

**‘Live Recordings’ of the Shots in Dealey Plaza:
Reliability of Ear-Witness Evidence in the JFK Assassination**

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Abstract: *Courts and other fact-finding bodies often face the task of examining eyewitness accounts to resolve factual issues. It is not unusual to find significant differences between witness recollections. The JFK assassination record contains a large number of detailed witness accounts of the events seen and heard at the scene of this horrific crime. This body of evidence illustrates how apparently divergent recollections of an event may, nevertheless, converge on particular details and provide a very reliable basis for determining key facts.*

The Zapruder film captures the visual image of the assassination of President Kennedy but not the sounds of the shots fired at the President’s car. Two major government reviews and hundreds of independent researchers have exhaustively studied the film in an effort to ascertain the number and timing of the shots, which is considered key to whether more than one assassin was involved. Enormous effort has been spent analyzing all the physical evidence that might establish exactly when the bullets were fired. In the clamour for scientific proof, there has been very little attention paid to witness accounts of the relative spacing of the shots. These witnesses recalled a shot pattern that fits with the evidence as a whole but which does not fit the widely accepted single bullet theory.

Abraham Zapruder’s 8 mm. movie camera has been described as the only unimpeachable witness to the assassination of President Kennedy.² The authenticity of the Zapruder film has been verified in meticulous detail.³ Nevertheless, the film has been the source and subject of more controversy and disagreement than any other single piece of evidence relating to the assassination.

The timing of the shots has been the subject of intense study by assassination researchers. The goal of this research has been to establish the times of the first and second of the three shots that were fired at the President’s motorcade in Dallas on November 22, 1963. (The third shot is seen in frame 313 of the Zapruder film as the President’s head ruptures from the final bullet). It is generally acknowledged that if the time between any two of the shots was much less than 2.3 seconds the shots could not have been fired by a lone gunman using Oswald’s bolt-action Mannlicher-Carcano rifle.⁴

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² “A Matter of Reasonable Doubt”, *Life Magazine*, Vol 61, No. 22, November 25, 1966, p. 41.

³ Roland J. Zavada, “Analysis of Selected Motion Picture Photographic Evidence” (Zavada Report), 1998 Assassination Records Review Board, (Ref. 318420P).

⁴ See *infra*, fn. 91-94. This rifle was found on the sixth floor of the Texas School Book Depository (Warren Commission Exhibit CE139, often referred to by its serial number, C2766).

The Warren Commission⁵ and, later, the House Select Committee on Assassinations (HSCA)⁶ relied on expert interpretations of the Zapruder film and of other physical evidence to establish the timing of the shots. The HSCA commissioned a major acoustical study of two-way radio transmissions that were recorded by the Dallas police on a mechanical 'dictabelt' system. Tape recordings of what were thought to have been live commercial radio broadcasts were analysed by engineers and scientists to determine if shot sounds could be heard. A Nobel physicist analysed patterns of camera jiggle to determine when Abraham Zapruder's body responded to the sound of the shots. Medical experts opined on the cause of each gesture and grimace of President Kennedy and Governor Connally seen in the Zapruder film. In the relentless drive to bring expert opinion to bear on the evidence, the confident recollections of the many witnesses to the assassination were ignored.

It is apparent that members of the Warren Commission realized that the body of witness evidence relating to the pattern of shots had some significance, since this evidence was mentioned in their report.⁷ This witness evidence was completely ignored by the HSCA. The HSCA reached a conclusion that there were likely four shots, three of which were made from the sixth floor window of the Texas School Book Depository and one of which came from the 'grassy knoll' and missed the motorcade. This conclusion was based on scientific analysis alone and was at odds with the witness accounts.

The HSCA did not appear to be concerned that its conclusion lacked other evidentiary support and conflicted with the vast majority of witnesses who recalled exactly three shots. A few years later, the National Academy of Sciences completely discredited the acoustical work and identified several problems with the methods used and some of the assumptions made.⁸ The National Academy concluded:

- (a) The acoustic analyses do not demonstrate that there was a grassy knoll shot and in particular there is no acoustic basis for the claim of a 95% probability of such a shot.
- (b) The acoustic impulses attributed to gunshots were recorded about one minute after the President had been shot and the motorcade had been instructed to go to the hospital.

It is not clear why the Warren Commission and the HSCA paid such little attention to the witness evidence. It is possible that they failed to realize that the ability of witnesses to count shots and recognize a sound pattern would be of assistance in establishing the shot pattern. Or they may simply have believed that witnesses are not reliable.

⁵ Report of The President's Commission on the Assassination of President John F. Kennedy, U.S. Gov. Printing Office, 1964, (Warren Report) hereinafter cited as WR.

⁶ Final Report of the Select Committee on Assassinations, U.S. House of Representatives, 95th Congress, 2nd Session, Report no. 95-1828, U.S. Gov. Printing Office, 1979,

⁷ WR 105.

⁸ National Academy of Sciences (NAS) Report of the Committee on Ballistic Acoustics (1982, National Academies Press) available at <http://www.jfk-online.com/nas00.html>

Of course, witnesses can be reliable or unreliable. Knowing how to tell the difference is important. Courts and investigators depend on witness testimony and generally do not have difficulty distinguishing between recollections that are reliable and those that are not. Psychologists have tested and studied witness perception, memory and recall under a variety of conditions. While these studies confirm that individual witnesses are fallible, they show that honest witness recollection is, more often than not, accurate - with the greatest accuracy on the most salient details.⁹ Courts find it safe to rely on witness testimony where the testimony is consistent with other evidence and particularly if there is corroboration on material details.

