# The Missing Bullet in the JFK Assassination

By: Lucien C. Haag, Forensic Science Services, P.O. Box 5347, Carefree, AZ 85377

**Keywords: assassination, 6.5x52mm Carcano, ballistic coefficient, exterior ballistics, James Tague, John F. Kennedy, Lee Harvey Oswald, Model 91/38 Carcano, President Kennedy, ricochet, terminal ballistics, Texas School Book Depository, TSBD, Western Cartridge Company, WCC**

***ABSTRACT***

***The ballistic evidence in the November 22, 1963, JFK assassination clearly supports the proposition that Lee Harvey Oswald fired three shots from the 6th floor, southeast corner window of the Texas School Book Depository building with his Model 91/38 6.5mm Carcano rifle.***

***Two of these three shots struck President Kennedy. The bullet from one of these two shots also struck Texas Governor Connally. Unaccounted for is the fate of the bullet from the missed shot, its order in the three shot sequence and its flight path. This article, the fourth in a series, presents a step-by-step review and analysis of the assassination, as well as the exterior and terminal ballistics of the 160-gr. 6.5mm WCC Carcano ammunition. This article concludes that the missing shot was the first shot fired, the bullet from this shot struck the asphalt of Elm Street at a relatively steep angle and subsequently self-destructed.***

## Introduction

Two of the three previous articles by this author have explained the fate of two of the three shots fired by Lee Harvey Oswald from the 6th floor window of the Texas School Book Depository building (TSDB) [1, 2]. These articles also described the solid association of Oswald's M91/38 Carcano rifle, found hidden in the northeast corner of the 6th floor, with the 6.5mm Western Cartridge Company (WCC) bullet that struck Governor Connally and the fragmented remains of the 6.5mm WCC bullet that struck the President in the head.

The three fired WCC 6.5x52mm cartridge cases found on the floor under the 6th floor window were also identified as having been fired in Oswald's M91/38 rifle. The association of these two bullets and cartridge cases with Oswald's rifle was established by at least seven forensic firearms examiners of long experience, each of whom worked for different agencies. However, three shots occurred, but only two fired bullets were recovered. A third, missing bullet with no known or certain downrange ballistic damage was ever found at the scene.

The 1964 Warren Report contained only seven pages of the 888 pages that dealt with the reconstruction of the shooting sequence [3]. The most important ballistic questions at the time were: Was there one gun (shooter) or two guns (shooters), i.e., did one gun fire both bullets? Was the responsible gun the 6.5mm Carcano recovered from the 6th floor of the TSBD less than an hour after the assassination? Could the recovered rifle be associated with Oswald? Could Oswald be placed at the scene at the time of the assassination? These questions were answered, but the Warren Commission was unable to say where the bullet from the third shot went or even when it was fired. The well-known Abraham Zapruder film is of no assistance with regards to this matter. The film does not begin until well after the presidential limousine has already made its sharp turn onto Elm Street and is about 70 feet down the street. This only became apparent to the Warren Commission when they went to the scene in May of 1964 for the purpose of a reenactment. They came to the realization that the President moved into Oswald's potential line of fire after the presidential limousine turned onto Elm Street, but *before* Zapruder had restarted his Bell and Howell Zoomatic movie camera following some earlier footage. The Commission subsequently labeled this "position A" as the first point at which a person in the sixth floor window could have taken a shot at the President after the car rounded the corner at Houston and Elm Street. **Figure 1**, reproduced from the Warren Report to illustrate eyewitness Howard Brennan's position, illustrates this theory with the

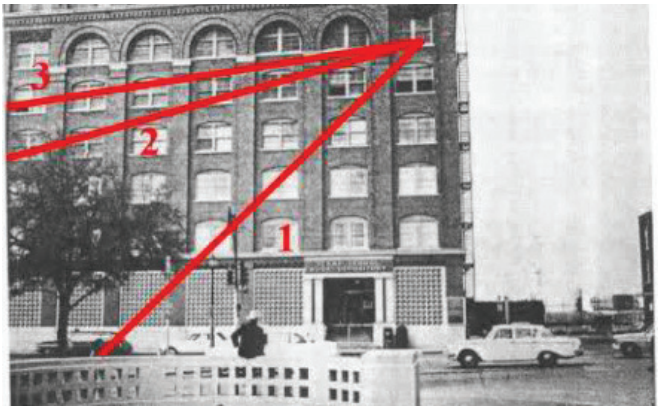


**Figure 1: From the Warren Commision's May 1964 reenactment (1 = the missed first shot, 2 = JFK's first gunshot wound, 3= JFK's fatal head wound)**

Date Received: February 5, 2015
Peer Review Completed: March 3, 2015

possible flight path for this first shot depicted as red line No. 1.

If the first shot indeed occurred just after the limousine turned onto Elm Street, then Oswald had about 8 seconds in which to get off three shots with the first shot a total miss. Moreover, if the first shot went into the street behind the presidential limousine after Zapruder re-started his movie camera, the impact would have been obscured by the limousine, assuming such an impact created a visible phenomenon.

Empirical testing of the various possibilities, coupled with the established facts in this historic case, followed by an eliminative process, allows the most likely sequence for Oswald's three shots, the fates of the associated bullets to be determined, as well as the effective elimination of other postulated explanations.

Sequence for the Missed Shot

The first gunshot wound received by President Kennedy was the perforating wound that entered his upper right back. This bullet exited the President's throat intact and went on to strike Texas Governor Connally in the back while in yaw as evidenced by an out-of-round entry wound and an elliptical hole in the back of Governor Connally's suit coat. The second gunshot wound to the President was the horrific head wound forever frozen in frame 313 of Abraham Zapruder's 8mm home movie. These wounds, along with the ballistic evidence subsequently associated with them, account for two of the three shots fired from Oswald's 6.5mm Carcano rifle. There is no evidence of any kind that a third shot was fired at the President from the 6th floor window of the Texas School Book Depository *after* the President's fatal head wound, nor as the presidential limousine was speeding away from the scene. But there were a number of eye and ear witnesses who described a shot from the area of the 6th floor window of the TSBD immediately after the presidential limousine turned from Houston Street onto Elm Street and passed under the 6th floor window. Most noteworthy were the accounts of Howard Brennan, Amos Euins and Tina Towner; all three of whom were at the intersection of Houston and Elm Streets directly across from the TSBD. Using simple eliminative processes, the multiple witness accounts, the time available to operate the bolt-action Carcano rifle and fire the *first* shot to hit the President, along with a modicum of common sense, leads to only one reasonable conclusion: the first of Oswald's three shots missed the President as well as the other occupants of the presidential limousine and the limousine. The initial shot would have been fired in a relatively steep downward angle toward Elm Street and the presidential vehicle. But where did this bullet go, what did it hit, and why was no physical evidence of its impact site ever discovered in the days, weeks, months and even years to follow?


