

# Cushing and the treatment of brain wounds during World War I

## Historical vignette

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Harvey Cushing, perhaps the most important founder of American neurosurgery, was an Army neurosurgeon in France from 1917 to 1918. Over a 3-month period in 1917 he and his team operated on 133 soldiers with a brain wound. The operative mortality rate for their last 45 patients was 29%, considerably lower than the usual postoperative mortality rate of approximately 50% for those with a brain wound. This accomplishment was lauded at the time and eventually, for some, it was Cushing who was responsible for lowering the postoperative mortality rate of brain wounds during World War I. As the decades passed he was eventually credited as the “originator of brain wound care.” This report shows that these attributions are misplaced. Cushing merely followed the enlightened surgical precepts of the time developed by Continental (European) surgeons. It also examines Cushing’s writings to ascertain how these misperceptions concerning his originality might have been generated. (DOI: 10.3171/2011.1.JNS101259)

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EARLY in WWI, contaminated and infected soft-tissue wounds were often incompletely debrided. They were then dressed so they would remain open to ensure drainage.<sup>9,13,32,51</sup> The wound was often then bathed in various antiseptics and closed secondarily many days after receipt of the wound. Most brain wounds in this war were also treated in this fashion. Surgeons commonly made a cruciate scalp incision, fashioned a small craniectomy at the skull penetration site, cleansed the brain wound track, and drained it through a partially or unclosed scalp.<sup>38</sup> Using this open drainage technique the early postoperative mortality rate of debrided brain wounds often ranged from 44% to at least 60%.<sup>1,2,16,43,57</sup>

In the US, if not elsewhere, Harvey Cushing is often credited as the person primarily responsible for altering brain wound care in this war to achieve a mortality rate substantially lower than other WWI surgeons. Thus Matson, an American WWII surgeon, stated, “During World War I, 1914–1918, the operative mortality in acute penetrating missile wounds of the head was reduced principally due to the operative techniques introduced by Harvey Cushing from 50 to 60 percent early in the war to 28.8 percent in his last series of 45 cases.”<sup>46</sup> More recently, Brandvold et al.<sup>11</sup> stated that Cushing was the “originator of brain wound care.”

But how could this be? The US did not enter the war

until April 1917. By this time that European war had been raging for more than two and a half years, and by then Continental (European) surgeons had treated thousands of patients with a brain wound. Prior to 1917, but anticipating possible US entry into the war, select American surgeons were sent to Europe to work with their European counterparts either in Allied (France, Russia, Great Britain, and Italy) or Central Powers (Germany and Austria-Hungary) hospitals.<sup>45</sup> There they learned to treat wounds inflicted by industrial warfare. Did Cushing possess special insights because he was among the world’s most experienced brain surgeons and had spent a brief time treating brain wounds at The American Hospital in Paris in 1915? This is unlikely because during this 4-week stay in France he operated for only about 10 of those days, on only a few French soldiers.<sup>18</sup> Furthermore, when he began treating brain wounds in earnest in 1917, his early surgical mortality rate approximated 55%.<sup>27</sup>

How then has Cushing received so much credit for introducing operative techniques that dramatically reduced wartime brain wound mortality? Some of these techniques continued to be used in WWII<sup>46,58</sup> and in the Korean<sup>47</sup> and Vietnam wars.<sup>40,41</sup>

## Cushing’s Experience in France, 1917–1918

Cushing arrived in France as part of Harvard’s contribution to the Allied war effort on May 30, 1917.<sup>20</sup> The Harvard Unit, although part of the US Army Medical Corps, was assigned to British No. 11 General Hospital

Abbreviations used in this paper: BJS = British Journal of Surgery; BMJ = British Medical Journal; WW = World War.

located by the sea in Camiers, France. General Sir Anthony Bowlby, in charge of all forward British hospitals in France, then assigned Cushing to Casualty Clearing Station No. 46 located just a few kilometers behind the front for the Passchendaele Offensive, which lasted from July 31 to November 10.<sup>22,52</sup> Cushing remained there from July 22 through November 1.<sup>23</sup>

During this time he and his team operated on 219 soldiers with a head wound. One hundred and thirty-three of these wounds involved the brain. Cushing documented this experience in 2 papers. The first paper was a modest work of 6 pages published in the *BMJ* in February 1918. There he gave his mortality data and provided a brief outline of his surgical technique.<sup>27</sup> The second paper, a stupendous study of 126 pages published in the *BJS* in April 1918, discussed many types of head and brain wounds, their treatment, and mortality rates.<sup>28</sup> As these 2 papers underlie his reputation as the originator of brain wound care, at least for some, a careful reading of them is worthwhile to learn how Cushing achieved this exalted status.

