 thigh	Howard	Right	Aug. 30, Sept. 3	Deep cut
McKenna, J.	Pvt	I	11th PA	Upper 1/3 leg	Howard	—	Aug. 30, Sept. 3	Chinn Ridge
Terry, W.	Pvt	I	3rd PA Res.	Thigh, unspecified	Howard	Left	Aug. 30, Sept. 3	Henry Hill
Werneck, F. J.	Cpt	D	54th NY	Lower 1/3 thigh	Crain	Right	Aug. 29, Sept. 3	Unfinished railroad
Fox, M.	Pvt	B	1st MI	Thigh, unspecified	Howard	Right	Aug. 30, Sept. 4	Deep cut
Hodgeboom, W. B.	Pvt	K	5th NY	Leg, unspecified	Howard	—	Aug. 30, Sept. 4	Groveton
Stone, B.	Cpt	K	11th MA	Middle 1/3 thigh	Howard	Right	Aug. 29, Sept. 4	Unfinished railroad
Laugbery, J. M.	Pvt	B	11th PA Res	Leg, unspecified	—	Right	Aug. 30, Sept. 4	Chinn Ridge
Stevens, ?	Pvt	—	13th MA	Thigh, unspecified	Howard	Right	Aug. 30, Sept. 4	Chinn Ridge
Clune, J.	Pvt	F	14th Inf.	Middle 1/3 thigh	—	Right	Aug. 30, Sept. 5	Henry Hill
Donnelly, R.	Pvt	A	25th OH	Lower 1/3 thigh	Summers	Right	Aug. 30, Sept. 5	Chinn Ridge
Gardiner, J.	Pvt	—	73rd OH	Lower 1/3 thigh	Howard	Right	Aug. 30, Sept. 5	Chinn Ridge
Hatch, O. C.	Pvt	C	48th PA	Upper 1/3 leg	—	Right	Aug. 29, Sept. 5	Unfinished railroad
Jennings, T.	Pvt	—	24th NY	Upper 1/3 thigh	Howard	Right	Aug. 30, Sept. 5	Groveton/Deep cut
Muller, E.	Pvt	F	29th NY	Middle 1/3 thigh	—	Left	Aug. 29, Sept. 5	Unfinished railroad
Will, J.	Pvt	A	10th NY	Lower 1/3 thigh	Howard	—	Aug. 30, Sept. 5	Groveton
Winkler, J.	Pvt	C	4th PA	Lower 1/3 thigh	Howard	Right	Aug. 30, Sept. 5	Henry Hill
Clark, G. W.	Sgt	C	30th NY	Upper 1/3 leg	Howard	Right	Aug. 30, Sept. 6	Deep cut
Pitcher, J.	Pvt	K	94th NY	Middle 1/3 thigh	—	Right	Aug. 29, Sept. 6	Chinn Ridge
Rodgers, E. F.	Sgt	C	1st MI	Unspecified	Howard	Right	Aug. 30, Sept. 6	Deep cut
Kerrigan, J.	Pvt	K	5th NY	Middle 1/3 thigh	Dorr	Right	Aug. 30, Sept. 7	Groveton
Case, H.	Pvt.	I	12th NY	Upper 1/3 leg	Weisel	Right	Aug. 29, Sept. 8	Deep cut
Cooper, A.	Cpl	F	101st NY	Middle 1/3 thigh	—	Left	Aug. 30, Sept. 8	Unfinished railroad
Fitzmorris, E.	Pvt	K	12th NY	Lower 1/3 thigh	—	Right	Aug. 30, Sept. 8	Deep cut
Powers, J.	Pvt	H	74th NY	Lower 1/3 thigh	—	—	Aug. 29, Sept. -	Unfinished railroad
Weiss, C.	Pvt	F	29th NY	Lower 1/3 thigh	—	—	Aug. 29, Sept. -	Unfinished railroad
Brasier, J. P.	Pvt	C	75th OH	Lower 1/3 thigh	Bigelow	Right	Aug. 30, Sept. -	Chinn Ridge
Cupp, W.	Pvt	A	44th NY	Lower 1/3 thigh	—	—	Aug. 30, Sept. -	Deep cut
Murit, B.	Pvt	H	17th NY	Upper 1/3 thigh	—	—	Aug. 30, Sept. -	Deep cut
Rowell, A.	Pvt	F	94th NY	Upper 1/3 thigh	—	—	Aug. 30, Sept. -	Chinn Ridge

Source: Barnes (1870–1888[2.3]:tables XXXIV, XXXV, XXXVI, XXXVII, LXXII, LXXIII, LXXXV).