**Figure 2: Leica® 3D laser scan with Elm Street intercept angles**

It may seem counterintuitive that the first shot was a miss since it would have occurred when the President and the presidential limousine were closest to Oswald's position. How could a shooter with past military marksmanship training, good scores on the rifle range, and a rifle with a telescopic sight miss the President, the presidential limousine or any one of its other occupants at such a relatively close distance? There are a number of choices and considerations. From the 3D laser scanning work of Tony Grissim and Michael Haag, the direct distance down to Elm Street from the 6th floor window of the TSBD in the area where the presidential limousine and its occupants were briefly visible after turning onto Elm Street was approximately 90-ft.to street level at the earliest shooting opportunity. This initial location has a downward angle of about 41 degrees. At a distance of about 126-ft. and a 31° downward angle, the presidential limousine disappeared under a Southern Live Oak tree after approximately 48 feet of travel as shown in **Figure 2**. At such close range, a telescopic sight can be a disadvantage, particularly in locating and tracking a moving target that is effectively traversing ones limited field of view. The field of view of the 4x18 Ordnance Optics, Inc. telescopic sight at 100 feet, measured by this writer, was only 80-inches (6.7-feet). An unobstructed view of the presidential limousine and its occupants was only briefly possible for this first shot. The initial opportunity was just prior to the presidential limousine passing under a hanging traffic signal on Elm Street. The second and final opportunity took place between the time it emerged from under this traffic signal and its support pole to when it disappeared under the branches and foliage of a Southern Live Oak tree. This is apparent in **Figure 3** taken from the Secret Service's reenactment prepared 5 days after the assassination. The black **X**s have been added to give the reader some idea of the shooting 'window' available from Oswald's 6th floor location. The distance between the two **X**s shown in **Figure 2** and **Figure 3** is approximately 48 feet. At 5 to 6 miles per hour, the presidential limousine would cover this distance in about 6 seconds. Oswald's military

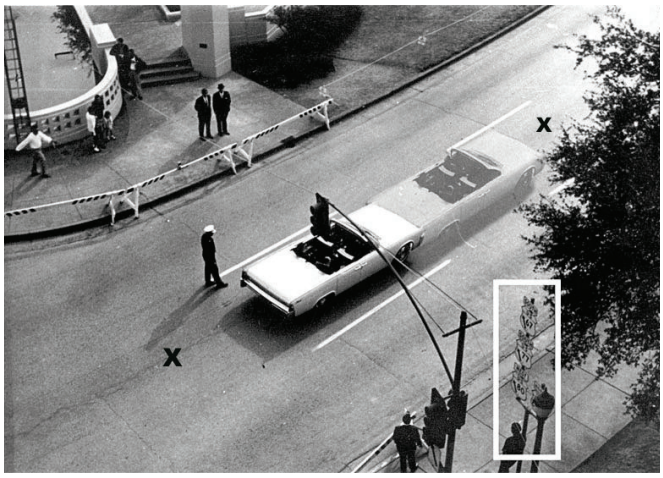


**Figure 3: From the Secret Service reenactment, 5 days after the assassination**

**(The Xs denote the locations used to plot the trajectories shown in Figure 2. Route signs designated as a result of eyewitness Amos Euins' account. Note the interference of a shooter's sight picture due to the traffic signal and tree.)**

**Figure 4: Western Cartridge Company 6.5mm Carcano cartridges (L), fired and unfired 160gr. WCC 6.5mm Carcano bullets (R)**

**(Fired bullet recovered after penetrating 25 inches of Elm)**

RIFLE ZEROED at 50-yds.

| Range (Yards) | Velocity (Ft/Sec) | Energy (Ft/Lbs) | Momentum (Lb-sec) | Drop (inches) | Bullet Path (inches) | Time of Flight (Seconds) |
|---|---|---|---|---|---|---|
| 0 | 2160.0 | 1657.3 | 1.53 | 0.0 | -0.8 | 0.00000000 |
| 10 | 2131.9 | 1614.4 | 1.51 | -0.04 | -0.48 | 0.01398028 |
| 20 | 2103.9 | 1572.3 | 1.49 | -0.15 | -0.24 | 0.02814565 |
| 30 | 2076.2 | 1531.2 | 1.47 | -0.34 | -0.08 | 0.04249961 |
| 40 | 2048.7 | 1490.9 | 1.46 | -0.62 | 0.0 | 0.05704573 |
| **50** | **2021.4** | **1451.4** | **1.44** | **-0.97** | **0.0** | **0.07178764** |
| 60 | 1994.4 | 1412.8 | 1.42 | -1.41 | -0.09 | 0.08672907 |
| 70 | 1967.5 | 1375.1 | 1.40 | -1.94 | -0.26 | 0.10187380 |
| 80 | 1940.9 | 1338.1 | 1.38 | -2.56 | -0.52 | 0.11722570 |
| 90 | 1914.5 | 1302.0 | 1.36 | -3.27 | -0.88 | 0.13278868 |
| 100 | 1888.3 | 1266.6 | 1.34 | -4.08 | -1.33 | 0.14856675 |
| 110 | 1862.4 | 1232.1 | 1.32 | -4.98 | -1.88 | 0.16456393 |
| 120 | 1836.7 | 1198.3 | 1.30 | -5.98 | -2.53 | 0.18078431 |
| 130 | 1811.3 | 1165.4 | 1.29 | -7.09 | -3.28 | 0.19723201 |
| 140 | 1786.1 | 1133.2 | 1.27 | -8.3 | -4.13 | 0.21391117 |
| 150 | 1761.2 | 1101.8 | 1.25 | -9.62 | -5.1 | 0.23082594 |
| 160 | 1736.5 | 1071.2 | 1.23 | -11.05 | -6.18 | 0.24798051 |
| 170 | 1712.2 | 1041.3 | 1.22 | -12.6 | -7.37 | 0.26537908 |
| 180 | 1688.1 | 1012.2 | 1.20 | -14.27 | -8.68 | 0.28302580 |
| 190 | 1664.2 | 983.8 | 1.18 | -16.05 | -10.12 | 0.30092486 |
| 200 | 1640.7 | 956.2 | 1.17 | -17.97 | -11.68 | 0.31908046 |

**Figure 5: Exterior ballistics for the 160-gr.6.5mm WCC Carcano bullet (BC=0.28 / Nov. 22, 1963 - Dealy Plaza metrological conditions)**

training had been on motionless targets and with open sights; not telescopic sights. It is reasonable to assume that any practicing he might have done with his Carcano rifle was also likely on stationary targets. The taking of this shot also required him to move from his assembled hiding place and to briefly expose himself to one or more of a number of on-lookers on the southwest corner of Houston and Elm Street. Two of these were Howard Brennan and Amos Euins: both of whom described a rifleman in the easternmost 5th or 6th floor window of the TSBD when the first shot rang out. Euins is also one of the persons who directed the police to the TSBD and recalled that the first shot occurred just as the presidential limousine passed the highway route signs [see the white rectangle in **Figure 3**]. Finally, there is the matter known to many disappointed hunters as "buck fever". The term often applied to that bungled first shot at the quarry when it first appears. Whatever the reason for a miss, the terminal ballistic fate of the bullet from this first shot remains a mystery. But it is one mystery that has an explanation in forensic ballistics.

