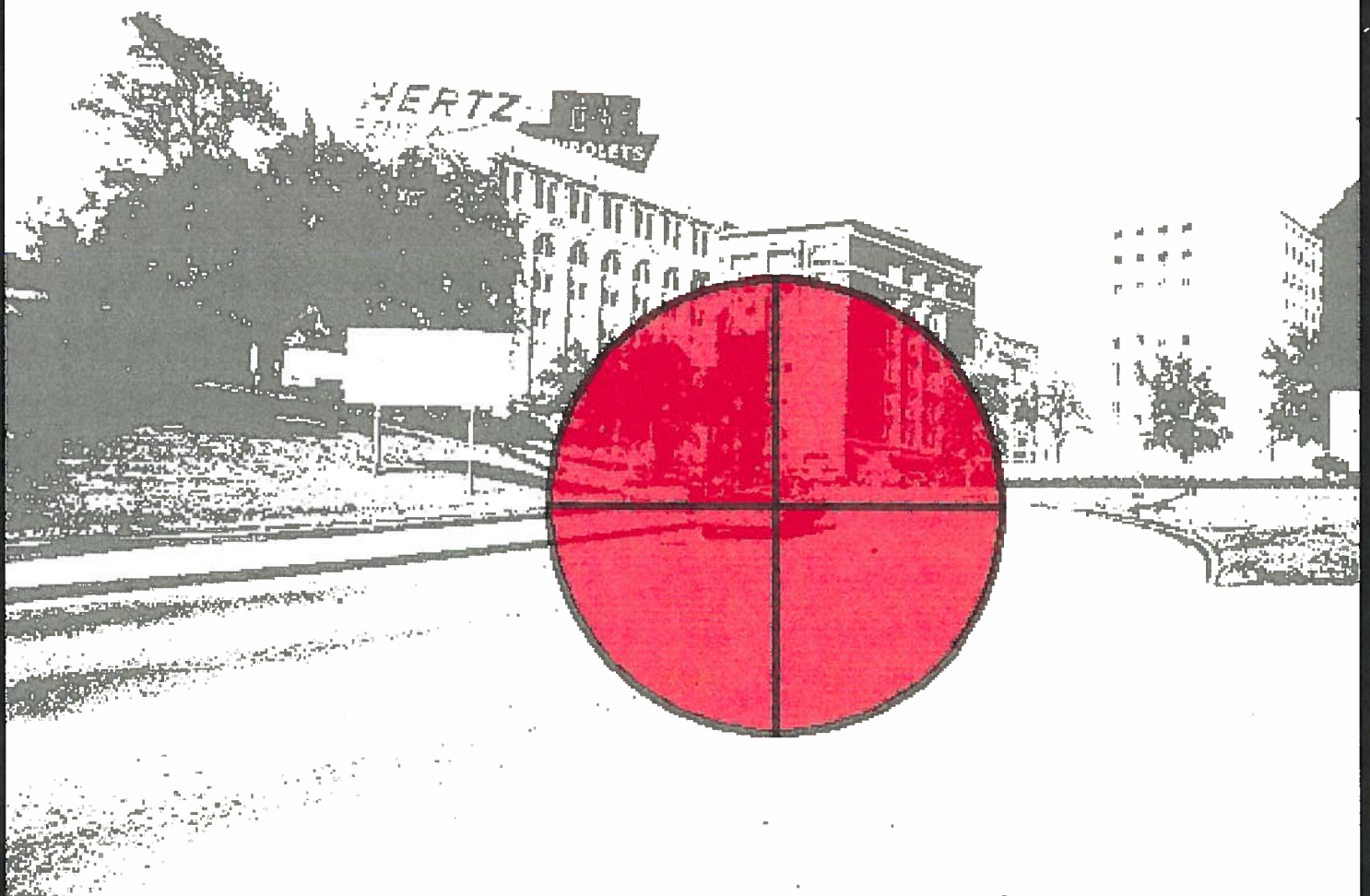


# **Analysis of Gunshots in Dealey Plaza on November 22, 1963**





**Dealey Plaza, Dallas, Texas**

Note: [The original photo was replaced with this one for copyright reasons.]

# ANALYSIS OF GUNSHOTS IN DEALEY PLAZA ON NOVEMBER 22, 1963

*The first complete, visual explanation of the  
sequence of shots during the assassination  
of President John F. Kennedy*

John T. Orr, Jr.



**President and Mrs. Kennedy at Love  
Field on November 22, 1963**

ANALYSIS OF GUNSHOTS IN DEALEY PLAZA  
ON NOVEMBER 22, 1963

Table of Contents

Introduction . . . . .	1
First Shot . . . . .	4
Second Shot . . . . .	15
Third Shot . . . . .	21
Fourth Shot. . . . .	37
The Closing Argument . . . . .	42
The Prevalent Theories . . . . .	45
Where Things Went Wrong. . . . .	49
Conclusion . . . . .	56
Appendix A: The Jiggle Effect . . . . .	58
Appendix B: Neutron Activation Analysis . . . . .	60
Appendix C: Additional Photographs . . . . .	62
Notes . . . . .	66

# ANALYSIS OF GUNSHOTS IN DEALEY PLAZA ON NOVEMBER 22, 1963

## Introduction

At 12:30 p.m. on November 22, 1963, the Presidential limousine, leading a motorcade proceeding slowly down Main Street in Dallas, entered Dealey Plaza. It turned right onto Houston Street, went one block, and turned left onto Elm Street. Moving down a slight incline, the limousine passed through a "fire zone" (fig. 1), within which the shots were fired that killed President John Kennedy and wounded Governor John Connally. The assassination was investigated by two official bodies, the Warren Commission in 1963-64 and the House Select Committee on Assassinations (HSCA) in 1976-79. Their findings generated a great deal of controversy that persists 31 years after the crime.

The evidence was overwhelming that during the assassination Lee Harvey Oswald fired three shots with a Mannlicher-Carcano (M-C) rifle (fig. 2) from the southeast corner window of the sixth floor of the Texas School Book Depository (TSBD). That evidence included the following:

- A nearly whole bullet recovered at Parkland Hospital (fig. 3) and two bullet fragments found in the limousine were conclusively determined to have been fired from Oswald's M-C rifle.
- Oswald's palm print and fibers matching the shirt he was wearing were found on the rifle, which was stashed on the sixth floor.
- Eyewitnesses saw a man fitting Oswald's description firing a rifle out the window during the assassination. One of them identified Oswald in a line-up.
- Oswald's fingerprint and palm prints were on the boxes used to build the sniper's nest (fig. 4).
- While attempting to flee, Oswald shot and killed police officer J.D. Tippit in front of witnesses, and the spent cartridges left near Tippit's body were fired by the revolver found on Oswald when he was arrested.

The Warren Commission devoted almost all of its 888-page report to exhaustively laying out the evidence proving that Oswald was capable of firing and did fire the three shots. That conclusion is taken as the starting point for this report. Where the Commission turned vague and unsure of itself was on



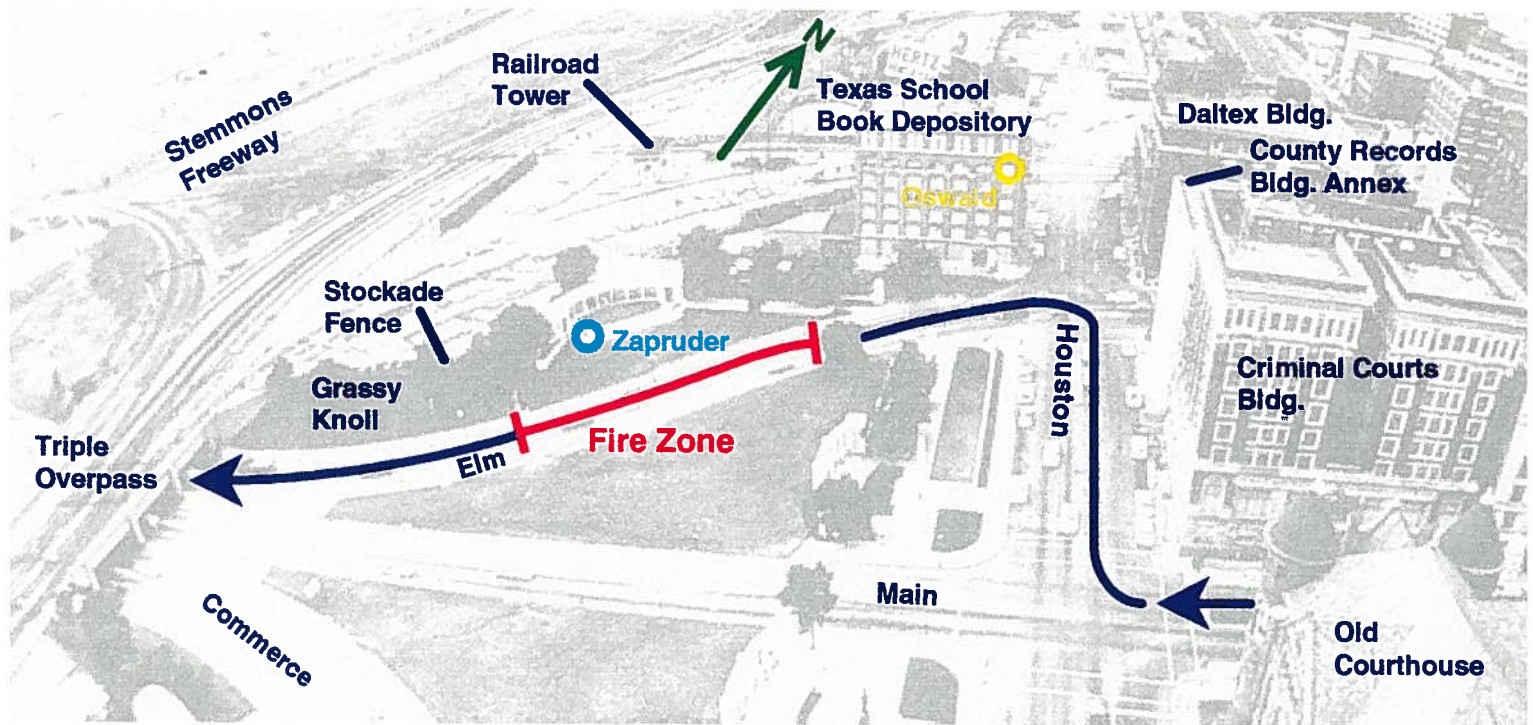


Fig. 1. The assassination scene: Dealey Plaza, Dallas, Texas, on November 22, 1963. (WI)

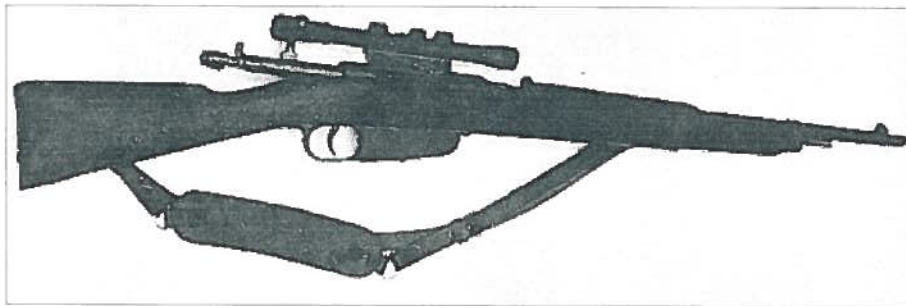


Fig. 2. Oswald's Mannlicher-Carcano, a 23-year-old Italian military rifle.



Fig. 3. M-C bullet recovered at Parkland Hospital.

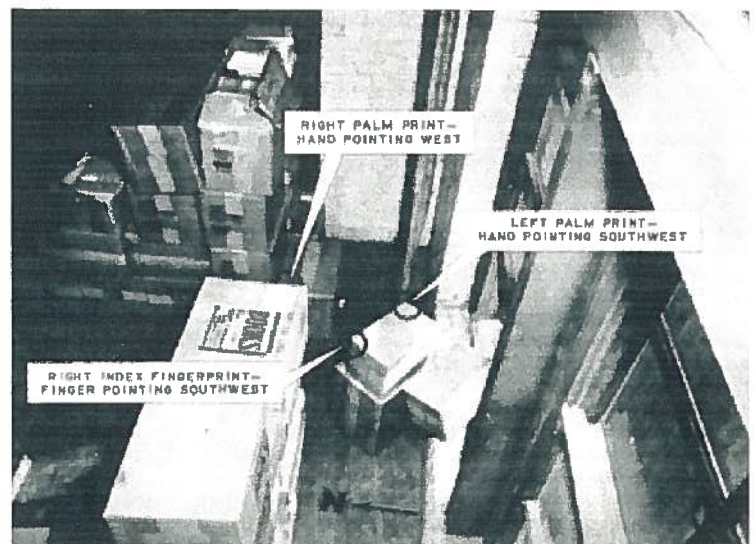


Fig. 4. Oswald's corner window perch.

the questions of where those shots landed and whether anyone else fired any shots.

This report answers those questions with concrete, scientific proof beyond a reasonable doubt. It proves that four shots were fired during the assassination. While Oswald, a mediocre marksman with a defective rifle, was inflicting nonfatal wounds on the President and Governor, an expert shooter from another position put a fatal bullet through the center of the back of the President's head. The sequence set out here is consistent with all of the raw photographic, medical, physical, and scientific evidence in the official record and with all facts determined to a reasonable degree of scientific or medical certainty by the testifying experts. It also is consistent with the overwhelming weight of the eyewitness testimony. (That does not include the earwitness testimony as to the number and point of origin of the gunshots. Such testimony is notoriously unreliable in shooting cases, and there were many conflicting accounts in this one.) No official report or widely circulated independent analysis of the assassination has ever presented a complete visual reconstruction of the sequence of shots. This report is able to do that, because it is the correct explanation—the only one that does not have to hide from the evidence or suspend the laws of nature.

The following conventions are used in the report:

- The home movie taken by Abraham Zapruder from the north side of Elm (fig. 1, p. 2) will be referred to often as a reference for the timing and visible effects of the shots. The Warren Commission numbered each frame consecutively, and the FBI determined that the film was running at 18.3 frames per second. The fire zone is roughly from frame 200 (Z200) through Z340. It is recommended that the report be read in conjunction with viewing a videotape copy of the film, using slow motion and still-frame at key points.
- All references to the left or right side of an object or body are from the perspective of the object or body and not from the viewer's perspective.
- There are several possible reference points to mark the firing of a bullet, including when the trigger is pulled, when the muzzle blast is heard, or when the bullet strikes something. The reference point used in this report is the point at which the bullet first strikes something other than air. The Zapruder frame used to mark the firing of a shot is the one before the first frame showing some evidence of the shot.
- All references to the downward, upward, or side-to-side angles of



trajectory or direction of bullets landing in the limousine are relative to the horizontal or vertical plane of the limousine at the time.

- An effort has been made to keep the macabre aspects of the report to a minimum. Photos showing the full extent of the President's head injury may be found in The Killing of a President by Robert J. Groden.
- The federal government has at its disposal highly sophisticated computer programs capable of converting photos of a scene taken at various angles into fully animated three-dimensional models that can be viewed and zoomed in on from any perspective.<sup>1</sup> Using the hundreds of photos taken during the assassination, such a computer could verify with great precision the sequence of shots. That process will be referred to in this report as "computer recreation."
- Almost all of the facts relied on are from the official Warren Commission or HSCA record. To keep the length of the report manageable, most citations are omitted, but they can be provided separately. The more significant findings of fact and conclusions of the writer that do not appear in the official reports are **highlighted in bold**. Photos taken by the writer are indicated by a "(WP)" in the caption. Illustrations substantially modified by the writer (such as by adding a trajectory line to a photo) are indicated by a "(WI)" in the caption.

Some of the photos and drawings on these pages are copyrighted and are reproduced here solely for their evidentiary value and not for any commercial purpose.

### First Shot

As the limousine made the slow turn onto Elm, Oswald was ready in his sniper's perch. He was holding his M-C rifle, a surplus Italian military weapon he had ordered by mail for \$19.95. Its telescopic sight was so misaligned the Army would have to modify its mounting before it could even be test fired with any accuracy. The M-C rifle fires a bullet that is 30 mm. long and 6.5 mm. in diameter. (One inch equals 25.4 mm. or 2.54 cm.) It is a full-metal-jacketed military round with a tough bronze jacket (90% copper and 8% zinc) covering the entire bullet except the open base, where the lead core is exposed. The M-C is one of the sturdiest and most stable bullets ever tested. A stable bullet is one that has great penetrating power due to its resistance to yawing (wobbling on its long axis) and tumbling when it enters a body. As long as it does not strike something hard like bone, the M-C bullet can pass through many inches of human tissue essentially in a straight line, cutting a path only slightly wider than

its diameter.

The limousine came almost to a stop as it rounded the sharp turn onto Elm and then slowly accelerated to an average speed of about 11 m.p.h. The President was sitting on the right end of the rear bench seat, and his wife was on the left side (fig. 5). Governor and Mrs. Connally were in the small jump seats in front of them, the Governor on the right. Secret Service Agent William Greer was driving, and Agent Roy Kellerman was across from him on the front bench seat. Oswald steadied his rifle and fired the first shot **at Z204** at a range of about 173 feet, just as the President's head moved clear of the last branch of a live oak tree that had partially obstructed Oswald's view for about 40 frames (figs. 6 & 7). The bullet struck the President in the upper back just to the right of the center of the spinal column, exited in the front of the neck below the larynx, and **struck the chrome strip above the windshield**.

The first shot is the most difficult of the three shots landing in the limousine to pinpoint photographically, because a sign almost entirely blocked Zapruder's view of the passenger area and the Zapruder frames are blurred at that point. However, the effects of the shot can be seen (fig. 8). (The only photos of Z204-207 available for this report are the low-resolution video images shown in fig. 8. The color slides in the National Archives show the effects of the shot much clearer.) At Z204, the President's head is turned sharply to the right looking at the crowd. His right hand is raised in a wave. By Z205 (about 1/18 sec. later) major changes have taken place. His head has been whipped around to almost a straight forward position and is tilted to the left and **his eyes appear (in the high-resolution slides) to be closed**. His right hand is moving down rapidly toward his throat. The HSCA panel of photographic experts examined these frames and confirmed that the right hand stopped abruptly in the midst of a wave and the head moved rapidly to the left and that the President was reacting to a "severe external stimulus" by Z207.<sup>2</sup>

The Zapruder film is the only known photograph of the exact point of impact of the first shot, but many other pieces of evidence confirm the timing of the shot. Among them are the following:

- Phil Willis, standing on the south curb of Elm, took a color slide at Z202 (fig. 9). He recalls that he took the picture "at the very instant that the first shot was fired."<sup>3</sup> A comparison of that slide and a photo taken three seconds later at Z255 (fig. 10) shows the rapid changes that took place in the security detail. In the slide, all of the Secret Service agents in the follow-up car appear normal, scanning the area ahead and to the side, and the motorcycle police are looking straight ahead. In the second photo, four agents have turned back toward the TSBD (arrows), and three



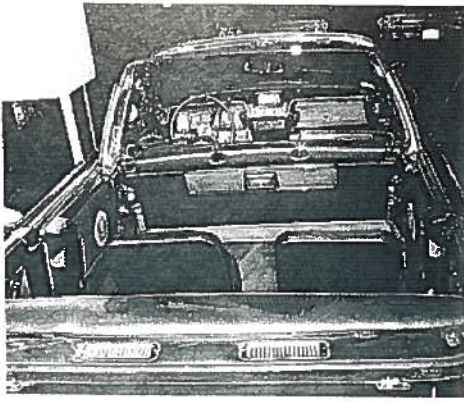


Fig. 5. Presidential limousine.

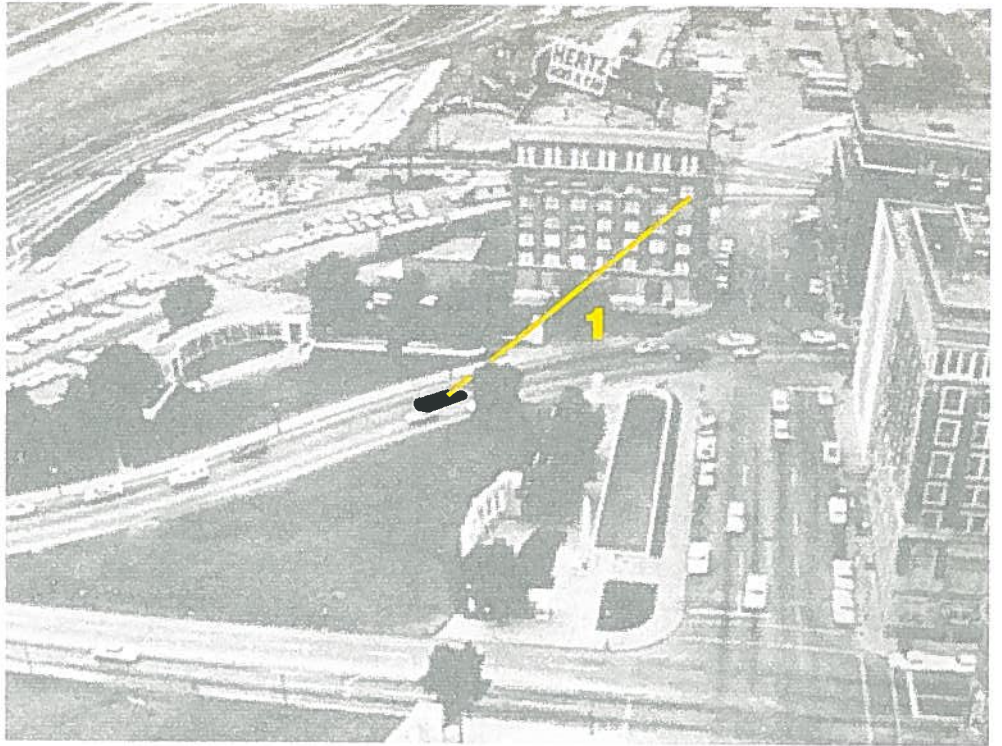


Fig. 6. Trajectory of first shot. (WI)

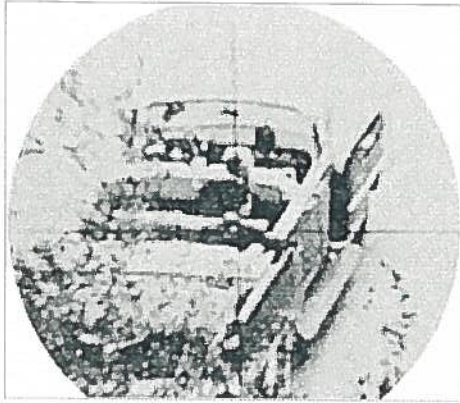


Fig. 7. FBI reenactment photo through Oswald's sight at Z207, closest photo to Z204.



Fig. 8. President's head and right arm reacting to first shot.

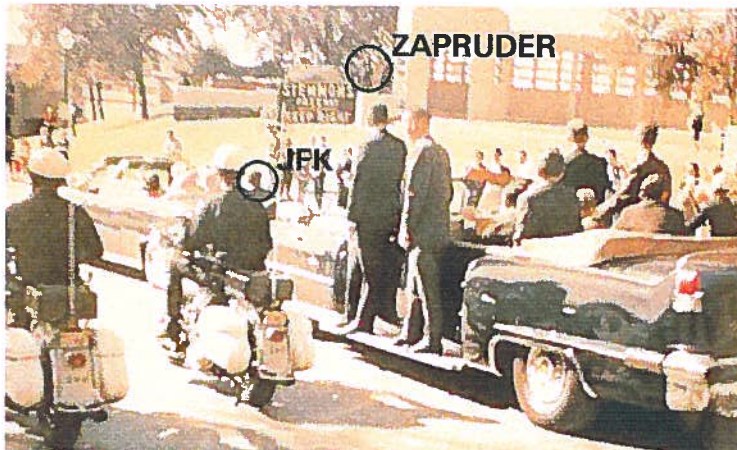


Fig. 9. Color slide taken by Phil Willis at Z202, 1/9 sec. before first shot.



Fig. 10. Photo taken at Z255.

police officers have turned toward the limousine.

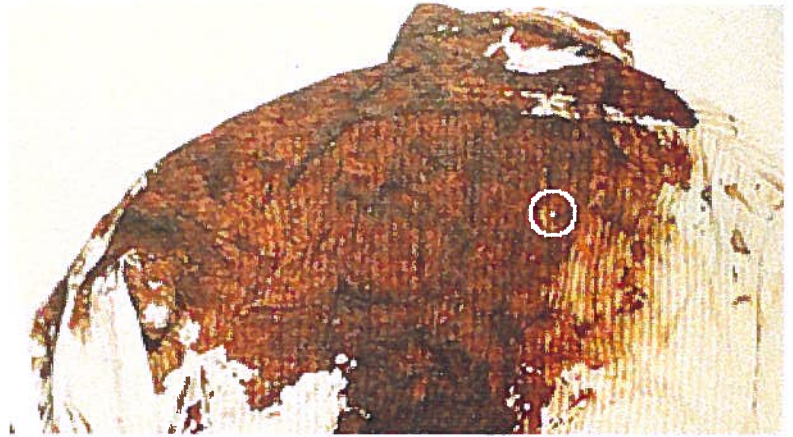
- Medical and physical evidence described in this section establishes that the President's head was turned well to the right at the time of the shot. The last time he is seen turned to the right during the assassination is Z204.
- Ken O'Donnell, the President's closest personal aide, watched his boss like a hawk in public situations. He testified that at the time of the shot the President was looking to the right and waving with his right hand. At the instant of the shot, he withdrew his hand and was thrown to the left. This testimony perfectly describes the sequence shown in Z204-207.
- The other eyewitness testimony is highly consistent in describing the location of the President or the motorcade at the first sound of gunfire. It is not possible to pinpoint an exact frame with such testimony, but taken together it strongly points toward a shot around Z204.
- The President is seen waving casually until Z204. He clearly was not shot before then. Also, a shot more than a few frames before Z204 would have required Oswald to fire through the branches of a tree.
- As discussed in the following section, the second shot was fired by Oswald at Z236, the impact of which is unmistakable on the Zapruder film. Based on HSCA timing tests, a first shot more than a few frames past Z204 would not have allowed Oswald time to work the bolt action, re-aim, and fire by Z236.
- The jarring sound of a gunshot produces an involuntary flinch, or jiggle, when a person is operating a movie camera. As more fully discussed in Appendix A, this "jiggle effect" is seen as a blurring motion on the film. Experts determined that Zapruder's jiggle reaction time was about five frames after a shot. There is a strong jiggle on the Zapruder film beginning at Z209, precisely the point where one would be expected for a shot at Z204.