When corroborated by other evidence, including testimony from other independent witnesses, the likelihood of error in witness evidence is greatly reduced. The chance of material error diminishes rapidly as the number of pieces of independent, consistent evidence increases. In the absence of a common source of error, witness mistakes will be caused by random factors. The likelihood that a high proportion of a large number of witnesses will independently perceive an event in the same *incorrect* way becomes extremely small. Dishonesty is an inherently random factor unless there is collusion between witnesses. The testimony of the randomly mistaken or dishonest witnesses will necessarily fail to converge on a common explanation. Conversely, barring a common reason for witnesses to all have the same incorrect recollection, the convergence of consistent witness evidence on a particular detail can have only one reasonable explanation: they all shared a common observation.

It is the consistency of a many pieces of independent evidence, however potentially weak each individual piece might be, which provides the ultimate assurance of reliability. Courts and juries understand this. The HSCA apparently did not.

The use of large numbers of mutually corroborated independent witness accounts to establish simple matters of fact may be usefully applied to the JFK assassination. The JFK assassination record is perhaps the largest and most complete public account of any criminal investigation in human history. The record consists of 26 volumes of evidence (approximately 25,000 pages) and a 1000 page report of the Warren Commission, the complete congressional record of the HSCA and the vast collection of original documents and records in the John F. Kennedy Assassination Records Collection at the U.S. National Archives and Records Administration (NARA).

In the absence of some reason for common error, there is no justification in logic or experience for disregarding the consistent independent recollections of a high proportion of many witnesses on matters of simple fact recollection.¹⁰ The facts established by the

⁹ Loftus, Eliz. F., **Eyewitness Testimony**, (Cambridge, MA: 1979), Harvard University Press at p. 25 ff.

¹⁰ Eye-witness identification is a complex area and there are some famous cases in which a person was wrongly identified by several people. Suffice it to say that eyewitness identification is not simple fact recollection. It is a recollection of many facts combined with an opinion that the person being identified was the person seen on a previous occasion. We are concerned here with much simpler facts that do not require an opinion from the witness.

recollections of many witnesses form the foundation for the analysis of the shots that took place in Dealey Plaza.

Let us have a look at the evidence.

The number of shots

Within minutes after the shots were heard at 12:30 pm on November 22, 1963, independent sources began reporting that three shots had been fired at the President's motorcade. At 12:34 pm, approximately four minutes after the shots were fired, the first wire story flashed around the world:

"DALLAS NOV. 22 (UPI) -- THREE SHOTS WERE FIRED AT
PRESIDENT KENNEDY'S MOTORCADE TODAY IN DOWNTOWN
DALLAS. JT1234PCS"¹¹

This report had been transmitted by United Press International reporter Merriman Smith from a radio telephone located in the front seat of the press car in the Presidential motorcade, six cars behind the President's limousine. Smith's communication with the Dallas UPI office was made less than a minute after the shots were heard, as his car entered the Stemmons freeway enroute to Dallas' Parkland hospital.¹²

Merriman Smith's dispatch was the first of many reports. There were dozens of journalists riding in the motorcade in three open press cars and a press bus, none of whom reported hearing a number of shots other than three. Dallas Morning News reporter Mary Woodward described hearing three shots as she stood in front of the Texas School Book Depository.¹³ Photographers Robert Jackson and Tom Dillard riding in a car in the motorcade heard three shots.¹⁴

Of 178 witnesses whose evidence was compiled by the HSCA, 132 reported hearing exactly three shots, 17 recalled hearing two, 7 said they heard two or three shots (total: 88 percent). A total of 6 people said they thought they heard four shots and 9 said they were not sure how many shots they heard. Another 7 people said they thought they heard 1, 5, 6, or 8 shots.¹⁵

Few of those who thought they heard other than three shots were sure about it. Bystander Robert Edwards gave this puzzling testimony:

¹¹ United Press International wire report, issued November 22, 1963, 12:34 pm CST. An original teletype copy of this is in the Sixth Floor Museum, Dallas, Texas.

¹² Merriman Smith, "Eyewitness--The death of President Kennedy", UPI story, Nov. 23, 1963. See also: *Pictures of the Pain: Photography and the Assassination of President Kennedy*, Richard B. Trask, (Danvers, Mass.: Yeoman Press, 1994), page 392.

¹³ "Witness from the News Describes Assassination", Mary E. Woodward, Dallas Morning News, November 23, 1963

¹⁴ See *infra*, fn. 24 and 76.

¹⁵ D. M. Green, "Analysis of Earwitness Reports Relating to the Assassination of President John F. Kennedy", Report No. 4034, House Select Committee on Assassinations Hearings, Vol. 8, p. 128 (abbreviated: 8 HSCA 128) at page 142.

Mr. BELIN. How many shots did you hear, if you remember?

Mr. EDWARDS. Well, I heard one more than than was fired, I believe.

Mr. BELIN. You mean you said on the affidavit you heard four shots?

Mr. EDWARDS. I still right now don't know how many was fired. If I said four, then I thought I heard four.¹⁶

Jean Hill, who was standing on the south side of Elm Street near the President's limousine when the fatal bullet struck, said she thought she heard four to six shots. All one can conclude from such a statement is that she was not sure how many shots she heard, but that she had an impression there were more than three and fewer than seven.¹⁷ One witness thought he heard eight shots, five of which were heard several minutes after the motorcade had departed Dealey Plaza.¹⁸

Echo or Reverberation

Some researchers have suggested that ear-witnesses to the assassination may have been fooled by echoes.¹⁹

Although many witnesses, if not most, were confused as to the direction of the sound source, there are no indications that witnesses had difficulty in hearing the distinct shot sounds. James Tague, who was standing at the far west side of Dealey Plaza in the median between Main and Commerce streets a few feet from a railroad overpass and about 200 feet from the scene of the assassination, said he heard three distinct shots and some reverberation but no separate echoes. He was standing directly in line with the President's limousine and the sixth floor window of the Texas School Book Depository.²⁰

Any reflection of sound off the various surfaces in Dealey Plaza would have created additional sounds arriving at the observers' ears within fractions of a second after the sound of the original muzzle blast. Sound travels at 1127 feet per second. For people located within 55 feet of a reflective surface, which would include most of the people lining the streets as the motorcade passed, the first of the reflected sound waves would have reached their ears less than one-tenth of a second after the sound of the muzzle

¹⁶ Edwards: WC 6 H 205. In his affidavit sworn Nov. 22, 1963, WC 24 H 207, Mr. Edwards said he thought there were four shots. In his a December 2, 1963 interview with the FBI he is reported to have said he heard three or four shots. He was standing with his friend Robert Fischer who heard only three shots.