Exterior and Terminal Ballistic Review for the WCC 6.5mm Carcano Ammunition

During the original investigations by the FBI Laboratory and the Biophysics Laboratory at the Edgewood Arsenal, the nominal muzzle velocity of the 160-gr WCC 6.5mm Carcano bullet fired from Oswald's M91/38 Carcano rifle was determined to be 2160f/s [3]. This is in close agreement with the same ammunition fired from the two M91/38 Carcano rifles obtained by this writer in 2013 and is a testimonial to the long shelf life of well made ammunition. Two views of the WCC full metal-jacketed bullet are shown in **Figure 4**. This long cylindrical, round nosed bullet was determined by this writer to have a G1 ballistic coefficient (BC) of 0.28 in the supersonic region. This determination was accomplished with the use of Doppler radar, which allowed an exterior ballistic table to be prepared over the relevant distances in the assassination (**Figure 5**). This table is useful in a number of ways. Such parameters as flight time, residual velocity, downrange kinetic

energy and momentum at specific distances all have potential value in evaluating the likely consequences of such a bullet striking any number of potential objects.

For example, consider the lead-positive impact site found on the interior surface of the windshield of the presidential limousine described in Part 2 of this series [4]. The responsible 'projectile' failed to perforate the windshield or even produce a hole in the first layer of the glass. FBI forensic firearms examiner Robert Frazier concluded that this damage was the consequence of one of the greatly decelerated bullet fragments that exited President Kennedy's head. This was a very reasonable and logical conclusion on the part of Mr. Frazier, but there have been those who know, or understand very little about wound or terminal ballistics who have disputed this. Could Mr. Frazier have overlooked the possibility that this damage was the result of a third shot fired at the departing limousine as it accelerated towards the triple underpass after the President received his fatal head wound? Certainly the bullet would have lost some of its initial velocity during its flight to the presidential limousine. Its remaining velocity at impact with the interior surface of the windshield would have been further reduced by that of the departing vehicle. The notion that the damage to the windshield was caused by a missed shot is easily dismissed when one looks at the downrange velocity of this bullet at any of the distances in **Figure 5**.

The distance at which the President sustained his fatal head wound, captured and memorialized in frame 313 of the Zapruder film, was approximately 90 yards from Oswald's position in the 6th floor window. Let's err on the side of caution and assume that by the time a subsequent live round was chambered and fired, the presidential limousine was 150 yards downrange and that the limousine driver, William Greer, had accelerated the vehicle to 60mph (88f/s). The calculated velocity of a WCC 6.5mm Carcano bullet at that distance is 1761f/s. Subtracting 88f/s from this value gives 1673f/s; an impact velocity easily capable of completely perforating the windshield.

James Tague's Injury

There was a third gunshot victim in the JFK assassination. Twenty-six year old James Tague, who was walking out from under the triple underpass and facing the on-coming presidential limousine, was struck in the face by some small, unknown, low velocity object during the shooting sequence. This unknown object was of sufficiently low energy that it only produced a minor bleeding injury and apparently left no identifiable foreign body in the wound.

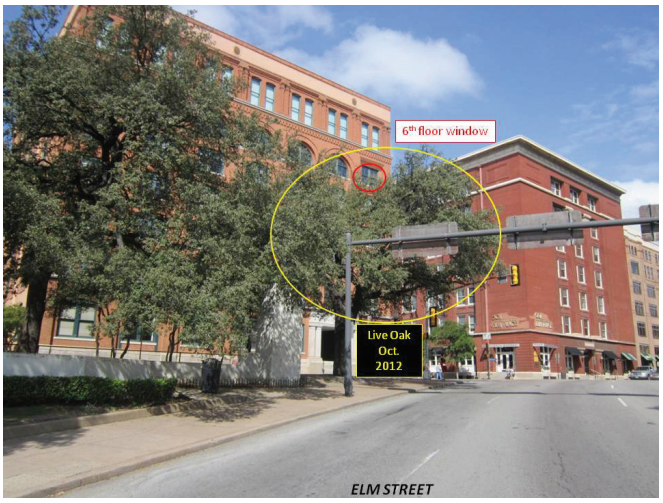


**Figure 6: October 11, 2012 photo by L. Haag**

Modern 3D laser scanning carried out by Michael Haag and Tony Grissim of Leica Geosystems in 2013, established the straight line distance to James Tague's position to be approximately 178 yards from the 6th floor window. Exterior ballistics calculations, using the previously derived BC, show that the WCC 6.5mm Carcano bullet would be down to 1693f/s at that distance; a velocity that is vastly greater than any threshold velocity to merely break skin and produce a superficial injury.

The probable source of Mr. Tague's superficial injury will be revisited toward the end of this article, but it is necessary to introduce the reader to this individual at this time because his minor injury, coupled with his location, becomes an important factor in evaluating the fate of the missing bullet.

The Southern Live Oak (Quercus virginiana)

At the time of the assassination, there was a Southern Live Oak tree just below and slightly to the southwest of the 6th floor window of the TSBD building. This tree interfered with Oswald's sight picture of the presidential limousine and its occupants shortly after it turned from Houston Street onto Elm Street. This can be seen in **Figure 1** and **Figure 3**. **Figure 1** was taken 4 months after the assassination. **Figure 3** was excerpted from a black and white film taken 5 days after the assassination during the Secret Service reenactment. Both figures provide a good sense of the tree's appearance at the time of the assassination. This tree is still there today. **Figure 6**, taken by this writer in October of 2012, provides a view of this tree from the middle of Elm Street looking back toward the 6th floor window of the TSBD.

The possibility of Oswald having fired a shot through the

branches of this tree raises a number of questions that can be tested. To what degree would striking one or more such branches decelerate a WCC 6.5mm Carcano bullet? How much deflection would occur? Would striking one or more such branches destabilize, deform and/or fragment one of these bullets? If so, could one of these fragments reach James Tague's location, and what sort of residual velocity would such a fragment have? Would the damage to the branches be obvious and how long would it persist? The same Doppler radar system that was used in the previous articles by this author, combined with some simple downrange witness panels, was used to answer all of these questions.

The first step involved the acquisition of some representative branches from a Southern Live Oak. AFTE member Lannie Emanuel, a resident of the Dallas area, was contacted for this purpose. He subsequently shipped this writer a collection of freshly cut Southern Live Oak branches ranging in diameter from 0.5 inches to 1.1 inches. Some of these branches were initially assembled in a side-by-side array so that single branches could be struck directly or simply grazed by bullets from one of the author's M91/38 Carcano rifles positioned approximately 50 feet away and secured in a Zero-One® rifle rest. A second array was prepared with a number of branches mounted in tandem, so that multiple branches could be struck by shots from the same rifle secured as before. Witness panels located at known distances downrange from these arrays of branches were used to record the stability and integrity of the departing bullets. After each shot, a green laser inserted in the bore of the rifle was directed to the first impact site on a struck branch. The array of branches was then moved aside and the laser's intercept on the witness panel marked. The deflection angle was calculated via the tangent function on a common scientific calculator. This was accomplished by dividing the distance of offset between the laser intercept on the witness panel and the bullet hole by the distance from the strike on the branch to the witness panel. The author's Infinition® Doppler radar system was also used to measure the velocity loss experienced by the bullets upon impact with the branches and to plot the post-impact stability of the bullets.