### Details of Cushing's Publications in the *BMJ* and *BJS*, 1918

In his *BMJ* paper,<sup>27</sup> Cushing noted that 55 of the 133 patients with brain wounds died postoperatively, yielding an overall operative mortality rate of 41%. For the first month at Casualty Clearing Station No. 46, Cushing and his team operated on 44 soldiers, 24 (54.5%) of whom died. During the second month, 18 (40.9%) of 44 operative patients died, while for the third month, 45 underwent debridement but only 13 (28.8%) succumbed. Cushing denied this improvement occurred because of case selection; rather, it reflected experience and the evolution of operative technique.

Cushing stated that the main features of his surgical technique were: 1) removing the skull en bloc around the site of cranial penetration; 2) detecting indriven bone fragments by palpating them along the missile track by means of a soft rubber catheter; 3) removing pulped brain along the missile track by applying gentle suction to the catheter; and 4) instilling the antiseptic dichloramine T dissolved in oils into the cleansed wound track and onto the dura at the end of the debridement. Removing a portion of skull around the missile entry site instead of nibbling bone away (removing bits of bone piecemeal) around this site avoided working directly in the area of contaminated bone. It also allowed an examination of the removed inner skull table. Missing inner table bone was sure to be in the brain and required removal. Cushing evinced a great disdain for finger palpation of the wound track to locate bone fragments. "Almost from the outset"<sup>27</sup> he used a soft rubber catheter to explore the missile track, palpate indriven bone fragments, and remove them (as well as disorganized brain) by applying gentle suction to the catheter. Toward the end of his experience Cushing began instilling Dakins' dichloramine T dissolved in oil in the wound track and simultaneously noted a reduction in postoperative infections.

In addition to the 4 "essential" features listed above, Cushing ascribed other features of his neurosurgical care

that he believed contributed to the lowering of the mortality rate. These secondary items included a preoperative neurological examination, obtaining stereoscopic roentgenograms to localize indriven foreign bodies, full shaving of the head so no wounds would be missed, administering local anesthesia, making a tripartite scalp incision, removing intracerebral metallic fragments with a magnet, closure of the wound with galeal sutures, and dressing serious wounds in the operating room. Interestingly, in his *BMJ* article Cushing did not specifically mention primary wound closure, a fundamental change from the usual way of treating a brain wound by open drainage; he did, however, provide 3 illustrations showing this.

On one hand Cushing<sup>27</sup> assured readers that, "Aside, possibly, from the principle of track suction there is nothing original about (his) procedure" while on the other he stated that the secondary items listed above "though less novel were nevertheless contributory to the successful outcome of the more severe cases." The reader might infer that, despite his disclaimer, Cushing's secondary surgical techniques were at least somewhat novel.

Concluding his *BMJ* article Cushing acknowledged that the British surgeons Sargent (whom he had visited in France in 1915 and 1917) Gray, Anderson, and Wagstaffe had contributed to the improvement in cranial operations. Except for noting Gray's observation that an awake patient under local anesthesia could materially help the operation by coughing on command to extrude pulped brain,<sup>39</sup> Cushing did not mention any specific contributions made by the others or refer to any of their several published writings, even though some had been treating brain wounds for years instead of months (as Cushing had).

Cushing's *BMJ* paper showing such an ultimately low mortality rate made an impression because that journal's editorialists highlighted it at the time of its publication, lauding Cushing's "remarkable achievement."<sup>33</sup> After reiterating his technique the editorialist gave thanks to Cushing as well as "to the initial contributions of Gray, Sargent, and many other British surgeons (plus) our continental brethren." Cushing clearly knew from whence many of his surgical ideas came but chose not to specify their origins. The *BMJ* editorialists working on a publishing deadline could not investigate these matters more thoroughly and would not have considered that their job.

### Cushing's Failure of Attribution

A modest amount of reading in the American Civil War and WWI surgical literature allows one to learn of prior wound classification schemes, preoperative patient evaluation and preparation, as well as surgical techniques that Cushing incorporated and wrote about without specific acknowledgment.