¹⁷ FBI Report (Jean Hill), March 13, 1964, WC 25 H 854.

¹⁸ A. C. Millican, undated Statement, Decker Exhibit 5823, WC 19 H 486.

¹⁹ See for example, D. M. Green, *ibid*, at p. 136-7. Despite acknowledging an Army simulation in which 20-30 witnesses showed no confusion about the number of shots, Green suggests that reflections from buildings may have caused witnesses to inflate the number of shots.

²⁰ James Tague, testimony: WC 7 H 557. Tague was also struck by a bullet fragment that ricocheted off the curb near where he was standing.

blast. The reflected sound waves would not have been as loud as the sound arriving directly from the rifle.²¹

Echo or reverberation may well have affected witness perception of the direction of the shots. But if echoes confused people about the number of shots, this would only have caused witnesses to perceive *more* shots than were actually fired. As most witnesses heard exactly three shots and since there is other evidence that at least three shots were fired, it appears that there was little confusion about the number of shots due to echoes.²²

2. The relative timing of the shots.

The 1.....2.....3 pattern

There is a significant body of evidence regarding the relative spacing of the shots. The Warren Commission, in stating its conclusion that there were three shots, observed that most witnesses recalled that the second and third shots were closer together than the first and second.²³ The Commission made little use of this evidence in reaching its conclusions, however.

There were at least 44 witnesses who recalled this pattern.

Photographer Robert H. Jackson, who was one of four people who actually saw the sniper's rifle in the sixth-floor window of the School Book Depository building, testified:

Then we realized or we thought that it was gunfire, and then we could not at that point see the President's car. We were still moving slowly, and after the third shot the second two shots seemed much closer together than the first shot, than they were to the first shot.

...

I would say to me it seemed like 3 or 4 seconds between the first and the second, and between the second and third, well, I guess 2 seconds, they were very close together. It could have been more time between the first and second. I really can't be sure.²⁴

Linda Willis, a fourteen year old girl watching the motorcade with her father, recalled:

²¹ The amplitude of a sound wave varies inversely as the square of the distance the sound has traveled from the source. For example, to Listener A, a sound is 4 times as loud as that heard by Listener B situated twice the distance from the source as A. See D. M. Green, *ibid*, at p. 133.

²² Examples of other evidence of at least three shots: Governor Connally felt a bullet strike his back seconds after he heard the first shot. He also heard and felt the effect of the third bullet that struck the President's head (WC 4 H 129) seconds later. Amos Euins (Affidavit November 22, 1963, WC 24 H 207) standing across from the Texas School Book Depository said that he looked up to the sixth floor window after he heard the first shot and saw two shots being fired from the sniper's rifle. There were three empty shells found inside the sniper's window.

²³ WR 115. See also Warren Commission member Allan Dulles' comment at WC 5 H 174

²⁴ Jackson: WC 2 H 159

Yes, I heard one. Then there was a little bit of time, and then there were two real fast bullets together. When the first one hit, well, the President turned from waving to the people, and he grabbed his throat, and he kind of slumped forward, and then I couldn't tell where the second shot went.²⁵

Dallas Mayor Earle Cabell, who was riding in the motorcade two cars behind Vice-President Johnson's car, recalled a longer pause between the first and second shots:

I heard the shot. Mrs. Cabell said, "Oh a gun" or "a shot", and I was about to deny and say "Oh it must have been a firecracker" when the second and the third shots rang out. There was a longer pause between the first and second shots than there was between the second and third shots. They were in rather rapid succession. There was no mistaking in my mind after that, that they were shots from a high-powered rifle.

...

Mr. HUBERT. Could you estimate the number of seconds, say, between the first and second shots, as related to the number of seconds between the second and third shots? Perhaps doing it on the basis of a ratio?

Mr. CABELL. Well, I would put it this way. That approximately 10 seconds elapsed between the first and second shots, with not more than 5 seconds having elapsed until the third one.

Mr. HUBERT. Two to one ratio?

Mr. CABELL. Approximately that. And again I say that, as you mentioned, as a matter of being relative. I couldn't tell you the exact seconds because they were not counted.²⁶

Texas patrolman Hurchel Jacks, driver of the Vice-President's car, said that the pause between the first two shots was long enough for a Secret Service agent to shield the Vice-President with his body:

I heard a shot ring out which appeared to come from the right rear of the Vice President's car. Mr. Rufus Youngblood, the Secret Service Agent riding in my car asked me what that was and at the same time he advised the Vice President and Mrs. Johnson to get down. He climbed to the rear of the seat with the Vice President and appeared to be shielding the Vice President with his own body. At that time I heard two more shots ring out.²⁷

Lady Bird Johnson recalled:

We were rounding a curve, going down a hill, and suddenly there was a sharp loud report--a shot. It seemed to me to come from the right, above my shoulder, from a building. Then a moment and then two more shots in rapid succession.²⁸

Luke Mooney, of the Dallas County Sheriff's office, testified:

²⁵ L. Willis: WC 7 H 498

²⁶ Cabell: WC 7 H 478

²⁷ Jacks: CE 1024, WC 18 H 801. Statement signed Nov. 28, 1963

²⁸ Johnson: WC 5 H 564. Statement dictated in early Dec. 1963 and signed July 16, 1964.

