

*Even with modern medical and surgical techniques, Lincoln would not have survived the severe distortion of the skull and large cavity formation in the brain caused by Booth's shot.*

## The Wound That Killed Lincoln

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**N**INETY-NINE YEARS AGO, on the evening of April 14, 1865, Washington was aglow with happy hysteria over the surrender of Lee at Appomattox five days earlier. Grant, the conquering hero, was in town and the newspapers had suggested that he might accompany President and Mrs. Lincoln to Ford's Theatre that evening.<sup>1,2</sup> People flocked to the theatre.

Just after the second intermission, at about 10 PM, a dashing, compulsive young actor named John Wilkes Booth entered the front door of the theatre, bantered with the ticket taker, who knew this popular actor well, and ascended rapidly to the dress circle. There he paused for a moment while he selected a letter or visiting card from several in his pocket, to show to anyone who might challenge him, and advanced toward the door of the presidential box, which was at the right side of the theatre and built partly out onto the stage. By a stroke of luck, he found no guard at the door of the box.<sup>3</sup>

Booth knew that the lock on the box door was broken and would yield to the gentlest pressure.<sup>4</sup> He quickly let himself inside and picked up a stout wooden bar which he had hidden just inside the door earlier in the day and wedged it between the moulding at the edge of the door and a notch which he had cut in the plaster behind the door. Booth then found himself in the long narrow anteroom which ran behind both the boxes. The two boxes had been let together by removing the partition between them as was the custom when the presidential party used the box. Booth then knelt and peered through a tiny hole which he had drilled in one of the doors between the anteroom and the main portion of the box, during his visit earlier that day. Through this hole he could see President Lincoln, who was seated in the left end of the box, nearest the audience but shielded from it by a woven curtain so that he was visible only to those directly across the theatre. Lincoln was sitting in a high-backed rocking chair with satin cushions (Fig 1). On Lincoln's right sat Mrs. Lincoln and on her right, close to the front of the box, sat Major Rath-



Fig 1.—Rocking chair in which Lincoln was sitting when shot by John Wilkes Booth in Ford's Theatre.

bone and his fiancée. Having ascertained the location of the President, Booth then entered the occupied portion of the box via one of the two doors from the anteroom. Testimony indicated that since the large rocking chair partly blocked the door directly behind Lincoln, the assassin probably proceeded toward the door at the end of the anteroom which was nearer the stage and slipped in behind Major Rathbone's settee and Mrs. Lincoln's chair, pointing his small Derringer pistol at the President's head and pulling the trigger when he was about two feet away.<sup>4</sup> The unexpected, loud report startled not only those in the box but also the audience and the players, who all looked toward the box in bewilderment, not knowing whether this was part of the action of the play or an unexpected development. Major Rathbone leapt from the sofa and moved toward the well-dressed intruder, who shouted something which Major Rathbone thought sounded like the word "freedom." As Rathbone approached, the assassin raised a glittering hunting knife with a 7¼ inch blade and slashed at Rathbone who parried the blow upward with his left

forearm.<sup>4</sup> The knife, which was extremely sharp, caused a deep laceration which extended from near the Major's elbow upward along the upper arm for a distance of several inches, despite the protection of his civilian jacket. The wound bled profusely. The intruder then evaded Rathbone and climbed backwards over the edge of the box, striking his left toe on the frame of a large engraving of Washington which hung on the front of the box and catching his left spur in one of the flags which draped the front. While Booth had jumped down to the stage from heights greater than this in many of his acting roles, the catching of the spur apparently caused him to land heavily on his left foot, tearing the carpet and causing a transverse fracture of his fibula just above the ankle. Despite the fracture, he shouted the motto of Virginia, "*Sic Semper Tyrannis*" (so always to tyrants), and limped quickly across the stage in full view of the audience, waving his knife as he went.

#### First Physician on the Scene

The screams of Mrs. Lincoln could be heard coming from the box and a young Army assistant surgeon, Dr. Charles A. Leale, rushed from his nearby seat, to the door of the President's box which was blocked effectively by Booth's barricade. The wounded Major Rathbone finally made himself heard through the door and persuaded those outside to stop pushing so that he could dislodge the obstructing bar. Surgeon Leale was the first inside and found the President still seated in the rocking chair with his head slumped forward on his chest; he was kept from sliding onto the floor by the support of Mrs. Lincoln. Dr. Leale found him pulseless and apneic, and quickly transferred him to the floor of the box where he gave him mouth-to-mouth respiration and then moved to a position astride his chest to give artificial respiration. It has been stated that he pressed upward on the abdomen and chest to stimulate the heart. How similar his maneuvers were to modern closed chest cardiac massage, one can only conjecture but the similarity of modern recommendations for resuscitation is interesting.<sup>5, 6, 29</sup> In any case, his immediate resuscitation measures were successful and respirations and pulse were restored. Dr. Leale was a Lincoln admirer who had come to the theatre to see the President after completing his day's work in charge of the officers' ward at the U.S. Army General Hospital at Armory Square. His own account of the event, written in 1909, is worth quoting. He wrote:

*(Original spellings retained throughout historical documents.)*

As I looked at the President, he appeared to be dead. His eyes were closed and his head had fallen forward. He was being held upright in his chair by Mrs. Lincoln, who was weeping bitterly.