#### *Head Wound Classification*

Cushing's elaborate layer-by-layer delineation of head wounds put forth in his *BJS* paper recalls the scheme used to classify head wounds during the American Civil War. Cushing was quite familiar with the surgical writings of this war.<sup>17,50</sup>

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## *Preoperative Neurological Examination*

The importance of the preoperative neurological examination was stressed by several British surgeons years before Cushing came to France as an army surgeon.<sup>42,54,59</sup> In 1915, for instance, Percy Sargent, one of England's foremost neurological surgeons, and Gordon Holmes, eventually one of England's premier neurologists, wrote, "Too much importance cannot be attached to a complete examination of the local lesion but of the symptoms of cerebral disturbance in each case as these are the only reliable indications of the extent and intensity of the intracranial injury."<sup>56</sup> As these writings were in the English medical literature Cushing was sure to have read them.

## *Completely Shaving the Head*

The necessity of completely shaving the head was emphasized by several WWI surgeons including Sargent, who wrote of this in 1915, the year Cushing visited him.<sup>39,42,56,59</sup>

## *Local Anesthesia*

Local anesthesia was widely used during WWI. The May 1917 Interallied Conference (see below) on the treatment of brain wounds concluded that local anesthesia was preferred.<sup>15</sup>

## *Scalp Incision*

Cushing's tripartite incision was really a variant of the commonly used cruciate incision.<sup>38</sup>

## *Use of a Bone Flap to Expose the Damaged Brain*

The great French neurosurgeon Thierry de Martel advocated and published on use of a bone flap to expose the damaged brain in 1917. This work was translated into English in 1918.<sup>12</sup>

## *Disdain for Finger Exploration of the Brain Wound Track*

Cushing's disdain for finger exploration of the brain wound track may well have come from Sargent, who in 1915 admonished, "On no account must the finger be thrust deeply and roughly into the brain."<sup>56</sup>

## *Use of an Electromagnet to Extract Ferrous Intracerebral Foreign Bodies*

Among the many WWI surgeons to use an electromagnet to extract ferrous intracerebral foreign bodies were de Martel,<sup>12</sup> Tuffier<sup>61</sup> and Depage.<sup>29</sup> Cushing visited Tuffier in 1915 to learn of French neurosurgery.<sup>19</sup> Unequivocally, Cushing followed de Martel's technique closely, including sliding an ordinary, sterile, large building nail down the wound track to contact the metallic fragment. Once contact had been made the nail was magnetized and withdrawn along with the metallic fragment.

## *Incising an Intact Dura to Remove an Underlying Clot and Pulped Brain*

Owing to the potential for infection, incising an intact dura to remove an underlying clot and pulped brain was a very controversial subject.<sup>38</sup> Cushing advocated

this approach in his *BJS* paper. As early as 1915, however, Tabuteau<sup>59</sup> advocated opening an intact dura when it was "discoloured, non pulsating and doughy." Pulped brain or clot lay below. He opined that such brain might "act as a foreign body and give rise to after-symptoms." In 1916 Gray concurred and reported that in this circumstance intact dura had been opened more than 50 times without fatality in hospitals that he supervised.<sup>39</sup>

## *Primary Wound Closure*

Although Cushing did not specifically mention primary wound closure for brain wounds in his *BMJ* paper he dwelt upon it at considerable length in his *BJS* paper. By 1917 the treatment of soft-tissue wounds had gone through several stages. As previously stated, early in the war they were modestly debrided and then left open to allow drainage. Various disinfectants were then applied for many days, notably Dakin's hypochlorite solution. Bacterial studies of the wound exudate were performed and when the bacterial count had greatly decreased the wound was sutured closed secondarily. This process took many weeks. Not only was it very labor intensive, but for the war effort it meant that thousands were kept from effective service for a protracted period of time. Because of these shortcomings several French surgeons quite early in the war began thoroughly debriding fresh wounds that were contaminated but not yet infected. They meticulously removed all dead tissue, foreign bodies, and bone sequestra. Some then simply closed the "mechanically disinfected" wound. Others washed the completely debrided wound with chemicals such as ether or iodine (adding "chemical disinfection") in the operating room before immediately closing it. As performed in this fashion by sophisticated surgeons in the appropriate circumstances, this so-called primary wound closure was surprisingly successful. In 1916 Le Maitre (cited by Cushing below) reported 216 successes in 218 such closures. In 1918 he reported 1555 successes from 1618 primary closures, with only 19 complete failures. If surgeons for whatever reason did not feel primary wound closure was feasible they would pack the thoroughly debrided wound open. Granulation tissue would form and the wound would then be definitively closed 3–6 days later. This was called a delayed primary closure.<sup>32,35,51,62</sup> These techniques were used by Central Powers surgeons as well.<sup>64</sup>