Table 5 Howard intermediary amputation possible matches

Pit Limb	$\delta^{13}\text{C}_{\text{col}}$	$\delta^{18}\text{O}_{\text{ap}}$	%c	Amputation	Side	Possibility 1	Possibility 2	Possibility 3	Possibility 4	Possibility 5	Possibility 6	Possibility 7
C	-17.17	24.1		Proximal thigh	Right femur	Eagan (NY)	Jennings (NY)	Stevens (MA) ^b	Freyer (MI) ^b	Rodgers (MI) ^b	Fox (MI) ^b	—
E	-18.29	24.4		Proximal thigh	Right femur	Eagan (NY)	Jennings (NY)	Stevens (MA) ^b	Freyer (MI) ^b	Rodgers (MI) ^b	Fox (MI) ^b	—
A	-17.09	24.1		Middle thigh	Right femur	Stone (MA)	Stevens (MA) ^b	Freyer (MI) ^b	Rodgers (MI) ^b	Fox (MI) ^b	—	—
F	-17.68	23.2		Middle thigh	Left femur	Terry (PA) ^b	Will (NY) ^a	—	—	—	—	—
J	-17.2	23.6		Middle thigh	Left femur	Terry (PA) ^b	Will (NY) ^a	—	—	—	—	—
B	-17.31	23.6		Distal thigh?	Left femur	Terry (PA) ^b	Will (NY) ^a	—	—	—	—	—
D	-17.05	23.1		Distal thigh	Right femur	Gardiner (OH)	Winkler	Will (NY) ^a	Stevens (MA) ^b	Freyer (MI) ^b	Rodgers (MI) ^b	Fox (MI) ^b
G	-18.98	23.1		Proximal leg	Left tibia	Hodgeboom (NY) ^c	McKenna (PA) ^a	—	—	—	—	—

^aSide unspecified.^bLocation unspecified.^cSide and location unspecified.

have included Howard's work, expanding the number of possible matches between the study limbs and intermediary amputation list. Even without including these cases, there are more amputations assigned to Howard than bones in the pit, although the pit remains to be fully excavated. Its prior disturbance from plowing and possible displacement of bones offers another explanation. Alternatively, if Howard operated at more than one location on the property, the study remains may represent only one of two or more pits containing human remains from activities at the rendezvous. Operations there are described as being done in the Dogan orchard and, when rains became intense, were moved to shelter. In any case, Assistant Surgeon Benjamin Howard heads the list of surgeons trained and experienced enough to be credited with professionally amputated limbs in the study pit.

Although the osteobiographies of those represented by the injured limbs are defined here mostly by their injuries, humanizing these remains might focus on one known survivor of Second Manassas. Private George Coons suffered wounds resulting in the amputation of his left leg by Surgeon Jacob Y. Cantwell, 82nd Ohio, at the Stone House. Left behind during the Union Army's retreat, Private Coons lingered without food, water, or medical care until the group of U.S. Army medical personnel were allowed on the battlefield. Private Coons was taken to Carter Hospital in Washington, D.C., and was discharged 25 November 1862. George Coons lived as a prosperous farmer and businessman until his death in 1920 at the age of 80. He was regularly sent a wooden prosthetic, so many, in fact, that his family recalled finding discarded legs in silos, haylofts, and closets of the old family farm. Descendants of Private George Coons remain grateful to the doctors who served at Manassas, who, in their words, "allowed at least one man to have a fine, full life" (Roger Coons Williams 2018, pers. comm.). The story of Private George Coons serves as a proxy for those missing limbs, individuals who were both visible measures of the cost and losses of war (Faust 2008), and symbols of fortitude, courage, and great pride.

Then and now the remains of soldiers are honored for service to country. Memorialization of war dead was first formalized during the Civil War by the creation of national cemeteries (Cohn and Silvio 2002). In 2018, the two skeletons from the pit were interred at the most known of these spaces, Arlington National Cemetery.