The second and third shot was pretty close together, but there was a short lapse there between the first and second shot.²⁹

Secret Service Special Agent (SA) Paul Landis, standing on the right rear running board of the President's follow-up car, recalled only two shots. He said that the interval between the first and second shots was enough for him to quickly look at the President, scan the depository building and the crowd and look at a tire of the President's limousine. He concluded:

The time lapse between the first and second report must have been about four or five seconds.³⁰

Bonnie Ray Williams, one of three men watching the motorcade from the fifth floor of the Texas School Book Depository just below the window where the rifle was seen, recalled:

The first shot--there was two shots rather close together. The second and the third shot was closer together than the first shot and the second shot, as I remember.³¹

Deputy Sheriff Roger Craig standing on Main Street watching the motorcade testified:

Mr. BELIN. About how far were these noises apart?

Mr. CRAIG. The first one was--uh--about three seconds--2 or 3 seconds.

Mr. BELIN. Two or 3 seconds between the first and the second?

Mr. CRAIG. Well, it was quite a pause between there. It could have been a little longer.

Mr. BELIN. And what about between the second and third?

Mr. CRAIG. Not more than 2 seconds. It was--they were real rapid.³²

Senator Ralph Yarborough, riding with the Vice-President, provided an affidavit stating:

After what I took to be about three seconds, another shot boomed out, and after what I took to be one-half the time between the first and second shots (calculated now, this would have put the third shot about one and one-half seconds after the second shot--by my estimate--to me there seemed to be a long time between the first and second shots, a much shorter time between the second and third shots--these were my impressions that day), a third shot was fired. After the third shot was fired, but only after the third shot was fired, the cavalcade speeded up, gained speed rapidly, and roared away to the Parkland Hospital.

I heard three shots and no more.³³

²⁹ Mooney: WC 3 H 282.

³⁰ Landis: CE 1024, WC 18 H 755

³¹ Williams: WC 3 H 175

³² Craig: WC 6 H 263

³³ Yarborough: WC 7 H 439. The affidavit was sworn July 10, 1964

SA Winston Lawson, traveling in the lead car ahead of the President, testified:

... It came from behind me. Then I heard two more sharp reports, the second two were closer together than the first. There was one report, and a pause, then two more reports closer together, two and three were closer together than one and two.³⁴

SA Rufus Youngblood, riding with the Vice-President, recalled:

There seemed to be a longer span of time between the first and the second shot than there was between the second and third shot.³⁵

SA George Hickey, riding in the rear of the President's follow-up car, provided this account:

After a very short distance I heard a loud report which sounded like a firecracker. It appeared to come from the right and rear and seemed to me to be at ground level. I stood up and looked to my right and rear in an attempt to identify it. Nothing caught my attention except people shouting and cheering. A disturbance in 679x [*the car he was in*] caused me to look forward toward the President's car. Perhaps 2 or 3 seconds elapsed from the time I looked to the rear and then looked at the President. He was slumped forward and to his left, and was straightening up to an almost erect sitting position as I turned and looked. At the moment he was almost sitting erect I heard two reports which I thought were shots and that appeared to me completely different in sound than the first report and were in such rapid succession that there seemed to be practically no time element between them. It looked to me as if the President was struck in the right upper rear of his head.

The first shot of the second two seemed as if it missed because the hair on the right side of his head flew forward and there didn't seem to be any impact against his head. The last shot seemed to hit his head and cause a noise at the point of impact which made him fall forward and to his left again.³⁶

Many others recalled that the second and third shots were closer together than the first and second, including Special Agents Forrest Sorrels³⁷, William McIntyre³⁸, William Greer (driver of the President's limousine)³⁹ and Samuel Kinney (driver of the Secret

³⁴ Lawson: WC 4 H 353

³⁵ Youngblood: WC 2 H 150

³⁶ Hickey: CE 1024, WC 18 H 762

³⁷ Sorrels: WC 21 H 548 and WC 7 H 345. "There was to me about twice as much time between the first and second shots as there was between the second and third shots."

³⁸ McIntyre: WC 18 H 747. "The Presidential vehicle was approximately 200 feet from the underpass when the first shot was fired, followed in quick succession by two more."

³⁹ Greer: WC 2 H 118. Greer stated that the second followed the first by three or four seconds and "The last two seemed to be just simultaneously, one behind the other, but I don't recollect just how much, how many seconds were between the two. I couldn't really say."

Service follow-up car)⁴⁰, Sheriff's Deputies C.M. Jones⁴¹, Allan Sweatt⁴², John Wiseman⁴³, Harold Elkins⁴⁴, Dallas Police Chief Jesse Curry⁴⁵, Dallas police officer Clyde Haygood⁴⁶, and bystanders Victoria Adams⁴⁷, Eugene Boone⁴⁸, Lee Bowers⁴⁹, Rose Clark⁵⁰, James Crawford⁵¹, Wesley Frazier⁵², James Jarman Jr.⁵³, Emmett Hudson⁵⁴,

⁴⁰ Kinney: CE 1024, WC 18 H 731. "There was a second of pause and then two more shots were heard." SA Kinney, like SA Hickey, saw JFK's hair fly up on the second shot.

⁴¹ Jones: WC 19 H 512 (Decker exhibit, 5323). "I heard an explosion followed in about 3 to 5 seconds later two more explosions."

⁴² Sweatt: WC 19 H 531 (Decker exhibit). "I heard a shot and about 7 seconds later another shot and approximately 2 or 3 seconds later a third shot".

⁴³ Wiseman: WC 19 H 535 (Decker exhibit). Wiseman was standing in front of the Sheriff's office, which is on Main Street, half a building from the corner of Main and Houston, when he heard the first shot. "I ran at once to the corner of Houston and Main Street and out into the street when the second and third shots rang out".