I placed my finger on the President's right radial pulse but could perceive no movement of the artery. For the purpose of reviving him, if possible, we removed him from his chair to a recumbent position on the floor of the box, as I held his head and shoulders while doing this, my hand came in contact with a clot of blood near his left shoulder. Remembering the flashing dagger in the hand of the assassin, and the severely bleeding wound of Major Rathbone, I supposed the President had been stabbed, and while kneeling on the floor over his head, with my eyes continuously watching the President's face, I asked a gentleman to cut the coat and shirt open from the neck to the elbow to enable me, if possible, to check the hemorrhage that I thought might take place from the subclavian artery or some other blood vessel. This was done with a dirk knife, but no wound was found there. I lifted his eyelids and saw evidence of a brain injury. I quickly passed the separated fingers of both hands through his blood matted hair to examine his head, and I discovered his mortal wound. The President had been shot in the back of the head, behind the left ear. I easily removed the obstructing clot of blood from the wound, and this relieved the pressure on the brain.

As the President did not then revive, I thought of the other mode of death, apnoea, and assumed my preferred position to revive by artificial respiration. I knelt on the floor over the President, with a knee on each side of his pelvis and facing him. I leaned forward, opened his mouth and introduced two extended fingers of my right hand as far back as possible, and by pressing the base of his paralyzed tongue downward and outward, opened his larynx and made a free passage for air to enter his lungs. I placed an assistant at each of his arms to manipulate them in order to expand his thorax, then slowly to press the arms down by the side of the body, while I pressed the diaphragm upward: methods which caused air to be drawn in and forced out of his lungs.

During the intermissions I also with the strong thumb and fingers of my right hand by intermittent sliding pressure under and beneath the ribs, stimulated the apex of the heart, and resorted to several other physiological methods. [Perhaps he used anal dilation, a popular method.] We repeated these motions a number of times before signs of recovery from the profound shock were attained; then a feeble action of the heart and irregular breathing followed.

The effects of the shock were still manifest by such great prostration, that I was fearful of any extra agitation of the President's body, and became convinced that something more must be done to retain life. I leaned forcibly forward directly over his body, thorax to thorax, face to face, and several times drew in a long breath, then forcibly breathed directly into his mouth and nostrils, which expanded his lungs and improved his respiration. After waiting a moment I placed my ear over his thorax and found the action of the heart improving. I arose to the erect kneeling position, then watched for a short time, and saw that the President could continue independent breathing and that instant death would not occur.

I then pronounced my diagnosis and prognosis: "His wound is mortal; it is impossible for him to recover."

When the brandy and water arrived, I very slowly poured a small quantity into the President's mouth, this was swallowed and retained.

We decided that the President could now be moved from the possibility of danger in the theatre to a house where we might place him on a bed in safety. To assist in this duty I assigned Dr. Taft to carry his right shoulder, Dr. King to carry his left shoulder and detailed a sufficient number of others, whose names I have never discovered, to assist in carrying the body, while I carried his head, going first. We reached the door of the box and saw the long passage leading to the exit crowded with people. I called out twice: "Guards, clear the passage! Guards, clear the passage!" A free space was quickly cleared by an officer and protected by a line of soldiers in the position of present arms

with swords, pistols and bayonets. When we reached the stairs, I turned so that those holding the President's feet would descend first. At the door of the theatre, I was again asked if the President could be taken to the White House. I answered: "No, the President would die on the way."

It was necessary to stop several times to give me the opportunity to remove the clot of blood from the opening to the wound.

The great difficulty of retaining life during this brief time occupied in moving the President from the theatre to Mr. Petersen's house, conclusively proved that the President would have died in the street if I had granted the request to take him such a long distance to the White House. I asked for the best room and we soon had the President placed in bed. He was lifted to the longitudinal center of the bed and placed on his back. While holding his face upward and keeping his head from rolling to either side, I looked at his elevated knees caused by his great height. This uncomfortable position grieved me and I ordered the foot of the bed removed. Dr. Taft and Dr. King reported that it was a fixture. Then I requested that it be broken off; as I found this could not satisfactorily be done, I had the President placed diagonally on the bed and called for extra pillows, and with them formed a gentle incline plane on which to rest his head and shoulders.

I examined the President's entire body from his head to his feet and found no other injury. His lower extremities were very cold and I sent the Hospital Steward, who had been of great assistance to us in removing the President from the theatre, to produce bottles of hot water and hot blankets, which were applied. I also sent for a large sinapism and in a short time one very nicely made was brought. This I applied over the solar plexus and to the anterior surface of his body.

As the symptoms indicated renewed brained compression, I again cleared the opening of clotted blood and pushed forward the button of bone, which acted as a valve, permitted an oozing of blood and relieved pressure on the brain. I again saw good results from this action.

Then I sent the Hospital Steward for a Nelaton probe. No drug or medicine in any form was administered to the President, but the artificial heat and mustard plaster that I had applied warmed his cold body and stimulated his nerves.

The Hospital Steward arrived with the Nelaton probe and an examination was made by the Surgeon General and myself, who introduced the probe to a distance of about two and a half inches, where it came in contact with a foreign substance, which lay across the track of the ball; this was easily passed and the probe was introduced several inches further where it again touched a hard substance at first supposed to be the ball, but as the white porcelain bulb of the probe on its withdrawal did not indicate the mark of lead it was generally thought to be another piece of loose bone. The probe was introduced the second time and the ball was supposed to be distinctly felt. After this second exploration nothing further was done with the wound except to keep the opening free of coagula, which, if allowed to form and remain for a short time, produced signs of increased compression, the breathing becoming profoundly stertorous and intermittent, the pulse more feeble and irregular.

