

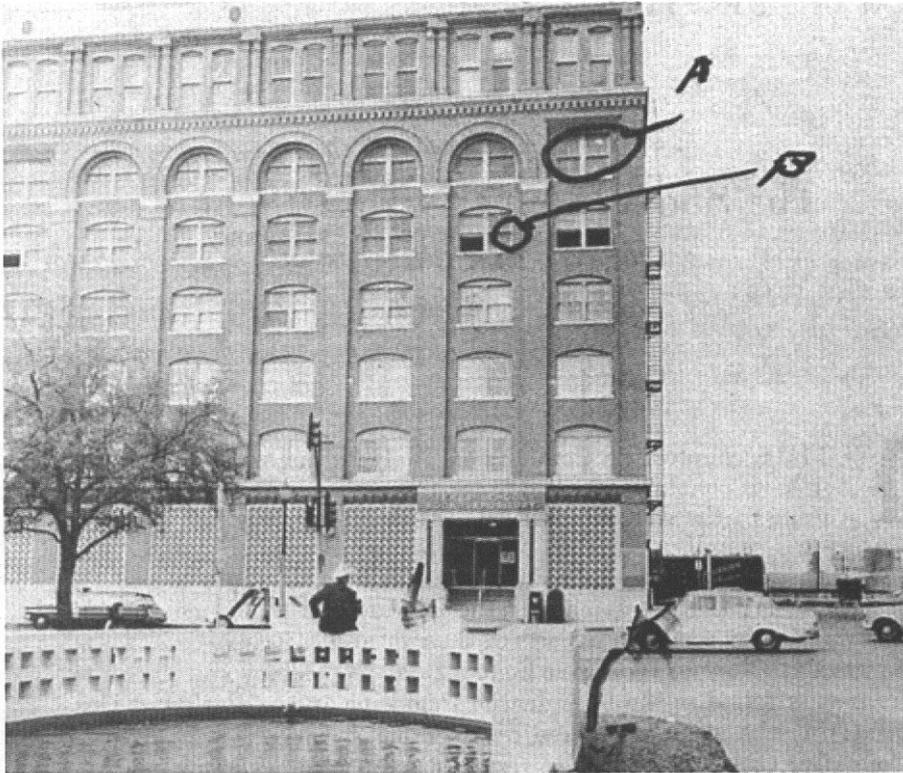
## CHAPTER III

# The Shots From the Texas School Book Depository

**I**N THIS chapter the Commission analyzes the evidence and sets forth its conclusions concerning the source, effect, number and timing of the shots that killed President Kennedy and wounded Governor Connally. In that connection the Commission has evaluated (1) the testimony of eyewitnesses present at the scene of the assassination; (2) the damage to the Presidential limousine; (3) the examination by qualified experts of the rifle and cartridge cases found on the sixth floor of the Texas School Book Depository and the bullet fragments found in the Presidential limousine and at Parkland Hospital; (4) the wounds suffered by President Kennedy and Governor Connally; (5) wound ballistics tests; (6) the examination by qualified experts of the clothing worn by President Kennedy and Governor Connally; and (7) motion-picture films and still photographs taken at the time of the assassination.

### THE WITNESSES

As reflected in the previous chapter, passengers in the first few cars of the motorcade had the impression that the shots came from the rear and from the right, the general direction of the Texas School Book Depository Building, although none of these passengers saw anyone fire the shots. Some spectators at Houston and Elm Streets, however, did see a rifle being fired in the direction of the President's car from the easternmost window of the sixth floor on the south side of the building. Other witnesses saw a rifle in this window immediately after the assassination. Three employees of the Depository, observing the parade from the fifth floor, heard the shots fired from the floor immediately above them. No credible evidence suggests that the shots were fired from the railroad bridge over the Triple Underpass, the nearby railroad yards or any place other than the Texas School Book Depository Building.



COMMISSION EXHIBIT No. 477

Position of Howard L. Brennan on November 22, 1963. (Photograph taken on March 20, 1964, and marked by Brennan during his testimony to show the window (A) in which he saw a man with a rifle, and the window (B) on the fifth floor in which he saw people watching the motorcade.)