⁴⁴ Elkins: WC 19 H 540 (Decker exhibit). Elkins said a "couple of seconds elapsed" after the first and "then two more shots ring out"

⁴⁵ Curry: WC 4 H 172. Chief Curry was not asked directly about the shot pattern. He was asked about the positions of the President's car on Elm Street when he heard the shots. He said that he heard the first shot when the President's car was mid-way between Houston Street and the overpass; that at the second shot the car was about 25-30 feet further along; and the third occurred after it had moved another 15-20 feet. In making this distinction of the distances traveled between the shots, he described the last two shots as being closer together as measured by the distance the President's car traveled between shots.

⁴⁶ Haygood: WC 6 H 298. "The last two were closer than the first. In other words, it was the first, and then a pause, and then the other two were real close."

⁴⁷ Adams: WC 6 H 388. "And we heard a shot, and it was a pause, and then a second shot, and then a third shot."

⁴⁸ Boone: WC 3 H 292. "there seemed to be a pause between the first shot and the second shot and third shots-a little longer pause.

⁴⁹ Bowers: WC 6 H 287. "I heard three shots. One, then a slight pause, then two very close together".

⁵⁰ Clark: CE 2100, WC 24 H 533 (FBI report). "She noted that the second and third shots seemed closer together than the first and second shots".

⁵¹ Crawford: WC 6 H 172. "The second shot followed some seconds, a little time elapsed after the first one, and followed very quickly by the third one". He also confirms that the VP security car had completed the turn when the first shot was heard.

⁵² Buell Wesley Frazier testified before the Warren Commission but was not specifically asked about the shot pattern. However, he did mention that he heard a noise and then a few seconds later heard two more but did not elaborate: WC 2 H 234. In his 1969 testimony at the Clay Shaw trial he said this (Transcript, State of Louisiana v. Clay L. Shaw Trial, Feb 13, 1969, afternoon, page 27-28, part of the HSCA JFK Collection, Ex. RG 233):

A Shortly after there were two more in rapid succession.

...

Billy Lovelady⁵⁵, John Martin Jr.⁵⁶, Mary Ann Mitchell⁵⁷, Joe Molina⁵⁸, Lillian Mooneyham⁵⁹, Samuel Paternostro⁶⁰, Arnold Rowland⁶¹, Edward Shields⁶², William Shelley⁶³, Ruth Smith⁶⁴, John Solon⁶⁵, Pearl Springer⁶⁶, Ruth Thornton⁶⁷, and reporter Mary Woodward.⁶⁸

Q Did you recognize any of the noises as rifle shots?

A Well, the two that come in fast succession by that time, like I said, people were hollering, and then I recognized them, they were rifle shots.

Q Approximately how much time lapsed from the first noise you heard until you heard the second noise?

A It was just a few seconds.

Q How much time elapsed from the time you heard the second noise until you heard the third noise?

A When I heard the second noise, the third was followed nearly just right back to back. It was fired in rapid succession.

⁵³ Jarman: WC 3 H 204. "and then the third shot was fired right behind the second one."

⁵⁴ Hudson, FBI report, November 26, 1963 CD5 (unpublished Warren Commission document): "He said he then heard two more loud reports which sounded like shots, such reports coming in rapid succession after the first shot." His much later testimony was quite different, however: see, *infra*, fn. 78.

⁵⁵ Lovelady: CE 2003 (affidavit) WC 24 H 214. "there was a slight pause after the first shot and then the next two was right close together".

⁵⁶ Martin: FBI Interview, March 31, 1964. CD 897 "he heard a loud report and first thought that it was a firecracker and a few seconds later heard two more reports".

⁵⁷ Mitchell: FBI Interview, January 18, 1964. CD 329 "heard a loud report or explosion and then after a short pause of four or five seconds, there were two more rapid explosions".

⁵⁸ Molina: WC 6 H 371. "Of course, the first shot was fired then there was an interval between the first and second longer than the second and third."

⁵⁹ Mooneyham: CE 2097, WC 24 H 531. "Following the first shot, there was a slight pause and then the second and third shots sounding closer together"

⁶⁰ Paternostro: CE 2105, WC 24 H 536. "He said he estimated several seconds, possibly four or five or more, elapsed between the first report and the second and third reports"... "then when the other reports followed in quick succession"

⁶¹ A. Rowland: WC 19 H 494 (Decker exhibit). "and then in about 8 seconds I heard another report and in about 3 seconds a third report"

⁶² Shields: WC 7 H 394. "I heard one shot and then a pause and then this repetition-two shots right behind the other".

⁶³ Shelley: WC 6 H 329. "Well, I heard something sounded like it was a firecracker and a slight pause and then two more a little bit closer together.

⁶⁴ Smith: CD 206. "...she heard what she felt was a shot. She stated there was a pause then two more shots fairly close together."

⁶⁵ Solon: CE 2105, WC 24 H 535. "First shot, pause, two shots, then echoes of the shots. Mr. Solon advised he would judge that approximately five and one-half seconds was taken for all three shots."

⁶⁶ Springer: CE 2087, WC 24 H 523. "She recalled that after the first shot there was a pause, then two more shots were fired close together."

There are others who reported hearing a shot and then two more shots, without specifying the amount of time between shots.⁶⁹

The witnesses who recalled equally spaced shots

There were ten witnesses who thought that the shots were about equally spaced. Four witnesses, Clifton Carter, Delores Kounas, James Romack and Jack Watson, gave unqualified views that the spacing was "even" or "equal".

Carter stated in an affidavit dated May 20, 1964:

"I distinctly remember three shots. There was an interval of approximately 5 to 6 seconds from the first to the last shot, and the three shots were evenly spaced."⁷⁰

An FBI report on Delores Kounas states:

"She stated there were three of these noises which she now knows were shots equally spaced by a few seconds."⁷¹

In his first two statements in March 1964 James Romack did not comment on the spacing. This comment was made in response to a somewhat leading question at his deposition on April 8, 1964:

"Mr. ROMACK. Oh, they happened pretty fast. I would say maybe 3 or 4 seconds apart.