The WCC 6.5mm Carcano bullets always survived intact in these single branch strikes but were destabilized, so the question of bullet fragments becomes moot. Deflection angles for these single strikes were small, ranging from 0.3 degrees to 1.8 degrees. The subsequent array of ten, nominal 1-inch diameter, Southern Live Oak branches, shown in **Figure 7,** was subjected to additional shots. Single to multiple hits occurred during the eight shots fired into this group of branches from a distance of 50 feet. The results are depicted in **Figure 8**. Deflection angles for these shots ranged from 1 degree to 7 degrees. Doppler radar results showed velocity


**Figure 7: Ten Dallas Live Oak branches and a downrange witness panel**


**Figure 8: Oblique view after eight shots**

loss values to be small, ranging from 17f/s for a single shallow graze, to 201f/s for a single direct strike to a 1.1-inch Southern Live Oak branch. The highest velocity loss was 309f/s for strikes to multiple tandem branches. The amount of deflection (in degrees) was calculated as before, via the tangent function from the lateral displacement distance between the laser intercept on the witness panel, and the bullet hole divided by the distance from the first struck branch to the witness panel. These experiments were later modified and repeated, using a slightly harder wood (Mesquite) with the same results for bullet integrity, bullet destabilization and bullet deflection. A high speed video of a strike to four tandem branches was recorded during the various demonstrative tests carried out for the PBS-NOVA program *Cold Case:JFK,* which aired

on November 13, 2013. **Figure 9** shows two of the frames from the Phantom® camera recording of this shot, in which the Carcano bullet can be seen approaching the array of branches in the upper frame of this figure, and then departing intact, but destabilized in the lower frame of this figure.

The ballistic damage to the Southern Live Oak branches was obvious, and likely to be visible for months, possibly years given the slow growth rate of these trees. To this writer's knowledge, no such damage to any branches in this tree was ever reported following the assassination.

Given the small amount of deflection induced in these heavy bullets striking one or more of these test branches, damage sites in multiple branches of the Elm Street Southern Live Oak, if they existed and had been found, would have had excellent value for trajectory reconstruction for the missed shot, and the mystery concerning it would have been solved. Moreover, *if* Oswald's first shot struck several branches of the Southern Live Oak, deflection would have been small, and the intact but destabilized bullet would have gone into the asphalt of Elm Street with a remaining high velocity.

The Houston-Elm Street Traffic Signal

Another disruption in Oswald's sight picture, as the presidential limousine turned on to Elm Street, was a traffic signal and its support beam almost immediately below the 6th floor window. These objects can be seen in the black and white Secret Service reenactment film prepared 5 days after the assassination [See **Figure 3**]. This traffic signal became the focus of a September 2011 National Geographic television program entitled *The Lost Bullet*, in which author/journalist Max Holland observed, among other things, a possible bullet hole in the metal back plate associated with the traffic signal [5]. Regrettably, his discovery did not occur until long after the traffic signal and its back plate had been replaced. This writer was unable to find any evidence that the traffic signal, its back plate or its support pole had ever been examined for possible bullet damage by anyone experienced in processing shooting scenes. However, Max Holland' astute observation and his interesting hypothesis could be tested. Such testing has now been done. After showing a number of pictures of the assassination traffic light to several City of Phoenix traffic engineers, and acquiring aluminum and steel traffic signal back plates comparable to the back plate that can be seen on the original traffic signal, this writer and Michael Haag conducted a number of terminal ballistic tests on these back plates. 3D laser scans were used to determine the distance from the 6th floor window to the traffic signal, and the intercept angle a bullet fired from that location would have had upon striking the back plate. The M91/38 Carcano was mounted in

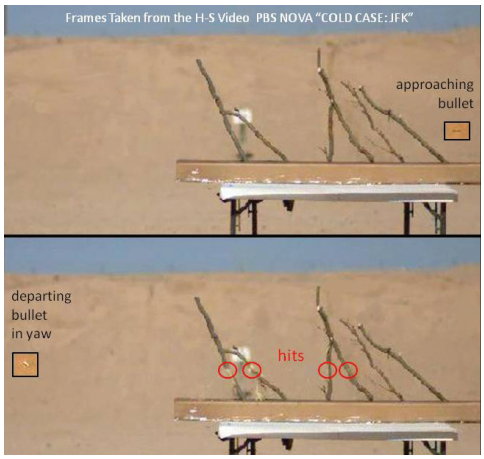


**Figure 9: 6.5mm WCC Carcano bullet through multiple branches**

a Zero-One® rest with the individual back plates positioned at the appropriate angle to the pre-impact flight path of the bullet (ca. 25°). A large downrange witness panel was erected to record the impacts of the bullets or bullet fragments. The Leica® 3D laser scanner was used to measure the deflection angles of the bullets by scanning in the gun position, each bullet hole in the back plate and the subsequent impact points in the downrange witness panel. Doppler radar was again employed to measure the impact and exit velocity of each bullet. **Figure 10** shows the basic setup for these tests. **Figure 11** provides a view from the bullet-perforated, mild steel back plate to the witness panel after three shots were fired.

These tests quickly revealed that whether aluminum or steel, the bullet damage (in the form of elliptical holes and missing paint) was obvious and should have been so in the weeks, months and years following the assassination. Knowing the tragic history of this location, one would reasonably conclude that the day this traffic signal and its back plate were taken down and replaced, any bullet hole in the back plate would have been obvious. Velocity loss values in these tests were relatively small; approximately 60f/s for the aluminum back plate and 190f/s for the steel back plate, leaving these bullets with residual velocities well in excess of 1800f/s. The bullets emerged from the aluminum back plates intact but destabilized and experienced about 0.6° of deflection. Perforation of the steel back plates consistently resulted in the bullet breaking into two pieces producing a pair of deflection angles for each shot. The average of the combined deflection angles for the shots through steel was 2.3° ± 1.7°.

Applying these results to the events of November 22, 1963, means that if the first shot struck the traffic signal back plate just as President Kennedy was obscured by it, the exiting bullet, or two bullet fragments would very likely have struck

the presidential limousine or one of its occupants, including the President. Bullet damage to the limousine should have been easy to find, given the high residual velocity of a bullet (or two bullet fragments in the case of a steel back plate) and the short remaining distance to the limousine. Moreover, such an event would clearly not allow the exiting projectile(s) to reach James Tague's position near the triple underpass. Such a ballistic event would require the bullet to undergo an angular change of more than 40° and then travel approximately 154 yards to reach his location. This is something that is not possible as a consequence of the perforation of one of these thin metal back plates (**Figure 12**).