## Near the Depository

Eyewitnesses testified that they saw a man fire a weapon from the sixth-floor window. Howard L. Brennan, a 45-year-old steamfitter, watched the motorcade from a concrete retaining wall at the southwest corner of Elm and Houston, where he had a clear view of the south side of the Depository Building.<sup>1</sup> (See Commission Exhibit No. 477, p. 62.) He was approximately 107 feet from the Depository entrance and 120 feet from the southeast corner window of the sixth floor.<sup>2</sup> Brennan's presence and vantage point are corroborated by a motion picture of the motorcade taken by amateur photographer Abraham Zapruder, which shows Brennan, wearing gray khaki work clothes and a gray work helmet, seated on the retaining wall.<sup>3</sup> Brennan later identified himself in the Zapruder movie.<sup>4</sup> While waiting about 7 minutes for the President to arrive, he observed the crowd on the street and the people at the windows of the Depository Building.<sup>5</sup> He noticed a man at the southeast corner window of the sixth floor, and observed him leave the window "a couple of times."<sup>6</sup>

Brennan watched the President's car as it turned the corner at Houston and Elm and moved down the incline toward the Triple Underpass. Soon after the President's car passed, he heard an explosion like the backfire of a motorcycle.<sup>7</sup> Brennan recalled:

Well, then something, just right after this explosion, made me think that it was a firecracker being thrown from the Texas Book Store. And I glanced up. And this man that I saw previous was aiming for his last shot.

\* \* \* \* \*

Well, as it appeared to me he was standing up and resting against the left window sill, with gun shouldered to his right shoulder, holding the gun with his left hand and taking positive aim and fired his last shot. As I calculate a couple of seconds. He drew the gun back from the window as though he was drawing it back to his side and maybe paused for another second as though to assure himself that he hit his mark, and then he disappeared.<sup>8</sup>

Brennan stated that he saw 70 to 85 percent of the gun when it was fired and the body of the man from the waist up.<sup>9</sup> The rifle was aimed southwesterly down Elm Street toward the underpass.<sup>10</sup> Brennan saw the man fire one shot and he remembered hearing a total of only two shots. When questioned about the number of shots, Brennan testified:

I don't know what made me think that there was firecrackers thrown out of the Book Store unless I did hear the second shot, because I positively thought the first shot was a backfire, and subconsciously I must have heard a second shot, but I do not recall it. I could not swear to it.<sup>11</sup>

Brennan quickly reported his observations to police officers.<sup>12</sup> Brennan's description of the man he saw is discussed in the next chapter.

Amos Lee Euins, a 15-year-old ninth grade student, stated that he was facing the Depository as the motorcade turned the corner at Elm and Houston. He recalled:

Then I was standing here, and as the motorcade turned the corner, I was facing, looking dead at the building. And so I seen this pipe thing sticking out the window. I wasn't paying too much attention to it. Then when the first shot was fired, I started looking around, thinking it was a backfire. Everybody else started looking around. Then I looked up at the window, and he shot again.<sup>13</sup>

After witnessing the first shots, Euins hid behind a fountain bench and saw the man shoot again from the window in the southeast corner of the Depository's sixth floor.<sup>14</sup> According to Euins, the man had one hand on the barrel and the other on the trigger. Euins believed that there were four shots.<sup>15</sup> Immediately after the assassination, he reported his observations to Sgt. D. V. Harkness of the Dallas Police Department and also to James Underwood of station KRLD-TV of Dallas.<sup>16</sup> Sergeant Harkness testified that Euins told him that the shots came from the last window of the floor "under the ledge" on the side of the building they were facing.<sup>17</sup> Based on Euins' statements, Harkness radioed to headquarters at 12:36 p.m. that "I have a witness that says that it came from the fifth floor of the Texas Book Depository Store."<sup>18</sup> Euins accurately described the sixth floor as the floor "under the ledge." Harkness testified that the error in the radio message was due to his own "hasty count of the floors."<sup>19</sup>

Other witnesses saw a rifle in the window after the shots were fired. Robert H. Jackson, staff photographer, Dallas Times Herald, was in a press car in the Presidential motorcade, eight or nine cars from the front. On Houston Street about halfway between Main and Elm, Jackson heard the first shot.<sup>20</sup> As someone in the car commented that it sounded like a firecracker, Jackson heard two more shots.<sup>21</sup> He 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. Then after the last shot, I guess all of us were just looking all around and I just looked straight up ahead of me which would have been looking at the School Book Depository and I noticed two Negro men in a window straining to see directly above them, and my eyes followed right on up to the window above them and I saw the rifle or what looked like a rifle approximately half of the weapon, I guess I saw, and just as I looked

at it, it was drawn fairly slowly back into the building, and I saw no one in the window with it.