The bullet fired by Oswald at Z204 moved downward at an angle of 19° and from right to left at an angle of 13°. The bullet struck the back of the President's coat 5-3/8 inches below the top of the collar and 1-3/4 inches right of the midline (fig. 11) and penetrated his shirt 5-3/4 inches below the top of the collar (fig. 12). It entered the President's upper back about 1-1/2 to 2 inches right of the centerline of the spinal column (fig. 13).

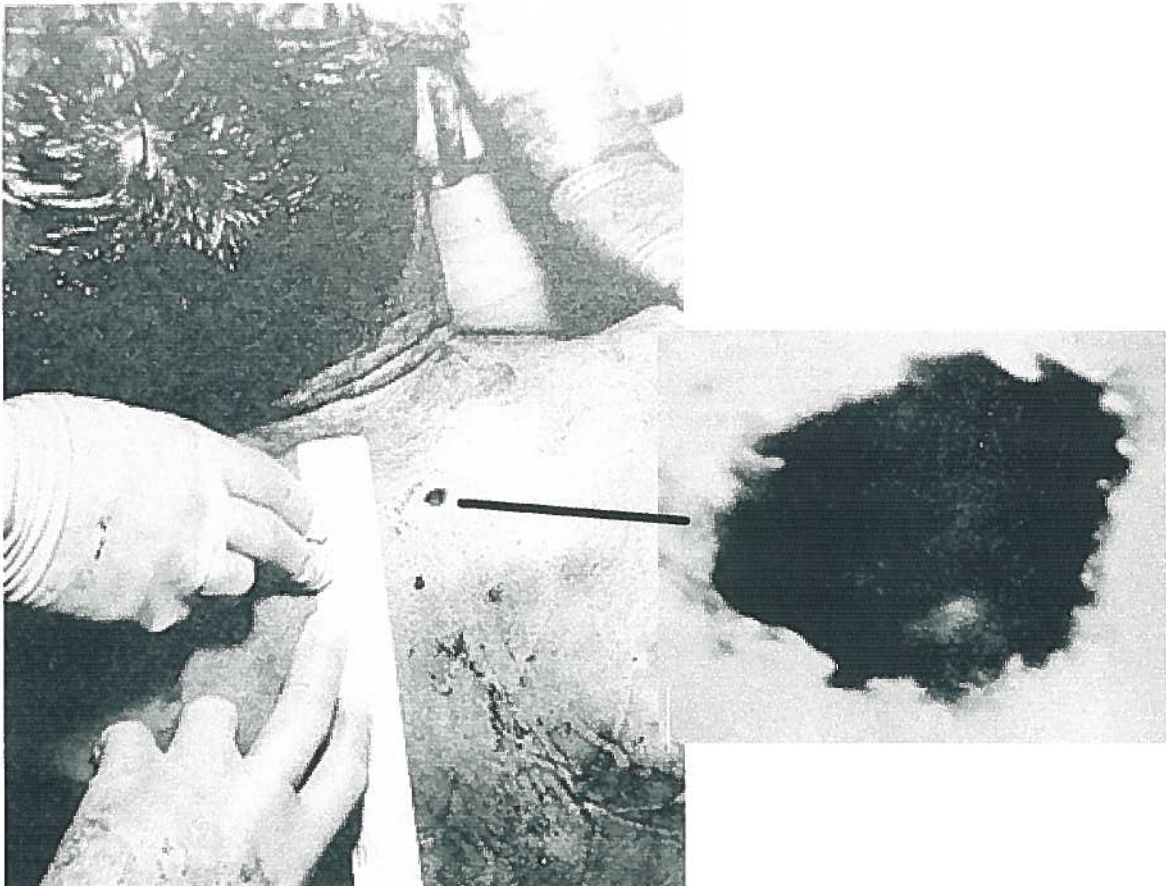




**Fig. 11. Bullet hole in back of coat.**



**Fig. 12. Bullet hole in back of shirt.**

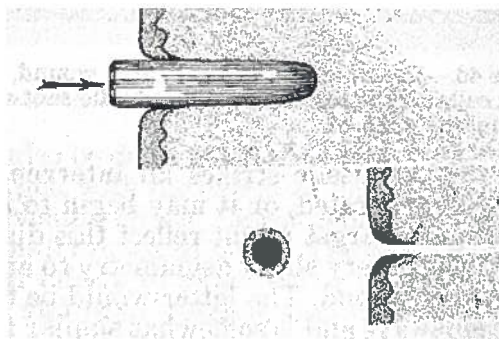


**Fig. 13. Autopsy photo of President's back.**

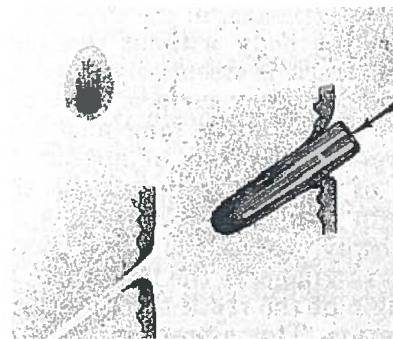


When a bullet strikes the surface of the skin, it leaves an "abrasion collar," a discolored area of burned skin around the hole. When the bullet strikes at a perpendicular angle to the skin surface it leaves a round hole and a collar of uniform width around the hole (fig. 14). When the bullet strikes at a tangential angle (fig. 15), it leaves an elliptical hole with the long axis oriented in the direction of the path and a collar that is wider in the direction from which the bullet came. An abrasion collar extended clockwise from 12 o'clock to 6 o'clock indicates a pure right-to-left approach angle. A collar extended from 3 o'clock to 9 o'clock indicates a pure low-to-high approach. The first shot left an abrasion collar extended clockwise from 1 o'clock to 7 o'clock, indicating that the bullet struck the lower right side of the skin surface first. It should be emphasized that the abrasion collar does not indicate the relationship of the whole upper body to the bullet path. It only indicates the angle of the path relative to the surface of the skin at the point of impact. The abrasion collar here is consistent with the bullet being fired from Oswald's position. The bullet struck the right side of the skin first, consistent with its right-to-left direction. Even though the bullet was moving at a downward angle of 19° relative to the street, it struck the lower right skin surface first, because the skin where the upper back curves into the neck was tilted forward at an angle slightly greater than 19°. This forward shoulder roll is evident in photos on the following pages.

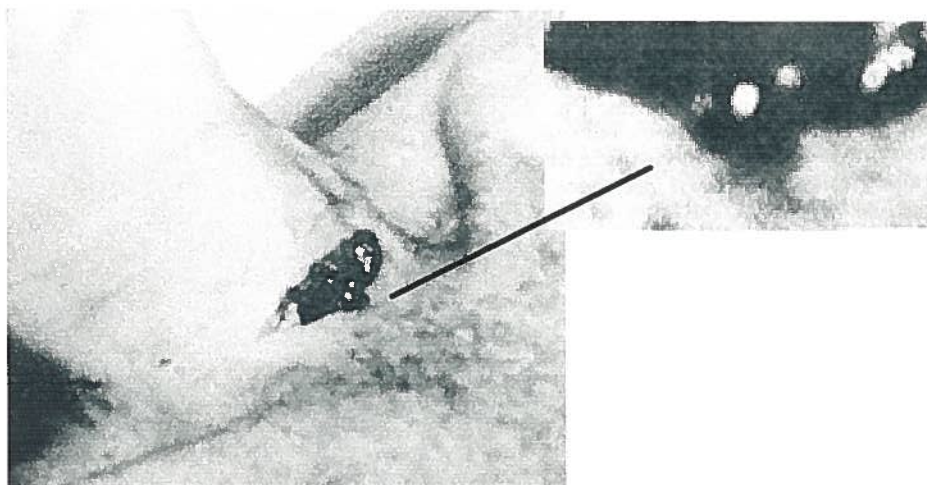
The first shot exited the body in the front of the neck below the larynx almost directly on the vertical centerline. A doctor at Parkland Hospital cut a tracheotomy incision through the upper part of the small exit hole, but the lower circumference is still visible in the autopsy photo (fig. 16). The exit wound was slightly higher than the entry wound with the torso in an upright position (fig. 17). There is only one way for an ultra stable bullet like the M-C to enter a body at a sharp downward angle and exit about six inches away at a higher point in the body. **It struck bone and was deflected upward.** In this case, the bone was the spinal column. On entering the back, the bullet penetrated less than two inches of soft tissue and then fractured the right transverse process of the first thoracic vertebra (T-1). The transverse process is a thin flange of bone extending from the rear of the body of the vertebra (figs. 18, 19 & 20). The HSCA pathology panel noted an "interruption in the continuity of the right transverse process of the 1st thoracic vertebra...."<sup>4</sup> In other words, the HSCA panel found that the bullet completely separated the process from the T-1 vertebra. Dr. G.M. McDonnell, a consulting radiologist to the panel, wrote in his report, "There is an undisplaced fracture of the proximal portion of the right transverse process of T1 (or the region of the costovertebral junction)."<sup>5</sup> The "proximal portion" is the inner part where the process joins the body of T-1. The "costovertebral junction" is where the end of the first rib joins the body of T-1. Striking the transverse process and the bone in the area of the costovertebral junction **caused the bullet to be deflected upward at an 11° angle** (fig. 21). In homicide cases it is common for



**Fig.14. HSCA drawing of perpendicular bullet entry.**



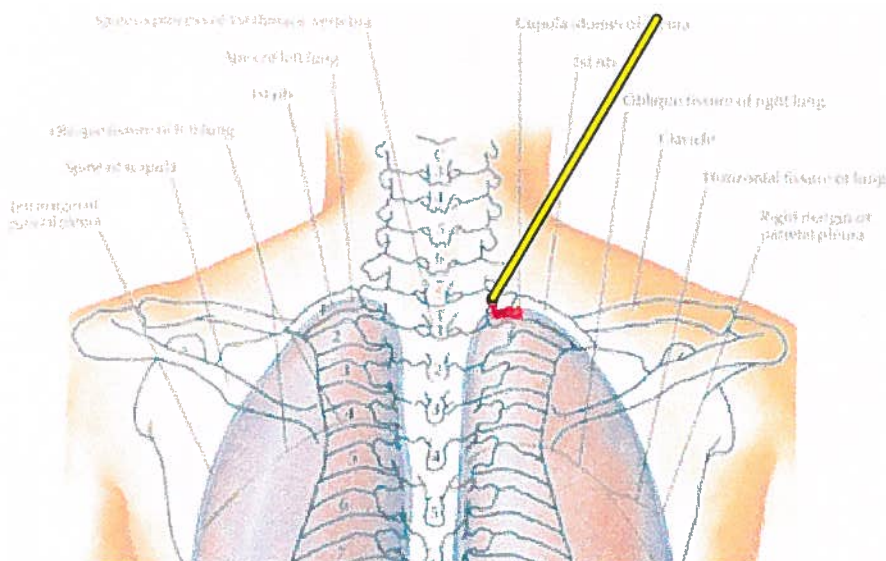
**Fig. 15. HSCA drawing of tangential bullet entry.**



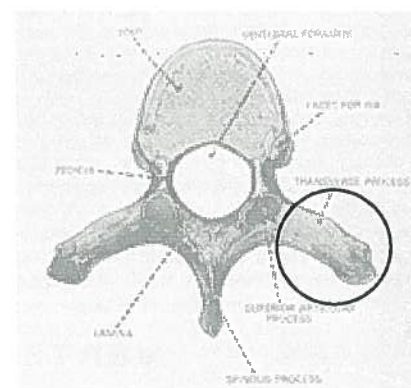
**Fig. 16. Autopsy photo showing exit hole below incision.**



**Fig. 17. Dr. Baden, head of the HSCA pathology panel, illustrating upward angle from entry to exit.**



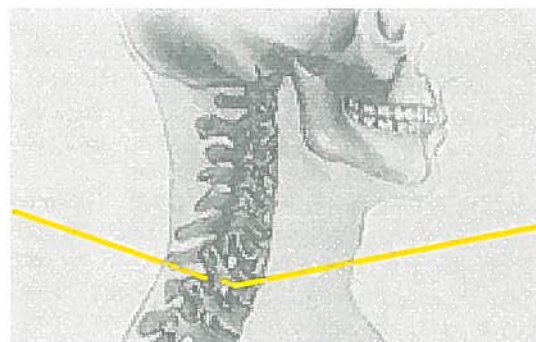
**Fig. 18. Cutaway of first shot striking right transverse process (RTP) of T-1. Red area indicates damage to bone and bruise on top of lung. (WI)**



**Fig. 19. Top view of T-1, RTP circled.**



**Fig. 20. Side view of T-1, RTP circled.**



**Fig. 21. Cutaway of bullet path through back and neck. (WI)**

bullets entering the chest area to strike bone and be deflected at a sharp angle. Because of their hard, tough jackets, full-metal-jacketed military bullets are among the most easily deflected when striking another hard object. Bullets do not ricochet at a mirror image of the approach angle because of the absorption of energy on impact. **Here the upward deflection angle was 8° less than the entry angle. The impact also reduced the right-to-left angle of the bullet slightly.**

Autopsy x-ray #9, a front view of the President's neck and upper chest, shows the damage to the spinal column (fig. 22). The bullet made a circular hole in the inner edge of the process. The extent of damage to the bones in this area can be appreciated by comparing it to what originally had been a mirror image of bone structures on the left side of the spine. When a bullet penetrates thin bone such as the process or skull, it creates a cone- or fan-shaped explosion of bone fragments on the exit side of the bone. In this instance, **the blast of pulverized bone and air from the process created** a fan-shaped bruise on the top of the right lung directly below it. Dr. Norman Chase, another consulting radiologist to the HSCA panel, examined the x-ray and concluded that the first rib appeared to be separated from the sternum (fig. 23).

After deflecting off of the bone, the bullet travelled upward at a substantially reduced velocity and struck the trachea. **The deformed, sharp-edged nose** of the bullet ripped a laceration through the right front quadrant of the trachea in the area of the second and third cartilage rings (fig. 23). **The reason that a bullet from the right rear struck the trachea in the right front is that the President's head was turned sharply to the right as he waved to the crowd, twisting the trachea around to a sideways orientation.**

The **jagged** bullet then sliced a small exit hole in the lower neck on the midline (fig. 16, p. 10) and ripped through the overlapping layers of shirt collar below the collar button, leaving irregular flaps in each layer (fig. 24). (Such slit-like tears are typical for exit holes in clothing.) **The sharp-edged nose** then took a small nick out of the right side of the tie knot (fig. 25). As the Warren Commission correctly noted, the long dimension of the nick indicates the direction of the bullet path and is horizontal in the photo. However, the tie knot does not hang vertically as in the photo when worn. As shown in figure 26, it is tilted up by the tie resting on the chest. **This upward tilt makes the direction of the nick consistent with a bullet travelling at an upward angle of 11° as it caught the tie (fig. 27).** The fact that the bullet struck the right side of the collar and tie is further confirmation that the President's head was turned sharply to the right at the time of impact. The bullet exited the neck on the midline moving farther left. **If the President's neck had not been twisted far around to the right inside the collar, the bullet would have struck the left side of the collar and tie knot.**



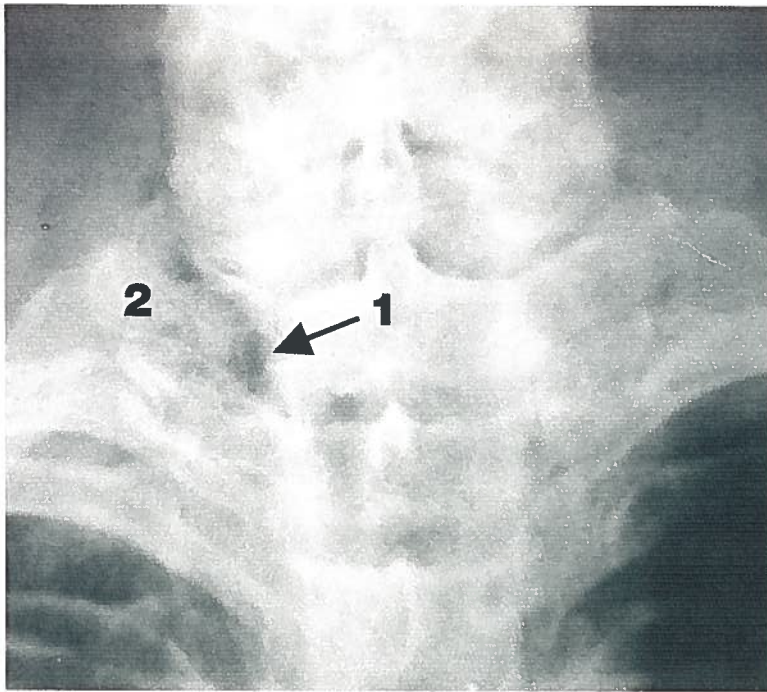


Fig. 22. Close-up of autopsy front chest x-ray showing dark hole in proximal portion (1) of RTP (2), separating the process from the body of T-1.

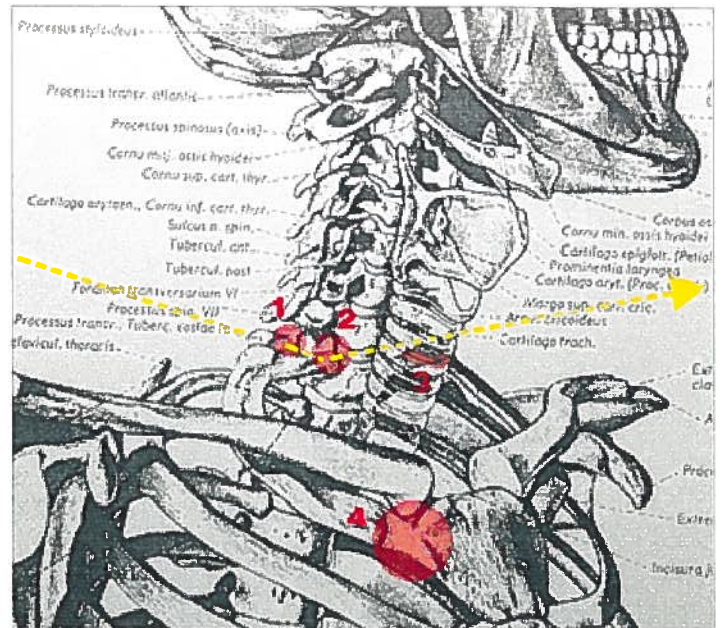


Fig. 23. Cutaway of approximate path of bullet as indicated by injury to RTP (1), costo-vertebral junction (2), trachea (3), and junction of first rib and sternum (4). Trachea injury lines up with trajectory line when head is turned to right as President's was. (WI)

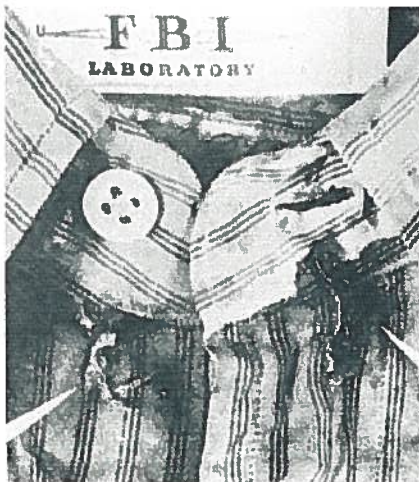


Fig. 24. Exit slits in collar.

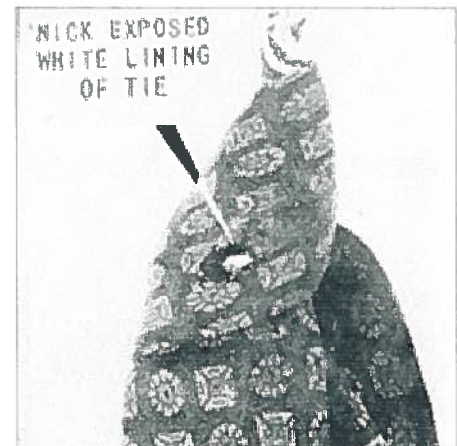


Fig. 25. Nick in right side of tie knot.

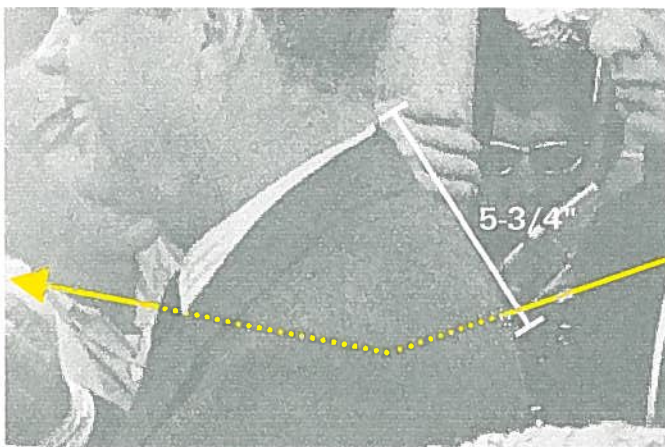


Fig. 26. Bullet path superimposed on photo taken about one hour before assassination. Entry point above measured distance allows for normal wrinkling of shirt material. (WI)



Fig. 27. Photo of tie knot tilted up 11 degrees.

After clipping the tie, the M-C bullet continued on its 11° low-to-high path, barely missing Governor Connally's left ear, and struck the chrome strip above the windshield, denting but not penetrating it (fig. 28). The FBI firearms expert testified that the bullet that struck it was moving at a substantially reduced, but still fairly high, velocity. **The deformation of the chrome establishes a low-to-high and right-to-left approach angle. Much like with a tangential wound to the skin, the bullet created an elliptical dent pointed upward and to the left. The leftward angle is further established by the long crease to the right of the ellipse and the sharp fold to the left. The upward approach is confirmed by the long fold of pushed-up chrome above the ellipse.**

The deformed, weakened bullet broke into two pieces on impact with the chrome. The nose portion (CE567) came to a stop in the dent and bounced back in the direction from which it came, to the right. It was later found wedged in the crack of the front seat cushion to the right of the centerline. The FBI used the ballistic markings on this fragment (fig. 29) to establish that it was fired from Oswald's rifle to the exclusion of all other weapons. A Warren Commission closeup photo of CE567 in the files of the National Archives shows **textile fibers** embedded in the exposed lead of the nose (fig. 30). **There is no reference to these fibers anywhere in the volumes of the Warren Commission or HSCA reports. Photographs of CE567 taken by the writer in September 1994 reveal that the fibers shown in the Commission photo are still present on the fragment, although they have shifted slightly over the years. The fibers appear to match the fibers in the President's shirt collar in color and other physical characteristics. The writer's photos in fact show that the fragment is covered with textile fibers of several types, some of which are consistent in appearance with threads in the President's tie and white tie liner (fig. 31).**

**When the nose of the bullet buried into the chrome, the force of the impact broke off the base of the structurally weakened bullet.** The leftward momentum of the base fragment flung it farther to the left, and it struck the windshield just to the left of, and just below the top of, the rearview mirror. **Since the base fragment hit the glass at a sharp glancing angle at a greatly reduced velocity,** it did not penetrate the glass. It left only a tiny nick with short hairline cracks radiating from it. This "spidering" gradually increased as the limousine sped toward Parkland Hospital. The first high resolution photo of the windshield after the shot is at Z255 (fig. 32). **The nick appears as a small, dark starburst pattern against a light colored background. The longest of the radiating cracks is almost exactly in line with the direction of impact (yellow arrow).** In a photo taken from the rear a few seconds later as the limousine is speeding away, that crack line has gotten noticeably longer and the starburst pattern appears white against the dark shadows under the triple overpass (fig. 33). When the official photos were taken in Washington the next morning, all of the cracks were much longer (fig. 34).

The base portion of the bullet was almost completely spent after striking



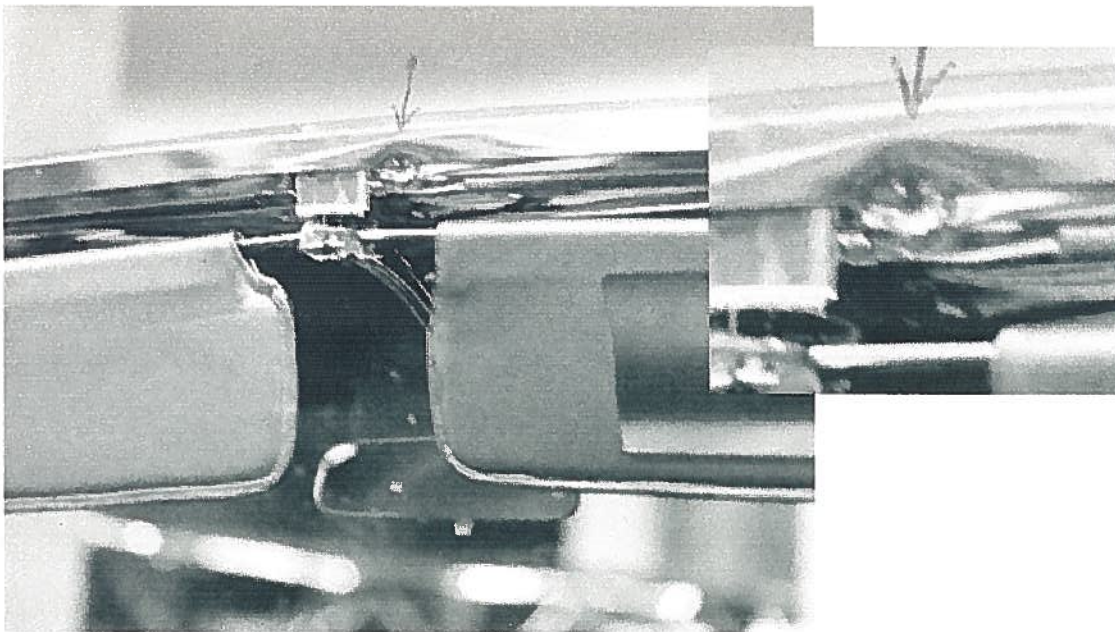


Fig. 28. Dent in chrome strip above windshield.