This writer truly appreciated Max Holland's original idea around which **The Lost Bullet** was developed, but his hypothesis is easily disproved with just a little testing and basic understanding of exterior and terminal ballistics. In fact, he had an excellent assistant in this television program; Larry Sturdivan, who had a degree in physics and a lifelong career in wound ballistics, and who undoubtedly pointed out the fallacy of Mr. Holland's hypothesis. Mr. Sturdivan's statement on page 143 of his book, The JFK Myths, is worth committing to memory because it is so true: **"A bullet traveling at moderate to high velocity (e.g.- 600fps and above) cannot be abruptly deflected and remain intact** [6]**."** Mr. Holland either failed to understand this, or simply could not let go of his idea, and we will see that things do not improve in his most recent re-invention of this notion. Nonetheless, **The Lost Bullet** is well worth watching, should the reader have the opportunity, because it provides the viewer with enhanced versions of several witnesses' photographs and movie films (including the Zapruder film), as well as the recorded recollections of important eye and ear witnesses.

The Houston-Elm Street Traffic Signal Support Beam

Mr. Holland has returned with a revised hypothesis in the November 28, 2014, issue of Newsweek magazine [7]. His passion to explain James Tague's injury by a deflected first shot has now focused on the cylindrical steel support beam from which the traffic signal was suspended. Here we all have an advantage. Fortunately, the traffic signal support beam still exists and is in storage at the Dallas Park and Recreation Department facility. Holland's conclusion in his article is that the bullet from Oswald's first shot struck the cylindrical steel support beam and was deflected toward the west, ultimately resulting in James Tague's minor facial injury, either by impact with the concrete curb in front of him or a strike and ricochet from the ground near a manhole cover. He describes multiple inspections of this support beam by a retired FBI metallurgist, Frank DeRonja, before and after it was taken down and placed in storage in July of 2012. Holland and


**Figure 10: Velocity loss and deflection tests for traffic signal backplates**


**Figure 11: Velocity loss and deflection tests for traffic signal backplates**

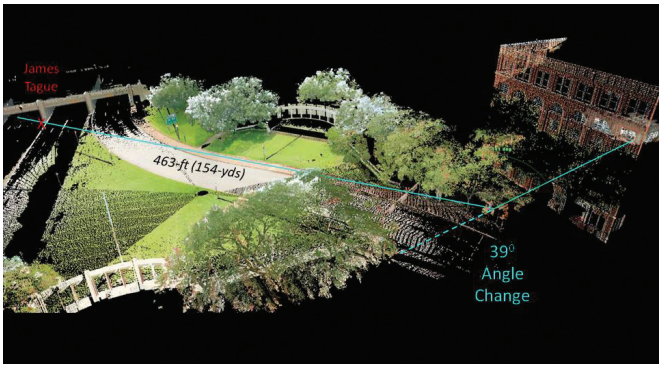


**Figure 12: 3D laser scan measurements for a deflected 1st shot bullet to reach James Tague**

DeRonja never found any physical damage to the support beam that was consistent with an impact by a 160-gr. WCC Carcano bullet, but went on to opine that a very slight graze, which did not deform the metal, might no longer be obvious

given the considerable passage of time and re-painting of the support beam. The Newsweek article also alludes to four test shots into "exact replicas" of the steel beam conducted at the H.P. White Laboratory, employing "comparable ammunition" (further details not specified). The article goes on to describe that three of these shots left very obvious physical damage to the beam and fragmentation of the bullet. One of these 4 shots created a ricochet and left a shallow groove "barely discernible to the touch". *No* photographs of the experimental design, the resultant ballistic damage to the test beams or any means to measure deflection angles and velocity loss were presented by Mr. Holland. Yet, from these tests, Mr. Holland provides a trajectory reconstruction on page 35 (Figure 4 in his Newsweek article) showing a post-impact flight path from the traffic signal support beam to an area near and in front of James Tague. Notably missing from this figure and the text of the article are the angular components of a 6th floor bullet's *intercept* with the steel support beam, its *departure* angle and the *angular change* (degree of deflection) that would have to occur to justify Holland's figure 4. This same conclusion (a barely perceptible graze followed by a large deflection angle) is reached without demonstrable experimental results in the DeRonja-Holland Report available on the Internet. [8]. A portion of this report is reproduced here as follows: "*If eyewitness reports of a strike on the pavement in conjunction with the first shot are to be assigned any weight, then the phenomenon must have been caused by a hit of a bullet jacket fragment after its separation from the lead core during a low-angle bullet ricochet from the mast*." While it is true that several eye witnesses provided somewhat divergent accounts of something striking Elm Street near the presidential limousine after it turned onto Elm Street, it would not likely have been a mere jacket fragment from a bullet striking the overhead support beam. This will be demonstrated later in this article.

This writer has also examined the steel support beam at the Dallas Park and Recreation Department (DPRD) facility from the perspective of a shooting reconstructionist. Multiple test shots by this writer into two cylindrical steel poles comparable in dimensions to the beam at the DPRD showed that an impact by anything other than the most shallow of grazing strikes by a 6.5mm Carcano bullet would leave obvious and lasting physical damage to the support beam. Such ballistic damage would range from a deep, 3 dimensional groove in the steel, to an actual perforation as the bullet's impact point occurs further into the body of the support beam. In addition, as the engagement between bullet and steel beam deepens, velocity loss increases and the bullets fragment. Further deepening of the bullet's engagement results in perforation of these cylindrical steel targets. The setup for these tests is shown in **Figure 13**. Several examples of the test results

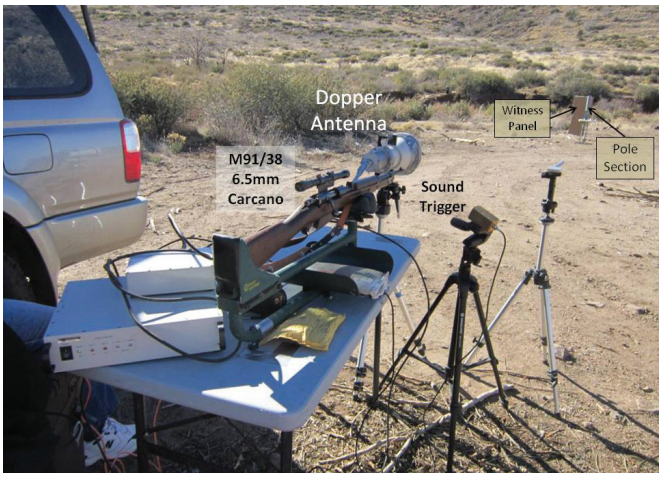


**Figure 13: Setup for projectile strikes to a steel traffic signal beam**

are provided in **Figure 14** through **17**. As with all previous tests, the author's M91/38 Carcano, WCC 6.5mm Carcano ammunition, Doppler radar and downrange witness panels were used to measure deflection angles and velocity losses for those bullets or bullet fragments that survived impact with the exemplar support beam.

Again, this writer does not fault Mr. Holland and his thought process in an effort to account for Oswald's first shot; it is his unfounded and undemonstrated conclusion that are very bothersome. Indeed, a reading between the lines of his own testing very likely disproves his hypothesis, and a full disclosure of the H.P. White shooting tests should confirm this. This writer wishes that that bullet *did* strike the beam and leave a three dimensional record of its flight path. Had it done so, the mystery surrounding Oswald's first shot would effectively be solved. But there is absolutely no evidence that it did strike the steel support beam, and Mr. Holland's figure 4 in the Newsweek article is a failed notion lacking in facts, supporting data, or any published test results. Indeed, as a scientific proposition, it is *excluded* by some fundamental laws of physics and the ballistic testing carried out and illustrated here by this writer.