During the night Mrs. Lincoln came frequently from the adjoining room accompanied by a lady friend. At one time Mrs. Lincoln exclaimed, sobbing bitterly: "Oh, that my little Taddy might see his father before he died!" This was decided not advisable. As Mrs. Lincoln sat on a chair by the side of the bed with her face to her husband's, his breathing became very stertorous and the loud, unnatural noise frightened her in her exhausted, agonized condition. She sprang up suddenly with a piercing cry and fell fainting to the floor. Secretary Stanton hearing her cry, came in from the adjoining room and with raised arms called out loudly: "Take that woman out and do not let her in again." Mrs. Lincoln was helped up kindly and assisted in a faint-

ing condition from the room. Secretary Stanton's order was obeyed and Mrs. Lincoln did not see her husband again before he died.

As morning dawned it became quite evident that the President was sinking, and at several times his pulse could not be counted. Two or three feeble pulsations being noticed, followed by an intermission when not the slightest movements of the artery could be felt. The inspirations became very prolonged and labored, accompanied by a guttural sound. The respirations ceased for some time and several anxiously looked at their watches until the profound silence was disturbed by a prolonged inspiration, which was followed by a sonorous expiration.

The protracted struggle ceased at twenty minutes past seven o'clock on the morning of April 15, 1865, and I announced that the President was dead.

Immediately after the death the few remaining in the room knelt around the bed while the Rev. Dr. Gurley delivered one of the most impressive prayers ever uttered.

Then I gently smoothed the President's contracted facial muscles, took two coins from my pocket, placed them over his eyelids and drew a white sheet over the martyr's face. I had been the means, in God's hand, of prolonging the life of President Abraham Lincoln for nine hours.<sup>7</sup>

Pressure to move the President out of the theatre was undoubtedly heightened because there had been some overt public criticism of Mr. Lincoln's liking for the theatre, which in those days was considered somewhat immoral, and because the day was Good Friday.<sup>8</sup>

Dr. Charles S. Taft, Acting Assistant Surgeon, US Army, second doctor on the scene, gave his own description of the "Last Hours of Abraham Lincoln," in an article written on April 22, 1865, for the *Philadelphia Medical and Surgical Reporter*.<sup>9</sup> His account bears out the essentials of Dr. Leale's statement, but it contained a series of conflicting descriptions of the pupillary and other findings. His account adds some interesting details:

The President was removed to a house opposite, and laid upon a bed in 15 minutes from the time the shot was fired.

The wound was there examined, the finger being used as a probe, and the ball found to have passed beyond the reach of the finger into the brain. The respiration now became labored; pulse 44, feeble, eyes entirely closed, the left pupil much contracted, the right widely dilated; total insensibility to light in both. The left upper eyelid was swollen and dark from effused blood; this was observed a few minutes after his removal from the theatre. About 30 minutes after he was placed upon the bed, discoloration from the effusion began in the internal canthus of the right eye, which became discolored and swollen with great protrusion of the eye.

About 11:30 p.m., twitching of the facial muscles of the left side set in and continued some 15 or 20 minutes, and the mouth was drawn slightly to the same side. Sinapisms over the entire anterior surface of the body were ordered, together with artificial heat to the extremities.

The wound began to ooze very soon after the patient was placed upon the bed, and continued to discharge blood and brain tissue until 5:30 a.m., when it ceased entirely; the head, in the meantime, being supported in such a position as to facilitate the discharge of the wound, and in keeping the orifice free from coagulum. While the wound was discharging freely, the respiration was easy; but the moment the discharge was arrested from any cause, it became at once labored.

It was also remarkable to observe the great difference in character of the pulse whenever the orifice of the wound

was freed from coagulum, and discharged freely; thus relieving, in a measure, the compression. This fact will account for the fluctuation in the pulse, as given in the subjoined notes.

About 2 a.m., an ordinary silver probe was introduced into the wound by the Surgeon General. It met an obstruction about three inches from the external orifice, which was decided to be the plug of bone driven in from the skull and lodged in the track of the ball. The probe passed by this obstruction, but was too short to follow the track the whole length. A Nelaton probe was then procured and passed into the track of the wound for a distance of 2 inches beyond the plug of bone, when the ball was distinctly felt; passing beyond this, the fragments of the orbital plate of the left orbit were felt. The ball made no mark upon the porcelain tip, and was afterwards found to be of exceedingly hard lead.

Some difference of opinion existed as to the exact position of the ball, but the autopsy confirmed the correctness of the diagnosis upon first exploration. No further attempt was made to explore the wound.

After cessation of the bleeding from the wound, the respiration was stertorous up to the last breath, which was drawn at 21 minutes and 55 seconds past 7; the heart did not cease to beat until 22 minutes and 10 seconds past 7.

The wonderful vitality exhibited by the late President, was one of the most interesting and remarkable circumstances connected with the case. It was the opinion of the surgeons in charge, that most patients would have died in 2 hours, Lincoln lived from 10:30 p.m. until 7:22 a.m.

About 1 p.m., spasmodic contractions of the muscles came on, causing pronation of the forearms; the pectoral muscles seemed to be fixed, the breath was held during the spasm, and a sudden and forcible expiration immediately succeeded it.

At about the same time both pupils became widely dilated and remained so until death.

During the night Drs. Hall, May Liebermann and nearly all the leading men of the profession in the city, tendered their services.

It was at this time, as Dr. Leale placed silver coins on the eyelids, that Secretary of War Stanton is said to have uttered the immortal words, "Now he belongs to the Ages."