Fig. 29. CE567.



Fig. 30. Fibers embedded in CE567.

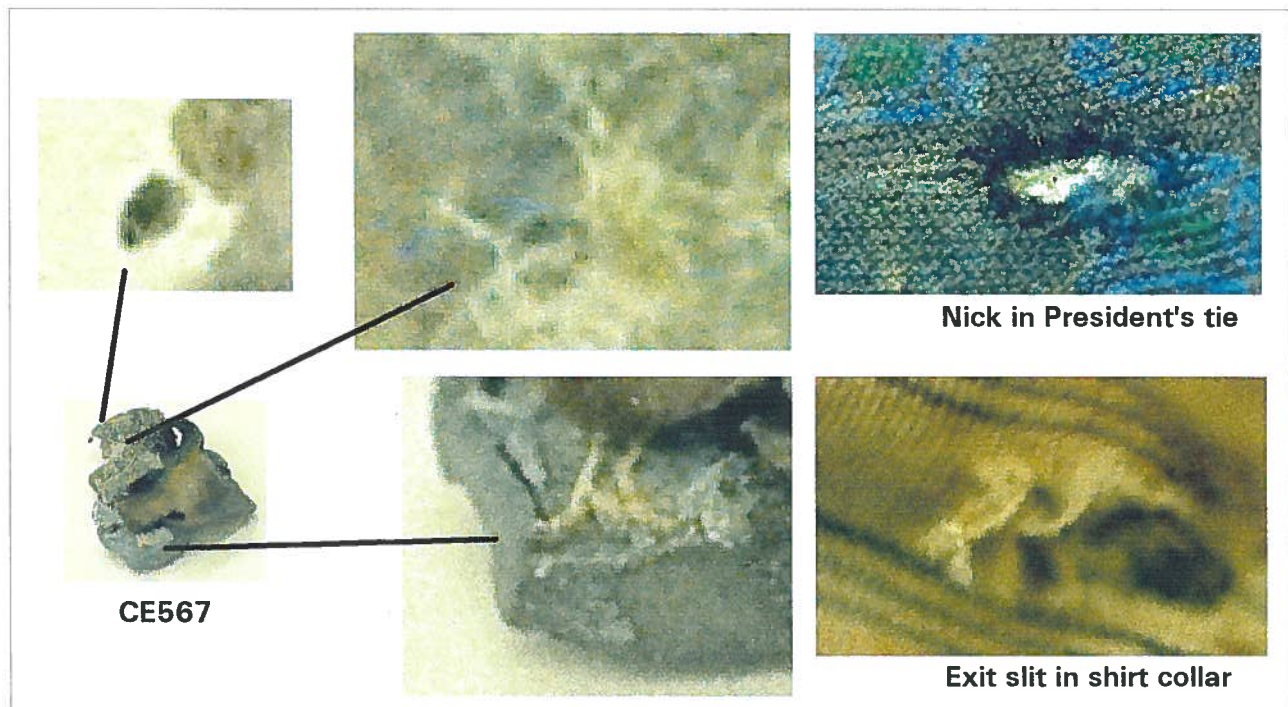


Fig. 31. September 1994 photos of CE567 and clothing. (WP)

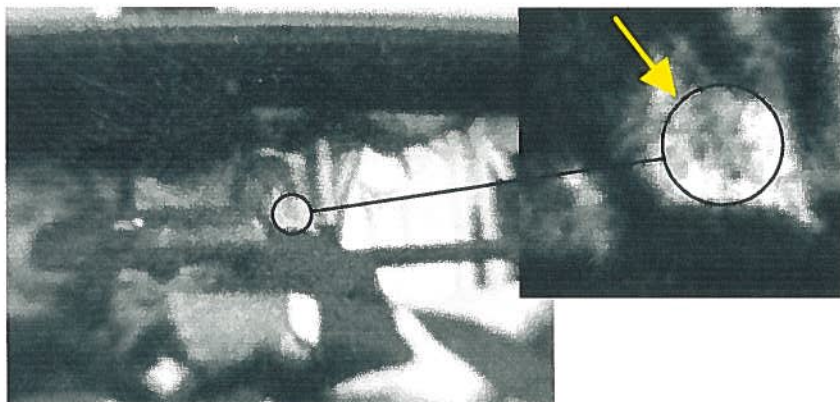


Fig. 32. Photo taken at Z255 shows nick in glass. Inset is computer enhanced to bring out crack lines.



Fig. 33.



Fig. 34.

the windshield, and it fell harmlessly to the front carpet. The FBI found a trace of lead and no copper on the inside of the windshield at the nick, indicating that the exposed lead core, not the bronze jacket struck the glass. **The base portion split into two fragments, either from striking the glass or being kicked around the floor in the ensuing chaos.** One of the fragments, the end of the bronze jacket with the lead core missing, was found on the floor between the right edge of the front seat and the right front door. That fragment (CE569) was matched by the FBI to Oswald's rifle to the exclusion of all other weapons. The fragment is smashed almost flat and appears to have been stepped on (fig. 35). The other fragment from the base was never recovered and **probably was kicked out when a door was opened.**

Visually reconstructing the path of the first shot could be done with great precision using one of the federal government's computer recreation programs. It is difficult to do accurately with a 3-D program on a home computer, in part because Z204 is blurred and a road sign blocks the view of almost the entire passenger area. There are, however, clearer photos taken shortly before the shot on which accurate reconstructions can be drawn, because the torsos of the President and Governor are in almost exactly the same positions as in Z204. The most accurate is the slide taken by Phil Willis at Z202, less than 1/9 sec. before the shot (fig. 36). Reconstructions from other angles are shown in figures 37 and 38. (Other photos relevant to the assassination are in Appendix C.)

As the President emerges from behind the sign on the Zapruder film at Z224, he is in full reaction to the first shot. By Z236, the direct hit to the spinal column has triggered a neurological response that splays the elbows well above horizontal with the fists lined up in front of the face (fig. 39). This reaction, known as the Thorburn position, was identified by Dr. John Lattimer, the first independent medical expert permitted to examine the autopsy photos and x-rays. Dr. Lattimer's medical journal article on his findings included a discussion of William Thorburn's 1889 article describing the reaction of the body to damage to the spinal column in the cervical region. (The T-1 vertebra is connected to the seventh cervical vertebra, C-7.) Dr. Lattimer reprinted the drawing from Dr. Thorburn's article showing a man lying on his back with his elbows pointed directly away from his body and his forearms folded inward.

The first shot caused serious injury to the President, but would not have been fatal.

### Second Shot

The second shot was fired by Oswald at **Z236** at a range of about 200 feet (fig. 40). This was 1.75 seconds after the first shot, slightly more than the





Fig. 35. CE569.



Fig. 36. Path of first shot superimposed on Willis slide. (WI)

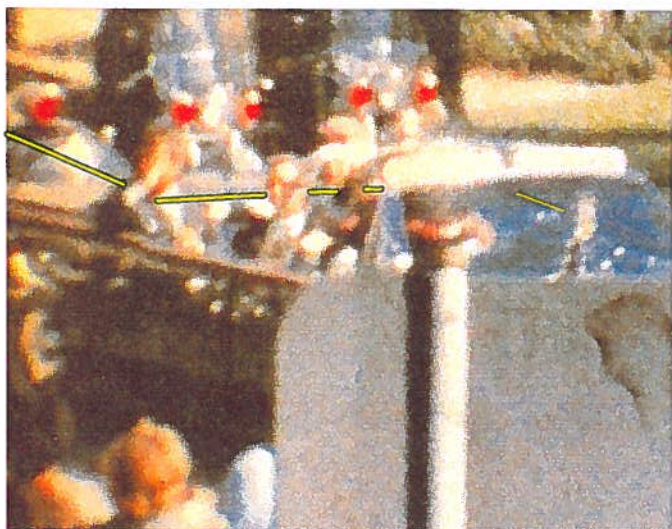


Fig. 37. Shot superimposed on Z193, last clear Zapruder frame before shot. (WI)

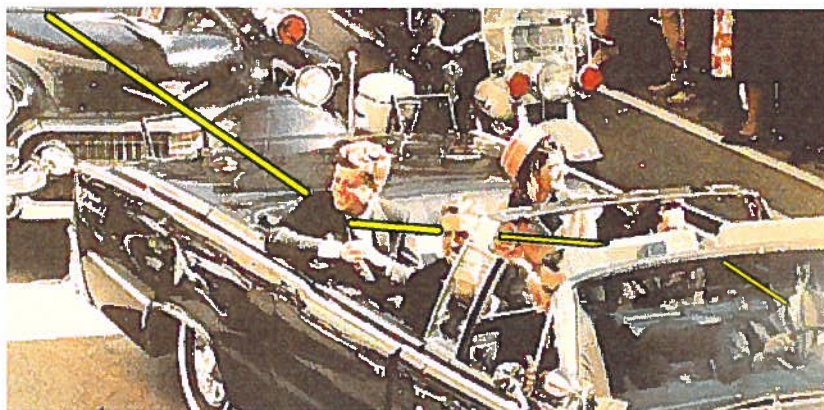


Fig. 38. Shot projected on Main Street photo. (WI)

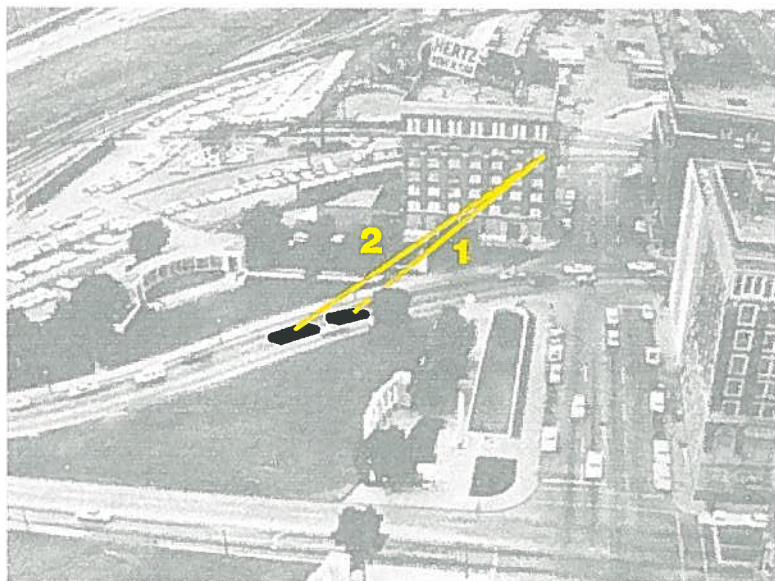


Fig. 40. Trajectory of the second shot. (WI)



Fig. 39. President in Thorburn position.

minimum time required to pull the trigger, work the bolt action, aim, and fire again, as determined by HSCA firing tests. The M-C bullet moved at a downward angle of 16° and a right-to-left angle of 8° . The President had shifted to the left from the impact of the first shot. **The second shot narrowly missed the President's right arm and struck Governor Connally in the back by his right armpit (fig. 41).** The M-C bullet, with its tremendous penetrating power, exited from the right chest and struck the Governor's left thigh.

Medical experts testified that the voluntary reaction to the pain of an injury is sometimes slightly delayed, but the involuntary physical reaction to the force of a blow is almost simultaneous with impact. If someone is punched in the face, the jaw does not wait a few seconds before it is driven in the direction of the force of the punch. The visible effects of the fist-like impact of the bullet blasting through the Governor's chest first appear in Z237. By the next frame, the involuntary reactions are unmistakable—his cheeks are puffed from a collapsed right lung, the right shoulder has been driven down sharply, the face is contorted, and a large shock of hair has flown up on the right side of the head (fig. 42). In the book Six Seconds in Dallas, Josiah Thompson prepared a chart showing the dramatic drop of the right shoulder between Z237 and Z238, much too rapid to be anything but the force of a blow (fig. 43). By Z244, the Governor is seen in full voluntary reaction to the pain (fig. 44). When Life magazine asked Governor Connally to examine prints of the individual Zapruder frames in 1966, he concluded that the bullet struck his chest within a couple of frames of Z234. All three doctors who treated the Governor at Parkland agreed that the chest was hit while his torso was "turned to the right and nearly parallel with the flight of the projectile,"<sup>6</sup> and that his position in the mid-Z230s was consistent with the bullet path through the chest having been caused by a shot from Oswald's position. As discussed further in Appendix A, there is a jiggle on the Zapruder film at Z241, exactly where one would be expected for a shot at Z236.

The bullet made small entry holes in the Governor's suit coat and shirt (figs. 45 & 46) and then entered the back (fig. 47). There are no photos in the record of the Governor's injuries, but they were fully described by the veteran surgeons who treated them. Dr. Robert Shaw, the chest surgeon, had treated well over 1,000 civilian and military bullet wounds. He testified that the entry wound was an 8 mm. by 15 mm. oval with clean edges of the type caused by a pristine bullet entering at a declining angle. A pristine bullet is one that has hit nothing but air since leaving the muzzle and is spinning smoothly. It enters the body with drill-like precision leaving a circular or oval hole with smooth edges. Bullets that are not pristine generally are yawing excessively or tumbling, have sharp, deformed edges, and leave irregular, rough-edged holes. They often drag clothing fibers into the wound. The bullet that entered the Governor's back had



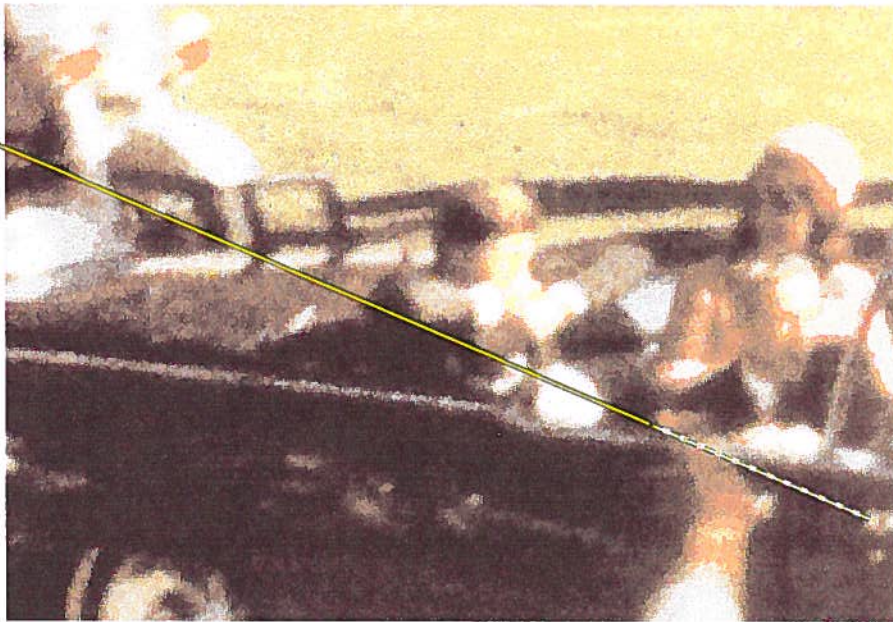


Fig. 41. Path of second shot superimposed on Z236. (WI)



Fig. 42. Governor's reaction at Z238.

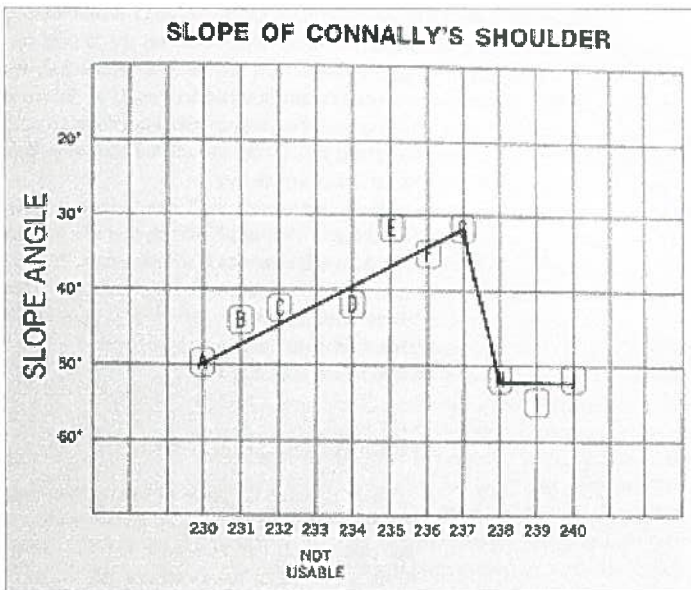


Fig. 43. Chart of shoulder drop at Z237.



Fig. 44.

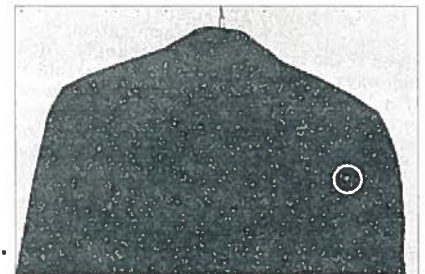


Fig. 45.



Fig. 46. Governor's shirt back.

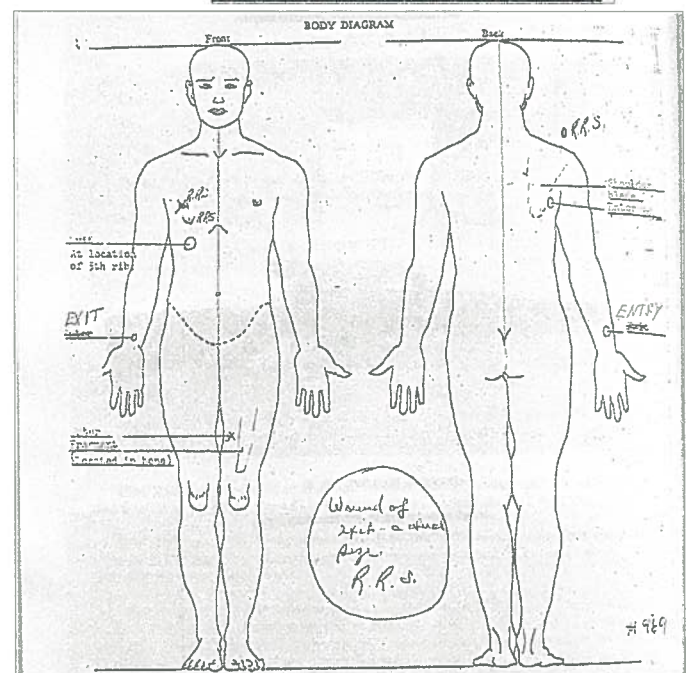


Fig. 47. Governor's entry and exit wounds.



none of these characteristics.

Since the Governor's torso was twisted to the right and tilted back, the bullet passed through the chest at considerably greater right-to-left and downward angles than its 8° and 16°, respectively, relative to the limousine (fig. 48). The bullet clipped the fifth rib and rode along the rib as it passed through the right edge of the chest. The force of the glancing impact partially flattened one side of the bullet from the middle to the base, knocked out about 10 cm. of rib, and cracked the rib just to the right of where it joins the spinal column in the back. The bullet did not penetrate the right lung, but large pieces of bone from the rib did extensive damage to the middle and lower lobes of the lung. Clipping the rib caused the bullet to begin turning sideways slowly as it passed through 12.5 inches of the chest, slowing it down markedly and doing extensive damage to the tissue in its path. The sideways bullet, bone fragments, and tissue exploded out of the front of the chest leaving a huge hole about two inches in diameter one inch below the center of his right nipple (fig. 49). The HSCA pathology panel concluded that the bullet moved essentially in a straight line through the chest.

The bullet, **oriented just past full sideways with the base end slightly forward**, ripped a large H-shaped tear in the front of the shirt (fig. 50). The middle bar of the H is 38 mm. long, 8 mm. longer than the bullet. The bullet, base end forward, then tore through the suit coat leaving a 10 mm. by 10 mm. hole (fig. 51). By the time the bullet struck the coat, its velocity had been greatly reduced. The thick suit coat put up strong resistance to the slow, blunt-end-forward bullet. A very high count of copper residue was measured around the coat hole caused by the copper alloy jacket pressing against the resisting fibers. **This resistance also sheared off three tiny fragments of lead from the hump extruded from the open base of the bullet (fig. 52). These fragments sprayed out of the coat and flew past the Governor's left leg.** They landed on the floor mat under Mrs. Connally's jump seat, where they were found when the limousine was searched in the White House garage hours later.

**After piercing the coat, the bullet, base end forward, struck the inside of the Governor's left thigh** a few inches above the knee (fig. 47, p. 18). The left pants leg had a 7 mm. by 9 mm. hole in it (fig. 53). The slow moving bullet penetrated the skin only a quarter of an inch, leaving a hole about the diameter of the bullet. When the base end buried in the thigh, it left a fourth fragment of lead, smaller than the three under the jump seat, embedded in the soft tissue under the skin. That fragment showed up in x-rays and was left there as harmless when the leg was treated. The bullet worked its way loose from the hole and was trapped inside the pants leg. The bullet later was found at Parkland Hospital on, or within a few feet of, the stretcher on which the

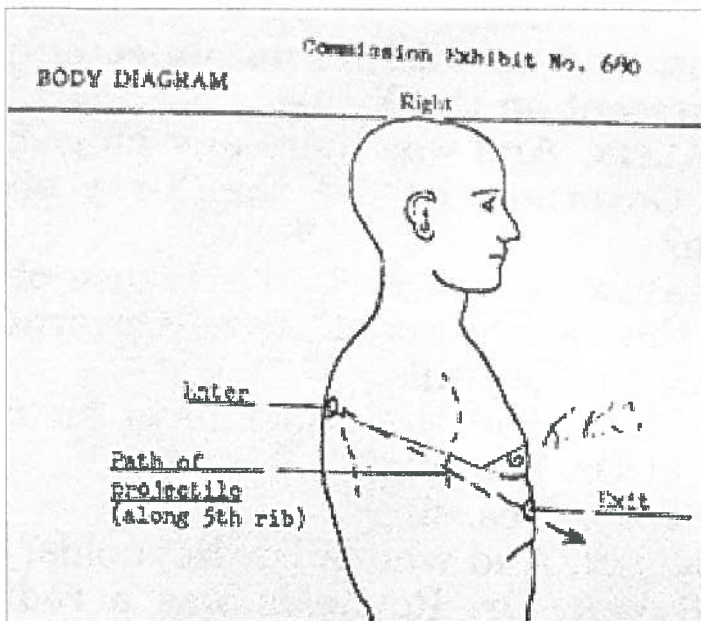


Fig. 48. Exhibit showing downward angle of bullet through chest (initialed solid line).

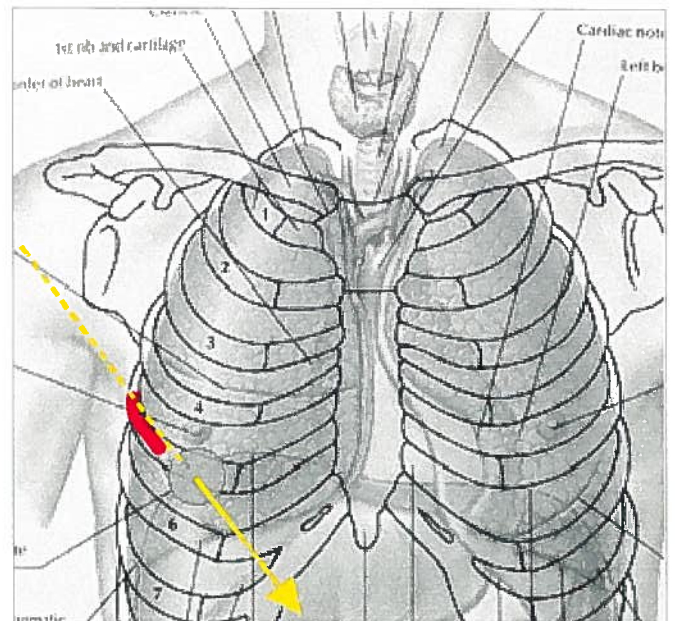


Fig. 49. Illustration of bullet track through chest showing blown out section of fifth rib and large exit hole. (WI)



Fig. 50. Large exit tear in shirt.

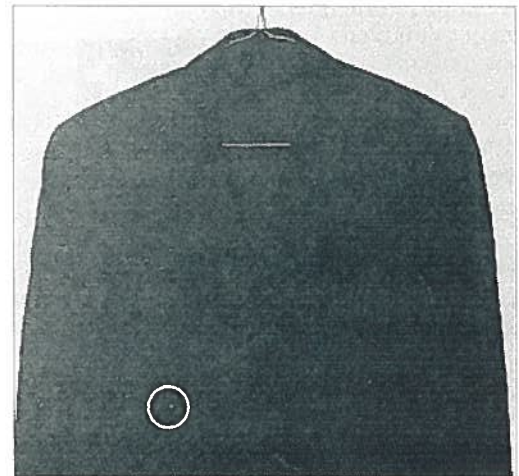


Fig. 51. Exit hole in coat front.