Mr. BELIN. Were they equally spaced, or did one sound like it was closer than another one in time?

Mr. ROMACK. It sounded like to me that they were evenly spaced. They rang out pretty fast.

Mr. BELIN. Have you ever operated a bolt action rifle?

Mr. ROMACK. Yes, sir.

Mr. BELIN. Do you own one?

⁶⁷ Thornton: CE 2107, WC 24 H 537. "Then she said two more reports followed in quick succession"

⁶⁸ Woodward: FBI report, CE2084, WC, 24 H 520. "There seemed to be a pause of a few seconds and then there were two more loud noises...". In her Dallas Morning News report, published November 23, 1963, she stated: "Then after a moment's pause I heard another shot and I saw the President start slumping in the car. This was followed rapidly by another shot". In a 1988 interview by Nigel Turner for the film "The Men Who Killed Kennedy", Mary Woodward stated: "The second two shots were immediate --- it was almost as if one were an echo of the other -- they came so quickly. The sound of one did not cease until the second shot." ... "and then the third shot came very, very quickly, on top of the second one"

⁶⁹ See, for example, T.E. Moore, WC 24 H 534; Patricia Anne Lawrence, WC 22 H 660; James Underwood, WC 6 H 169.

⁷⁰ Affidavit of Vice-presidential aide Clifton Carter dated May 20, 1964. WC 7 H 475. No earlier statement was provided by Mr. Carter.

⁷¹ FBI report dated November 24, 1963, WC 22 H 846.

Mr. ROMACK. Yes, sir.

Mr. BELIN. Did it sound like the shots were faster than it could be operated with a bolt action rifle?

Mr. ROMACK. No, sir." ⁷²

Jack Watson was operating radio communications in the Sheriff's office in the Courts building which looks out onto Main Street, a short block from the Texas School Book Depository. He said:

"and about that time I heard three loud reports evenly spaced which I presumed to be rifle or shotgun blasts." ⁷³

Another four witnesses: API photographer James Altgens⁷⁴, motorcycle patrolman Marriion Baker⁷⁵, Dallas news photographer Thomas Dillard⁷⁶ and bystander Ronald Fischer⁷⁷ gave qualified opinions, using words like "almost regular", "approximately", "pretty well even". Fischer said "As far as I can remember, the shots were evenly spaced." but he also thought he had had heard four shots. Altgens could recall hearing only two of the shots and was not certain how many there were.

Emmett Hudson, testified in July 1964 that the shots were equally spaced. However, the FBI report about Hudson made a few days after the assassination stated:

"He said he was looking directly at President Kennedy and saw his head slump to one side simultaneously with the loud report made by the first shot fired by the assassin. He said he then heard two more loud reports which sounded like shots, such reports coming in rapid succession after the first shot. He volunteered the shots were fired 'just about as fast as you could expect a man to operate a bolt action rifle' or words that effect." ⁷⁸

In his deposition on July 24, 1964 Hudson gave a confused story that was very different from his earlier statement. At this time he thought the shots took place over two minutes and "seemed pretty well evenly spaced". The inconsistency between this testimony and his much earlier statement was not addressed.

Two witnesses, Lawrence O'Brien and Phillip Willis, thought the shots were equally spaced but they appear to have been occupied with other tasks at the time of the shots. O'Brien was in one of the open press cars in the motorcade. He provided his 'impression' of the shot spacing, in response to a rather leading question:

⁷² Romack, April 8, 1964, WC 6 H 280

⁷³ Statement of Jack Watson, November 22, 1963, WC 22 H 522

⁷⁴ Altgens: WC 7 H 520. "They seemed to be at almost regular intervals and they were quick."

⁷⁵ Baker: WC 3 H 247. "It seemed to me like they just went bang, bang, bang; they were pretty well even to me."

⁷⁶ Dillard: WC 6 H 164. "I heard three-the three approximately equally spaced."

⁷⁷ Fischer: WC 6 H 195.

⁷⁸ Hudson: FBI report November 26, 1963 (part of the HSCA JFK Collection: Ex. RG 233, and Warren Commission Document CD5). WC testimony: (WC 7 H 565).

"Mr. ADAMS. Is it your recollection that these sounds were evenly spaced?

Mr. O'BRIEN. That is my impression. As I say, I apparently immediately engaged the driver in conversation after the first shot which forces me to conclude that there had to be a time between the first and second and third shots- because I simply-describing the exchange of my question and his answer, and his answer, I must say, probably was completed after the third shot. But he had started his answer to the question at about or just before the third shot." ⁷⁹

Willis, thought the shots were fired approximately two seconds apart but he said his immediate attention was on his daughters:

"I proceeded down the street and didn't take any other pictures instantly, because the three shots were fired approximately about 2 seconds apart, and I knew my little daughters were running along beside the Presidential car, and I was immediately concerned about them, and I was screaming for them to come back, and they didn't hear me. But I was concerned about them immediately, because I knew something tragic had happened, and the shots didn't ring out long like a rifle shot that is fired into midair in a distance." ⁸⁰

Witnesses who recalled the reverse pattern

Six witnesses apparently recalled the reverse pattern of shots with the first two sounding closer together than the second and third.

The President's secretary, Kenneth O'Donnell, riding on the left side of the middle seat of the President's follow-up car, described the shots this way:

Mr. SPECTER. And was there any distinguishable tempo to the shots?

Mr. O'DONNELL. Yes; the first two came almost simultaneously, came one right after the other, there was a slight hesitation, then the third one. ⁸¹

It may be noted this statement was made six months after the assassination and Mr. O'Donnell had not provided any statements or notes close to the time of the assassination.