#### Chronology of Hours After the Shooting

Time (Close approximations)

10:13 PM Lincoln shot  
Clot on left shoulder but very little ooze from wound at first.

10:20 Wound probed by finger of Dr. Leale to depth of two inches.

10:30 Moved to house across the street from theatre—clots evacuated repeatedly to relieve breathing.

10:50 Brandy apparently swallowed; one pupil contracted; one pupil dilated, both unresponsive to light.

10:55 Pulse, 48

11:00 Brandy not swallowed; left eyelid echymosed; pulse 42 and weaker.

11:30 Right eye socket filled with blood with great protrusion of eye; pulse, 45.  
Twitching of face on left for 20 minutes; mouth drawn slightly to left.

1:00 AM Spasmodic contractions of muscles, pronation of both forearms; both pupils widely dilated, stayed so until death; breath held during spasms; pulse to 100.

1:30 Pulse, 95

2:00 Silver probe passed by Dr. Barnes, hit plug of

skull at three inches (verified at autopsy) too short to follow whole length of track. Nelaton probe 7½ inches and struck the left orbital plate. (Taft)

2:32 Pulse, 54

5:30 Oozing of fluid, blood and brain tissue ceased; breathing stertorous; pulse, 64 and thready; respirations, 27.

7:21::55 Breathing ceased.

7:22::10 Pulse imperceptible.

12:10 PM Autopsy performed at White House.

#### Description of the Autopsy

Permission for an autopsy was obtained by Dr. Robert King Stone, family physician of the late President, and at about noon, some five hours after death, a postmortem examination of the brain was made at the White House in the President's bedroom. Dr. Stone, testifying at the trial of the conspirators, stated:

The next day, previous to the process of embalment, an examination was made in the presence of Surgeon General Joseph K. Barnes, Assistant Surgeon Edward Curtis, Assistant Surgeon J. Janvier Woodward, of the Army. We traced the wound through the brain and the ball was found in the anterior part of the same side of the brain, the left side; it was a large ball, resembling those which are shot from the pistol known as the Derringer; an unusually large ball—that is, larger than those used in the ordinary pocket revolvers. It was a leaden hand-made ball, and was flattened in its passage through the skull, and a portion had been cut off in going through the bone, I marked the ball "A. L.," the initials of the late President, and in the presence of the Secretary of War, in his office, enclosed it in an envelope, sealed it with my private seal and endorsed it with my name.<sup>4</sup>

The man who actually did the autopsy was an Army doctor who was on duty at the Army Medical Museum, Assistant Surgeon J. Janvier Woodward. He was assisted by another Army doctor, Assistant Surgeon Edward Curtis. Dr. Woodward's handwritten report of the autopsy was brief but is as follows:

Surgeon General's Office  
Washington City D.C.  
April 15th, 1865  
Brigadier General J. K. Barnes  
Surgeon General U.S.A.

General:

I have the honor to report that in obedience to your orders and aided by Assistant Surgeon E. Curtis, U.S.A., I made in your presence at 12 o'clock this morning an autopsy on the body of President Abraham Lincoln, with the following results. "The eyelids and surrounding parts of the face were greatly ecchymosed and the eyes somewhat protuberant from effusion of blood into the orbits.

There was a gunshot wound of the head around which the scalp was greatly thickened by hemorrhage into its tissues. The ball entered through the occipital bone about one inch to the left of the median line and just above the left lateral sinus, which it opened. It then penetrated the dura mater, passed through the left posterior lobe of the cerebrum, entered the left lateral ventricle and lodged in the white matter of the cerebrum just above the anterior portion of the left corpus striatum, where it was found.

The wound in the occipital bone was quite smooth, cir-

cular in shape, with bevelled edges. The opening through the internal table being larger than that through the external table. The track of the ball was full of clotted blood and contained several little fragments of bone with a small piece of the ball near its external orifice. The brain around the track was pultaceous and livid from capillary hemorrhage into its substance. The ventricles of the brain were full of clotted blood. A thick clot beneath the dura mater coated the right cerebral lobe.

There was a smaller clot under the dura mater of the left side. But little blood was found at the base of the brain. Both the orbital plates of the frontal bone were fractured and the fragments pushed upwards towards the brain. The dura mater over these fractures was uninjured. The orbits were gorged with blood. I have the honor of being very respectfully your obedient servant.

E. J. J. Woodward  
Assistant Surgeon  
U.S.A.

A true copy George A. Otis, Assistant Surgeon USA<sup>10</sup>

Dr. Taft was present when Dr. Woodward did the autopsy but did not participate in it. Dr. Taft made several written statements at various times concerning the final location of the bullet within the brain. In addition to statements to the newspapers on the day of the autopsy in which he apparently indicated that the bullet was on the right side, his lengthy description entitled "The Last Hours of Abraham Lincoln," included a report of the autopsy. He began his statement in a manner calculated to establish its authority:

The following brief report of the circumstances attending the assassination, last hours and autopsy of the late President will doubtless prove of much interest to the profession and may be relied upon as correct in all particulars, the notes from which it is written having been submitted to comparison with others taken, and corrected by the highest authority. . . .