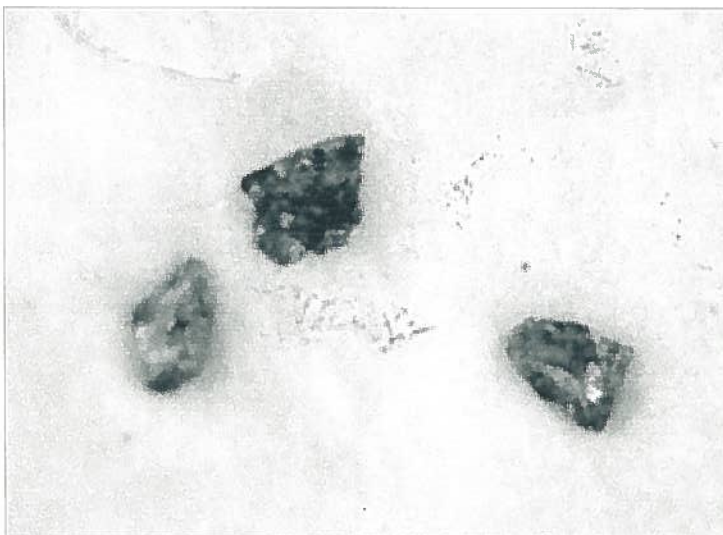


Fig. 52. Three lead fragments from base of bullet.

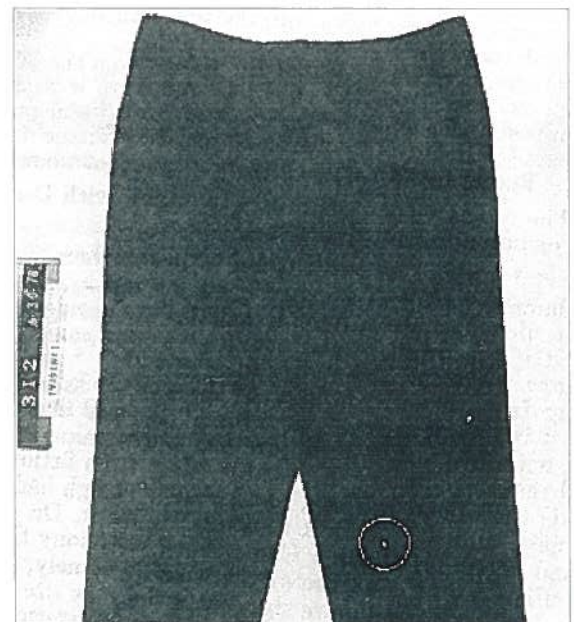


Fig. 53. Bullet hole in pants.

Governor's pants were removed. That M-C bullet, designated by the Warren Commission as CE399, was determined by the FBI to have been fired by Oswald's rifle to the exclusion of all other weapons.

The top half of CE399 is essentially in perfect condition, but the bottom half is somewhat flattened on one side from striking the Governor's rib (fig. 54). A base view of CE399 clearly shows the distorted shape (fig. 55). (The dark circle near the center is where a core sample was removed for chemical testing.) A side view of the base shows that a small hump of the lead core has been squeezed out of the base and that the top half of the hump is missing where the tiny fragments broke off (fig. 56).

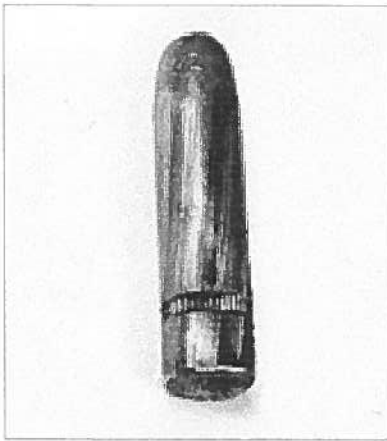
**The fragments found under the jump seat positively tie CE399 to the limousine. One of the three lead fragments was consumed in chemical testing, but the remaining two match indentations in the base of CE399. The most distinctive match is shown in figures 57 and 58.**

In addition to the injuries already described, Governor Connally was treated at Parkland for an injury to his right wrist. **However, the wrist was not struck by CE399.** The right hand was holding the Governor's Stetson at the time of the second shot, and the hand and wrist can be seen above the top of the door throughout the sequence (figs. 41 & 42, p. 18). The right wrist was nowhere near the bullet path at Z236. **The bullet fragment that did strike the wrist about four seconds later** (as discussed below) partially severed the radial nerve, which controls the thumb. It would have been almost impossible for the Governor to have held the hat with his thumb with that nerve cut. The Governor is seen holding the hat with his thumb for four seconds after the second shot.

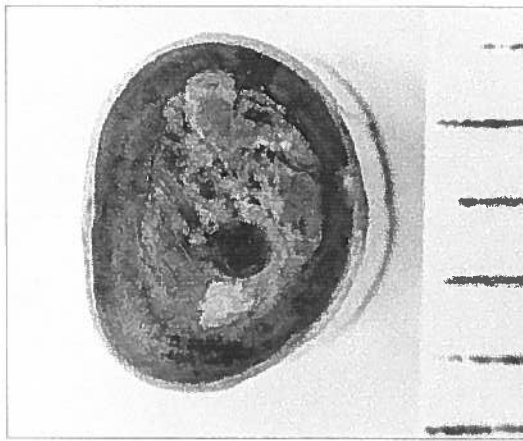
### Third Shot

Lee Harvey Oswald was a mediocre rifleman using a cheap mail-order rifle with a badly misaligned sight. He was accustomed to firing at stationary targets. Not surprisingly, he missed his presumed target, the President's head, with the first two shots. **The third shot was fired at Z312 by a different shooter from a different location with a different type of ammunition. He killed the President with one shot to the very center of the back of the head from a range of about 100 yards. The third shot was beyond Oswald's capability, particularly with this weapon.**

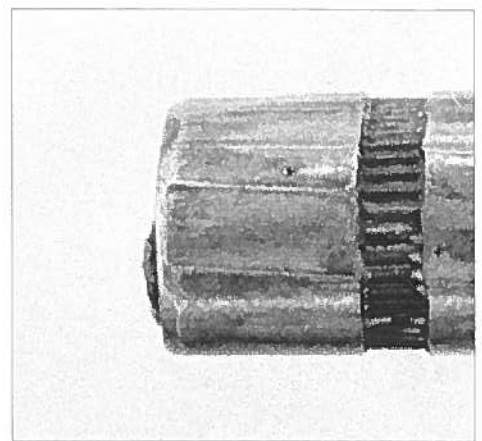
Figure 59 is an HSCA drawing recreating the exact position of the President's head as seen by Zapruder at Z312. It shows the path of the bullet moving from the left rear of the head toward the right front—that is, moving closer to Zapruder. **It is physically impossible for Oswald to have fired that shot.** Oswald was to the right rear of the limousine at all times as it moved down Elm



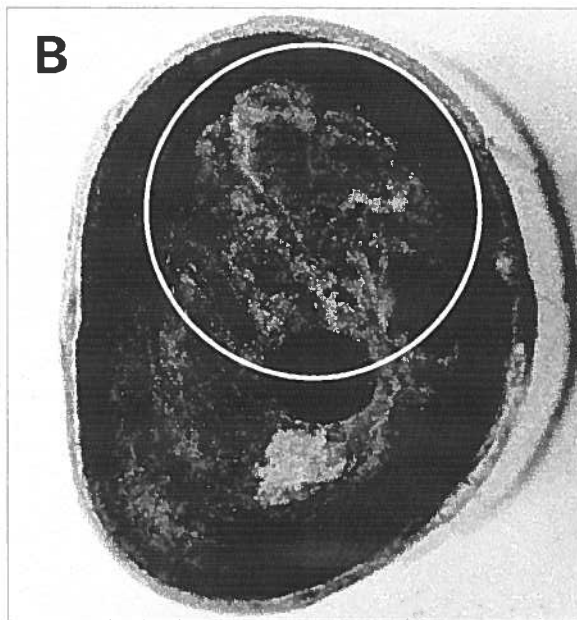
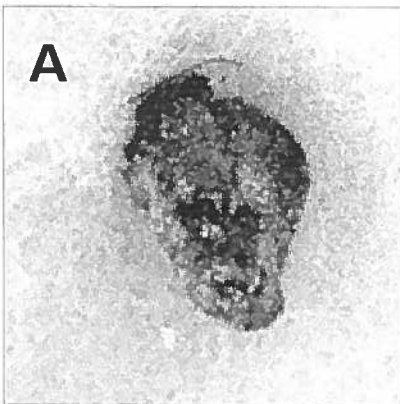
**Fig. 54. Bottom half of CE399 partially flattened.**



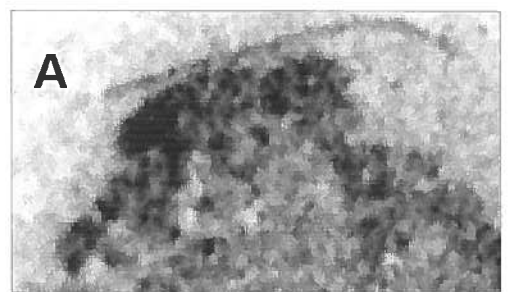
**Fig. 55. Base view of CE399.**



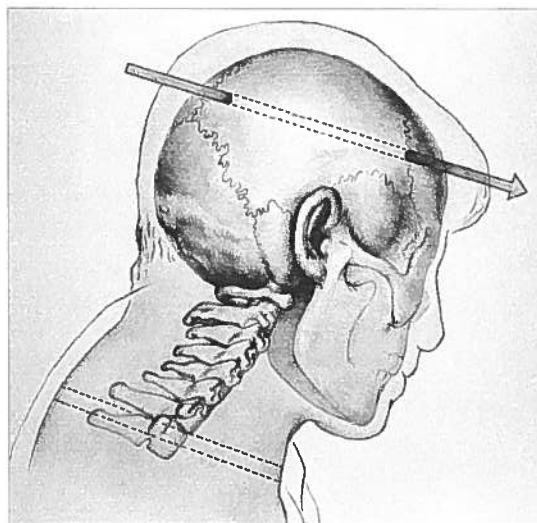
**Fig. 56. Side view showing top part of lead hump missing.**



**Fig. 57 A & B. Lead fragment found under left jump seat (A) and matching indentation in CE399 (B).**



**Fig. 58 A & B. Close-up of knob on top of fragment (A) and matching indentation on CE399 (B).**



**Fig. 59. HSCA drawing of the head shot from Zapruder's perspective.**



Street. Any shot at the President from Oswald would have moved from right to left, away from Zapruder. An FBI photo of the scale model of Dealey Plaza illustrates this (fig. 60). The white strings show Oswald's firing angle at various points. The position at Z312 is approximately at the middle string. **The physical, medical, and ballistic evidence summarized below conclusively proves that the fatal head shot came from the left rear of the limousine.**

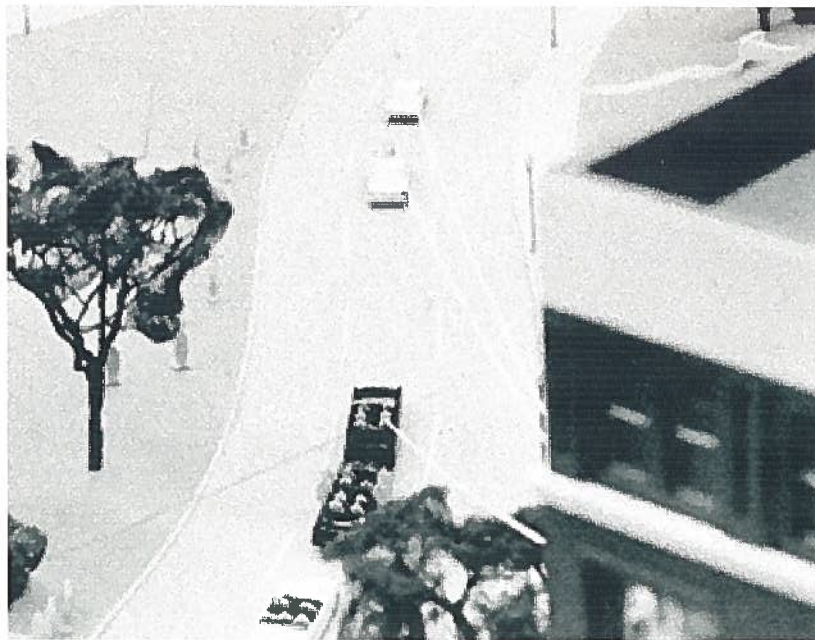
The HSCA pathology panel concluded that the fatal bullet moved through the President's head essentially in a straight line from left to right. The bullet struck the head in the cowlick area almost exactly on the vertical midline (fig. 61). The entry hole in the scalp is a 9 mm. wide by 15 mm. high ellipse with a clean regular shape consistent with being made by a pristine bullet. The ellipse is tilted to the upper right indicating a left-to-right path. Further confirmation of this direction is the abrasion collar, which runs clockwise from 3 o'clock to 10 o'clock. This establishes a left-to-right, low-to-high path. As was the case with the shot to the President's back, the low-to-high entry does not mean that the shot came from below the President. It means only that the bullet struck the lower side of the forward curving scalp first.

The bullet immediately began breaking up and penetrated the skull a fraction of an inch to the right of the hole in the scalp. It cut a track or canal through the brain in a straight line from left to right. What was left of the lead core of the bullet exited the right side of the head above and forward of the right ear. **The destruction and debris the bullet left behind prove that it was a soft-nosed bullet (or a hollow-point, which is virtually identical ballistically) of the type used in varmint hunting.** Such bullets are essentially the ballistic opposite of, and easily distinguished from, military bullets like the M-C.

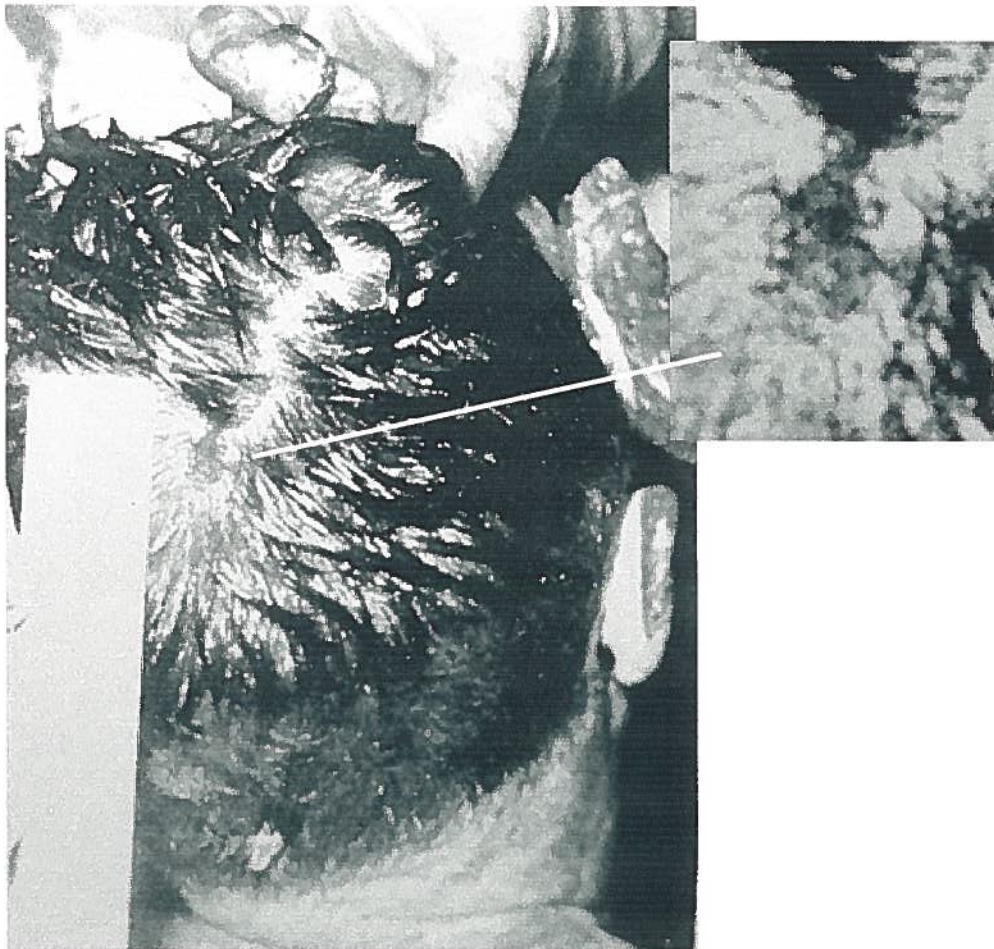
Soft-nosed hunting bullets, like the .257 caliber Roberts (fig. 62), have a copper jacket that is open at the nose and closed at the base. The molten lead core is poured into the nose and left partially exposed. The bullets move at a high velocity (around 3,000 feet per second) that heats up and softens the exposed lead. On impact, soft-nosed bullets begin to break up immediately and expend tremendous destructive energy inside the target. The front end mushrooms and the soft jacket peels back and often separates from the lead core. The bullet immediately begins to fragment into many pieces that do extensive internal damage.

Varmint-hunting rifles are very accurate weapons usually fitted with high-powered telescopic sights. They are designed to kill small, fast-moving targets at long ranges with one shot. According to the 1975 book The Modern Rifle, a marksman with a good varmint rifle should be able to stop a prairie dog at 200 yards.<sup>7</sup> A .257 cal. soft-nosed bullet, which has the same 6.5 mm. diameter as





**Fig. 60. Scale model of Dealey Plaza.**



**Fig. 61. Autopsy photo of the head showing showing left-to-right elliptical entry wound**



**Fig. 62. Recent photo of a .257 cal. Roberts bullet. (WP)**

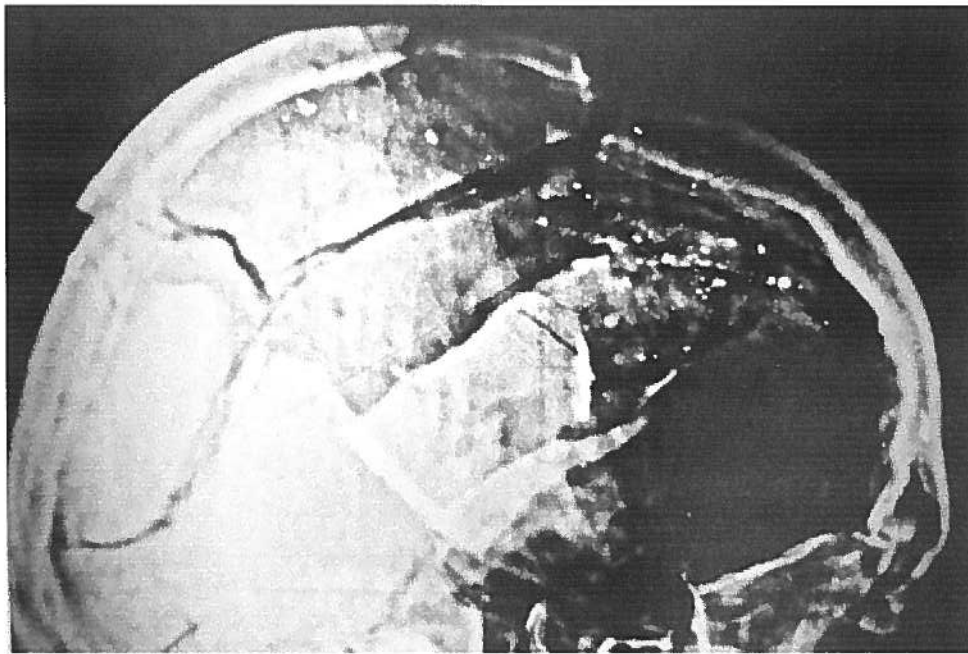
the M-C, is one of the largest and most destructive varmint rounds.

In the late 19th Century, the use in combat of fragmenting bullets similar to the soft-nosed was becoming more common. Fragmenting bullets were causing such devastating wounds that the Hague Peace Conference of 1899 called for the more "humane" non-fragmenting full-metal-jacketed bullet that has been used universally in combat ever since. A military bullet, as previously noted, has a metal jacket that completely covers the bullet except for the partially open base, through which the molten lead is poured. This sturdy construction enables the bullet to pass through human tissue cleanly with little or no deformity to the bullet. As long as it hits nothing harder than tissue, a military bullet can pass through two or three people before coming to rest, making it unsuitable for most civilian uses. Since it cuts a straight, narrow track and expends little energy inside the target, the military bullet typically causes much less internal injury than a soft-nosed hunting round. Also contributing to the humane characteristics of the M-C bullet in particular is its moderate velocity, about 1900-2000 f.p.s. The design characteristics and medium velocity of the M-C keep it from breaking up on impact with a human target.

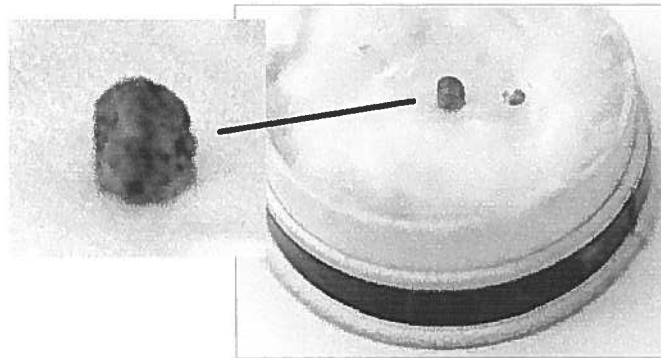
**The fatal shot to the President's head left the unmistakable footprint of a soft-nosed hunting bullet.** When it penetrated the skull it sprayed many tiny dust-like metal fragments in a cylindrical to slightly cone-shaped pattern from the point of entry toward the exit hole (fig. 63). Secret Service Agent Kellerman, who observed the autopsy and saw the skull x-rays, said the fragments looked like a "mass of stars" in the head. Minute lead particles were embedded in the inside of the skull around the exit hole. Somewhat larger, irregular metal fragments also were dispersed in the forward part of the head as the bullet continued to disintegrate (fig. 64). This "lead snowstorm" is the trademark of a soft-nosed bullet. The book Gunshot Wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques by Vincent Di Maio explains, "As the expanding bullet moves through the body, fragments of lead break off the lead core and are hurled out into the surrounding tissues."<sup>8</sup> The book describes the x-ray of a soft-nosed bullet wound:

One of the most characteristic x-rays and one that will indicate the type of weapon and ammunition used is that seen from high-velocity rifles firing hunting ammunition. In such a case, one will see a "lead snowstorm" (Figure 11-3). Such a picture rules out a full metal jacketed rifle ammunition or a gunshot slug.<sup>9</sup> [emphasis added]

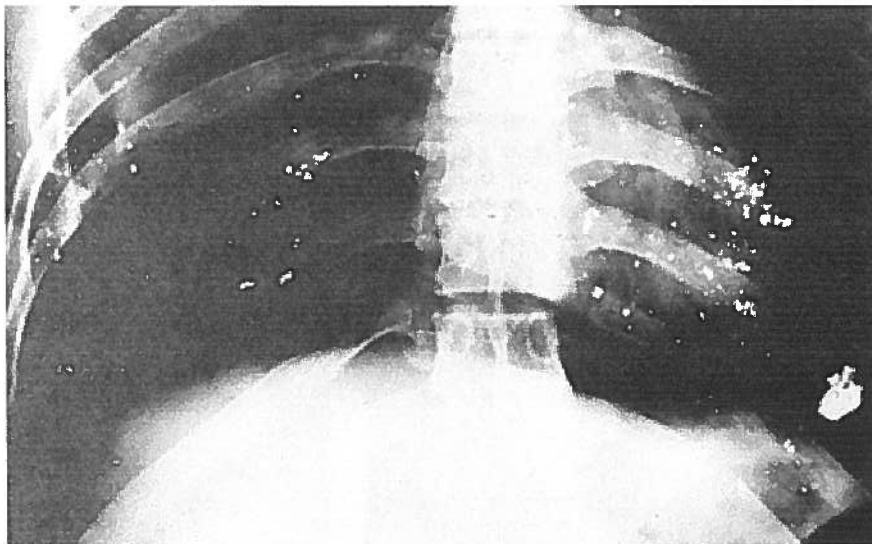
The "Figure 11-3" referred to (see fig. 65) shows the same kind of fragment dispersion as the President's skull x-ray.



**Fig. 63. HSCA enhanced x-ray of right side of President's skull. Small white particles are bullet fragments.**



**Fig. 64. Lead fragments recovered from brain. Inset shows cylinder-shaped left side of largest piece.**



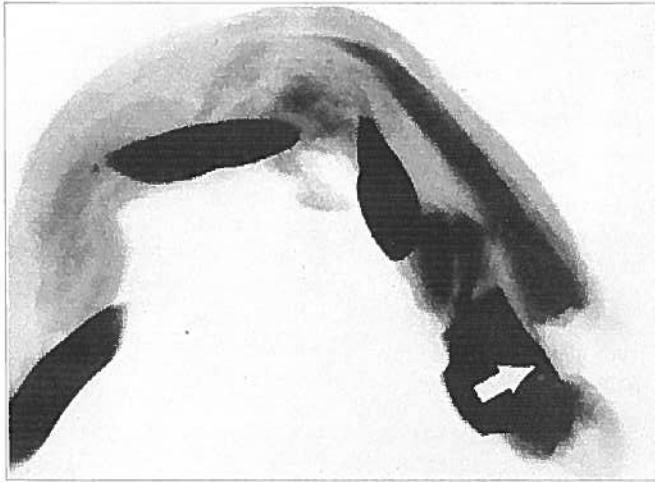
**Fig. 65. Textbook "lead snowstorm" x-ray of soft-nosed hunting bullet.**



This pattern is so conclusive that it alone has been used to exonerate murder suspects. Homicide Investigation by LeMoyne Snyder, a classic text, cites the case of a deer hunter killed by a single shot in the chest. There were two suspects, one firing military bullets and one firing soft-nosed bullets. The rifles were test-fired into beef rib. The military bullet left no fragments at all in the beef (fig. 66). The soft-nosed bullet left numerous tiny flecks of lead in the meat on the exit side of the bone (fig. 67) like those seen in the dead man's chest, "prov[ing] that it was soft-nosed ammunition" and not a military bullet.<sup>10</sup> The same kind of conclusive comparison can be made with the first two shots in this case. Each M-C bullet passed through the back and chest, two layers of skin, and several layers of clothing, and both struck bone. Yet neither left any fragments at all in the chest. Warren Commission tests showed that even M-C bullets that had been massively damaged by striking bone twice broke up into two or three large chunks (like the bullet that struck the windshield).<sup>11</sup> A tumbling M-C also may lose a few flakes of lead from the extruded core at the base (like the four flakes stripped from the base of CE399). However, a pristine M-C is ballistically incapable of producing a lead snowstorm on impact. The HSCA's own testifying wound ballistics expert did not disagree. Larry Sturdivan did not even mention the M-C when testifying about the type of bullet that caused the pattern of fragments seen in the side x-ray of the President's skull (fig. 63, p. 26). Instead, he concluded, "So, this case is typical of a deforming jacketed bullet leaving fragments along its path as it goes."<sup>12</sup> This is the textbook description of a soft-nosed hunting bullet. According to Wound Ballistics and the Scientific Background by Karl G. Sellier and Beat P. Kneubuehl, (pp. 172-175), soft-nosed hunting rounds are classified as deforming and fragmenting jacketed (or, more precisely, semi-jacketed) bullets. A military bullet like the M-C has the opposite ballistic classification. It is a "full-jacketed, nondeforming bullet." (HSCA pathology panel report, vol. 7, p. 170.)