As WWI progressed it became apparent that often a great disparity existed in wound treatment techniques between British and French surgeons. This came to the attention of Lloyd George, the British Prime Minister, and he mandated that joint conferences on wound care be established so that the best techniques would be disseminated to all Allied medical personnel. The first Interallied Surgical Conference was held in March 1917 and these conferences were held at frequent intervals thereafter and their contents published.<sup>37</sup> Brain wound treatment was discussed at the 7th conference held on May 18, 1917.<sup>14</sup> At this meeting, of the 3 surgeons who discussed surgical technique, one advocated primary closure when possible,<sup>61</sup> another closed the scalp primarily but left a gauze wick in the missile entry site for 24 hours,<sup>31</sup> while the third initially closed the scalp loosely over a pack and then definitively closed it 48 hours after the brain

debridement (performed a delayed primary closure).<sup>29</sup> The final consensus adopted by the conference was that surgeons had the option of closing well-debrided brain wounds either primarily or secondarily.<sup>15</sup> Willems, a Belgian surgeon, attended this May conference and with his associate, Albert, thereafter incorporated primary brain wound closure into their surgical armamentarium.

In his *BJS* paper Cushing dwelt at length on the primary closure of brain wounds but failed to cite those who had performed this long before he had arrived, nor did he cite the consensus of the May Interallied Surgical Conference of which he was certainly aware. In this paper he stated, without attribution:

...early in the war many surgeons who dealt largely with cranial injuries came to advocate the immediate excision and closure of a scalp wound overlying fractures with penetration. They were doubtless forced to this alternative more because of the unhappy consequences of a fungus cerebri in case of wounds left open than through any broad conception of the general principles of primary wound closure which was then discountenanced.

We are now aware, largely through the pioneer work of French military surgeons, that so far as possible during the first few hours before infection takes place practically all wounds should be given the chance of union by primary suture. The necessity of the most detailed primary debridement of the wound as emphasized by Depage, Duval, Le Maitre and others before these immediate closures are attempted is making its way as a matter of fundamental surgical as well as military importance.<sup>28</sup>

Cushing did not include references for these surgeons' works, but the Index Medicus for 1916 lists papers by Lemaître,<sup>44</sup> Depage,<sup>30</sup> and Duval<sup>33</sup> that concern soft-tissue or extremity wounds. Having set forth the increasing acceptance of primary wound closure for extremity wounds, Cushing then continued, "These principles apply no less to cranio-cerebral wounds than to the extremities..."<sup>28</sup> The immediate juxtaposition of Cushing's last sentence to his preceding exposition on the development of the primary closure of extremity wounds without divulging that many surgeons were already closing brain wounds primarily, or that the May Interallied Conference sanctioned this technique, is misleading. It may have led many uninformed readers to believe it was Cushing who formulated the idea that if extremity wounds could be closed primarily so could brain wounds. Possibly this underlies the misconception that Cushing was the originator of brain wound care, the individual who first had a broad conception of the general principles of primary wound closure as they applied to the brain.

### Cushing's WWI Surgical Predecessors

The first WWI surgeon to report on the success of primary closure for noninfected brain wounds was Robert Bárány in 1915 (Fig. 1).<sup>7</sup> He was a surgeon with the Austro-Hungarian army and assigned to a hospital located in the Przemysl fortress, which later was surrounded by the Russian army. He began using this method in December 1914 and produced a brief manuscript outlining his results and treatment rationale, which he completed by the end of January 1915. The manuscript was flown to Vienna for publication in *Wiener klinische Wochenschrift*



FIG. 1. Robert Bárány (1876–1936) graduated from medical school in Vienna in 1900. He joined an otology clinic there in 1903 and did his seminal work on the human vestibular system thereafter. Following WWI he was Professor of Otology at the University in Uppsala, Sweden. This US government picture is from a Wikipedia article on Bárány.

in May. An expanded version appeared later in the year in *Beiträge zur klinischen Chirurgie*.<sup>5</sup> In this latter work Bárány noted that the wounded could not be evacuated and he could follow his patients for a long time. Thus, he could compare the outcomes of patients whose brain wounds were treated by conventional open drainage and those whose wounds were treated with immediate scalp closure after brain debridement. Among 21 patients with a survivable brain wound treated with missile track cleansing and open drainage, 13 (62%) died of brain infection.