I didn't even see a form in the window.<sup>22</sup>

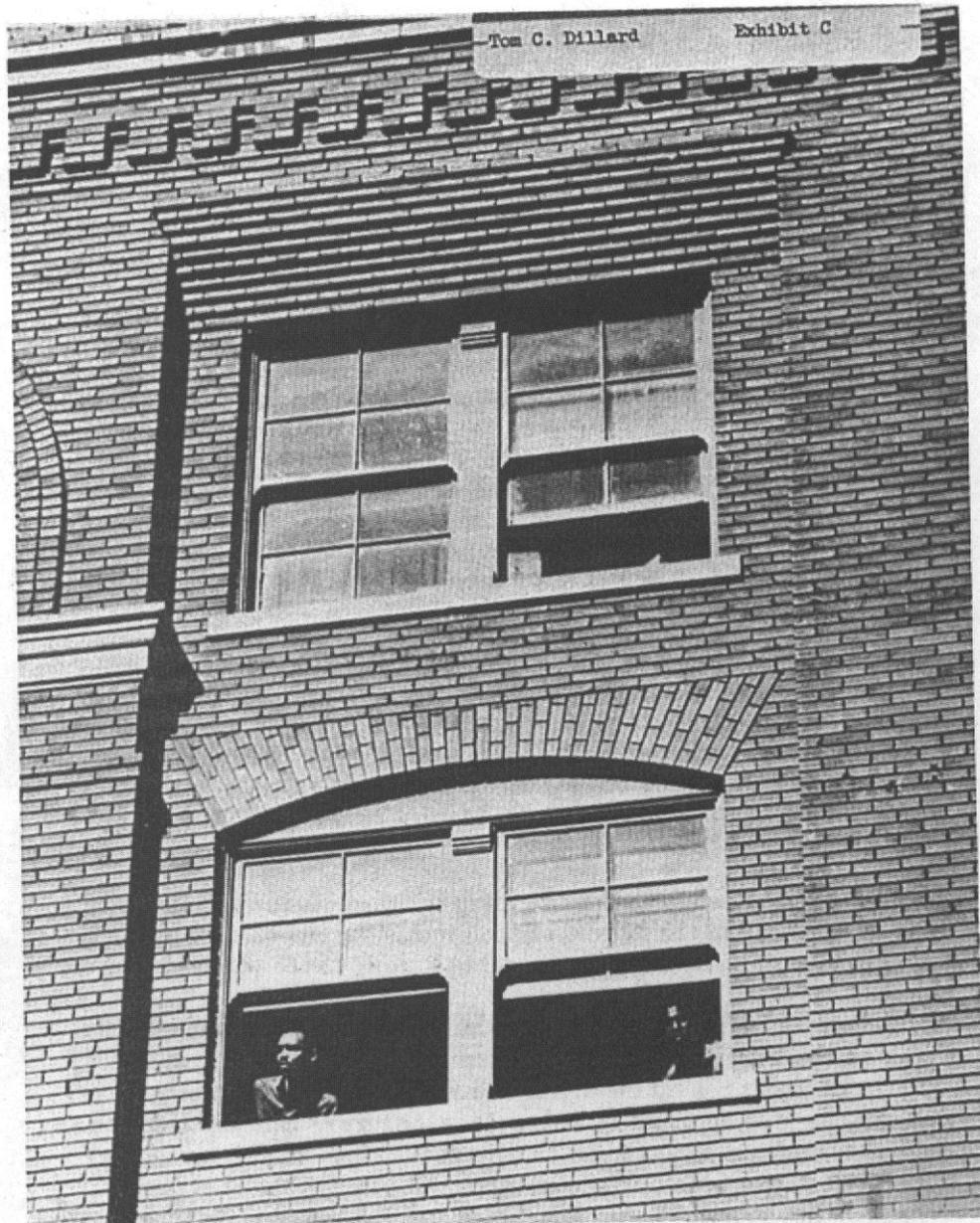
In the car with Jackson were James Underwood, television station KRLD-TV; Thomas Dillard, chief photographer, Dallas Morning News; Malcolm O. Couch and James Darnell, television newsreel cameramen. Dillard, Underwood, and the driver were in the front seat, Couch and Darnell were sitting on top of the back seat of the convertible with Jackson. Dillard, Couch, and Underwood confirmed that Jackson spontaneously exclaimed that he saw a rifle in the window.<sup>23</sup> According to Dillard, at the time the shots were fired he and his fellow passengers "had an absolutely perfect view of the School Depository from our position in the open car."<sup>24</sup> Dillard immediately took two pictures of the building: one of the east two-thirds of the south side and the other of the southeast corner, particularly the fifth- and sixth-floor windows.<sup>25</sup> These pictures show three Negro men in windows on the fifth floor and the partially open window on the sixth floor directly above them. (See Dillard Exhibits C and D, pp. 66-67.) Couch also saw the rifle in the window, and testified:

And after the third shot, Bob Jackson, who was, as I recall, on my right, yelled something like, "Look up in the window! There's the rifle!"