The most decisive evidence that this was a soft-nosed round is the presence of two pieces of metal next to the entry hole, but on the outside of the back of the skull, between the skull and the scalp (fig. 68). The HSCA pathology panel concluded that the bullet threw off these fragments when it began separating on impact with the scalp. Ballistics experts know that a pristine M-C bullet would never break up on impact with soft tissue like the scalp. Test M-C bullets penetrated over 72 cm. of gelatin simulating human tissue and remained completely intact. Other M-C test bullets went through 47 inches of solid ponderosa pine without fragmenting. The Warren Commission ballistics experts fired M-Cs into ten skulls covered with simulated scalp. None of the bullets left fragments outside the skull on the entry side.

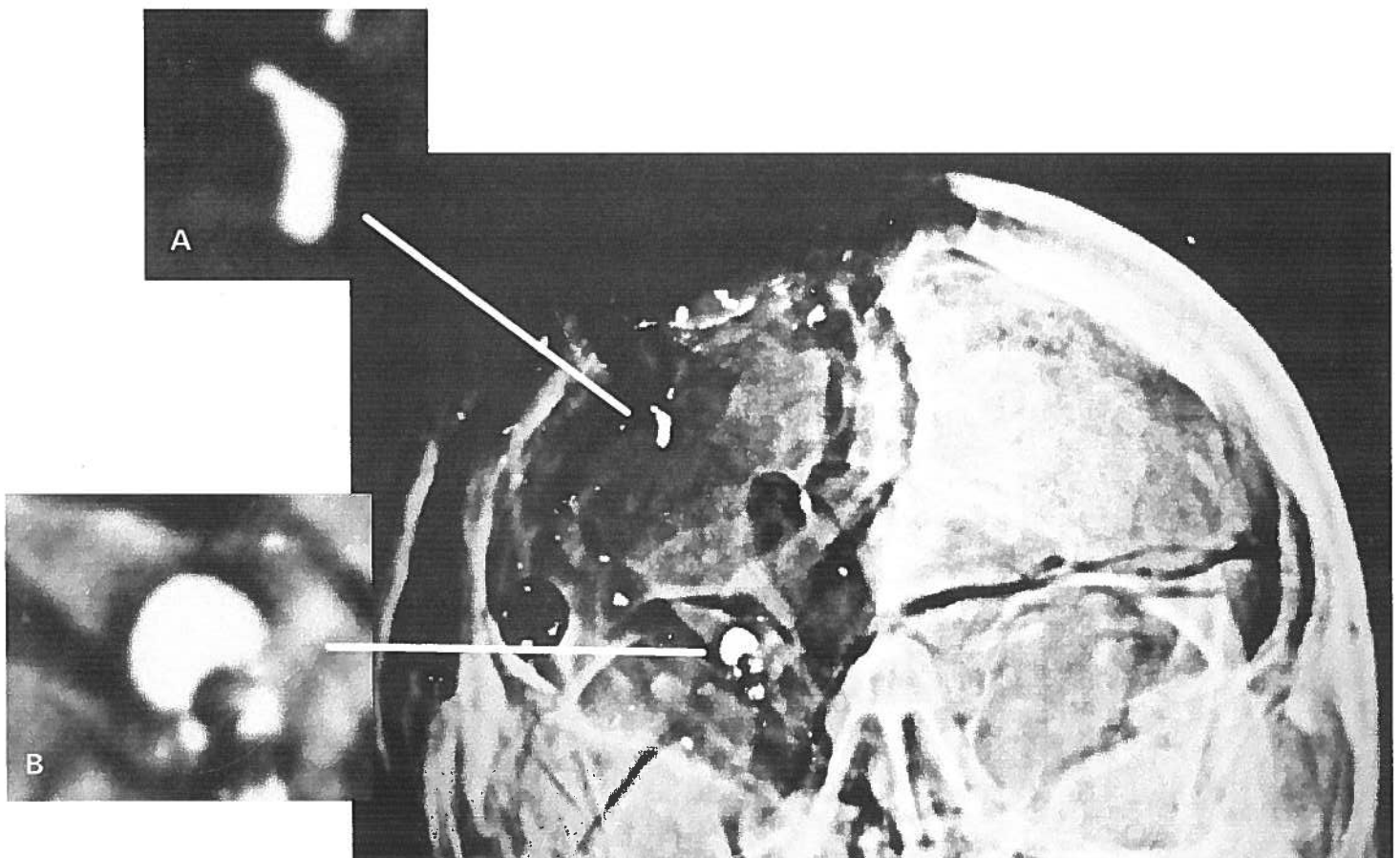
**These two fragments were pieces of the copper jacket of a soft-nosed bullet. The smaller one (A) is irregular in shape. It is a portion of the side of the jacket that peeled off**



**Fig. 66. Military bullet fired through beef rib (arrow) left no metal fragments.**



**Fig. 67. Soft-nosed bullet left many dust-like metal fragments on the exit side of the bone.**



**Fig. 68. HSCA enhanced autopsy x-ray of the front view of the skull. Small irregular fragment (A) and larger circular disk (B) are on the outside of the back of the skull.**

and was slung upward by the spinning bullet and wedged between the skull and scalp above the entry hole. The second fragment (B) probably is the single most important piece of physical evidence in the case. The presence of the fragment has been duly noted over the years, but its significance has been ignored. Invisible under the scalp and outside the skull, it was overlooked by the autopsy pathologists. If they had discovered and removed it, this case would have been quickly solved. The fragment is just to the right of the entry hole. It is a thin, flat circular disk with machine-smooth edges that the HSCA pathology panel determined to be 6.5 mm. in diameter. Except for being slightly humped or concave from the impact, the visible portion of the disk is a perfect circle. **It is the copper base of the jacket of a 6.5 mm (.257 cal.) soft-nosed bullet** that was scraped off by the skull acting like a chisel as the disrupted bullet penetrated the bone (fig. 69). There are no 6.5 mm. circular disks on an M-C bullet, because it has no solid base. **The presence of this fragment removes any doubt as to whether the fatal bullet could have been an M-C.**

When the bullet entered the skull, it made large cracks in the skull that radiated from the entry hole. Under the explosive pressure of the bullet and fragments passing through the brain, the entire upper right portion of the skull broke apart and much of the tissue from the right side of the brain exploded along with skull and bullet fragments forward and to the right of the limousine, **in the direction of the bullet**, as shown in the three home movies taken during the shot. The remaining portion of the lead core of the bullet continued in a straight line and exited from the right side of the head. An HSCA photo of a test firing of a .257 cal. Roberts soft-nosed bullet shows exactly the same pattern as the fatal head shot (fig. 70). The test bullet entered the gelatin and immediately began to disintegrate, spraying fragments in a cylindrical to slightly conical path, and the core continued in a straight line.

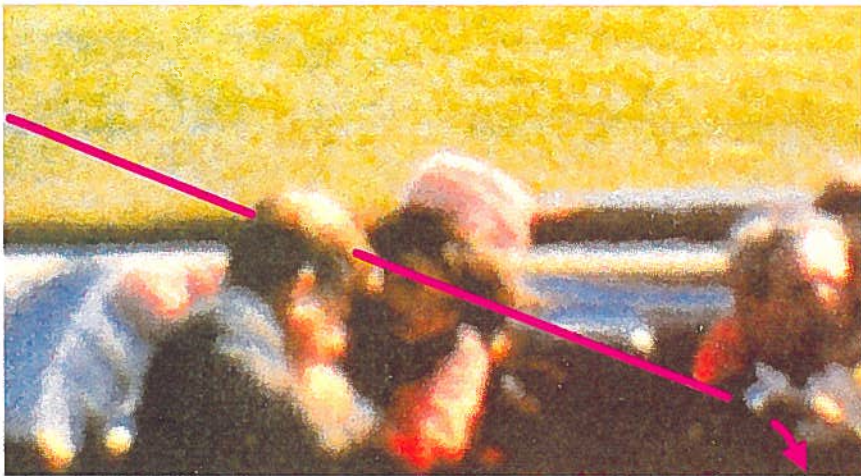
**After the lead core exited the skull, it struck the Governor's right wrist**, penetrated the radius bone, and exited almost totally spent from the underside of the wrist. Figure 71 is Z312, the last frame before the head explosion, **with the bullet track superimposed**. Confirmation of this track can be made by superimposing the HSCA drawing of the head at the instant of impact over the same photo of Z312 (fig. 72). The black arrow showing the bullet path in the drawing has been extended forward with the magenta line. It intersects the Governor's wrist at the same point as the line in fig. 71.

The sharp-edged lead core piece penetrated the Governor's coat sleeve 3/4 inch from the end (fig. 73). The FBI expert testified that it was a "very rough" hole consistent with having been made by a "mutilated bullet."<sup>13</sup> The lead piece then went through both layers of the French cuff of the shirt about 1-1/2 inches from the end of the cuff, leaving a 16 mm. by 9 mm. hole in the outer layer and an 18 mm. by 5 mm. hole in the inner layer. The FBI agent





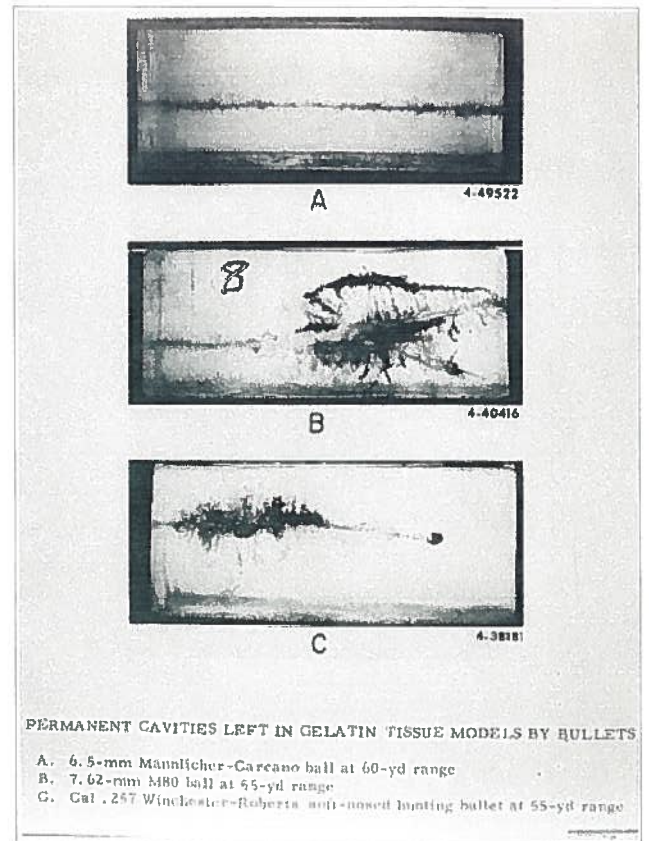
**Fig. 69.** Base of a .257 cal. Roberts is a 6.5 mm. circular copper disk. (WP)



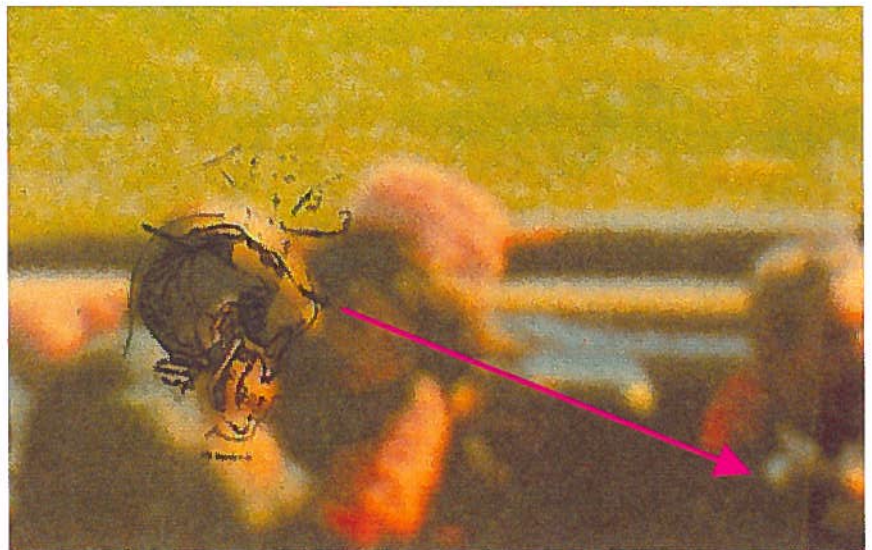
**Fig. 71.** Trajectory of third shot superimposed on Z312. (WI)



**Fig. 73.** Reentry hole in Governor's right front coat sleeve.



**Fig. 70.** Soft-nosed bullet fragmenting in simulated tissue (C). Contrast with narrow track of intact M-C bullet (A).



**Fig. 72.** HSCA drawing superimposed on Z312. (WI)

described the holes in the cuff as being ragged and irregular with star-shaped tears radiating from them. The lead fragment then entered the upper side of the forearm two inches above the wrist, creating a 2 cm. long ragged entry wound. Strong confirmation that the wound was caused by a jagged, deformed missile, as opposed to a smooth whole bullet, came from the fact that mohair fibers from the Governor's coat were dragged through the two layers of shirt cuff and deposited inside the wound. Dr. Charles Gregory, the doctor who treated the wrist injury, had experience with over 500 civilian and military gunshot wounds. He testified that the entry wound in the wrist was consistent in all respects with being caused by a distorted missile with sharp edges.

The lead piece went completely through the radius bone, breaking the bone into several pieces (fig. 74). Dr. Gregory found numerous tiny bits of lead at various levels on the exit side of the bone. At least four fragments of lead were removed from the wrist. (There are four fragments currently in the National Archives, but the record is unclear whether one or two others may have been consumed in chemical testing.) Several other fragments were left in the arm. Figure 75 is a close-up of two of the fragments removed. They have a characteristic in common with the largest lead piece from the President's head—a portion of the smooth-molded, cylinder-shaped side of the core of the bullet. (Additional evidence linking the head and wrist fragments comes from the neutron activation analysis of their chemical elements discussed in Appendix B.)

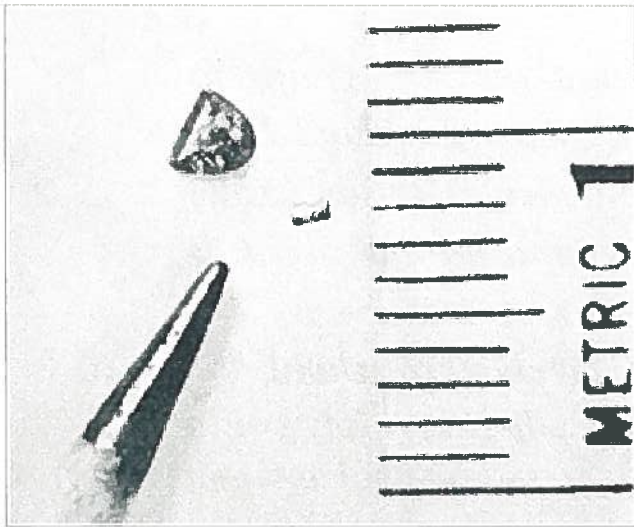
Passing through the wrist, the missile also severed a tendon and partially severed the radial nerve. As previously noted, it would have been almost impossible for the Governor to have continued holding his Stetson with his thumb after the damage to the radial nerve. He is seen in Z312 and several frames before that with his right arm in a stationary position and the hat brim held between the right thumb and fingers. The wrist is sharply cocked and only a thin strip of French cuff is visible. At Z313, only 1/18 second later, the forearm has moved about six inches forward, the wrist has flattened out, much more cuff is visible, and the hat has disappeared. (This movement is seen more clearly on the still prints of Z313 in the National Archives than on videotape still-frames.) The Governor then quickly rolled forward in the seat and brought his right hand up to partially cover his head in a defensive move. The hand is still holding the hat, but no longer with the thumb. The brim is squeezed between the fingers and palm (fig. 76).

After it had passed through the radius bone, the remainder of the lead core made a thin, almost unnoticeable slit of an exit wound in the middle of the palm side of the wrist just above the flexion crease and penetrated both layers of the French cuff again. **Almost totally spent, the fragment fell out harmlessly.** It was never recovered and **probably was kicked out on the pavement** during the mass

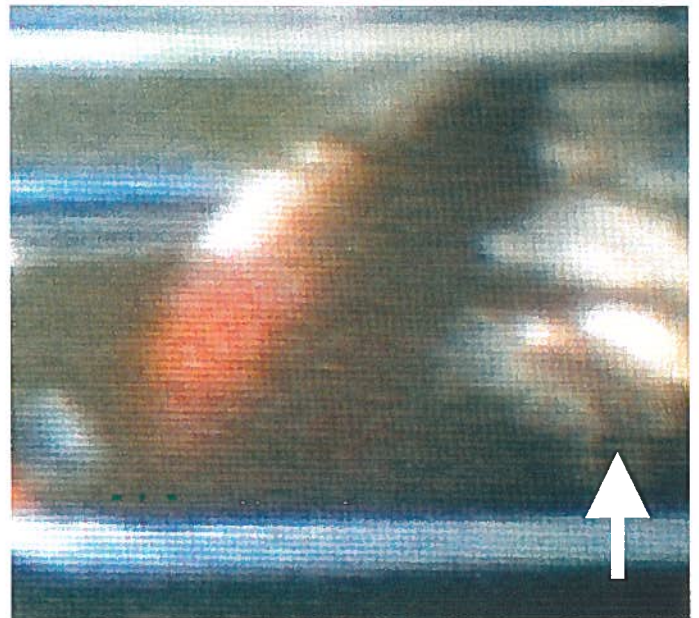




**Fig. 74. X-rays of the underside of the Governor's right wrist before and after treatment showing shattered radius bone and dust-like metal fragments.**



**Fig. 75. Two small lead fragments recovered from the Governor's wrist. The cylinder-shaped side of the lead core of the soft-nosed bullet is visible on both.**



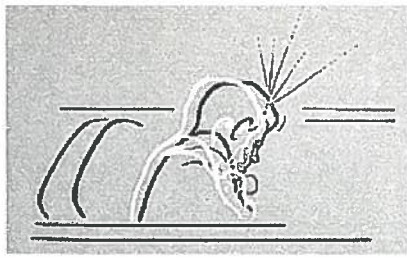
**Fig. 76. Governor squeezing his hat brim in his right palm after the head shot.**



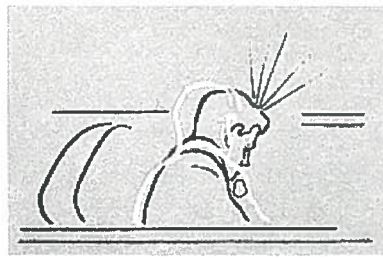
confusion of lifting both men out of the car at Parkland. The Governor had to be lifted out first so that his jump seat could be folded forward to get the President out. There were people climbing all over the area around the jump seat.

Turning to the President's movements after the head shot, the head can be seen in the Zapruder film being whipped violently back toward the left rear of the limousine, almost as though someone had grabbed his hair from that direction and jerked very hard. It took the efforts of photographic experts, a physicist, and a former combat surgeon to explain how a bullet from the rear could cause the head to be thrown to the rear. Photographic experts determined that the head actually moved slightly forward from Z312 to Z313 and then moved backward at a much faster rate (figs. 77 & 78). Dr. Luis Alvarez, a Nobel Prize winning physicist, studied this phenomenon and concluded that the movement to the rear was due to the jet recoil effect. The initial forward movement of the head was caused by the modest forward momentum imparted by the bullet striking the rear of the skull. The explosion of skull fragments, brain tissue, and bullet fragments out the right side of the head acted like a jet engine that caused the head to reverse itself and go in the opposite direction at a much faster rate. To test his calculations, Dr. Alvarez fired bullets into melons simulating skulls. Six of seven melons moved in the opposite direction from the bullet, that is, back toward the shooter. Dr. John Lattimer, the physician who identified the Thorburn reaction to the first shot, was a combat surgeon during World War II. He decided to repeat Dr. Alvarez' experiments under more realistic conditions. He used both melons and actual skulls. All 12 bullets fired into the skulls caused the skulls to move back toward the shooter (fig. 79). **One of the greatest ironies in a case full of ironies is that the President's last act before he died was to point toward his assassin with the involuntary movement of his head to the left rear.** For the past 31 years, no one has paid any attention.

The remaining question on the third shot is exactly where from the left rear the fatal shot was fired. Using the entry and exit points in the President's head and Governor's wrist, computer recreation could determine the position with great precision. It is harder to be accurate with only a home computer, a protractor, and a ruler. The first step is to measure the left-to-right angle by determining the angle of the track through the head and then establishing the position of the head from the photos. Figure 80 is an HSCA drawing of the head showing the entry and exit holes. Transferring those points onto an anatomy textbook top view of the skull (fig. 81) provides a close approximation of the angle through the head. It works out to be 26°. Another method is to trace the angle of the track or canal through the brain using the HSCA drawing of the autopsy photo of the top left perspective of the brain (fig. 82). (The photo itself is not available to the public.) The drawing is not very detailed, but the

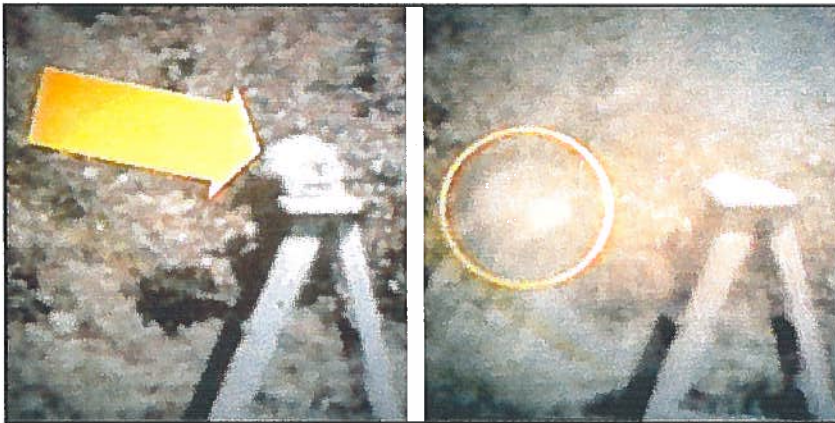


Superimposition of Zapruder frames 312 (white outline) and 313 (black outline) shows a sharp forward movement (in 1/18 sec.) before the left, backward snap.

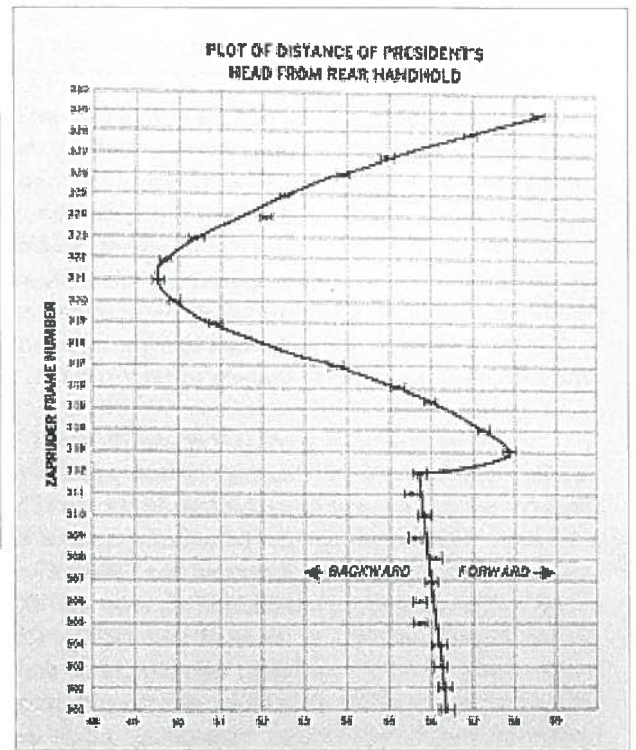


When Zapruder frames 313 (black outline) and 316 (white outline) are superimposed, it is clear that the President was forced left and backward under impact of the fatal shot.