Nellie Connally, who was sitting beside her husband in the President's limousine, thought the first two shots 'seemed' closer together than the second and third:

Mr. SPECTER. What is your best estimate on the time that passed from the first to the last shot?

Mrs. CONNALLY. Very short. It seemed to me that there was less time between the first and the second than between the second and the third. ⁸²

Her recollection of this was provided on April 21, 1964. There is no earlier statement or note in which the shot spacing was mentioned.

⁷⁹ O'Brien: WC 7 H 162

⁸⁰ Willis: WC 7 H 495.

⁸¹ O'Donnell: WC 7 H 448 (testimony given May 18, 1964).

⁸² Nellie Connally: WC 4 H 149

Cecil Ault was inside a courtroom in the Court House on Houston Street looking through a closed window. He did not testify and gave only a verbal statement to an FBI agent that is contained in an FBI report.⁸³ According to the report, Mr. Ault “noted that the first and second shots sounded to him to be close together and the third shot was spaced more after the second shot, first two shots sounding close enough to be automatic rifle”. The report also states: “Following the first shot Mr. Ault noted that President Kennedy appeared to raise up in his seat in the Presidential automobile and after the second shot the President slumped into his seat”. (It may be noted that the President actually fell over in his seat immediately after the third shot, which struck his head).

William and Gayle Newman were standing with their two children on the sidewalk 15 feet from the motorcade’s path at the time of the shots. The FBI report on Gayle Newman dated November 24, 1963 states: "She believed there were first two shots in succession, a pause, and then another shot was fired which struck the President".⁸⁴ In a separate FBI report of the same date regarding William Newman this statement is found: "It was his belief that two shots were fired in rapid succession".... and "about that time another shot was fired which he estimated was about 10 seconds after the first shot was fired".⁸⁵

Texas School Book Depository employee, Steven Wilson, was sitting in his office three floors directly below the sixth floor window sniper’s nest. He gave a statement in December 1963 in which he did not mention the spacing of the shots. In a statement dated March 25, 1964 he said he was positive that he heard three shots and gave his ‘opinion’ of the spacing:

In a matter of ten seconds or less after car and occupants were obscured from my view by the trees, I heard three shots. I am positive there were three shots, no more and no less. It is my opinion there was a greater space of time between the second and third shots than between the first and second. The three shots were fired within a matter of less than five seconds.⁸⁶

Conclusions about the shot pattern

As seen from the above review of the evidence, there are at least 44 witnesses who recalled a relatively long pause after the first shot and a much shorter separation between the last two. Only 6 thought the pattern was the reverse. Another 10 may have thought the shots were fairly equally spaced.

If one assumes that the likelihood of a witness recalling a simple pattern of three loud noises correctly was at least as great the likelihood of recalling it incorrectly, there is only one rational conclusion to be drawn from this evidence: the last two shots were closer together than the first two. If the shot pattern was 1...2.....3 one would have to explain how it could be possible that only 6 out of 60 witnesses perceived the pattern correctly. One would have to explain not only why the rest of the witnesses were mistaken, but why 44 of them randomly made the *same* mistake.

⁸³ Ault: FBI report dated January 10, 1964, CE2103, WC 24 H 534.

⁸⁴ Gayle Newman: WC 22 H 842.

⁸⁵ William Newman: WC 22 H 842.

⁸⁶ Wilson: statement, March 25, 1964, WC 22 H 685

One can conclude from this evidence that there were three unevenly spaced shots, the second shot being closer in time to the third than the first. Since the difference in spacing of the shots was obvious to so many witnesses, one can conclude that the second shot occurred several frames after the midpoint between the first and third shots. From the witness evidence as a whole, it appears likely that the last two shots were separated by a perceptible pause.

The time of the first shot

There is some dispute as to the time of the first shot. There appears to be a convergence of evidence of witnesses in the motorcade who recalled that the first five cars had turned the corner at Houston Street and Elm Street when the first shot was heard.⁸⁷ The Zapruder film shows the fifth car (the Vice-President's security car) still turning the corner at frame 191. This is consistent with the recollection of Hugh Betzner whose photograph, taken at frame 186, was made just before the first shot occurred. He said that he heard the shot as he

⁸⁷ These witnesses are:

In the VP car (4th in motorcade):

Hurchel Jacks (driver), WC 18 H 801, said "My car had just straightened up from making the left hand turn" when the first shot rang out.

SA Rufus Youngblood, WC 18 H 767, said that the VP car had turned the corner and he observed grassy area to his right before first shot was heard.

Vice-President Lyndon Johnson WC 5 H 562: said he heard the first shot "after we had proceeded a short way down Elm Street"

Lady Bird Johnson, WC 5 H 565: said "we were rounding a curve and going down a hill" when the first shot was heard.

Senator Ralph Yarborough WC 7 H 440: "as the motorcade went down the slope of Elm Street a rifle shot was heard by me".

Occupants of the VP follow-up car (5th in motorcade) described the moment of the first shot:

Joe Rich. (driver), WC 18 H 800: "I was staying right on his bumper" (of the VP car). "we turned off Houston Street onto Elm Street"

Clifton Carter, WC 7 H 474: "our car had just made the lefthand turn off Houston onto Elm Street and was right along side of the Texas School Book Depository Building"

SA Kivett, WC 8 H 778: "The motorcade was heading slightly downhill toward an underpass. As the motorcade was approximately 1/3 of the way to the underpass.."

SA Johns, WC 18 H 764: "at this time we were on a slight downhill curve to the right"

SA Taylor, (18 H 782): "our automobile had just turned a corner"

Occupants of Mayor Cabell's car (6th in motorcade) recalled hearing the first shot as follows:

Milton Wright (driver), WC 18 H 802: "had just turned onto Elm Street and approximately 30 feet from the intersection" [note: the turn onto Elm begins before the streets intersect due to the greater than 90 degree angle turn at Elm].