And I remember glancing up to a window on the far right, which at the time impressed me as the sixth or seventh floor, and seeing about a foot of a rifle being—the barrel brought into the window.<sup>26</sup>

Couch testified he saw people standing in other windows on the third or fourth floor in the middle of the south side, one of them being a Negro in a white T-shirt leaning out to look up at the windows above him.<sup>27</sup>

Mayor and Mrs. Earle Cabell rode in the motorcade immediately behind the Vice-Presidential followup car.<sup>28</sup> Mrs. Cabell was seated in the back seat behind the driver and was facing U.S. Representative Ray Roberts on her right as the car made the turn at Elm and Houston. In this position Mrs. Cabell "was actually facing" the seven-story Depository when the first shot rang out.<sup>29</sup> She "jerked" her head up immediately and saw a "projection" in the first group of windows on a floor which she described both as the sixth floor and the top floor.<sup>30</sup> According to Mrs. Cabell, the object was "rather long looking," but she was unable to determine whether it was a mechanical object or a person's arm.<sup>31</sup> She turned away from the window to tell her husband that the noise was a shot, and "just as I got the words out \* \* \* the second two shots rang out."<sup>32</sup> Mrs. Cabell did not look at the sixth-floor window when the second and third shots were fired.<sup>33</sup>



DILLARD EXHIBIT C  
Enlargement of photograph taken by Thomas C. Dillard on November 22, 1963.



**DILLARD EXHIBIT D**

**Photograph taken by Thomas C. Dillard on November 22, 1963.**

James N. Crawford and Mary Ann Mitchell, two deputy district clerks for Dallas County, watched the motorcade at the southeast corner of Elm and Houston. After the President's car turned the corner, Crawford heard a loud report which he thought was backfire coming from the direction of the Triple Underpass.<sup>34</sup> He heard a second shot seconds later, followed quickly by a third. At the third shot, he looked up and saw a "movement" in the far east corner of the sixth floor of the Depository, the only open window on that floor.<sup>35</sup> He told Miss Mitchell "that if those were shots they came from that window." When asked to describe the movement more exactly, he said,

\* \* \* I would say that it was a profile, somewhat from the waist up, but it was a very quick movement and rather indistinct and it was very light colored. \* \* \*

\* \* \* \* \*

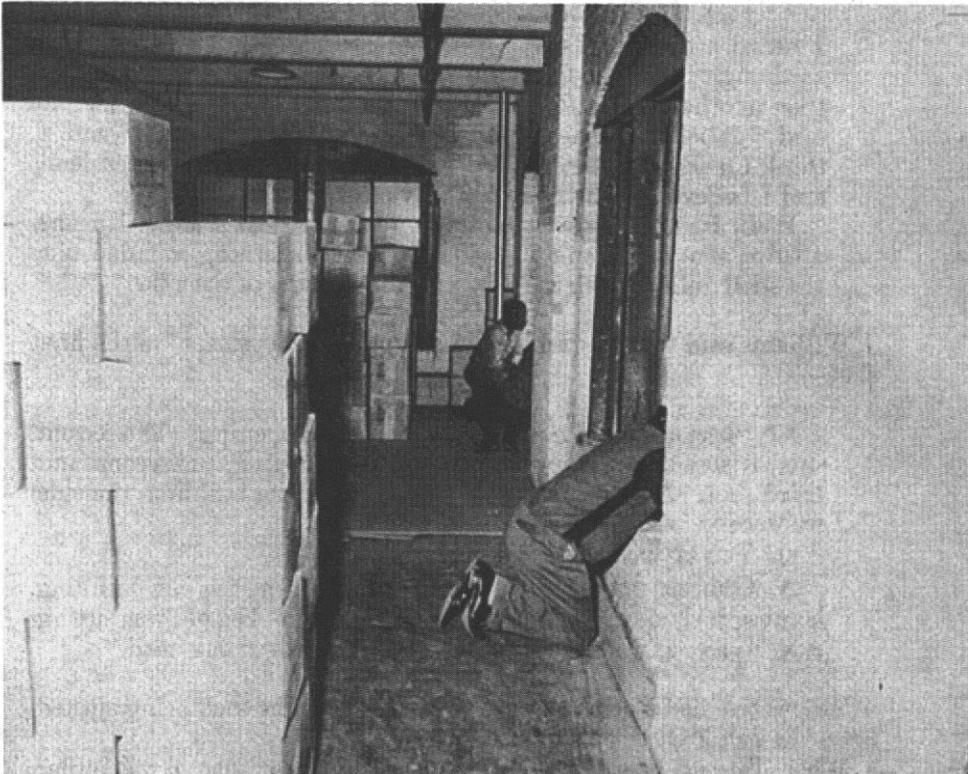
When I saw it, I automatically in my mind came to the conclusion that it was a person having moved out of the window. \* \* \*<sup>36</sup>