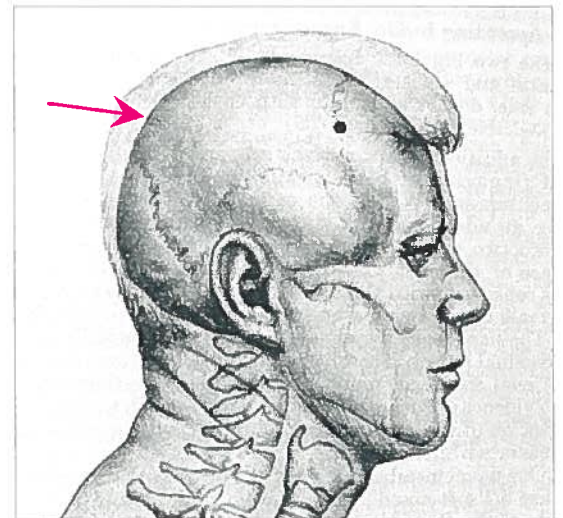
**Fig. 77. Drawing from Six Seconds in Dallas showing the short forward and then rapid left and backward movement of the President's head.**



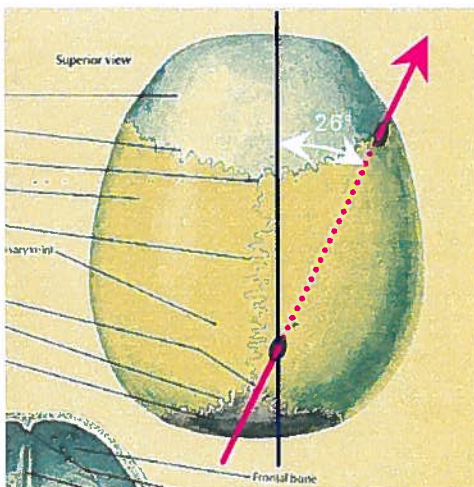
**Fig. 79. Test shots by Dr. Lattimer caused the skulls to fly backward toward the shooter.**



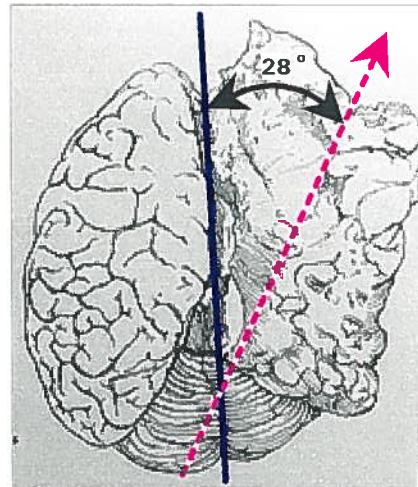
**Fig. 78. Chart from Six Seconds in Dallas traces forward and backward movement.**



**Fig. 80. HSCA drawing showing entry and exit points in skull. Entry hole (writer's arrow) is so close to center of back of skull, it is barely visible.**



**Fig. 81. Bullet path superimposed on textbook drawing. (WI)**



**Fig. 82. Left-to-right track added to HSCA drawing of autopsy photo. (WI)**

pattern of obvious tissue damage and the few shading lines of the canal are adequate to measure the angle, which is  $28^\circ$ . To convert this  $28^\circ$  estimated angle (assumed to be the more accurate number) through the head to the angle of the shot relative to the limousine, it is necessary to determine the direction the President's head was facing at Z312. Figure 83 shows several of a series of photos of a bust of the President taken from various angles to duplicate Zapruder's perspective at Z312. The photos that match the closest are the ones in which the head is turned  $6^\circ$  and  $8^\circ$  to the left, away from Zapruder. At Z312, the limousine was perpendicular to Zapruder at the front of the chrome roll bar. (That is where corresponding left and right points on the car are in a straight line to Zapruder.) The President's head is four feet behind that perpendicular point, meaning that the head appears to be turned  $3^\circ$  less to the left relative to the limousine than it really is. Adding the  $3^\circ$  to the  $6-8^\circ$  from figure 83 gives a left head turn of  $9-11^\circ$  relative to the direction of the limousine. That is subtracted from the  $28^\circ$  angle through the head, which gives a left-to-right angle of the shot relative to the limousine of  $17-19^\circ$ . The last adjustment is an addition of  $2^\circ$  to compensate for the leaning of the head far to the left and the forward head nod, which make the left-to-right angle of the bullet through the head  $2^\circ$  less than the angle relative to the limousine. The final left-to-right angle of the shot relative to the limousine is  $19-21^\circ$ . The direction of the limousine at Z312 was  $7^\circ \pm 1^\circ$  right of Oswald's line-of-sight based on HSCA drawings and confirmed by independent calculations. Figure 84 shows the positions at Z312 of Oswald and the limousine and the approximate position of the second shooter. All of this approximation of the left-to-right angle of the shooter is necessary only because the technology available to the writer is unsophisticated. Computer recreation can pinpoint the firing position to within a few feet.

The HSCA staff used the entry and exit holes in the skull and the head tilt in Z312 to project the vertical angle of the bullet path, which was determined to be  $16^\circ$  downward relative to the plane of the limousine. Projecting a line at that angle up to the TSBD, they found that it intersected a full floor above Oswald's window. They drew a huge margin-of-error circle around the line just large enough to reach Oswald's position. This assumption of error was not justified, because the reference points are clearly visible on the photographs. The line was correctly drawn; it just was not extended far enough. Figure 85 shows that the extended  $16^\circ$  line exactly intersects with the right center of the roof of the CRB Annex.

The book Crossfire by Jim Marrs reports that in 1975 an air conditioning repairman was searching for water leaks along the base of the west parapet on the roof of the CRB Annex (the side facing Dealey Plaza).<sup>14</sup> The worker felt under the lip of the roofing tar and found a .30 caliber shell casing with markings indicating that it was made at the Twin Cities Arsenal in 1953.





Fig. 83. Selected photos from a series taken of a bust of the President at various angles. The numbers indicate the degrees the head is turned to the left, away from the camera. (WP).

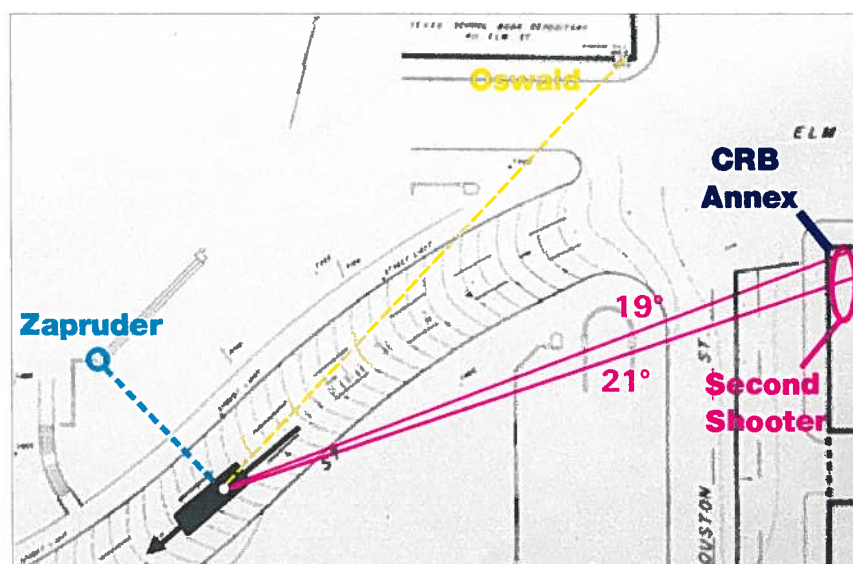


Fig. 84. Chart showing approximate firing position of second shooter. (WI)

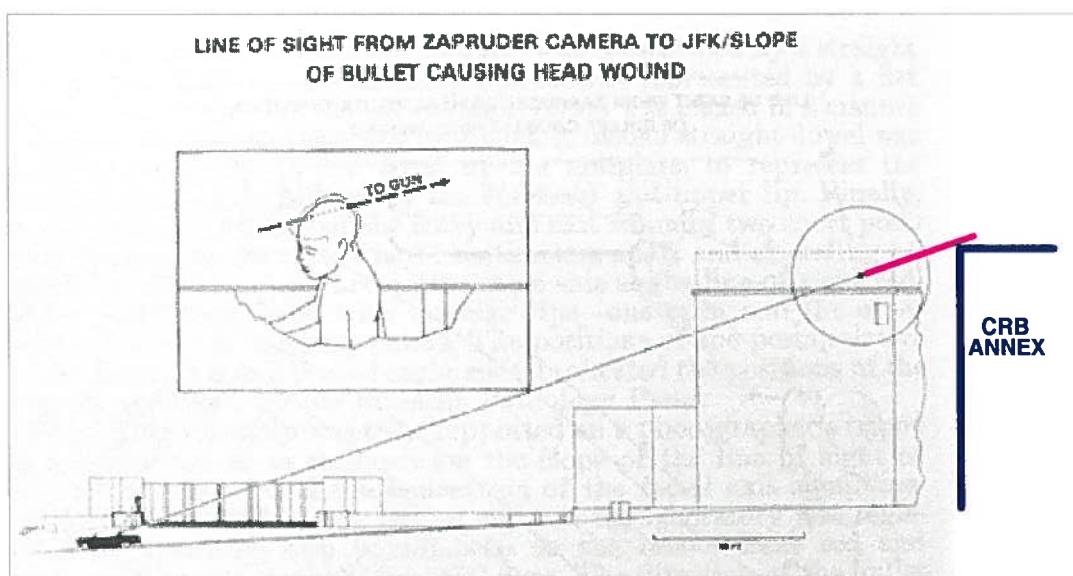


Fig. 85. HSCA drawing of trajectory of head shot. Color portion has been added to show that, while the 16 degree angle is 4 degrees too high for Oswald's window, it lines up perfectly with the roof of the CRB Annex. The CRB Annex is drawn at the distance of the right center of the roof from the car. (WI)

(Oswald's M-C cartridges were made in 1954.) One side of the casing was badly pitted, indicating exposure to the weather for a long time. The casing has an unusual crimp around the neck that rifle experts have told the worker indicates the possible use of a sabot. A sabot is a small sleeve that fits around a bullet that would enable a .30 cal. weapon to fire a smaller bullet, such as a .257 cal. soft-nosed bullet. A sabot would provide an assassin several important advantages. The larger, more powerful cartridge gives the bullet more velocity (i.e., destructive power), accuracy, and wind resistance. (Dealey Plaza was very windy on the day of the assassination, with gusts of over 20 m.p.h.) Perhaps more importantly, the rifling marks are left on the sabot, which separates from the bullet after it leaves the muzzle, making the bullet itself ballistically untraceable. **Twin Cities is an arsenal in Minnesota that makes only military ammunition and has never produced a sabot cartridge. This casing had to have been modified by an expert after manufacture.** The Gunner's Bible, by Bill Riviere, says on page 30 that "you have something close to the ultimate in a varmint load" if you take a .30 cal. cartridge and reduce the neck size to hold a .25 cal. soft-nosed bullet. Figure 86, p. 40, is a photo of the roof of the CRB Annex showing what appears to be a mechanical structure protruding along the edge of the roof near where the trajectory lines indicate the shot was fired. The metal box would have provided a perfect structure for an assassin to hide behind and rest his rifle on to increase accuracy. The relevance of the shell casing goes up substantially if it is determined that it was found within a few feet of the structure. A reconstruction of the third shot using the metal structure as the most likely firing point is shown in fig. 87, p. 40.

#### Fourth Shot

This report has accounted for all of the bullet damage to the limousine and all injuries to its passengers. There was, however, another shot. Three empty shell casings were found in Oswald's sniper's nest, and eyewitnesses confirm that he fired three times. This shot is the most difficult to reconstruct, because it missed the limousine, and there apparently is no photographic evidence of the moment of impact. However, the path of the shot can be approximated by piecing together the physical evidence and the eyewitness and earwitness testimony.

At least three witnesses saw what appeared to be a bullet striking the pavement to the left of the limousine. Royce Skelton was standing on the triple overpass above Elm Street. He told the Warren Commission that he saw a bullet hit the pavement to the left rear of the limousine in the left or middle lane of the street. The smoke and flying cement from the impact flew in a direction away from the TSBD. Skelton believed that he heard four shots and that the bullet that hit the pavement was one of the last two. Austin Miller, also on the

overpass, recalled hearing only three shots. He said one of them apparently hit the pavement to the left rear of the limousine, causing powder dust to spray up from the street. Virgie Rackley was standing in front of the TSBD and saw what appeared to be a bullet bouncing off the pavement in the middle of the left lane of Elm Street. In an early statement, she said it hit near the front of the limousine, but when she testified before the Warren Commission, she thought it hit either beside or to the rear of the limousine. She also was confused about the timing of the shot and seemed certain only that it was after the first shot.

Immediately after the assassination, a number of law enforcement officers gathered around a spot next to the south curb of Elm where a piece of turf had been kicked up. The divot mark was several feet downhill from a concrete sewer inlet. Dallas police officer J.W. Foster was one of those who inspected the mark. He testified that it appeared that a shot had hit the turf and ricocheted out. A news photograph shows a policeman crouching over the mark, apparently indicating the direction from which the shot came, the TSBD (fig. 88, p. 40).

Farther down the hill, a bullet or bullet fragment struck the south curb of Main St. near the triple overpass (fig. 89, p. 40). The FBI determined that the mark on the curb contained traces of lead but no copper, indicating that it was struck by a bullet or fragment with the lead exposed. The bullet or fragment then kicked up from the curb and grazed James Tague, who was standing next to his car a few feet from the curb. A photograph taken a few minutes later shows the cut on Tague's left cheek (fig. 90, p. 40). This evidence was not pursued by investigators until several weeks after the assassination, and there is no indication in the record that any systematic search was conducted for the bullet or for a ricochet mark in the pavement on Elm Street.

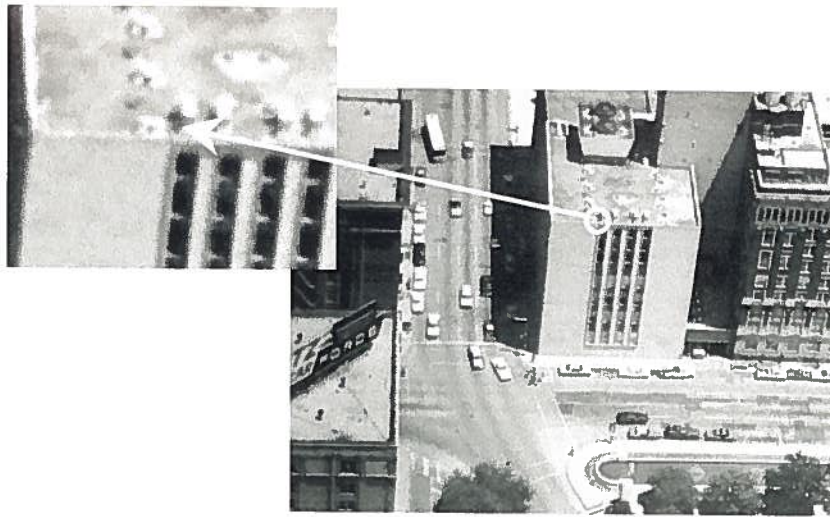
There also is no indication in the record that any photo analysis was done of the Zapruder film or the other home movies to determine whether there was any visible evidence of the impact of this shot. The writer has found only one segment. **As the limousine passes the sewer inlet, the divot in the grass can be seen in the Zapruder film in the area of Z393-400.** So without further expert analysis, it can only be said from the films that this shot occurred before Z393.

To try to further pinpoint the timing of the shot, it is necessary to turn in some detail to the evidence regarding the sound of gunshots. The best audio evidence would be a tape recording of the shots. HSCA investigators learned that a Dallas motorcycle policeman's microphone was stuck open during the assassination and the transmission was recorded on the police channel one dispatch dictabelt. The dictabelt was sent to an acoustics analysis firm, which conducted elaborate firing tests in Dealey Plaza to determine whether a number

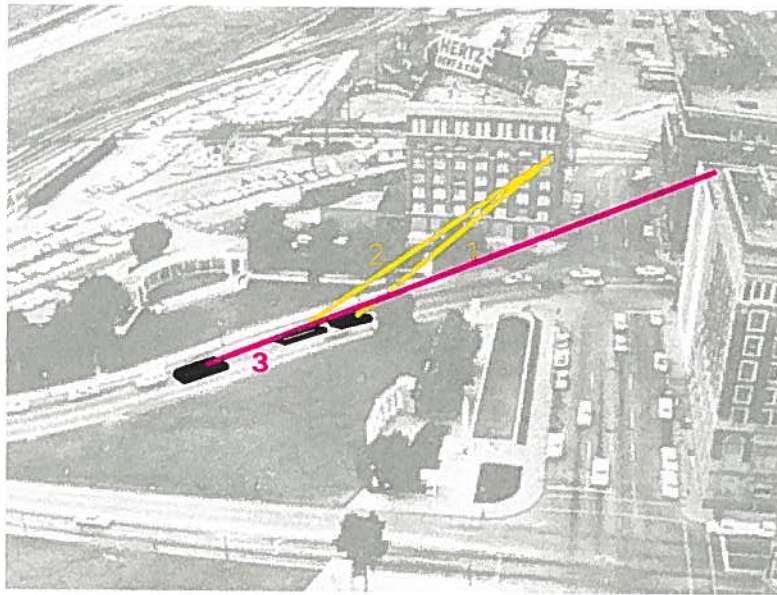


of faint clicks on the tape, inaudible amid the loud background noises, could be gunshots. The expert testified that there appeared to be four shots and that there was a 50% chance that one of them was fired from the grassy knoll area (see fig. 1, p. 2). HSCA staffers asked him to do additional tests to see if he could be more certain. He returned on the last day of the hearings and testified that further testing had raised the confidence level on his original opinion to 95%. The FBI and National Academy of Sciences separately studied the acoustics firm's report and determined that it had no scientific validity. There are several objective ways to confirm that the clicks are not the gunshots. The most compelling is that in the middle of the clicks the faint voice of Sheriff Bill Decker can be heard giving instructions to his men. The Decker transmission is crosstalk picked up from channel two, the special motorcade channel. On the channel two dictabelt, Decker's transmission is the sixth emergency message in reaction to the shots and comes more than a full minute after the police chief ordered the motorcade to proceed to Parkland Hospital. If the channel one tape is rewound to the point where the shots must have occurred, **none can be heard over the motorcycle engine and other background noise.** From the circumstantial evidence, it is almost certain that the motorcycle with the stuck microphone was near Parkland Hospital, more than two miles from Dealey Plaza.

In the absence of reliable evidence of recorded gunshots, it is necessary to turn to the earwitness evidence. As noted at the beginning of this report, such testimony is notoriously unreliable in shooting cases, and it is difficult to reconcile all of the different accounts of the number and point of origin of shots in this case. Dealey Plaza is a giant echo chamber with strong echoes bouncing off of buildings, monuments, and other structures for more than a second after a rifle fires. What some people perceived as echoes, others heard as separate shots. The first news flash over the UPI teletype, telephoned in from a motorcade car less than four minutes after the shots, began, "Three shots were fired...." Within an hour, three spent cartridge cases were found on the sixth floor of the TSBD. Within 48 hours most of the world had been told that Oswald was the assassin and that he had fired three shots. The Warren Commission acknowledged that the witnesses' testimony about the number of shots may have been "subconsciously colored by the extensive publicity,"<sup>15</sup> and almost no eyewitness whose statement was first taken after November 1963 said they recalled more than three shots. However, a number of witnesses interviewed shortly after the assassination recalled hearing four or more shots. (A complete compilation of the earwitness evidence can be found in Six Seconds in Dallas, pp. 254-271.) Although there is something for almost every theory from the earwitnesses, the fact remains that the large majority of them, whether subconsciously influenced or not, honestly thought they heard three shots. **The evidence in this report proves that four shots were fired, which means that two of them blended together for most bystanders. The evidence set out below indicates it was the first**



**Fig. 86. Vent tower on edge of roof of CRB Annex.**



**Fig. 87. Reconstruction of third shot. (WI)**



**Fig. 88. Police officer crouching over ricochet mark in turf. Sewer inlet is visible behind his heel.**



**Fig. 89. Ricochet mark in curb. Pen is in line with direction of bullet path.**



**Fig. 90. Fourth shot grazed bystander James Tague's cheek.**

**two, because they were close-together shots from the same rifle stitched together by echoes when no one was expecting or listening for shots. Most witnesses heard the last two shots as separate sounds even though they were even closer together, because by then the witnesses were listening for shots and the shots came from different rifles.**

The three shots striking inside the limousine were fired at **Z204, Z236,** and **Z312**. That is a spacing of 1.75 seconds between the first and second and a long 4.15 seconds between the second and third. Yet most of the earwitnesses who expressed an opinion about the spacing of the shots said the last two shots fired were bunched close together. Typical of the descriptions was that of Agent George Hickey in the follow-up car, who testified that when the President was struck in the head he heard two shots that "were in such rapid succession that there seemed to be practically no time element between them."<sup>16</sup> Agent Kellerman described the last two shots as sounding like a "double bang."<sup>17</sup> Agent Greer recalled that the "last two seemed to be just simultaneously, one behind the other."<sup>18</sup>

Bystanders all over Dealey Plaza said that the last two shots were very close together. One of the most convincing was S.M. Holland. Holland had a promontory view of the entire assassination scene from the triple overpass directly above Elm Street, and he demonstrated an uncanny ability to absorb what was happening during the few seconds of the shooting and accurately describe it later. Virtually everything he observed was corroborated by independent evidence. Holland was sure he heard four shots. He recalled that at the first shot the President slumped over and his hands went up to his neck. Holland said the second shot was about a second later, and he was positive that it hit the Governor. The third and fourth shots were very close together, just separated enough to be distinct sounds, which he heard at the point the President's head exploded. Holland recalled that the third shot sounded different from the others. He told an interviewer, "The report of the third shot wasn't nearly as loud as the first and second shot or the fourth shot."<sup>19</sup>

Without an audio recording of the shots, it is not possible to be completely certain of the timing of the fourth shot, but the evidence summarized above compels the conclusion that it was fired by Oswald a fraction of a second before or after the other shooter fired the head shot, most likely after. The assumption that it was immediately after the head shot is supported not only by Holland's recollection, but also by Dr. Alvarez' jiggle analysis (Appendix A). There is a sharp jiggle beginning at Z317 that Dr. Alvarez identified as being caused by the head shot at Z312, establishing a jiggle reaction time for Zapruder of about five frames. The only jiggles close enough to that one to be consistent with the "double bang" described by witnesses are a small jiggle beginning at Z312 and a large, sharp jiggle beginning at Z331. The jiggle at Z312 could indicate a shot



at about Z307, only 1/4 sec. before the head shot. However, it is unlikely that two shots so close together would have been perceived as separate events by the earwitnesses. The jiggle at Z331 would indicate a shot at about Z326, 3/4 second after the head shot. This spacing would seem to perfectly fit the separate but very close double bang described by witnesses and fit Holland's sequence. There is another piece of circumstantial evidence, described in the next section, indicating that Oswald's last shot came after the head shot.

Using Z326 as the approximate frame of the fourth shot results in a reconstructed bullet path in which the pieces of evidence summarized above fit together very neatly. Going back to the photo of the curb mark (fig. 89, p. 40), **the longitudinal axis of the mark, indicating the missile path, was measured using a 3-D computer program to be 37° counterclockwise from the curb line.** A line projected at that angle back up the hill passes directly over the divot in the grass next to the sewer inlet and then intersects with the left lane of Elm Street to the rear of where the limousine was at Z326 (fig. 91, p. 46). **This reconstruction indicates that Oswald fired into the pavement and the bullet or a fragment of it deflected at a reduced velocity slightly to the right on the slanted pavement. The missile ripped into the grass, deflecting up again and losing more velocity, and then struck the curb.** The missile did not chip any concrete, but merely brushed the surface of the curb smooth. **This is consistent with a low velocity missile striking at almost a flat angle.** The missile kicked up from the curb, grazed Tague's cheek and landed at an unknown point probably some distance away.

This report now has accounted for all injuries and damage caused by gunshots during the assassination.

### The Closing Argument

In every criminal trial, the prosecutor makes a closing argument that ties together the separate pieces of evidence and adds the reasonable inferences drawn therefrom to give a complete picture of the crime. It usually is necessary to draw inferences, because critical elements, such as motive, intent, and plan, are locked in the heads of the defendants, and they are not talking. The following paragraphs set out the closing argument that might have been made regarding the sequence of shots had Oswald survived to stand trial and been joined as a defendant by the other shooter.

**The evidence establishes that there were two shooters firing at the same time at the President and, therefore, that there was a conspiracy to assassinate him. The fact that it accomplished its objective in broad daylight in front of hundreds of witnesses, that no one has ever been convicted for it, and that it has gone largely unsolved for 31 years indicates that the person who planned it had a brilliant criminal mind. Why would such a**

mastermind entrust a mediocre rifleman like Oswald and a defective \$20 gun with the responsibility of killing the President? **The answer is that Oswald's primary role was to be the one blamed for the assassination, an assignment he went to great lengths to carry out.** There is a wealth of evidence beyond the scope of this report that during the months before the assassination Oswald **intentionally** left a trail of clues that after the fact would point to him being a lone-nut assassin. One of the more obvious was the staged photo he had his wife take of him wearing his revolver and holding a communist newspaper and his M-C rifle. On November 22, he left evidence all over the place that would identify him as the assassin after he had safely gotten out of Dallas. **Being stopped by Officer Tippit during his escape was the only thing that kept the plan from working perfectly.**

As the Presidential motorcade headed down Main Street toward Dealey Plaza, **the two shooters got ready.** Oswald had made himself conspicuous for about 15 minutes looking out the sixth floor window, at times holding up his rifle. **The other shooter was invisible on the roof of the CRB Annex. Oswald was to fire the first shots and draw all of the attention. If he was lucky enough to hit the President's head, the other shooter would not be needed. But it was correctly anticipated that Oswald would miss and the expert shooter would have to deliver the coup de grace.** The people who planned this murder were skilled professionals who carefully chose the right equipment for the job. Oswald's M-C rifle was a poor choice for accuracy and killing power, but it was ideal for its primary purpose of pointing toward Oswald as a lone-nut assassin. It was cheap, befitting his economic status; it was traceable through his handwriting on the mail-order slip; and its sturdy military bullets would remain largely intact, leaving clear rifling marks that could be conclusively matched to the rifle. The other shooter was holding a highly accurate .30 caliber varmint-hunting rifle loaded with bullets capable of killing the President with one shot and leaving no traceable ballistic marks.