Bárány observed that in some "segmental" wounds the entrance and exit sites just under the scalp might be infected but these superficial infections did not extend deep within the brain. He gradually came to believe that early after wounding the deep part of the missile track was uninfected. When open drainage was used, the initially uninfected brain became infected from the outside environment through the open skin. He then reasoned that thoroughly debriding a contaminated but not yet infected wound followed by skin closure might avoid secondary bacterial infection and allow primary wound healing to occur. Emboldened by this reasoning, Bárány performed primary wound closure on 13 patients with a brain wound. Four patients with severe wounds died the day of surgery. None of the 9 others succumbed.

Bárány concluded that if a gunshot wound presented before the development of gross infection (within the first 24 hours of wounding) the patient must be operated upon immediately. The wound entrance (and exit) site had to be excised, bone splinters and foreign bodies had to be removed from the brain, meticulous hemostasis obtained, and the entire wound primarily closed without drainage. This carefully reasoned approach was not from someone “forced” into primary brain wound closure.

Bárány’s radical approach drew immediate condemnation by more senior, academic surgeons.<sup>53</sup> Wilms, discussing the matter at a Central Powers war wound symposium in Brussels in April 1915, stated that the open treatment for tangential wounds was the normal method for war. He noted that Bárány’s method could only be performed in circumstances in which aseptic surgery could be carried out, where the wounded person could be operated on within 10–12 hours of wounding, where the wound was not dirty, and where there was an experienced surgeon in attendance.<sup>66</sup>

As few English-speaking people speak or read German, Bárány’s seminal works running completely against the established surgical wisdom were easily overlooked by British and Americans. That Bárány could not attend the Brussels meeting, Przemysl was captured, and Bárány was sent to a Russian prison camp also hindered the reading of his work. He could neither defend nor promote his ideas concerning primary closure. (Bárány was awarded the Nobel Prize in 1914 for his work on the vestibular system. Following negotiations among Swedish authorities, the Red Cross, and the Russians, Bárány was released from prison camp in 1916 so he could travel to Stockholm to receive his award. [[http://en.wikipedia.org/wiki/Robert\\_Bárány](http://en.wikipedia.org/wiki/Robert_Bárány)] He later devoted considerable energy to fully exploring the subject of primary wound closure.<sup>6</sup>)

In 1916 Velter<sup>63</sup> published his experience with 36 patients who had a penetrating brain wound. All scalp wounds were closed primarily after brain debridement. All but 1 soldier had been admitted to Velter’s surgical unit within 2–6 hours of wounding. The maximum delay until surgery was 40 hours owing to receiving large numbers of wounded. Nine patients died (25%). Six died of their severe brain injury and 3 died of infection. Two of these latter patients appeared to have an established infection when Velter first operated on them. Velter followed the 27 surviving patients 4–8 weeks after their debridement. He insisted that surgery for a brain wound be performed as an emergency. After thorough cleansing of the brain wound track he closed the dura with catgut, debrided and disinfected the scalp, then sutured it closed to achieve healing by primary intention.

Finally, in January 1918, more than a month before Cushing finished his *BJS* manuscript,<sup>25</sup> Willems and Albert<sup>65</sup> published preliminary results of 13 brain-wounded soldiers whose scalps they had closed primarily. All of these soldiers survived. Only 2 wound complications occurred: a small cerebral hernia that resolved following 3 lumbar punctures, and a superficial brain abscess, also successfully treated. Remarkably, Cushing’s 126-page *BJS* paper is silent on these antecedents. In fact, the paper is devoid of a single reference! For this Cushing apologized “that he has not had access to the abundant litera-

ture on the subject (of brain wounds) for this has prevented making suitable reference to the writings of others...”<sup>28</sup> Absent specific references, Cushing appears as the precocious innovator, especially from the way he structured his paper concerning primary brain wound closure.