The probable fate of the missed first shot

If a steeply downward first shot failed to strike any of these previously discussed objects as a result of being fired in haste or interrupted by the appearance of the traffic signal in the telescopic sight, or simply botched due to buck fever, then it could only have gone directly into the asphalt of Elm Street. This hypothesis can be, and has been tested. The first step required going back to the 3D laser scanning work of Tony Grissim and Michael Haag and the information illustrated in

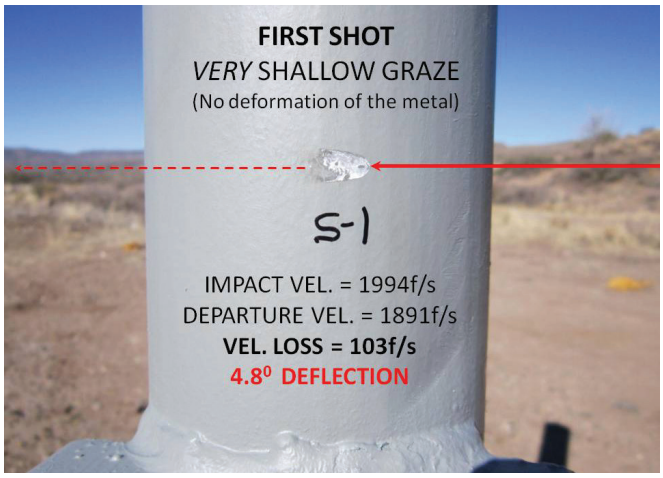


**Figure 14: Very shallow grazing strike to steel traffic signal beam**

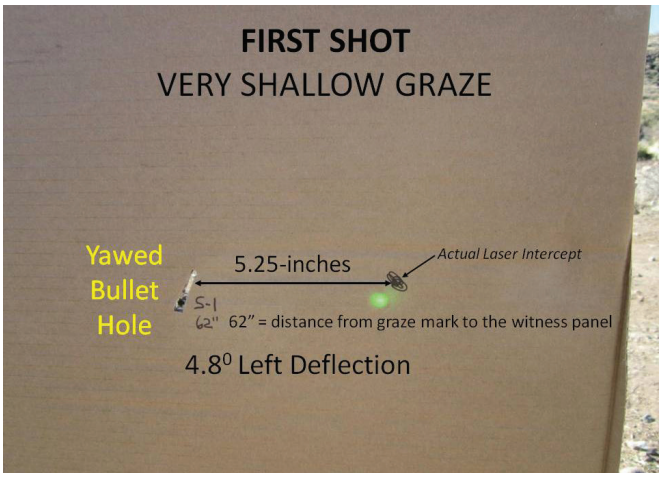


**Figure 16: Method for measuring bullet deflection**

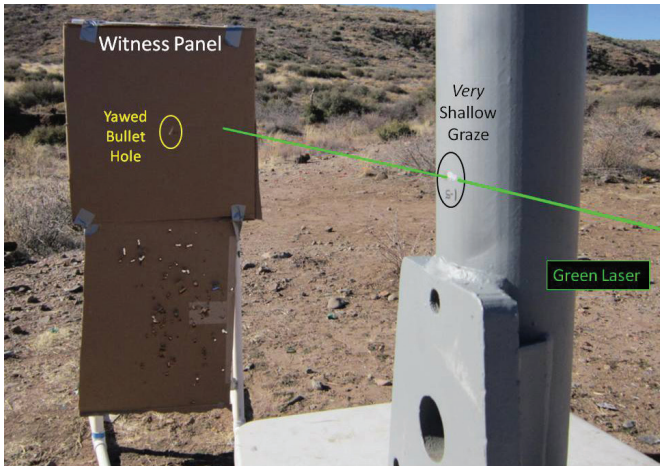


**Figure 15: Downrange witness panel for bullet deflection measurement**

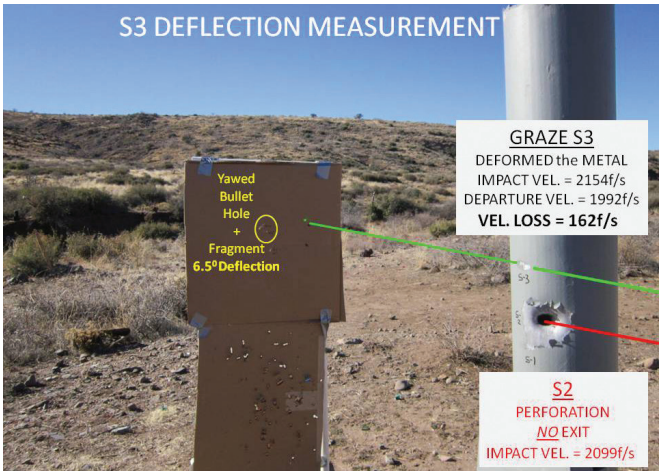


**Figure 17: Method for measuring bullet deflection**

**Figure 2**. Of the two intercept angles depicted in that figure, the 31 degree angle is the more likely to produce ejected bullet fragments and debris from the pulverized asphalt. This is of interest in regard to James Tague's injury and the potential injury to any bystanders in the immediate area of such an impact.

Multiple shots have been fired into sections of roadway asphalt with a nominal intercept angle of 30˚, all with the same surprising result; surprising in at least two ways. The WCC 160-gr. Carcano bullets are *completely* and *totally* destroyed with not one single, recognizable bullet fragment to be found in the nominal 1-inch deep impact craters. This may seem difficult to believe, but the answer and reason lies in the extreme 'g' forces acting on the bullet during the deceleration process. This phenomenon of total bullet destruction has been studied and explained in a previous article by this writer [9]. In this case, a bullet traveling approximately 2100f/s (1432 miles per hour) comes to a complete stop in about 1 inch of travel in the asphalt. A rough calculation of the decelerating forces acting on this bullet, expressed as gravities (g), yields a value of 1.6 million g. The relatively soft copper jacket disintegrates into minute fragments and the very soft lead core essentially vaporizes. The next surprise is the relatively confined, conical ejection of pulverized asphaltic material that departs the surface of the asphalt along an angle that is orthogonal to that surface. This cone of debris is so tightly confined, that a person or object could be standing within as little as 2 feet of the impact site and *not* be struck by any of this ejected debris. These phenomena of total bullet destruction and the orthogonal ejection of debris were documented with high-speed videography (20,000 frames per second with a

Phantom® camera) for the 2013 PBS-NOVA program, in which multiple shots were fired into roadway asphalt positioned 30 degrees to the flight paths of the incoming bullets. Witness panels were mounted approximately 12- and 18-inches to the side and beyond the impact sites. **Figure 18**, **19**, **20** and **21**are frame grabs from two of those shots. Other test shots have been carried out before and after the PBS-NOVA program with comparable results.