The shooters were in position as the limousine came down Houston Street. As it made the greater-than-90° turn onto Elm, it had to slow down to about two miles per hour. If Oswald had been a lone assassin, this would have been the best time to fire. Even he would have had a hard time missing an almost stationary target at such close range (fig. 92, p. 46). He could have fired two head-on shots from between two stacks of boxes and pulled back out of sight before the Secret Service had time to spot him. Instead, he waited until he had to stick his rifle out the window in almost full profile and the target was halfway down the hill and accelerating away from him. **The reason he had to wait was that the other shooter could not get in a position to fire when the limousine was rounding the corner without hanging out over the edge of the roof and making himself visible to bystanders. Also, the two shooters would have been firing at almost opposite angles, making it easy for investigators later to determine that there was more than one gun. They had to wait until the target was well clear of the corner and the firing angles were as close to each other as possible.**

The limousine came out of the turn and accelerated to an average speed of 11 mph down the hill. The President, his wife, and the Governor initially looked to the left side of Elm where there was a large group of bystanders. (Mrs. Connally is not visible in the Zapruder film at this point.) At about Z158, the sidewalk and bystanders came to an end on the left side, and within the next second all three turned to look at the crowd along the curb on the right. From Z175 to Z204 the President waved casually to the crowd on the right.

At about Z166, the President went under the branches of a live oak tree that partially obstructed Oswald's view until about Z200. While this prevented a clear shot during that span, the foliage was thin, and Oswald was able to begin sighting in on the target. As soon as the President emerged from the last branch, Oswald fired. **He was not used to firing at moving objects, and did not lead the target.** The FBI firearms expert testified that if Oswald had aimed at the center of the head and failed to lead, the shot would have landed near the base of the neck, which is what happened.

When Governor Connally heard the first shot, he knew immediately it was a rifle. He testified that, while he was behind the sign on the Zapruder film, he looked to the right to see if the President was hit, but he could see nothing. When he emerged from the sign at Z222, one second after the shot, he was in the same position as at the time of the shot except his head was cocked a little farther to the right, consistent with his testimony. He then went through several very rapid movements. First, he flipped his Stetson up with his right hand **to avoid crushing it against the door** as he ducked down to the right and winced (fig. 93, p. 46). **This is in reaction to hearing and feeling the bullet that had just whizzed by his left ear. He was not asked about this move and he probably did not recall it, because his overriding concern at that point was for the President, and the Governor was hit himself 1/3 second later.** Immediately after ducking, he began twisting his torso around to the right so he could see the President. **Halfway into the turn, the second shot hit him in the back.** Oswald fired it only 1.75 seconds after the first shot, barely enough time to work the bolt action and reacquire the target. (His wife testified that he would sit on the porch and practice looking through the sight while repeatedly working the bolt action.) **Since the President's head had tilted well to the left and Oswald took so little time to aim, he missed the President's head more than a foot to the right.**

The President's head did not explode with the second shot, so the expert shooter on top of the CRB Annex had to take over and get the job done. However, he did not fire until 4.15 seconds later, an eternity with the target moving away down the hill and the risk increasing of the President slumping out of view. The reason for the long wait is revealed in fig. 94, p. 46. A tree on the south side of Elm Street blocked the shooter's view of the President from just after the second shot until just before the third. When he could see the



President again, he fired a near-perfect shot to the center of the head, a shot well within the capability of a skilled marksman with a quality varmint-hunting rifle.

The fourth shot was fired by Oswald 3/4 second after the third. It missed the limousine to the left. This was an intentional miss to "cover" the third shot. Even a weak marksman like Oswald would not completely miss a 25 ft. long by 8 ft. wide limousine unless he intended to. Amos Euins, standing on the corner of Houston and Elm, saw Oswald look back toward him, in the direction of the CRB Annex, before firing his last shot. Why would he look in the opposite direction from his target in the middle of the shooting? He was probably the only person high enough to see the other shooter crouched behind the metal structure on the CRB Annex roof. Oswald was looking back to make sure that the other shooter was ready to fire so he (Oswald) could make his cover shot almost simultaneous with the third. Oswald had four cartridges in his rifle clip when the shooting started. The evidence indicates that he was instructed to fire the first two as quickly as possible after the President emerged from under the tree. If there was an obvious direct hit with either, the shooting would stop. If not, Oswald would have to fire three shots to match the physical evidence of three shots that would be left in the limousine. There were several people in the windows directly below him, and if they only heard two shots above them, there would be a discrepancy in the evidence. The third and fourth shots would have to be close enough together that the fourth would be fired during the echoes from the third. The fourth cartridge was left in the chamber of Oswald's rifle to allow ballistics experts to match it with the first two bullets fired.

Both shooters were instructed to get out of their buildings as quickly as possible. Oswald left the three spent cartridges on the floor, stashed his rifle by the stairwell, and ran down the stairs. The other shooter looked for his cartridge shell to take it with him, but it had rolled under a roofing flap when it was ejected. He could not risk taking the time to look for it. It was either decided that it was too risky to go back and look for it later or someone did look for it and could not find it because it had gone too far under the flap to be felt. It took a repairman ripping the roofing tar up to expose it.

### The Prevalent Theories

There are many theories about who ultimately was behind the assassination, but the speculation about the sequence of shots generally has gravitated around one of the two most prominent theories, the single bullet theory created by staff attorneys for the Warren Commission and the grassy knoll theory advocated by some private researchers.

The Single Bullet Theory. This theory was the Warren Commission's solution to a serious problem it had with its evidence. The FBI, Secret Service, and CIA reports on the assassination all concluded that three shots landed in the

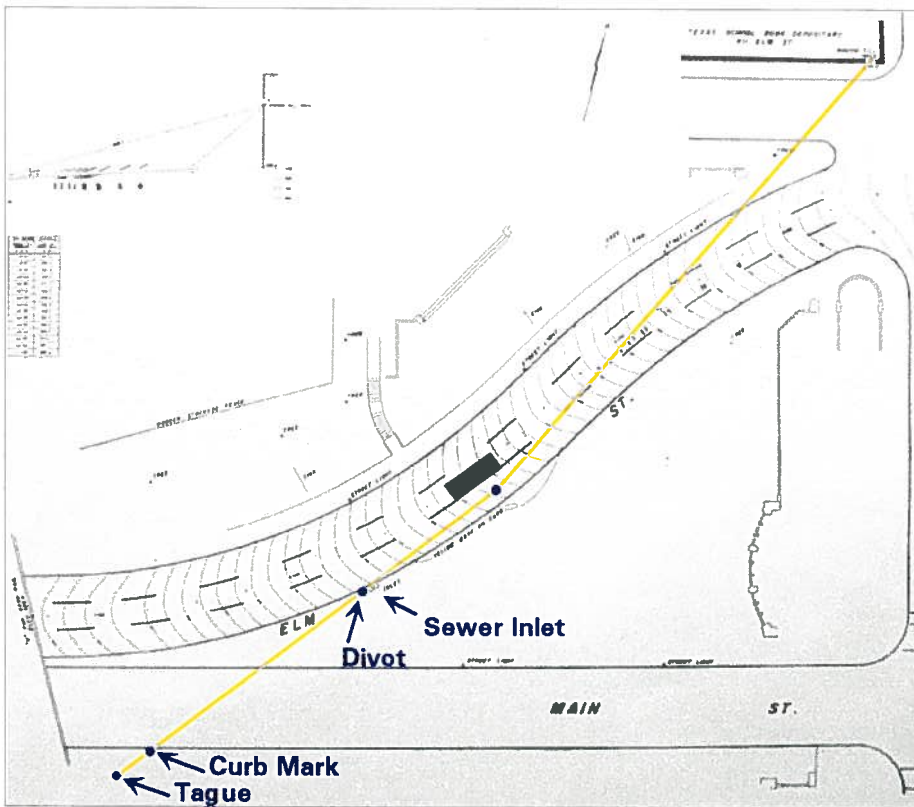


Fig. 91. Reconstruction of approximate path of fourth shot. (WI)



Fig. 92. Secret Service reenactment of the view through the telescopic sight on Oswald's rifle as the limousine turned the corner onto Elm Street.



Fig. 93. Governor Connally at Z230 ducking to the right, flipping up his hat, and wincing.

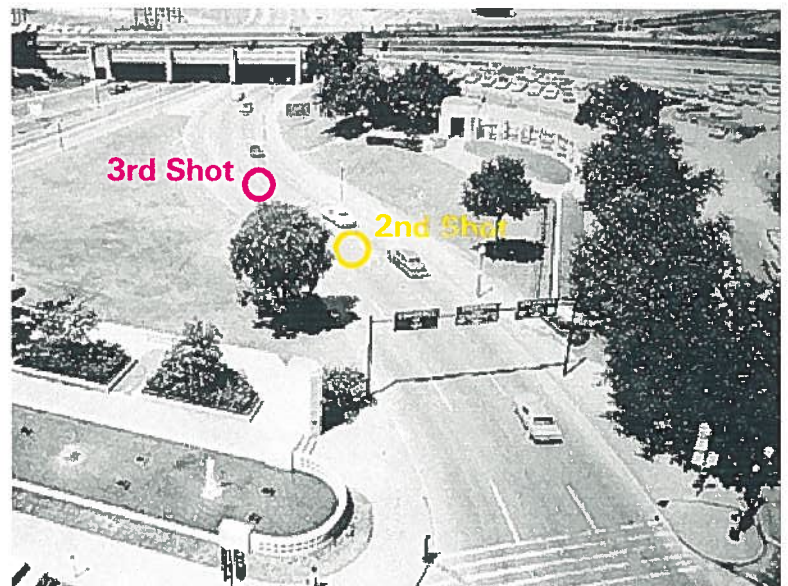


Fig. 94. View from the roof of the CRB Annex showing that the second shooter's line of sight to the limousine was blocked by a tree from immediately after the second shot until just before the third. (Triple overhead sign was erected after the assassination.) (WI)

limousine—the first hit the President in the back, the second hit the Governor in the back, and the third hit the President in the head. However, when the evidence regarding the nick in the Main Street curb and the cut in James Tague's cheek was fully developed several weeks after the assassination, it became clear that a bullet had completely missed the limousine. As discussed more fully in the next section, the Warren Commission never seriously considered the possibility of any shooter other than Oswald, and Oswald had left only three spent cartridges. There was another problem—almost everyone who viewed the Zapruder film early in the investigation correctly concluded that the Governor was hit in the back between Z235 and Z240. However, the Commission accepted the finding of an FBI agent that the minimum time required to fire two shots with the M-C rifle was 2.3 seconds. (Extensive HSCA tests established that the true minimum was less than 1.5 seconds.) Using the erroneous figure, the Commission staff ruled out the possibility of the Governor being hit in the Z230s as being too soon after the President was hit in the back for Oswald to have fired both shots. These and other problems the staff had in shoehorning all of its evidence into Oswald's three empty cartridge shells led to the birth of the single bullet theory, which is just that—a theory. It was not a finding of the Commission. In fact, three of the Commission members never believed the theory and would not sign on to it. The Commission was left with only a compromise statement that there was "very persuasive evidence" to support the theory. A fair paraphrase of the conclusion on the sequence of shots on pages 38 and 39 of their final report would be, "We don't know how Oswald did it, but we know he did it."

The single bullet theory (SBT) says that a bullet (CE399, the infamous magic bullet) fired from Oswald's M-C rifle between Z210 and Z225 accomplished the following: entered the President's back, travelled in a straight line and exited his neck, passing through four layers of clothing and two layers of skin; then entered the Governor's back, travelled in a straight line along the edge of his chest and blew a 5 cm. hole in his chest, passing through four layers of clothing and two layers of skin and knocking out 10 cm. of rib along the way; then entered the Governor's wrist and blasted through the thick radius bone, breaking it into several pieces and leaving several lead fragments behind, and passing through five more layers of clothing and two more layers of skin; and then entered the Governor's left thigh where it finally came to rest after penetrating another layer of clothing and another layer of skin. The bullet was found in almost pristine condition at Parkland Hospital. The Commission further theorized that another bullet from Oswald's rifle fired at Z312 had passed through the President's skull and somehow wound up throwing out metal fragments that struck the chrome strip above the windshield and nicked the glass by the rearview mirror.



The SBT is a physical impossibility and is easily proven so. There is not a single graphic representation of a bullet path in the almost 900 pages of the Commission's final report. To try to diagram the SBT is to destroy it. Running the sequence through a computer recreation program would establish that the two bodies were nowhere close to being aligned for a single shot to do all of that damage, not even considering the issues of condition of the bullet and its penetrating power. Just a few of the other ways to disprove the SBT are discussed below:

- The FBI reenactment photo through Oswald's telescopic sight at the point the Warren Commission says the SBT bullet was fired (fig. 95, p. 50) shows that the theory does not work. The dimensions of the reenactment car were different from the Presidential limousine, all of which differences favor the SBT. Even so, it can be seen in the photo that a bullet hitting the white dot (indicating the entry point in the President's back) and passing straight through the body would have hit the back of the seat well to the left of and below the Governor's right armpit where the SBT says it hit. Another photo of the same reenactment car (fig. 96, p. 50) shows staff counsel Arlen Specter illustrating the supposed SBT path with a probe. It is clear that for the magic bullet to have exited at the tie knot at the necessary downward angle, it would have had to enter at the top of the collar in the back, about six inches above the actual first shot entry hole (white dot). Also, the probe is pointing from left to right, meaning that such a bullet could not possibly have caused the sharp right-to-left path the surgeons found in the Governor's chest.
- The SBT says the magic bullet exited from the President's neck. However, the nose portion of another bullet, found on the front seat, has fibers embedded in it apparently matching the President's shirt collar and tie (fig. 31, p. 14). The SBT says that bullet fragment passed through the top of the President's head, dented the chrome strip, and landed on a leather seat. If that were correct, it would have no fibers embedded in it.
- The largest of the lead fragments recovered from the Governor's wrist has a portion of the cylindrical side of the lead core that is about 2.5 mm. long (fig. 97, p. 50). It could not possibly have come from the magic bullet. A close-up of CE399 (fig. 98, p. 50) shows that only a slight hump of lead was pushed out of the base and the top half of that hump is missing (**where the fragment in the Governor's thigh and the three pieces on the floor by the jump seat broke off**). If CE399 had lost a 2.5 mm. long section of lead core (bracket in photo) it would have lost far more weight than it did.
- The SBT says that at Z255 the only shot that had been fired was

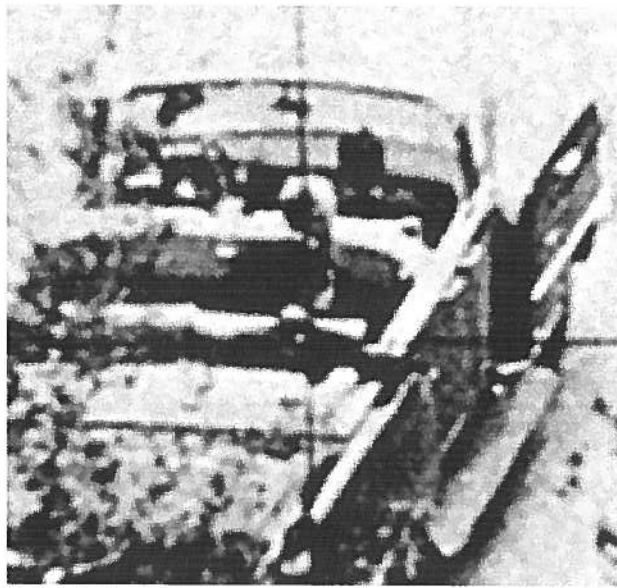
CE399, the whole bullet found at Parkland. Yet, the still photo taken at Z255 shows that a fragment already has nicked the windshield (fig. 32, p. 14). The Warren Commission said the nick was caused by the head shot three seconds later.

- Not a single eyewitness in Dealey Plaza said that the President and Governor were both hit by the first shot. All of those who expressed an opinion said that the President was hit by the first shot and the Governor by the second. The two people in the best position to know were the Governor and his wife. Governor Connally told *Life* magazine in 1966, "They talk about the 'one bullet' or 'two bullet theory,' but as far as I'm concerned, there is no 'theory.' There is my absolute knowledge, and Nellie's too, that one bullet caused the President's first wound, and that an entirely separate shot struck me." Mrs. Connally added, "No one will ever convince me otherwise." "It's a certainty," concluded the Governor, "I'll never change my mind."<sup>20</sup>

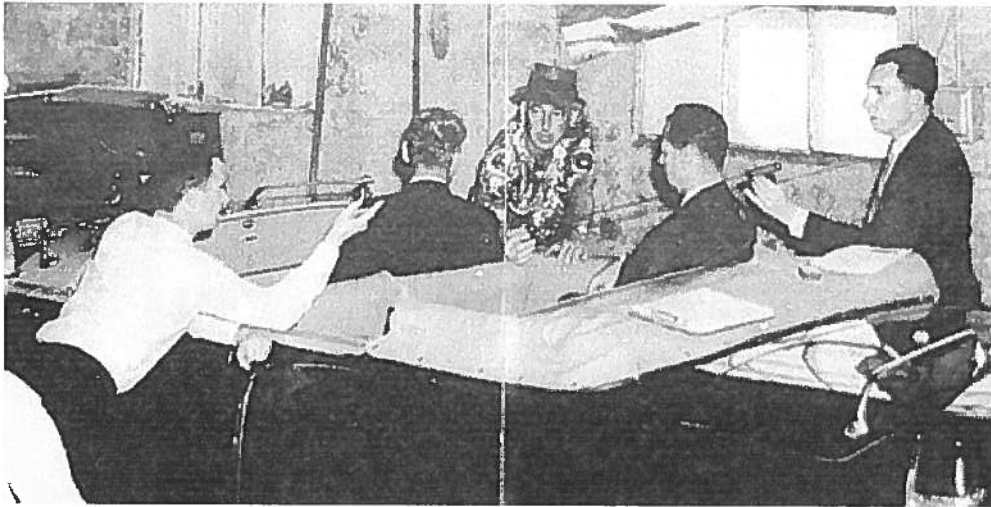
The Grassy Knoll Theory. A number of private researchers over the years have argued that the fatal head shot was fired from behind the stockade fence above the grassy knoll (fig. 1, p. 2), a position to the right and in front of the President. This theory is based primarily on the rapid head snap to the left rear, the fact that a number of earwitnesses thought the shots came from the grassy knoll area, and the considerable eyewitness testimony about suspicious activity behind the fence. However, the fact is that there is not a shred of medical, scientific, or physical evidence of a shot from the right front, and this report has proved that the head shot came from the left rear. It is true though that there was strong evidence of the presence of conspirators behind the fence. Two days before the assassination, two Dallas police officers saw several men behind the fence engaging in mock target practice, pointing rifles over the fence toward Dealey Plaza. By the time the officers got to the area, the men had disappeared. On November 22, one or more men flashed phony Secret Service credentials to witnesses who ran behind the fence immediately after the shooting. At least two witnesses saw a man with what appeared to be a rifle running behind the fence. It is quite possible that there were one or more conspirators stationed there to fire a last-resort shot down into the limousine at close range if necessary or to serve as a decoy to draw the crowd away from the two shooters until they could get out of their buildings. But it remains that there is no trace of a bullet fired from the right front.

### Where Things Went Wrong

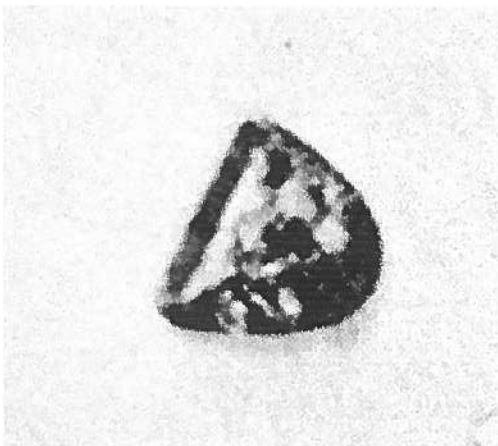
The sequence of four shots by two shooters proven by this report seems straightforward and rather obvious. How then could all of the official



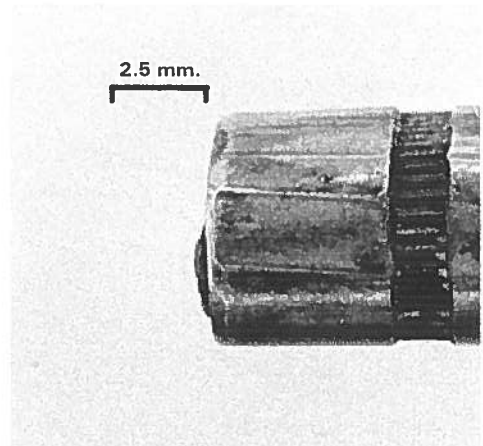
**Fig. 95. FBI reenactment photo through Oswald's telescopic sight.**



**Fig. 96. Arlen Specter using a probe to illustrate how a bullet could have passed through the President and hit the Governor at the entry hole in the coat.**



**Fig. 97. Close-up of largest wrist fragment. Left side is cylinder-shaped edge of lead core.**



**Fig. 98. Base of CE399. Hump of lead on bottom half has no exposed straight edge.**



investigators and private researchers who have tried to put the pieces together over the years have missed it? The answers to that question are as varied and complex as the people who have been charged with finding the solution and failed. Some of the reasons never will be known, but this section discusses a few of the more significant biases, errors, and omissions that derailed what would have been an easily solved homicide investigation had the victim not been the President of the United States.

The problems all started with the autopsy. As soon as the President was declared dead, Lyndon Johnson began making preparations to get out of Dallas as quickly as possible, fearing that an attempt would be made on his life. However, he would not leave on Air Force One without the President's widow, and Mrs. Kennedy would not leave without the President's body. This led to a very unseemly showdown at Parkland Hospital. The Secret Service started rolling the casket out of the emergency room, but were stopped by hospital officials, because Texas law required an autopsy to be performed before the body could be removed. After a heated argument that escalated into a physical altercation, the agents forcibly took the body from the hospital.

Mrs. Kennedy was asked where in Washington the autopsy should be performed, and she chose Bethesda Naval Hospital, because her husband had been in the Navy. Two senior pathologists on staff at Bethesda, Dr. James Humes and Dr. J. Thornton Boswell, were assigned to conduct the autopsy. They were not forensic pathologists, and neither had ever performed a gunshot wound autopsy. In short, they were not professionally qualified to perform this type of autopsy. (They were assisted by an Army wound research pathologist, but he arrived late and played only a minor role.) To further compound the situation, there were more than 25 people gathered around the table in the small autopsy room, creating what Dr. Humes would later describe as a "hysterical situation." Attorney General Robert Kennedy was waiting in the hospital lounge with the President's widow, and he called down to the autopsy room frequently and asked the doctors to hurry so he could get the body and Mrs. Kennedy back to the White House. On top of all of that, the doctors had to fight the normal shock and grief from the tragedy.

The pathologists did their best, but in this environment it was inevitable that mistakes would be made. The HSCA pathology panel took several pages to list all of the errors and deviations from established forensic pathology procedure during the autopsy, but two of the mistakes were monumental. First, the doctors did not discover the exit wound in the neck. They assumed that all of the tissue damage there was related to the tracheotomy incision that was made over the top part of the wound. With an entry wound in the back and no apparent exit, they assumed that a whole bullet was still in the body and

searched the x-rays for it. When they probed the entry wound in the back, they found that the bullet track went sharply downward, but came to an abrupt end less than two inches below the skin. **(This is the point at which the bullet deflected upward on striking the spinal column.)** They eventually concluded that the bullet had come to a stop just below the skin and worked its way back out the entry hole. Because of pressure from the Attorney General to complete the autopsy, Dr. Humes decided not to dissect the wound, the only way to visually examine the bullet track. When he learned from a doctor at Parkland the next morning that there was a wound in the neck, it was too late to do a dissection, because the body was lying in state in the White House. In his final autopsy report Dr. Humes wrote, "As far as can be ascertained this missile struck no bony structures in its path through the body."<sup>21</sup> Of course, this was speculation, since the pathologists did not even know the bullet had passed through the body when the autopsy was completed. However, this incorrect speculation was treated as a conclusive statement of medical fact by the Warren Commission investigators and became one of the foundation blocks upon which the single bullet theory was erected.

The other monumental error was the mislocation of the entry wound in the head. Early in the autopsy, the doctors swept back the hair that was covering the small wound and examined and photographed it. However, as the autopsy progressed, the hair apparently covered the wound again, and the doctors used some dried tissue in the hair (visible near the hairline in fig. 61, p. 24) as the reference point for the location of the wound. This tissue was, in fact, about four inches below the wound, an error of mammoth proportions for a forensic autopsy. Dr. Humes used the tissue location to describe the point of entry in his autopsy report and Warren Commission testimony. He conceded this error years later when he testified in the HSCA proceedings.

In a normal forensic autopsy these and other mistakes almost certainly would have been caught and corrected before the autopsy report was finalized. The pathologist would have examined the autopsy x-rays and photos and the victim's clothing to make sure that all of the entry and exit holes lined up and that the physical evidence was consistent with the raw notes. In this case, Dr. Humes was not permitted to even see the clothing and photos. He had used the x-rays only in a frantic attempt to find a missing bullet. They were taken away by agents during the autopsy, and he was not permitted to see them again until years later. In preparing his autopsy report, he had to rely solely on the doctors' raw notes and their recollections of what they had seen.