The calvarium was removed, the brain exposed, and sliced down to the track of the ball, which was plainly indicated by a line of coagulated blood extending from the external wound in the occipital bone, obliquely across from the left to right through the brain to the anterior lobe of the cerebrum, immediately behind the right orbit. The surface on the right hemisphere was covered with coagulated blood. After removing the brain from the cranium the ball dropped from its lodgement in the anterior lobe. The small piece of the ball, evidently cut off in its passage through the occipital bone, was previously taken out of the track of the ball, about 4 inches from the external wound. The hole made through the occipital bone was as cleanly cut as if done with a punch.

The point of entrance is one inch to the left of the longitudinal sinus and opening into the lateral sinus. The ball is flattened, convex on both sides, and evidently moulded by hand in a Derringer pistol mould as indicated by the ridged surface left by the nippers in clipping off the neck. The orbital plates of both orbits were the seats of comminuted fracture, the fragments being forced inward, and the dura mater covering them remaining uninjured. The double fracture was decided to have been caused by Contre coup. The plug of bone driven in from the occipital bone, was found in the track of the ball about three inches from the external wound, proving the correctness of the opinion advanced by the Surgeon General and Dr. Stone as to its nature, at the exploration of the wound before death.<sup>9</sup>

One of the most surprising features of a study of the records of this case is the repeated disagreement and contradiction of the various authors who

described the autopsy findings, concerning above which eye the bullet came to rest. Dr. Woodward, who performed the autopsy, described the bullet's lodging place as above the left eye,<sup>10</sup> as did Dr. Stone, Lincoln's family physician,<sup>4</sup> whereas both Surgeon General Barnes<sup>11</sup> and Dr. Taft<sup>9</sup> stated that it was lodged above the right eye. In fact, Surgeon Taft states that it was above the left orbit in one of his descriptions, and above the right eye in another.<sup>9</sup> Taft stated that the Nelaton probe, following the track of the ball, struck the bones of the left orbit, whereas in describing the autopsy he states that the ball came to rest behind the right orbit. On still another occasion Dr. Taft stated that the point of the Nelaton probe struck the orbital plate of the right eye.

#### True Lodgement of the Bullet Left in Doubt

Dr. Joseph K. Barnes, the Surgeon General of the US Army, appeared two years later as a witness in the trial of John H. Surratt and said, "The ball entered the skull [sic] to the left of the middle line, and below the line with the ear. It ranged forward and upward toward the right eye, lodging within a half inch of that orbit."<sup>11</sup> Thus, the true location of the resting place of the bullet is left in doubt by the conflicting accounts of four men who attended the autopsy.

Dr. Edward Curtis, who assisted at the autopsy, wrote a letter to his mother within a week after the autopsy, in which he stated, "I was surprised to find that the great man's brain weighed no more than that of an ordinary mortal." He also wrote, "I was simply astonished at the showing of the nude remains, where well rounded muscles built upon strong bones told the powerful athlete. Now did I understand the deeds of prowess recorded of the President's early days." (Quoted by Purtle.<sup>12</sup>)

Elsewhere, Dr. Curtis spoke reverently of the examination that was done: "There is laid bare what a few short hours hence was the fountainhead of a wit and wisdom that could save a nation. The part is lifted from its seat, when suddenly from out a cruel vent that traverses it from end to end through these very fingers, there slips a something hard—slips and falls with a metal's mocking clatter into a basin set beneath. The search is satisfied; a little pellet of lead."<sup>12,13</sup>

Dr. Curtis' blood stained cuffs, with splinters of bone and bits of hair cut from Lincoln's head at the time of the autopsy, were presented to the National Park Service and by them to the Army Institute of Pathology and are on display in their museum in Washington along with the fatal bullet and the probe used at the autopsy (Fig 2).

No mention was made of any residuals from a previous head injury sustained by Lincoln in his early teens, when he was kicked in the forehead by a balky horse he was using to turn a grist mill.<sup>14</sup> He was unconscious for "most of a day," and came

to continuing the same remarks he had been addressing to the horse when he lost consciousness. This was one of Lincoln's favorite stories about himself.

Data gleaned from other sources<sup>15</sup> indicate that Lincoln was 6 feet, 4 inches tall, weighed about 180 pounds (having lost about 40 pounds since he left Springfield) wore a hat size 7½, and boots which measured about size 12B. (It may be that his boots were larger when new, since leather shrinks with a century of aging.) Life masks measured 6½ inches from ear to ear and an estimated eight inches from front to back of the brain case. His fingers were long and slender and his arms and legs long for his body. Herndon described him as wiry, sinewy, raw-boned, thin through the chest from front to back and narrow across the shoulders. While his left pupil was closer to his upper lid, it seems unlikely that this represented a muscular imbalance since he was unable to reproduce the one or two episodes of double image which he had experienced, even though he strove to do so. His athletic prowess as a rail splitter and wrestler was well documented and only a few months before his death he put on a demonstration of wood chopping, making chips fly in all directions, and finishing by holding the heavy axe out at arm's length, much to the awe of the wounded soldiers he was visiting.

He was known to have had recurrent malaria, smallpox, frostbitten feet, lifelong constipation, and probably scarlet fever. The fact that his son Tad died of a disease suspected of being tuberculosis is also of interest.<sup>14</sup>

Certainly, he was a tall, wiry, asthenic, moody type, from "Old American" stock, who might have lived to a ripe old age had he not become President.