It is true that wartime surgical papers submitted from a battle zone are sometimes devoid of references for the reasons Cushing stated.<sup>36,55</sup> Cushing, however, made 4 trips to Paris between November 1917 and February 1918 when he submitted his *BJS* paper for publication.<sup>24</sup> There he had access to several great medical libraries. Furthermore, his reason for not citing those who performed the primary closure of brain wounds before him is patently false. In a paper presented at the American Philosophical society in April 1916 in which he discussed the treatment of wartime brain wounds after his 1915 stay in Paris, Cushing cited Bárány’s *Beiträge zur klinischen Chirurgie* paper.<sup>5,17</sup> And in his short *BMJ* article Cushing referred to 5 separate papers written by British and French surgeons.<sup>1,16,39,43,57</sup> Cushing definitely made use of the published literature on brain wounds when it suited him even in a war zone. Citing Abadie and Cuneo in his *BMJ* paper reveals that he had perused *La Presse Médicale* for the year 1916, in which Velter had published his outstanding results showing a surgical mortality rate possibly better than his own.

Cushing had another avenue whereby he undoubtedly learned of the latest on brain wound care—Sir Anthony Bowlby. Within a few days of arriving in France and being assigned to British General Hospital No. 11, Cushing met Bowlby. He then spent from the 6th through the 14th of June 1917 touring many frontline hospitals with him. In their journals neither Cushing<sup>21</sup> nor Bowlby<sup>10</sup> mentioned any substantive neurosurgical discussions that might have occurred during this tour but to this reviewer it is inconceivable that Bowlby did not inform the famous, newly arrived Cushing of the latest ideas on brain wound care. After all, Bowlby had just presented a paper on this subject at the May 17th Interallied Conference.<sup>8</sup>

From these revelations one can see that far from being the originator of brain wound care Cushing followed well-established practices developed by European surgeons. In his writings he appeared to be innovative to those unfamiliar with WWI surgery because Cushing purposely failed to mention those who preceded him, those who truly made original contributions. One may argue that Cushing was in strained, wartime circumstances that precluded the usual, careful annotation process and, anyway, he just wanted to get his paper out into the world. Even within this context, however, he could have easily referenced Bárány and Velter. Not to have done so is inexplicable as was his slight of Sargent and Thierry de Martel. Perhaps this treatment was the basis of Sargent’s subsequent “disdain...of anything originating in American clinics.”<sup>34</sup>

### The Reaction of Some American Surgeons

Cushing’s lack of candor did not go unrecognized by his WWI surgical peers. His failure to recognize those upon whose shoulders he stood was spotted almost immediately by Neuhoof of Columbia’s Base Hospital No. 2

and Towne and Goethals of Cushing's own Base Hospital No. 5 (which had been incorporated into British No. 11 General Hospital). Neuhof, in his extensive paper discussing the evolution in the treatment of brain wounds, remarked:

To the credit of American surgeons it can be stated that under the leadership of Colonel Harvey Cushing they contributed a real share to whatever progress (in the treatment of brain wounds [M.E.C.]) has been made. This was not arrived at through the development of new or original methods but by the adoption of the most desirable elements in the methods of Continental surgeons.<sup>49</sup>

Towne and Goethals,<sup>60</sup> in their extensive literature review of WWI brain debridement techniques, discovered the papers of Tabuteau, Bárány, and Velter. They called these individuals "prophets...largely without honor." (This reviewer regards Tabuteau as a minor prophet. Although he did close some brain wounds primarily [as did Gray and occasionally others], in contrast to Bárány and Velter, Tabuteau's paper was not mainly about this point). Pointedly, Cushing was not recognized as a prophet even by his own hospital colleagues. But these latter 2 papers were published in 1920. The war to end all wars was over; thoughts were now turned to peace, the Versailles' treaty, and the League of Nations. The great flu pandemic consumed much of the medical world. The papers by Neuhoff<sup>49</sup> and Towne and Goethals<sup>60</sup> on a subject seemingly irrelevant were relegated to an old journal on a library shelf, unremembered. Meanwhile, Cushing, the international neurosurgical luminary, continued to dominate the field and is influential to this day. Naturally, if an American wanted to learn about WWI neurosurgery he would turn to Cushing's writings. Need one go further?