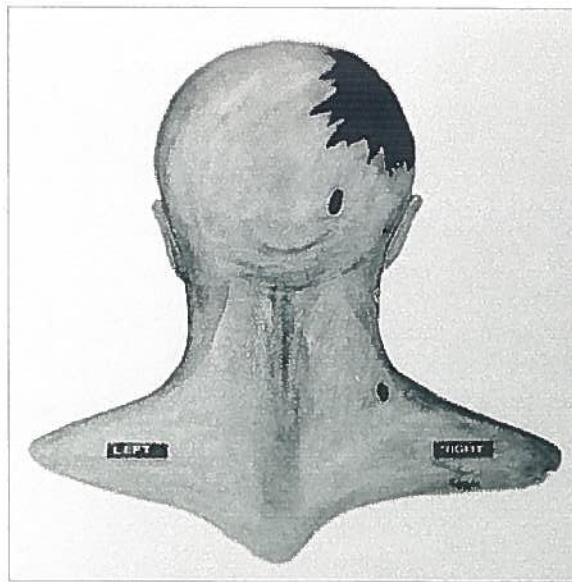
In a normal homicide investigation, a couple of homicide detectives would be given the file and would start putting the pieces together. They would have spotted some of the inconsistencies and gone over the autopsy report, clothing,

x-rays, and photos with the pathologists to make the necessary corrections. But, this case had no homicide detectives dispassionately piecing together facts. It was investigated by a ponderous political committee with a political agenda. By the time the Warren Commission was created, the President, the Deputy Attorney General, and the FBI Director had gone on record that it was important for the American people that Oswald be found to have been the lone assassin as quickly as possible. President Johnson even told Chairman Earl Warren that he had to take the job to dispel rumors of an international conspiracy that might start an atomic war. The Chairman took this mandate very seriously. The Warren Commission was strongly biased from the outset and never seriously considered the possibility of a conspiracy or multiple shooters. A staff outline circulated by Chairman Warren to the Commission members in January 1964 when the investigation was just getting underway had a chapter titled, "Lee Harvey Oswald as the Assassin of President Kennedy."<sup>22</sup> The final subsection of that chapter was reserved for the "Refutation of allegations" of possible accomplices in the assassination.<sup>23</sup> The Commission adhered very closely to this outline throughout the investigation. The FBI was charged with conducting the field investigation for the Commission. FBI Director Hoover decided within four days after the assassination that Oswald was a lone assassin, a conclusion that defined the scope and direction of the investigation from that point forward.

Even though it was operating under the heavy weight of pre-judgment, the Commission might have discovered the pathologists' errors and solved the crime but for a fateful decision by the Chairman. He acceded to the Kennedy Family's request and agreed that no one, not even the doctors, would be allowed to see the autopsy photos and x-rays during the investigation. The fear was that, if they were used in the case, they would have to be made public exhibits for the whole world to gawk at. While Warren's sensitivity was admirable, this decision meant that the Commission would conduct its investigation wearing blinders. It would have no way of knowing about the fracture of the spinal column, the round metal disk outside the back of the skull or the misplaced entry wound in the head. Since he was denied the benefit of the photos and x-rays, Dr. Humes was forced to describe the location of the wounds by memory to the Navy artist who created the Commission exhibits shown in figs. 99 and 100. As can be seen by comparing the drawings with the autopsy photos in this report, they are very inaccurate. If the Commission had been paying attention to its evidence, it would have seen that the side-view drawing has the head tilted much farther forward than it was in Z312. With the head in the proper position, Dr. Humes' entry and exit points in the head have the shot coming from the trunk of the limousine (fig. 101).

Accepting the inaccuracies in the autopsy report and the FBI agent's erroneous 2.3-second minimum firing time as uncontrovertible fact, the

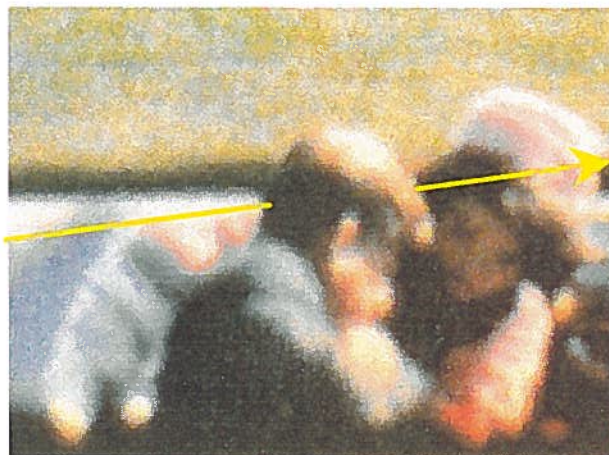




**Fig. 99. Warren Commission drawing incorrectly locating entry wounds.**



**Fig. 100. Commission drawing of side view.**



**Fig. 101. Commission trajectory superimposed on Z312. (WI)**

Commission staff had no hope of finding out what really happened. The single-bullet theory was the best it could do, but it was so implausible that half the Commission members did not believe it. If the Commission's Report were published today, the ink would not be dry on it before the news media would be picking it apart. However in 1963, the Establishment media loyally heaped praise on the Commission for its wisdom and thoroughness. The Commission's lone-assassin finding was ready for the history books. The "conspiracy buffs" who questioned such an august body were considered somehow anti-American. But, little by little private researchers and writers exposed the inaccuracies, omissions, and impossibilities of the Commission's findings. What they did not do was offer a better explanation for what happened. The grassy knoll theory is supported by even less evidence than the single bullet theory. The kind of tedious microanalysis of the evidence presented in this report is not the best way to sell books and screenplays. Besides, the autopsy x-rays and photos were (and still are) locked up in the National Archives, with access very rarely granted by the Kennedy Family.

A number of other factors have prevented private citizens from coming up with the solution before now. Among the more significant are the following:

- The Zapruder film, the most important single piece of evidence, was kept from public view for years by its owner, Time/Life. Even when one of the most loyal Warren Commission supporters, CBS News, asked for permission to use it, Time/Life refused on the basis that the film was an "invaluable corporate asset" and not available "at any price."<sup>24</sup> Those that did view the film and report on it sometimes gave misleading descriptions of what it showed.
- Most of the representatives of the news media who might have brought the correct facts to the attention of the public had committed themselves early on to the Commission findings.
- It takes a tremendous amount of time to cut through all the layers of misinformation in the assassination literature. It has taken the writer a year and a half to get access to the original evidence essential for this report.

Only in the last few years has enough information become available to make it practical for a private citizen to reconstruct the sequence of shots. Digitally enhanced prints of the Zapruder film now are available on high-resolution laserdiscs. Pirated copies of autopsy photos have started showing up in books and movies. Two companies in the past year have released mass marketed CD-ROM disks for home computers that contain a tremendous amount

of textual and visual information on the assassination. It is only a matter of time before other people come to the same conclusion as this report. It is imperative that the Department of Justice go public with it first.

### Conclusion

This report has presented conclusive physical, testimonial, and scientific evidence that four shots were fired by two shooters and that someone other than Lee Harvey Oswald killed President Kennedy. If any further confirmation is needed, there are a number of available options. The often-mentioned computer recreation program would be the best way to put all of the pieces together, especially to determine the precise firing point of the fatal head shot. However, there are quicker and easier ways to verify key elements of the sequence in this report and disprove the single bullet theory, including the following:

- Use the blueprints of the Presidential limousine to duplicate the seating arrangement of the President and Governor. Place life-size figures of them in the seats and fire an M-C bullet at an accurately located white dot on the back of the rear figure and see where the bullet goes. It will be impossible to line up the two figures in the seats to make the single bullet theory work.
- There is a wealth of evidence still to be tapped in the bullet and bullet fragments in the National Archives. A complete study needs to be done of their physical characteristics, including color, texture, density, and shape and the presence of foreign matter on them. The lead fragments from the floor of the limousine under the jump seat should be placed into the corresponding indentations in the base of CE399 to confirm that they match exactly. It should be determined if any of the irregular edges of the lead fragments from the Governor's wrist interlock with any edges of the lead fragments from the President's head. In addition, the largest lead fragments from the wrist and head each have a portion of the smooth cylindrical side of the lead core of the soft-nosed bullet. The arc of each should be measured to determine the diameter of the original core, which will be the same for each of the fragments and different from the diameter of an M-C core.
- Easiest of all, send a fiber identification expert with a magnifying device to the National Archives on Pennsylvania Avenue to examine the fibers embedded in CE567, the deformed M-C bullet nose found on the front seat cushion of the limousine, and compare them with fibers from the President's shirt collar, tie, and tie liner.

The official version of the assassination is that CE567 is the nose portion of the bullet that went through the top of the President's head. If the expert determines that any of the fibers from CE567 match fibers from the President's shirt or tie (which they will), the single bullet theory can be given a well-deserved retirement after 31 years and the real investigation into who assassinated President Kennedy can begin.



# Appendices

## Appendix A

### The Jiggle Effect

In 1966, Dr. Luis Alvarez, later a recipient of the Nobel Prize in physics, noticed some motion streaks in several frames of the Zapruder film printed in Life magazine. Dr. Alvarez had done considerable research for Bell & Howell, the manufacturer of Zapruder's camera, to try to prevent jiggling in hand-held movie cameras. He thought the motion streaks might be significant and undertook an extensive study and measurement of streaks that appeared between Z170 and Z335. He determined that some of the streaks were caused by Zapruder flinching in reaction to the sound of the gunshots. CBS-TV did an experiment to confirm Alvarez' conclusion. They put people with movie cameras in an environment similar to that in Dealey Plaza. Even though the camera operators were told to hold the camera steady and keep filming a car no matter what happened, they always flinched noticeably after a shot.

Alvarez charted his results (fig. A1) using vertical lines for the successive Zapruder frames, with horizontal deviations indicating jiggles. In charting the jiggles, Dr. Alvarez did not record the slow "panning" blurs caused by normal imperfect tracking of the limousine. He only measured rapid streaks consistent with a quick flinch. There were still many more jiggles than there were gunshots, so the presence of a jiggle does not prove a shot. However, based on Alvarez' theory and CBS's practical experiment, the absence of a jiggle should mean that there was no shot. Dr. Alvarez tried to match jiggles in the chart with the Warren Commission's erroneous findings on the timing of the shots and marked those points with arrows. The importance of this chart is not where he put the arrows, but whether there is a jiggle corresponding with each of the gunshots identified in this report.

Because of the obvious explosion of the President's head at Z313, he used that as the standard and concluded that the large jiggle centered on Z318 was Zapruder's flinch from that shot. This established a reaction delay for Zapruder of about five frames. This report has established that the second shot was fired at Z236. Dr. Alvarez's chart shows a jiggle centered on Z241, exactly five frames later. As discussed in the section of this report on the fourth shot, the jiggle centered on Z331 most likely is the reaction to the fourth shot at about Z326. Finally, this report has proved that the first shot was fired at Z204, but the jiggle chart is perfectly flat for more than ten frames after that. This is because Dr. Alvarez used the Warren Commission volumes' reprint of the still frames and the Commission omitted the frames spliced out by a Time/Life technician after they were damaged (Z208-Z211). The chart should have shown a blank space in the line at this point, and the HSCA did include a space to indicate the missing frames when it reprinted Dr. Alvarez' chart. Fortunately, Six Seconds in Dallas printed the missing frames (fig. A2). Focussing on the square holes in the wall above the limousine, it can be seen that there is a significant jiggle beginning at Z209 and lasting for three frames, exactly the location and duration that would be expected for a jiggle in reaction to a shot at Z204.

The jiggle analysis fully supports the sequence of shots set out in this report.

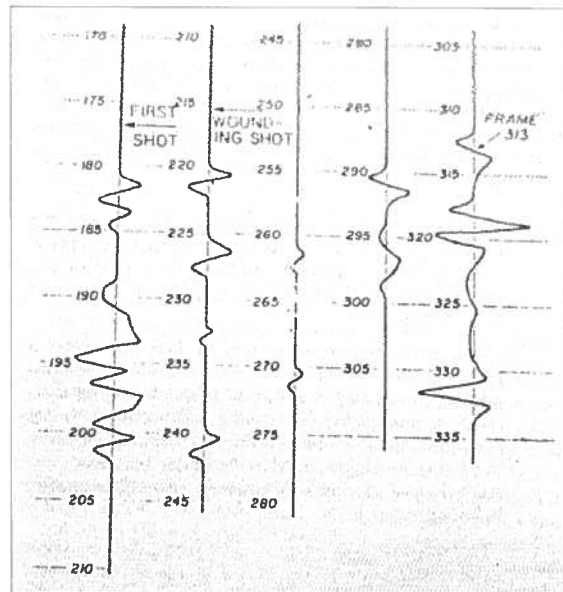


Fig. A1. Dr. Alvarez' chart of jiggles on Zapruder film.

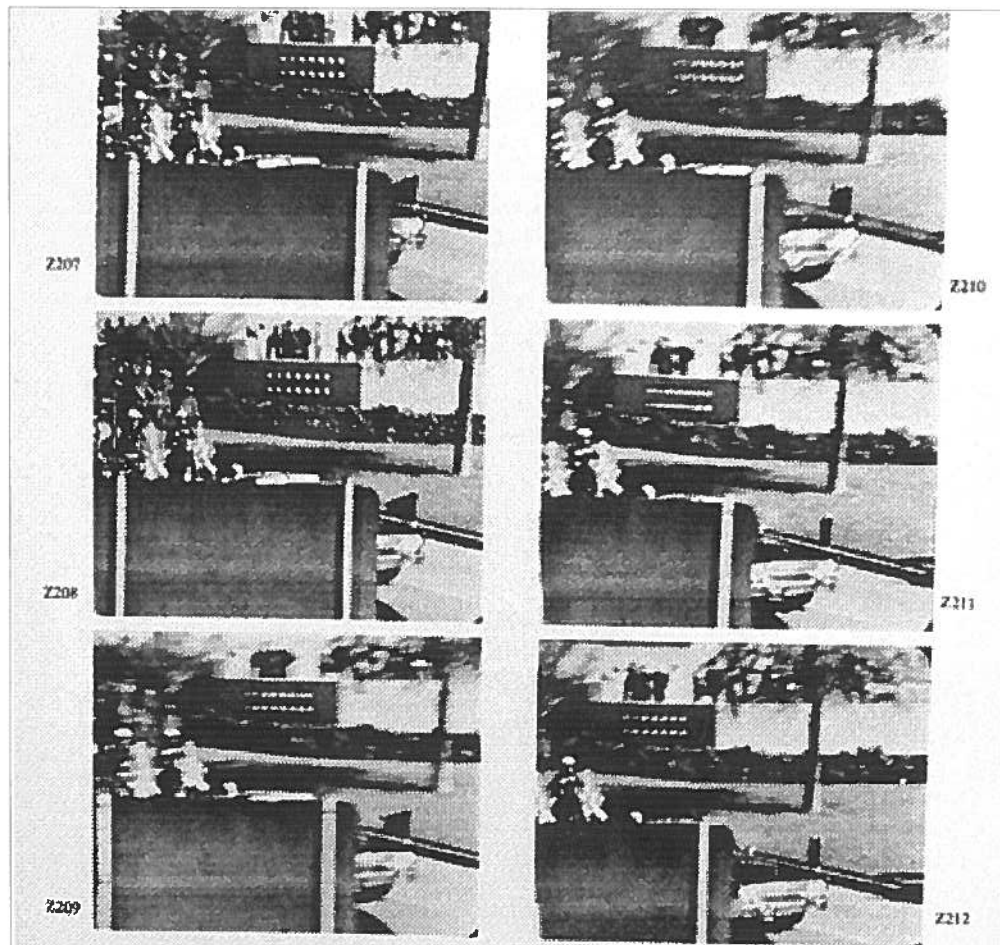


Fig. A2. Missing Zapruder frames showing strong jiggle at Z209-211.

## Appendix B

### Neutron Activation Analysis

Neutron activation analysis (NAA) is a process for measuring the chemical composition of an object through radioactivity. It has been used in criminal cases to try to determine the source of origin or manufacturer of various types of evidence, including bullets and bullet fragments. The machines that perform NAA tests are very sensitive and can measure elements down to a few parts per billion. However, the results in measuring bullet lead tend to be somewhat erratic. Of course, a lead core is made up almost entirely of lead, so it is the presence of other elements in minute quantities that is used to classify bullets. Because of normal variations in content and the imperfections of the testing procedure, samples taken from opposite ends of the same bullet may yield significantly different results. Even the same sample run through the machine four times may show a different composition each time. As a result, NAA testing is not the type of precise forensic test that yields conclusive results, like fingerprint analysis. It generally is used in court to make the point that a given bullet or fragment is consistent with having come from a particular box of bullets—that is, its chemical elements are present in quantities within the ranges found in the bullets sampled from the box.

During the HSCA hearings, Dr. Vincent Guinn was retained to perform NAA tests on most of the whole bullets and bullet fragments in the case. Even though NAA testing is not conclusive, it would be expected that the soft-nosed bullet fragments from the President's head and Governor's wrist would have significant composition differences from the M-C samples and that is the case. Figure B1 is the HSCA chart of the results of Dr. Guinn's testing. The first three columns are the sample numbers. The lead column is expressed as a percentage and is significant only to show that they all are basically pieces of lead. (The jacket material was not tested.) All of the other chemical elements are expressed as parts per million. The antimony, silver, copper, and manganese numbers of the head and wrist fragments are not markedly different from the M-C samples, except the very high copper count of the wrist sample. (Dr. Guinn testified that such high copper counts normally are due to a tiny piece of copper jacket adhering to the lead core.) However, the head and wrist samples had the highest concentrations of aluminum, sodium, and chlorine, much higher than any of the M-C samples. Dr. Guinn tested 17 known M-C samples including unfired test bullets. The average sodium count of the M-Cs was 13 ppm and none registered higher than 20 ppm. The head and wrist fragments measured 134 ppm and 120 ppm, respectively, about ten times the M-C average. Dr. Guinn tried to offer a reasonable explanation of how the head and wrist fragments could measure so high in sodium and chlorine if they were from M-C bullets, but he could not come up with one.

In spite of being stumped on that question, Dr. Guinn testified that it was highly probable that all of the specimens in Fig. B1 came from M-C bullets and that the presence of only two M-C bullets in the group was indicated. He declined to place a percentage on the probability. Dr. Guinn had taken a close interest in the case years



before his testimony and had even done an NAA analysis on sample M-C bullets as a personal project in the early 1970s. It seems obvious that his HSCA testimony was heavily influenced by the Warren Commission's conclusions. He matched up the bullet fragments exactly as required by the impossible single bullet theory. Dr. Guinn was the preeminent expert on NAA testing at the time, and it would be foolish to challenge his determination of the chemical composition of the bullet and fragments. However, it is reasonable to disagree with his matching up of the fragments because it was a determination of basic statistical probabilities. It would take several pages to fully explain why his determination of probabilities led him to an incorrect result, but one example should make the point. He found it to be highly probable that a fragment from the floor under the left jump seat came from the shattered bullet that went through the President's head. This report has proved by direct physical matching (fig. 57, p. 22) that the fragment instead came from the base of the nearly pristine magic bullet, CE399.

RESULTS FROM SEPTEMBER 1977 INAA OF EVIDENCE SPECIMENS AT U.C. IRVINE											
Sample Number				ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
CE-	FBI Q-	HC-	% Lead	Antimony	Silver	Copper	Aluminum	Manganese	Sodium	Chlorine	
<b>Magic Bullet</b> 399	1	1	101±4 <sup>b</sup>	833±9	7.9±1.4	58±3	ND <sup>c</sup>	0.09±0.02	5±1	19±12	
<b>Front Seat</b> 567	2	2	95±2	602±4	8.1±0.6	40±1	1.1±0.4	0.01±0.01	9±1	22±6	
<b>JFK Head</b> 843	4,5	4-1	95±2	621±4	7.9±0.3	40±2	5.5±0.7	0.10±0.01	134±3	59±10	
<b>JBC Wrist</b> 842	9	9-1	104±2	797±7	9.8±0.5	994±7	8.1±1.4	0.07±0.02	120±4	257±14	
<b>Rear Floor</b> 840	14	14-1	94±2	638±4	8.6±0.3	44±2	2.7±0.6	0.06±0.01	13±1	38±7	
		14-2	103±2	647±4	7.9±0.5	42±2	2.4±0.5	0.05±0.01	19±1	40±8	

<sup>a</sup> The absolute values shown for Al, Mn, Na and Cl are approximate values, since standards of these elements were not run, but table values used instead. However, this does not affect their relative values.

<sup>b</sup> The ± values shown for Pb, Sb, Cu, Mn, Na, and Cl represent one standard deviation, based only on the counting statistics. They were calculated in the usual way, taking into account the gross photopeak counts and the counts in the underlying Compton continuum. For a normal distribution, about 68% of the values observed in repetitive measurements should fall within the limits of the mean value ± 1σ. For Ag and Al, which were measured twice on each sample, the ± value shown is 1σ calculated either from the counting statistics or from the spread of the two values, whichever resulted in the larger σ values.

<sup>c</sup> ND means none detected.

Fig. B1.

## Appendix C

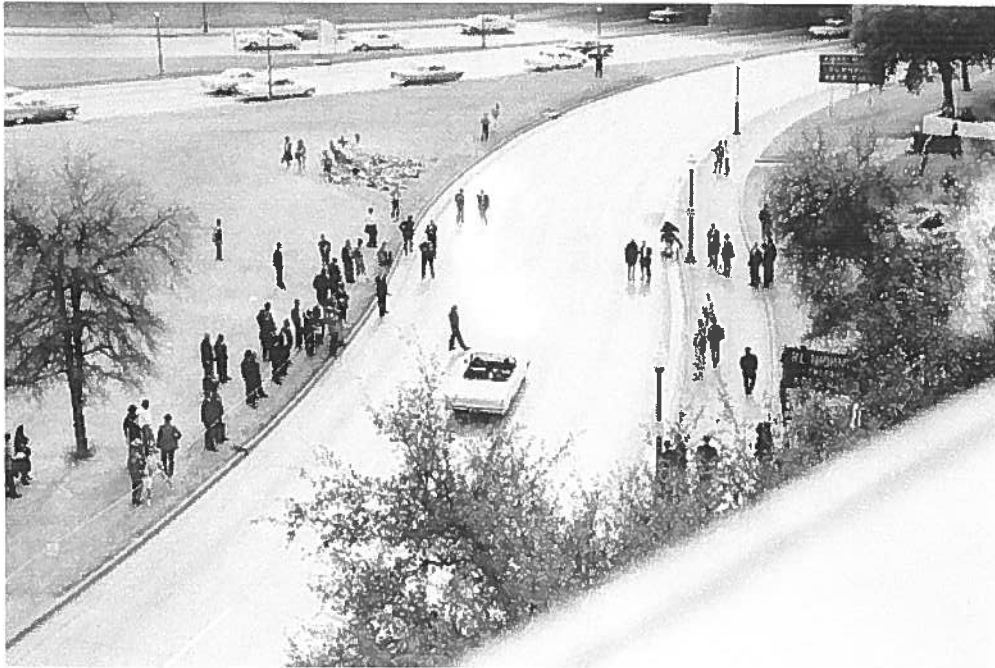
### Additional Photographs



**Fig. C1. On Houston Street.**



**Fig. C2. Turning on to Elm Street.**

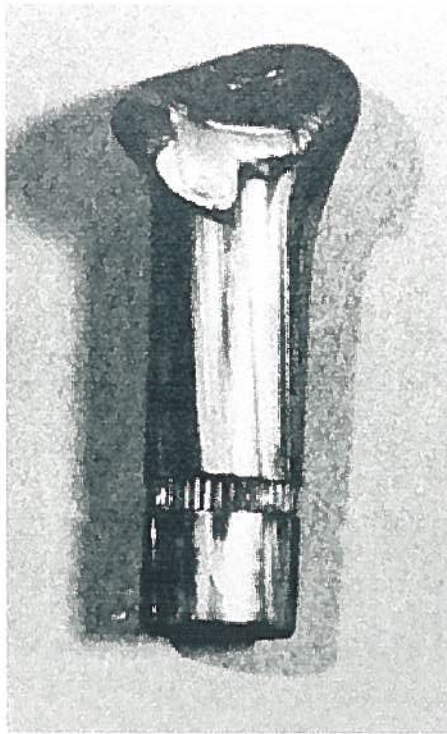


**Fig. C3. Secret Service reenactment photo of Oswald's view.**



**Fig. C4. Looking up Elm Street shortly after the assassination.**





**Fig. C5. Warren Commission test M-C bullet fired through cadaver wrist bone.**



**Fig. C6. Undamaged nose of the magic bullet, CE399. (WP)**





**Fig. C7.** The instant of the head shot.



**Fig. C8.** Speeding toward the triple overpass.

## Notes

1. Today Show, NBC—First TV tour of CIA headquarters, 11/16/93.
2. HSCA hearings, volume 6, page 16.
3. Warren Commission testimony, volume 7, page 493.
4. HSCA hearings, volume 7, page 98.
5. HSCA hearings, volume 7, page 219.
6. Secret Service field report—Interview of doctors who treated Governor Connally, 1/28/64.
7. The Modern Rifle, Jim Carmichel, page 184.
8. Gunshot Wounds: Practical Aspects of Firearms, Ballistics, and Forensic Techniques, Vincent J.M. Di Maio, M.D., page 155.
9. Ibid., page 260.
10. Homicide Investigation, LeMoyne Snyder, page 153.
11. The Warren Commission was presented with one M-C bullet that left metal flakes inside a test skull. The bullet was fired through a gelatin-filled skull, and two large chunks of the bullet exited the other side of the skull. When the gelatin was melted, a number of small metal flakes were recovered from it. However, this process provided no information about the dispersion pattern of the flakes inside the head. It would be normal for an M-C bullet on entering a skull to become somewhat flattened and have a portion of the lead core extruded from the base. The bullet then could begin tumbling and the exposed lead in the base could smash against the skull on the exit side. This would leave flakes of lead around the inside of the exit hole, but there would be no pattern of dust-like particles radiating from the entry hole as shown in the President's x-ray.
12. HSCA hearings, volume 1, page 401.
13. Warren Commission testimony, volume 5, page 64.
14. Crossfire, Jim Marrs, page 317.
15. Warren Commission report, page 107.
16. Warren Commission exhibits, volume 18, page 762.
17. Warren Commission testimony, volume 2, page 76.
18. Warren Commission testimony, volume 2, page 118.
19. Six Seconds in Dallas, Josiah Thompson, page 84.
20. Life magazine, 10/30/66.
21. Warren Commission report, page 504.
22. Presumed Guilty, Howard Roffman, page 257.
23. Ibid., page 261.
24. Should We Now Believe the Warren Report?, Stephen White, page 35.

Based on further testing,  
I now believe the fibers  
to the right are striated  
human tissue and above  
right are cotton gauze  
storage medium fibers.  
note to Fig 31 on p14

↑  
Probably incorrect,  
although not ruled  
out by FBI tests

Note to page 57