Any attempts to deduce which side of the brain was the final lodgement of the bullet prove frustrating and fruitless, because the two available statements as to which pupil was dilated and which was contracted are completely contradictory. Dr. Leale, who was first on the scene, stated clearly, according to quotations by Otis in *Medical and Surgical History of the War of the Rebellion*,<sup>16</sup> that the pupil of the left eye was slightly dilated, the right pupil was contracted; both were irresponsive to light. This is in the direct contradiction to the statement of Dr. Taft, the second man at Lincoln's side, who said, "The left pupil was much contracted and the right widely dilated; total insensibility to light in both."<sup>9</sup> In all fairness, as Mr. Eisenschiml pointed out, most of these men had been continuously awake and under great stress for over 30 hours, so that some confusion is understandable.

The statement that there was twitching of the face on the left side at about 11:30 PM (77 minutes after the shooting), with the mouth drawn slightly to the left during the twitching, is unchallenged in the descriptions of the symptoms and may have reflected irritation of the "facial" area of the cortex

on the right lateral surface of the brain from the "thick clot" found at the autopsy, "coating the right cerebral lobe." Perhaps this clot was caused by contrecoup. Whether the mouth was drawn to the left by the twitching on the left or because of transitory paralysis of the right side of the face is not known. It seems as though the mouth was pulled to the left by the twitching facial muscles. Large soft-tissue cavities have been shown by modern ballistic studies to form in the brain when bullets enter the skull,<sup>28</sup> and it is possible that some cortical areas such as this one opposite the wound of entrance might be damaged by this mechanism. The spasmodic contractions of the muscles with pronation of both forearms, at 1 AM, almost three hours after the shooting, may have reflected either severe brain stem damage with progressive edema and a state of decerebration, or a "seizure" from the cortical irritation. The fact that the President's condition then worsened progressively without further seizures, is more in keeping with a decerebrate status. On the other hand, if the bullet did traverse the brain stem, damaging it directly as it would if it crossed the midline, it is surprising that respirations could be maintained at all. Inequality of pupils is a frequent initial finding in many brain injuries with unequal brain damage on the two sides. Possibly the right and left third cranial nerves were irritated to different degrees as the inevitable swelling of the brain occurred, both from the cavity formation at the time of the bullet wound and the resultant edema. Whether the forces involved were sufficient to drive the brain downward toward the foramen magnum, compressing the temporal lobes over the free margins of the tentorium, with the resultant signs of the "Incisural Syndrome," is not known, although this is possible. If it were possible to know which pupil was contracted and which one dilated shortly after the passage of the bullet, some better conjecture as to the final resting place of the bullet might have been possible. Since the testimony concerning the pupils is conflicting, accurate deductions as to the resting place of the bullet becomes impossible. The wide dilatation of both pupils at 1 AM, less than three hours after injury, certainly marked a progression of cerebral edema as the President's condition worsened steadily. The cessation of bleeding and oozing at 5:30 AM, seven hours after the shooting, was another ominous sign of terminal shock from both blood loss and nervous system damage.

The fact that a small piece of metal had separated from the pistol ball and was found part way through the brain along the track of the ball, is slightly more suggestive of a tangential entrance of the ball into the skull (toward the left eye) since the edges of the skull frequently shave fragments from bullets when the angle of entry is tangential. On the other hand, the skull edges can shave off fragments even from bullets fired square-

ly into the skull (toward the right eye) so this differential point is of little value. The clean, punched-out edges of the wound in the bone sound more typical of a course directly into the skull, which might be considered to favor a course toward the right eye. Here again, one can only speculate.

#### Why Were the Roofs of the Orbits Fractured?

For the past 99 years, a number of authors have written pages of puzzled speculation as to why the orbital plates should have been fractured by a gunshot wound at the opposite end of the head. Col Gilmore of the Armed Forces Institute of Pathology has discussed the many view points very well.<sup>18</sup> Several different theories were advanced in efforts to explain the fractures. Some favored the theory of transmission of intracranial pressure from the semifluid contents of the brain, fracturing the orbital plates down into the orbits with their subsequent elevation by the accumulation of blood within the orbits.<sup>19</sup> Others speculated about contrecoup,<sup>16,20</sup> while still another thought that the President's head must have fallen forward and struck the edge of the box or some other hard object in order to fracture the orbital plates. One Englishman<sup>21</sup> decided the ball must have struck the orbital plates and bounced back into the brain. This seems unlikely. Only one author quoted a similar case where a bullet, creasing the top of the skull, brought about a similar fracture of one orbital plate, but not both.<sup>19</sup> Still other authors suggested that the autopsur might have been completely mistaken and that broken blood vessels over the roofs of the orbits, torn by the prosector, might have resembled fractures where none existed. Dr. Ashhurst, in his review<sup>22</sup> of *Medical and Surgical History of the War of the Rebellion*, quotes Saucerote, et al,<sup>23</sup> and suggests that a blow on the back of the head might distort the ovoid shape of the brain case, making it round momentarily, thus drawing the front portions toward the center with any fragments displaced inwards, as in this case. The thin, delicate bone of the orbital roofs would certainly fracture easiest under these conditions.

Before constructing experimental models, it seemed logical to consult an experienced modern medical examiner on the matter of the displaced orbital fractures. The facts of the shooting were systematically laid before the Chief Medical Examiner of the City of New York, Dr. Milton Helpert. First, the wound of entry into the occipital bone, one inch to the left of midline, was described. When the detailed description of the wound of entrance was completed, he commented that the bullet had entered through one of the thickest areas of the skull and that it obviously required most of the force of the missile to penetrate the bone, causing the skull to absorb a tremendous amount of energy in that instant. The elasticity of

the skull would have permitted it to be severely distorted at the moment of impact. Dr. Helpert's next remark was, "I presume that the roofs of the orbits were found to be broken." He went on to relate that this finding was well known to medical examiners and that it accounted for the eye sockets gorged with blood in many shooting victims. In persons shot through the front portions of the skull, for example, the roofs of the orbits open so widely as to catch herniations of dura as they snap back into place after the shot. Upward displacement of the fragments of the orbital roofs was not uncommon in his experience. Dr. Helpert asked if the dura mater had been stripped up from the floor of the brain case, speculating that additional fracture lines might have been present there, running from the wound of entry to the orbits. According to the record, the dura had not been stripped from the floor of the calvarium.