Earle Cabell, WC 7 H 479, said that he was turned around talking to Rep. Roberts and Mrs. Cabell with the TSBD situated to his back.

Mrs. Cabell, WC 7 H 486, "we were making the turn" ... "I was directly facing [the TSBD]"

[Rep. Ray Roberts did not provide any statement.]

was starting to wind his camera to take another. It is also consistent with the recollection of Phillip Willis who said that his photograph of the President, exposed at frame 202, was taken at the very instant the first shot was heard. His daughter, Linda, said that the first shot occurred when the President's limousine in line with her and the Stemmons sign, which occurs between frames 195 and 207.⁸⁸

Author Gerald Posner, in his book *Case Closed*, suggests that there may have been an earlier shot, at approximately frame 160, which missed the limousine entirely.⁸⁹ He proposes this scenario to explain John Connally's recollection that he was hit by the second shot. He suggests that the Governor and the President were both hit by the second shot at frame 223. This scenario, a modification of the single bullet theory (SBT) proposed by the Warren Commission, has been widely accepted, although the support for it appears to be largely conjectural.

How the shot pattern evidence affects the analysis of the assassination

In his theory, Posner posits that the bullets were fired at frames 160, 223 and 313 of the Zapruder film. This would mean that the second shot occurred almost five full seconds before the fatal shot, making the time between the first and second much *shorter* than the interval between the second and third.

The shot pattern evidence establishes that there was only one shot prior to the mid-point between the first and last shots. The Posner 'second bullet SBT' hypothesis is cannot be reconciled with the shot pattern evidence. If the SBT is correct, it must have occurred on the first shot⁹⁰.

Since the third shot struck the President in the head between frames 312 and 313, if the first shot occurred very close to frame 200, the mid-point of the shooting was at frame 256. The second shot must have been fired a perceptible amount of time after this mid-

⁸⁸ Betzner: statement, Nov. 24, 1963, WC 24 H 200; Phillip Willis: WC 7 H 493; Linda Willis: WC 7 H 498.

⁸⁹ Gerald Posner, of *Case Closed*, (New York: Doubleday, 1993), Ch. 14. Posner does not deal at all with the witness evidence cited above indicating that the VP and VP follow-up car had made the turn by the first shot. At frame 160 even the VP car has not completed the turn and the VP follow-up car is just entering the intersection.

⁹⁰ Not surprisingly, practically all of the witnesses who commented on the President's reaction to the first shot said that he immediately move to the left and brought his hands to his neck. Only one witness, SA Glen Bennett riding in the follow-up car behind the President, reported seeing him being hit by the second shot (Nov. 22, 1963 statement WC 18 H 760) although his original handwritten notes (CE 2112, WC 24 H 542) suggest it was the first shot:

"At this point I heard a noise that immediately reminded me of a firecracker. I immediately, upon hearing the supposed firecracker, looked at the Boss's car. At this exact time I saw a shot that hit the Boss about 4 inches down from the right shoulder; a second shoot (sic) followed immediately and hit the right rear high of the boss's head."

SA Hickey, who was seated beside Bennett, specifically noted that the President was not hit by the second shot and that it appeared to pass to the right of his head as his hair flew up at the moment the second shot was heard. See fn. 36. The only other point in the car struck by a bullet was Governor Connally.

point to account for the number of people who observed the unequal spacing. A second shot at frame 275 would make the time difference between the first and second shots twice as long as the interval between the last two, which is what many witnesses recalled.

The Warren Commission found that a minimum of about 2.3 seconds was required to fire, reload aim and fire again using Oswald's rifle.⁹¹ This appears to be based on the FBI re-enactment using that rifle. FBI ballistics expert Robert Frazier, who actually fired 3 shots in 4.6 seconds, said "4.6 seconds is firing this weapon as fast as the bolt can be operated, I think".⁹² The FBI's Ronald Simmons noted that one marksman fired three shots in 4.6 seconds using the telescopic sight and three shots in 4.45 seconds using the iron sights.⁹³ There was no time placed on the middle shots so we cannot determine the smallest interval between shots. None of the FBI marksmen had practised with the Mannlicher-Carcano rifle. Simmons admitted that with practice the shooter would likely be able to operate the bolt smoothly without moving the rifle from its target.⁹⁴ There was evidence that Oswald practised using the bolt action.⁹⁵

The witness evidence establishes that if Governor Connally was hit by the second bullet - as he and his wife always maintained - it must have struck him around frame 270 or later. Since Zapruder's film ran at an average speed of 18.3 frames per second, if Connally was hit any later than about frame 276 there would have been less than 2 seconds between shots and, therefore, more than one person shooting.

A shot around frame 270 would fit the shot pattern and would be consistent with the Warren Commission's 'lone assassin' conclusion. So, if the Warren Commission reached the correct conclusion and Connally was right about being hit by the second shot, there should be evidence of a shot striking him in the back at around frame 270.

There has not yet been a satisfactory resolution to the timing of the shots. The different explanations that have come forward do not explain all the evidence. Indeed, they all contemplate that a substantial amount of apparently reliable evidence is wrong. The single bullet theory did not receive unanimous endorsement of all members of the Warren Commission and has been mired in controversy since 1964.

We need to take a careful look at bodies of consistent witness accounts before reaching firm conclusions. When this witness evidence is dusted off and re-examined, it provides a surprising new perspective on the sequence of events during those tragic and awful few seconds in Dallas 40 years ago.

⁹¹ WR 97.

⁹² Frazier: WC 3 H 407

⁹³ Simmons: WC 3 H 446

⁹⁴ WC 3 H 449

⁹⁵ Testimony of Marina Oswald: WC 1 H 53 and 65