Trying to set the historical record straight and uncovering Cushing's less than candid wartime writings have greatly disappointed this author. Why did such a medical great as Cushing not acknowledge his antecedents? Why did he not just state that by the time he arrived in France primary brain wound closure was becoming more widely accepted? This would not have diminished the great worth of his brain wound papers. His ability to conceptualize and classify the various types of brain wounds was useful in itself and presaged his great work classifying meningiomas.<sup>26</sup> This lack of acknowledgement remains a mystery.

As for many others caught up in the cataclysm of war, Cushing could not quite put it aside either. He published the book *From a Surgeon's Journal* in 1936 a few years before he died. This work meticulously recounted his days in wartime France when he "was a soldier once... and young."<sup>48</sup> He had more than 20 years to make amends to those whom he had slighted in his wartime writings. He could have recognized them in his book but he did not. Hugh Cairns, a neurosurgeon, was the first Nuffield Professor of Surgery at Oxford and headed the British military neurosurgical effort during WWII. Dr. Cairns also studied with Cushing in Boston in 1926. In a letter to his wife at that time, Cairns wrote: "Cushing had the reputation of not giving sufficient credit to his assistants."<sup>74</sup> It appears that this trait of "not giving sufficient credit" extended to the accomplishments of his surgical forebears and peers as well.

## Disclosure

The author reports no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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## Editorial

### Harvey Cushing

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Placing any major surgeon's achievement in the context of the complex history of his specialty is bound to be difficult and perilous, the more so when the surgeon in question is a prima donna, not inclined toward meticulous or generous acknowledgement of the work of predecessors. The great strength of Dr. Carey's paper<sup>1</sup> is its account of how, in his reports of his battlefield surgery in 1917, Cushing incorporated contributions made by a number of Continental surgeons, notably Bárány and Velter, without giving them explicit credit.

The Europeans, after all, had been treating brain wounds since the start of their war in 1914. The Americans were late entrants to the conflict and to the surgical problems it posed. Cushing's apparent reluctance to acknowledge the work of his predecessors can be seen as a case study of the very broad tendency of Americans to believe that nothing particularly important or innovative had happened in the war until they came along and won it. History is now inclined to notice how many lessons the American forces fighting in France had to learn from their allies, and their enemies. Even Cushing came to recognize some of the wisdom, both military and surgical, accumulated by the men who had served far more time in the trenches than the Yankee doughboys and their medics.

One of the glories and frustrations of researching history is to find that exercises in contextualizing events can themselves be contextualized. It is somewhat surprising that this paper makes no reference to innovations in neurosurgery before World War I, almost as though no intracranial work had been performed. But of course, many of the techniques used in wartime had been pioneered earlier, some of them in fact by Cushing himself. For many years before the war he had been disdaining any contact between fingers and brain tissue, had been completely shaving patients' heads, had mastered bone flap techniques, experimented with local anaesthesia, and practiced primary closure, among other techniques. How would the story of wartime neurosurgery read if we traced all the peacetime influences on Cushing's continental associates?

Aside from being malignly influenced by his ego and his arrogance, Cushing was perhaps genuinely conflict-

ed about his relationship to his predecessors. As Carey notes,<sup>1</sup> he did, often enough, recognize that his work was unoriginal, especially in any given particular. It was in perfecting the complete experience, the total approach to the surgical problem, from shaving to suturing and everything in between, that Cushing achieved a whole that was greater than the sum of its parts, resulting in what appears to have been a great leap forward in outcomes (assuming that we can trust statistics from that era; Cushing appears to have been unusually rigorous in his use of statistics, but there is considerable room for doubt). To use an inappropriate metaphor, Cushing achieved his good results through an approach characterized by perfectionist overkill.

Similarly, his 126-page 1918 paper on his work at Passchendaele was a kind of publishing overkill, the uses of which Cushing well understood. Is it any surprise that this massive and comprehensive article would have been so often cited and so influential as English-speaking surgeons confronted brain wounds in later conflicts? It is not so clear, however, that to have published an extremely influential text on the subject necessarily made Cushing the "originator of brain wound care." Dr. Carey<sup>1</sup> draws this phrase from a 1990 article about craniocerebral injuries in fighting between Israelis and Lebanese. Is he setting up a straw man? To my knowledge no one writing primarily about Cushing's place in the history of neurosurgery has made a claim for the war work that is nearly so sweeping.