Experiments conducted with sagittal models made from templates of the skull in the region in question, certainly indicate that the displacement of fragments from fractures of the orbital roofs resulting from the distortion of a blow on the back of the head might well be upwards toward the brain, as the ovoid shape of the skull became more rounded from the force of the blow on the back of the head. Thus, we find ourselves in agreement with an opinion expressed by Dr. Saucerote and associates in the late 1700's,<sup>23</sup> that upward displacement of fragments would not be surprising.

#### Why Was the Wound of Entry on the Left Side of the Head?

Since the assassin approached from the President's right side, according to the testimony of the only two witnesses, it was puzzling that the wound of entrance should be on the rear left side of the head. This dilemma mystified some of those concerned with the assassination but was cleared up by the testimony of one of the witnesses at the trial of the conspirators,<sup>4</sup> Mr. James P. Ferguson. Mr. Ferguson had gone to the theatre in the hope of seeing his old friend, Grant, and happened to have been staring intently at Mr. Lincoln at the exact moment the shot was fired. He stated that immediately before the shot was fired, Mr. Lincoln's attention had been attracted by something in the pit of the theatre, he thought, and that the President had pulled aside the curtain which was between his end of the box and the audience, and had peered to his left, between the edge of the box and the edge of the curtain, down into the audience, with his head twisted sharply to the left and downwards. One might conjecture here on the possibility that the delinquent guard had belatedly realized the seriousness of letting a stranger enter the box and was calling to Mr. Lincoln to watch out. Another conjecture might be that Lincoln saw the pistol out of the corner of his eye and twisted

violently away. This might better explain the extreme twist of the head needed to permit the bullet to cross the brain, from left to right, if indeed it did. In any case, the shot was fired into the back of Lincoln's head at the moment when the head was twisted sharply away from the assassin, presenting the left rear portion of the head toward the pistol. This fact does not help in deciding near which eye the ball would lodge, since one does not know how far around the head was turned at the moment the shot was fired. It is certainly a fact that a ball fired solidly into the head would be more likely to go across the brain into the right hemisphere than to travel, more tangentially, completely within the left hemisphere. The chances of the bullet glancing off the skull would have been much greater had it been aimed tangentially, which would have been necessary, to place the bullet in the front portion of the same side of the brain into which it entered (ie, over the left orbit).

While President Lincoln often spoke and dreamed about being assassinated, he was fatalistic about it and deprecated all attempts to guard his life, despite the fact that his hat had at one time been shot from his head in one of the unsuccessful assassination plots.

### The Weapon

Lincoln was shot with a tiny pistol measuring only six inches in length, of a type popular among gamblers and adventurers because it could be easily concealed on the person (Fig 2). It was a type known as a Derringer, a name taken from a pioneer manufacturer of such pistols, Henry Deringer of Philadelphia. Indeed, the words Deringer and Philadelphia appear on the lock and barrel of the murder pistol. To the gunsmith's trade, a Derringer was a short-barreled pistol of large caliber, with a rifled barrel. While Booth's murder weapon had a barrel length of only 2½ inches, it



Fig 2.—Derringer pistol which Booth used to kill Lincoln. Fatal ball and the chips of bone removed from Lincoln's brain (right) and the probe which was not long enough to reach the end of the track of the ball (below).

fired a large ball almost one-half inch in diameter (.44 caliber) and Booth had elected to have it loaded on that night with a handmade ball of Britannia metal, which is harder than lead and may have required a leather or cloth patch wrapped around the hard bullet in order to seat it well among the grooves of the rifled barrel. A paper wad was often used to prevent grains of powder from trickling out around the ball and either the paper wad or the patch, or both, were certainly in the charge fired into Lincoln's head from close range. One can only guess at the charge of powder used, but ten grains of black powder were used in the first cartridge pistols of the same caliber which came into being a few years later and displaced the percussion cap ignition system of Booth's pistol. The barrel of the pistol was of iron, but the trigger guard and mountings were of German silver with a slightly brassy glint, probably accounting for the many erroneous references to the pistol as a small brass Derringer. There was a tiny box in the butt of the pistol for a spare percussion cap. The pistol was discovered the day after the shooting when Mr. William T. Kent, one of the first men into the box, returned to look for his latch key which he thought must have been pulled from his pocket when he lent Surgeon Leale his knife to cut open Lincoln's coat, vest, and shirt. While searching on the floor of the box, his foot struck an object which turned out to be the murder weapon.<sup>4</sup>

Booth was known to be an expert marksman on the testimony of John T. Ford, owner of the theatre, and had proudly demonstrated his prowess with a pistol at a shooting gallery only four days earlier.

While the pistol was small, it fired a large and heavy projectile with relatively low velocity which must have struck the back of the head with tremendous force.

### Could Lincoln Have Survived?

Could modern neurosurgical techniques, blood transfusions, supportive and antibacterial therapy have made it possible for Lincoln to have survived had he been shot in 1964 instead of 1865?