Transformed by weapons of war and the surgeon's saw, the limb bones retain significance not only as representations of individual soldiers but as examples of the life-saving efforts of the physician. But, just as the bones in this pit were transformed by the surgeon, the surgeon and American medicine were transformed by the bones of war. Civil War doctors recognized that American medicine would benefit from continued access to such amputations, as well as cadavers. They created the Army Medical Museum, now the National Museum of Health and Medicine, and anatomical acts that allowed use of the body for science. In Shauna Devine's comprehensive writing about the transformation in American medicine during and after the Civil War, the author states: "The war allowed, even demanded, the acquisition of specimens and bodies and, in doing so, altered perceptions of the body ... and the different ways (it) could be studied to develop knowledge" (Devine 2014:214).

Further discussion of this study's findings might center on the notion of these remains as sacred or subject, and how past and present events alter these perceptions, which, in turn, can change *who* is remembered and *how* (see the "Historical Bioarchaeology" thematic collection in *Historical Archaeology* [Novak 2020]).

Conclusion

Inherent in the discovery of human bones are obligations to investigate the circumstances and identities of found remains. The interdisciplinary approach of historical bioarchaeology is a means of investigation uniquely informative in this case given the context of the discovery and the availability of supporting data. This study's human remains add perspective to the actions and outcomes of those participating in this major Civil War conflict, those who fought and those who endeavored to keep men alive. Leg injuries imply movement across open, unprotected terrain. Bullet trajectories not only reveal those men moving toward their adversary or turned away, but in some cases, offer insight as to proximity of the opposing forces. The pit's remains show the devastating projectile damage to bones caused by 19th-century firearms and the life-saving efforts of skilled surgeons under challenging circumstances. The two mortally wounded men with untreated injuries suggest surgical triage

and perhaps intervention withheld when wounds were deemed inoperable or the chance of a successful outcome unlikely.

The surgeon's decisions of when and how to treat the injured in cases like these must be measured relative to the location of this pit and what occurred there. Evidence from the pit aligns with the Battle of Second Manassas, when John Dogan's Rosefield served initially as a Union field hospital and then a designated central gathering place for the thousands of wounded left behind by the retreating Union Army. Surgeons and volunteers affiliated with Federal forces arrived at the enemy-controlled battlefield under permission to treat and gather the wounded, many left for days without food, water, or care. They rendered aid as they were able until surgeons became uncertain whether operations could be tolerated by men already so weakened from their ordeal. The medical party found itself impaired from continued disorganization and Confederate control that led to the continued lack of ambulances, supplies, and food.

Assistant Surgeon Benjamin Howard and his comrades were commended for their service at the time, but their work is rarely known or acknowledged today. This study reveals their dedication and efforts under brutal circumstances, particularly those of Howard, who is named as surgeon for many of the lower-extremity amputations done on the battlefield in the aftermath of Second Manassas. Further archival research, extended isotope studies examining the origins of these men, and genealogical and genetic research provide avenues for establishing personal identification of some of the limbs. But, even without specific identities assigned, Howard's account of these events, as well as those of others who served and survived, like George Coons, enhance the pit's interpretation and provide perspective on late 19th-century medical training and research.

Events at Second Manassas should be fully acknowledged as part of the essential transformation that propelled American battlefield medical care toward the creation and implementation of an effective triage protocol and emergency-transport or ambulance system.

Additional outcomes include a cadre of well-trained surgeons (Reilly 2016) and appreciation for the necessity of detailed records and specimens that further contributed to achieving more effective treatments. "The Civil War could not have occurred without the support of its medical staff, suppliers, and volunteers, and medicine in America could not have been modernized so

quickly without the war” (Paciorek 2007:10). This pit is a stark reminder of the personal price paid for these advancements.

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Data Availability Images of human remains are available for research purposes and can be accessed by contacting the corresponding author.

Declarations

The National Park Service is dedicated to preserving and protecting the nation’s history, including at Civil War battlefield sites. Discoveries of human remains at these solemn spaces of sacrifice and service follow ethical guidelines for their treatment, documentation, and recovery. The inadvertent discovery and unique historical context of the human remains in this study resulted in mitigation that included excavation and analysis. Co-operative agreements with the Virginia Department of Historic Resources and the United States Army resulted in transfer of the two soldiers (Burials 1 and 2) to the Army’s 3rd U.S. Infantry Regiment, “The Old Guard,” for burial at Arlington National Cemetery in September 2018.

Conflict of interest The authors declare that they have no conflict of interest.

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