In the context of his total contributions to neurologic surgery, Cushing's battlefield experiences in World War I appear to have been derivative and perhaps secondary. It is an important corrective to note how he structured reports of his accomplishments in ways that appeared to slight predecessors and competitors. At the same time, much more could be said about the remarkable dedication with which this senior and aging surgeon (48 years old in 1917) risked his health and his career to serve his country in wartime. He did not shirk and he did not complain, except about the incompetence and laziness of people around him. A case can be made that Cushing's long hours of work under primitive conditions on one of the bloodiest battlefields in history were his very finest.

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## Response

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I wish to thank Professor Bliss for his outstanding biography of Harvey Cushing and especially for having reviewed my paper. This article was difficult for me to write. To impugn a main founder of modern neurosurgery is not something I undertook lightly. I debated with myself for more than 20 years before deciding to write of Cushing's failure to cite B $\acute{a}$ r $\acute{a}$ ny's precedence in the matter of the primary closure of wartime brain wounds. While it is true that neither of Cushing's chief biographers, the physiologist John Fulton and the historian Michael Bliss, considered Cushing to be the chief architect or originator of wartime brain debridements, eminent neurosurgeons have done so (see references 11 and 46). Clinicians are more apt to turn to prior, relevant clinical papers to obtain background material on subjects they are pursuing rather than purely historical accounts. I, therefore, believed it important to publicize the facts concerning the primary closure of brain wounds in the neurosurgical literature to prevent historical error by future neurosurgeons.

Cairns' observation of Cushing's failure to credit others helps explain Cushing's disregard of B $\acute{a}$ r $\acute{a}$ ny's (and Velter's) achievements. Professor Bliss provides two more clues: Cushing's ruthlessness and penchant for self-promotion.<sup>1</sup> I have been gratified to gain a further insight from Mr. Peter Schurr who reviewed this manuscript after I had submitted it to the *Journal of Neurosurgery*:

Shakespeare wrote in Twelfth Night that some achieve greatness and some have greatness thrust upon them. The effect of this achieving and thrusting is often to make the individual think he (or she) has some sort of divine messianic destiny. This allows him or her to take all sorts of liberties, which could include the adoption of work that was done by other people, either in the past or the present. They also become dogmatic and will not tolerate criticism or accept suggestions. I am sure you have done a service by pointing out a "correction factor" that is necessary in appreciating Cushing's contribution to our specialty but I still think he deserves the accolade of being the chief founder of modern neurosurgery. I know that Dandy and many others would not have agreed. Cushing borrowed tech-

niques from orthopaedic and plastic surgery but it was his colleagues and contemporaries who put Cushing on his pedestal. Once there he enjoyed the view.

The reader must not think that I dispute Cushing's great leadership in neurosurgery. Before World War II many American physicians who desired additional training went to Europe to study. As Professor Bliss has noted<sup>1</sup> many European surgeons came to the US in the 1920s to learn from Cushing. This must have been a first: European physicians learning from American physicians. However, Cushing advised readers that the neurosurgical work conducted at Casualty Clearing Station No. 46 was performed by a "neurosurgical team" (see references 27 [pp. 222, 226] and 28 [p. 559]). Although Cushing apparently operated on most of the wounded, junior team members also operated (see reference 28 [p. 559]). Cushing acknowledged by name several of the nonsurgeons who provided help at Casualty Clearing Station No. 46 as the hospital commander and the unit's photographer (references 27 [p. 226] and 28 [p. 284]). Strangely, he failed to name a single junior surgeon who directly contributed to his surgical results. A generous individual would have been more forthcoming regarding his surgical comrades immersed in the hell of Passchendaele. Cairns was right.

### Acknowledgment

Mr. Peter H. Schurr, CBE, qualified as a physician in 1943 after studying at Cambridge and University College Hospital London. Captain Schurr then served as a surgeon in the Royal Army Medical Corps in Egypt and Greece. After the war he trained in neurosurgery at Oxford with Sir Hugh Cairns and then spent a year as a research fellow in surgery at Harvard University. Upon returning to London Mr. Schurr became a neurosurgical consultant at both Guy's and Maudsley Hospitals from 1955 to 1985. He was then granted emeritus status. From 1977 to 1985 he was Honorary Consultant to the Queen Mary Military Hospital, Woolwich, London. Mr. Schurr was President of the Society of British Neurological Surgeons from 1982 to 1984.

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