Many competent authorities have expressed without reservation that Lincoln could not possibly have survived.<sup>27</sup> The large projectile, striking the head with the force of a sledgehammer, had driven a disc of bone almost one inch in diameter ahead of it through the lateral venous sinus, across the meninges, and into the brain to a depth of three inches. A fragment of metal the size of a modern dime had torn off and was left in the track and the balance of the projectile had traveled a distance of 7½ inches through the brain to lodge almost at the other side of the skull. Bits of Lincoln's long, heavy hair must necessarily have been driven into the brain by the bullet and there is a



question as to whether bits of patch or paper wadding, which may have accompanied the bullet, might have still clung to it during the passage of only 24 inches before striking Lincoln's head. This combination of foreign material scattered in a track through the center of the brain would have been impossible to locate and clean out, as any experienced wartime surgeon knows.

In addition, the brain had been probed to the full length of the unsterile fingers of at least two of the doctors who attended him, in an attempt to locate the ball, and with two unsterile probes, a silver one approximately six inches long and a porcelain-tipped rubber Nelaton probe, which reached to a depth of 7½ inches. The principles of aseptic technique and the concept of germs as the cause of wound infections, were unknown in Lincoln's day; while occasional Civil War soldiers were reported to have recovered from bullet wounds of the brain, these were obviously very rare exceptions.

The autopsy report that the track of the bullet could be easily distinguished because of the extensive destruction and the presence of pultaceous brain material along the track points up the tremendous damage but does not take into account the further damage which is now known to result from the momentary creation of a large cavity in the brain when it is struck by a missile traveling at the speed of a bullet.<sup>28</sup> There seems to be no reason to disagree with those who have stated that Lincoln could not possibly have survived this wound, even in modern times, and that, indeed, it is remarkable that he survived for about nine hours, as he did after the shooting. Even if he had survived, he most certainly would have been a decerebrate "vegetable," a cruel transformation from the sensitive, compassionate, and thoughtful Chief of State which he had been. Death probably spared him a vicious campaign of character assassination and defamation which would have accompanied his avowed attempts to curb post-war profiteering, exploitation, and vengeance directed at the prostrate South. As it was, assassination, at the very peak of his popularity, enshrined him forever in the history of the world.

#### Similarity Between the Wounds of Presidents Lincoln and Kennedy

While both Presidents were shot in the posterior portions of the head, President Kennedy had also sustained a moderately severe wound of the thorax and neck from a previous bullet. The ballistic properties of the bullets which killed the two men were at opposite ends of the velocity scale and demonstrated not only the difference in destructiveness between rifle and pistol bullets, but also the vast changes in the technology of firearms which had occurred in the intervening 98 years. The bullets which killed Kennedy were from high

velocity modern, but probably handloaded, military cartridges, were 6.5 mm in diameter (.25 caliber), with a muzzle velocity of some 2,500 feet per second, and a structure demonstrated to distort somewhat on penetration,<sup>28</sup> giving infinitely greater destructive efficacy. When combined with even a four-power telescopic sight, a shooting rest, a rifleman's sling, and a repeating, bolt action, the bullets were far more effective than the one slow-moving, heavy ball whose wound, while fatal, permitted Lincoln to survive nine hours after he was shot. The long (1¼ inches), slender (one-fourth inch) high-speed, military rifle bullet which struck President Kennedy in the right occipital region apparently loosened a large flap-like segment of the skull and caused massive loss of cerebral and cerebellar tissue and blood, which killed him in a matter of minutes. The head wound apparently followed a penetrating wound into the back of the right thorax and neck forming a large hematoma and causing the trachea to be deviated to the left according to the newspaper accounts. This was from the first bullet, fired only some five to eight seconds earlier. A detailed account of the Kennedy wounds must await release of the facts as ascertained at autopsy and inquest.

#### Summary

Lincoln was shot with a short-barrelled, rifled, percussion Derringer firing a .44 caliber ball of Britannia metal, from a distance of about two feet. A one-inch disc of bone was driven into the brain three inches, a fragment of the bullet shearing off and lodging part way through the brain. The balance of the ball ploughed 7½ inches through the brain, to lodge above one orbit. The apneic and pulseless President was resuscitated almost immediately by mouth-to-mouth respiration and closed chest manipulation by the first Army surgeon who could make his way through Booth's barricade of the Presidential box. The wound was later probed with unsterile fingers and two probes, after the custom of the day. Lincoln died some nine hours later, after signs of increasing pressure on the brain stem. Those at the autopsy, done only on the head, made multiple conflicting statements as to near which orbit the bullet lodged, permitting interesting but inconclusive speculation. The mystery of why the wound of entrance was on the left side of the head when the assassin had approached Lincoln from the right side was explained. The fact that the roofs of both orbits were fractured, with upward displacement of the fragments toward the brain, seems less mysterious in the light of modern medical examiners' knowledge. High-speed ballistic studies with motion pictures, suggest that severe distortion of the skull and large cavity formation in the brain might have been expected from the sledgehammer blow of this large, low-velocity pistol ball, whose entire

energy was absorbed by thick occipital bone. There appears little doubt that Lincoln would have died of this wound even with modern neurosurgical and supportive techniques.

The use of mouth-to-mouth resuscitation and closed chest manipulation are analagous to the present-day revivals of enthusiasm for these techniques. Points of similarity between the assassinations of Presidents Lincoln and Kennedy are numerous.

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