The end results of these truly remarkable shooting experiments is that any efforts to locate pieces of a fired 6.5mm Carcano bullet at or near any 'fresh' damage site in the asphalt of Elm Street the very day of the assassination were destined to fail. Such bullet-caused defects in asphalt quickly become slight depressions in the asphalt and re-acquire the general color and appearance of the adjacent asphalt as a result of traffic, rain, street sweepers, etc. For those who might claim that one or more bystanders would surely have been struck by bullet fragments or debris if the first shot struck the asphalt of Elm Street somewhere below the 6th floor window, this writer would urge them to have another look at the previous figures. Perhaps the most important result of all is that such an event (a steeply downward first shot into Elm Street) does not, and cannot explain James Tague's superficial injury to his cheek nor can the explanations for his injury offered and promoted by Mr. Holland.

James Tague's injury

The very essence of The Scientific Method is that of eliminating possibilities. A deflected bullet and/or bullet fragments from the traffic signal back plate, the traffic signal support beam,

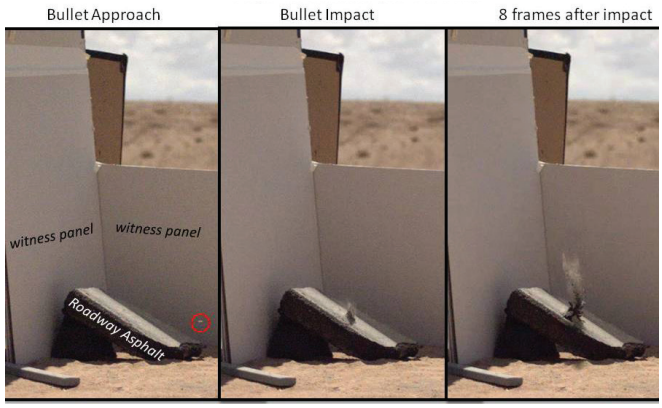


**Figure 18: PBS-NOVA H-S video frames -- 30° impacts into asphalt, Shot 1: 160 gr 6.5mm WCC Carcano bullet, 20,000 frames per second**

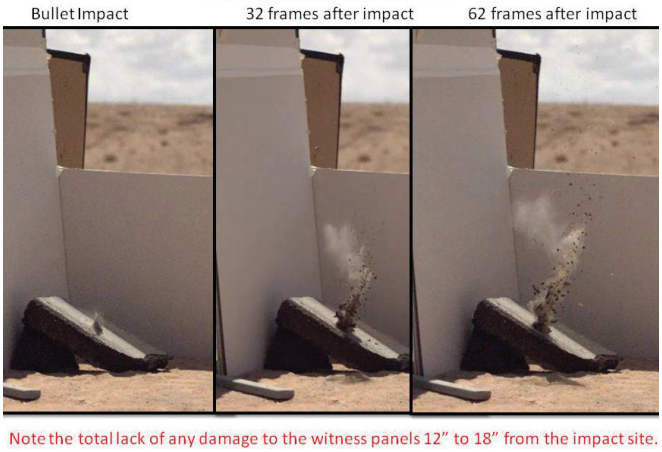


**Figure 19: PBS-NOVA H-S video frames -- 30° impacts into asphalt, Shot 1: 160 gr 6.5mm WCC Carcano bullet, 20,000 frames per second**

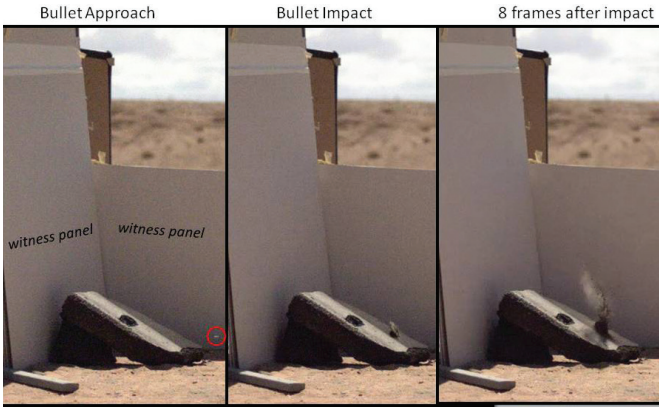


**Figure 20: PBS-NOVA H-S video frames -- 30° impacts into asphalt, Shot 2: 160 gr 6.5mm WCC Carcano bullet, 20,000 frames per second**

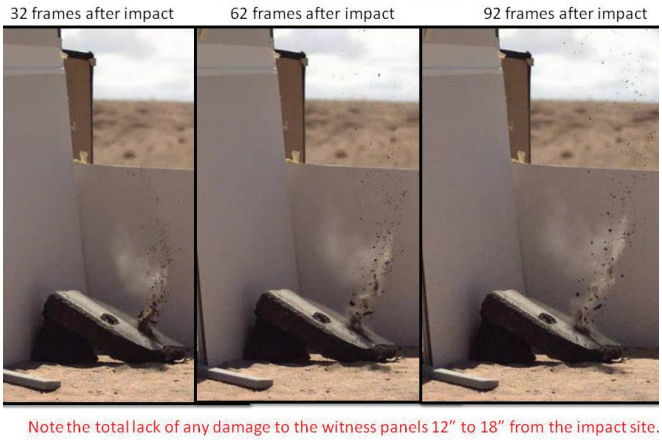


**Figure 21: PBS-NOVA H-S video frames -- 30° impacts into asphalt, Shot 2: 160 gr 6.5mm WCC Carcano bullet, 20,000 frames per second**

and branches of the Southern Live Oak tree and a downward shot into the asphalt of Elm Street, have all been eliminated as a source of James Tague's injury. It is also abundantly clear that Oswald's first shot occurred shortly after the presidential limousine turned onto Elm Street and that this shot was a miss. Therefore, it follows that Oswald's second shot produced President Kennedy's first gunshot wound, which has been associated with the bullet that also struck Governor Connally and came to be Warren Commission exhibit 399. This intact bullet is easily excluded as having anything to do with James Tague's injury. By elimination, this leaves the President's fatal head wound as the only remaining choice. But can it be supported in any way by the available physical evidence? The answer is a resounding "yes", and this writer is not the first to realize this. Physicist and life-long wound ballistician, Larry Sturdivan, author of the previously cited The JFK Myths, made this observation when he considered that the missing portion(s) of the fatal bullet (totaling approximately 92 grains) from the President's head wound cleared the windshield of the presidential limousine and departed in the general direction of James Tague [10, 11]. The conical spread of ejected bio-matter in Zapruder frame 313 supports this, as well as the lack of any other ballistic damage to forward areas of the presidential limousine (**Figure 22**). The fragmentation and upward distribution of 160-gr WCC Carcano bullet fragments upon striking flat bone, comparable in thickness to skull bone, shored by ordnance gelatin was also demonstrated in figure 8 in an earlier article by this writer [12].

**Figure 22: JFK's second gunshot wound: enhanced frame 313 from Zapruder film**

Google Earth and the Grissim/Haag laser scanning results provide a means of visualizing the ballistic requirements for a bullet fragment from President Kennedy's head wound reaching James Tague's location. As can be seen in **Figures 23** and **24**, it is not difficult to envision a bullet fragment reaching his location and producing a superficial injury, given the distance such a fragment must travel as well as the very poor exterior ballistic performance of such fragments and the greatly reduced initial velocity of these bullet fragments. It should be recalled that one of these fragments merely cracked the windshield of the presidential limousine and it only had to travel a few feet, not the nearly 90 yards between the President and James Tague at the moment of the President's fatal head wound.

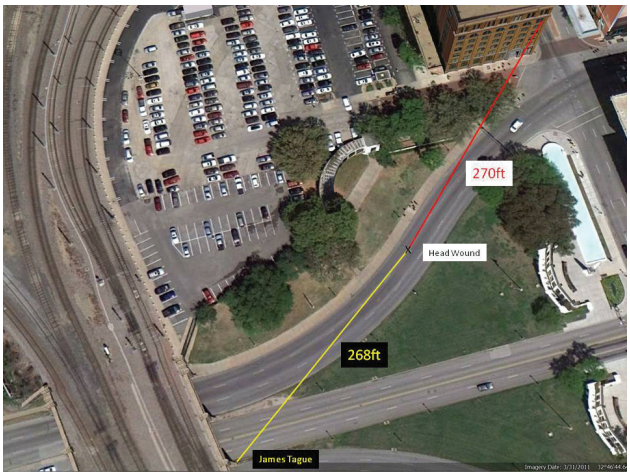


**Figure 23: Google Earth view of the assassination scene**

**Summary**

Lee Harvey Oswald's first shot, fired very shortly after the presidential limousine turned from Houston Street onto Elm Street, failed to strike the President, the presidential limousine or any of the other occupants in the presidential limousine.

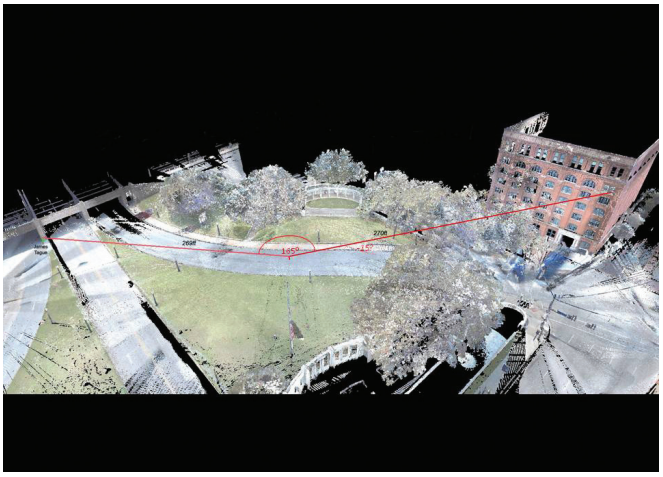

**Figure 24: Leica 3D laser scan image**

No physical evidence has ever been found that this bullet

struck the traffic signal, the traffic signal back plate or the traffic signal support pole. Had a 160-gr 6.5mm Carcano bullet struck one of these objects in any substantial way, it would have produced obvious and lasting damage, yet no such damage has ever been reported in the weeks, months and years following the assassination.

One writer, the journalist Max Holland, has recently (November 2014) proposed that a very shallow grazing impact to the traffic signal support pole deflected the bullet from this first shot and that this bullet went on to produce James Tague's superficial facial injury. This idea is easily excluded on some basic principles of physics related to exterior and terminal ballistics and the actual ballistic testing presented here.

An alternate choice for James Tague's superficial injury considered the first shot striking and being deflected by one or more branches of the Southern Live Oak tree as it interrupted Oswald's view of the presidential limousine and its occupants. But the testing presented here which showed small deflection angles, minor velocity losses and very obvious and lasting damage to bullet-struck branches effectively obviates this explanation.

The only reasonable remaining choice for the fate of Oswald's first shot, which has a sound basis in terminal ballistics, is that his initial, missed shot went directly into the asphalt of Elm Street, where the bullet underwent total self-destruction and the crater produced by this strike quickly morphed into nothing more than a vague depression in the asphalt.

In the early hours and days following the assassination, investigators did not think in terms of a complete reconstruction of this shooting and an accounting for all three of Oswald's shots. Indeed, it only gradually became apparent during the Warren Commission investigation that two bullets, not three, produced the two gunshot wounds to the President *and* the gunshot wound to Governor Connally. Prior to this, three wounds (2 in the President and 1 in Governor Connally), and three shots seemed to fit investigators' initial assessment in this horrific crime. By the spring of 1964, a bullet-caused crater in the asphalt would look like any other shallow depression or anomaly. Finally, there is no record of anyone carrying out a detailed examination of the branches of the Southern Live Oak tree for injuries consistent with bullet damage.

All of the ballistic events and time requirements are met with a first shot into Elm Street, a second shot into the President's upper right back, exiting and producing Governor Connally's wound and a third and final shot striking the President in the head. This third bullet fragmented during the production of the fatal wound; with one of these exiting fragments continuing westbound to produce James Tague's superficial facial injury as he watched the oncoming motorcade.

No shots from the grassy knoll, no shots from other buildings or an unintentional discharge by Secret Service Agent George Hickey, who was in the follow-up car (as recently claimed in "The Smoking Gun"), are needed to explain the ballistic events on that terrible day in November of 1963 [13].

**References**

[1]Haag, L.C., *"Tracking the 'Magic' Bullet in the JFK Assassination"*, AFTE Journal. Vol. 46: No. 2, Spring 2014, pp. 94-103.
[2]Haag, L.C., *"President Kennedy's Fatal Gunshot Wound and the Seemingly Anomalous Behavior of the Fatal Bullet"*, AFTE Journal. Vol. 46: No. 3, Summer 2014, pp. 218-223.
[3] Sturdivan, L.M., The JFK Myths: A Scientific Investigation of the Kennedy Assassination, Paragon House, St. Paul, MN (2005) p. 104.
[4] Haag, L.C., ref. 2, op. cit.
[5] *"The Lost Bullet",* National Geographic Channel presentation, first aired September 30, 2011.
[6] Sturdivan, Larry M., op. cit. p. 143.
[7]Holland, Max,*"Three Bullets Exploding JFK Murder Myths-The Truth Was Out There",* Newsweek, November 28, 2014, pp. 26-37.
[8] *"The DeRonja-Holland Report",* <http://www.washingtondecoded.com/site/2011/11/the-.html>.
[9] Haag, L.C. and A. Jason,*"Where are the Bullets?,"* AFTE Journal**.** Vol. 44: No. 3, Summer 2012, pp. 196-207.
[10] Sturdivan, Larry M., op. cit. p. 124.
[11] Haag, L.C. ref. 2, op. cit. p. 222.
[12] Haag, L.C. ref. 2, op. cit. Figure 8, p. 220.
[13] *"JFK: The Smoking Gun",* Reelz Channel, first aired November 3, 2013.