He could not state whether the person was a man or a woman.<sup>37</sup> Miss Mitchell confirmed that after the third shot Crawford told her, "Those shots came from that building."<sup>38</sup> She saw Crawford pointing at a window but was not sure at which window he was pointing.<sup>39</sup>

### On the Fifth Floor

Three Depository employees shown in the picture taken by Dillard were on the fifth floor of the building when the shots were fired: James Jarman, Jr., age 34, a wrapper in the shipping department; Bonnie Ray Williams, age 20, a warehouseman temporarily assigned to laying a plywood floor on the sixth floor; and Harold Norman, age 26, an "order filler." Norman and Jarman decided to watch the parade during the lunch hour from the fifth-floor windows.<sup>40</sup> From the ground floor they took the west elevator, which operates with push-button controls, to the fifth floor.<sup>41</sup> Meanwhile, Williams had gone up to the sixth floor where he had been working and ate his lunch on the south side of that floor. Since he saw no one around when he finished his lunch, he started down on the east elevator, looking for company. He left behind his paper lunch sack, chicken bones and an empty pop bottle.<sup>42</sup> Williams went down to the fifth floor, where he joined Norman and Jarman at approximately 12:20 p.m.<sup>43</sup>

Harold Norman was in the fifth-floor window in the southeast corner, directly under the window where witnesses saw the rifle. (See Commission Exhibit No. 485, p. 69.) He could see light through the ceiling cracks between the fifth and sixth floors.<sup>44</sup> As the motorcade went by, Norman thought that the President was saluting with his right arm,



COMMISSION EXHIBIT No. 485

Positions occupied by Depository employees on fifth floor on November 22, 1963.

\* \* \* and I can't remember what the exact time was but I know I heard a shot, and then after I heard the shot, well, it seems as though the President, you know, slumped or something, and then another shot and I believe Jarman or someone told me, he said, "I believe someone is shooting at the President," and I think I made a statement "It is someone shooting at the President, and I believe it came from up above us."

Well, I couldn't see at all during the time but I know I heard a third shot fired, and I could also hear something sounded like the shell hulls hitting the floor and the ejecting of the rifle \* \* \*.<sup>45</sup>

Williams said that he "really did not pay any attention" to the first shot—

\* \* \* because I did not know what was happening. The second shot, it sounded like it was right in the building, the second and third shot. And it sounded—it even shook the building, the side we were on. Cement fell on my head.

Q. You say cement fell on your head?

A. Cement, gravel, dirt, or something, from the old building, because it shook the windows and everything. Harold was sitting next to me, and he said it came right from over our head.<sup>46</sup>

Williams testified Norman said "I can even hear the shell being ejected from the gun hitting the floor."<sup>47</sup>

When Jarman heard the first sound, he thought that it was either a backfire—

\* \* \* or an officer giving a salute to the President. And then at that time I didn't, you know, think too much about it. \* \* \*

\* \* \* \* \* \* \* \* \*

Well, after the third shot was fired, I think I got up and I run over to Harold Norman and Bonnie Ray Williams, and told them, I said, I told them that it wasn't a backfire or anything, that somebody was shooting at the President.<sup>48</sup>

Jarman testified that Norman said "that he thought the shots had come from above us, and I noticed that Bonnie Ray had a few debris in his head. It was sort of white stuff, or something."<sup>49</sup> Jarman stated that Norman said "that he was sure that the shot came from inside the building because he had been used to guns and all that, and he said it didn't sound like it was too far off anyway."<sup>50</sup> The three men ran to the west side of the building, where they could look toward the Triple Underpass to see what had happened to the motorcade.<sup>51</sup>

After the men had gone to the window on the west side of the building, Jarman "got to thinking about all the debris on Bonnie Ray's head" and said, "That shot probably did come from upstairs, up over us."<sup>52</sup> He testified that Norman said, "I know it did, because I could

hear the action of the bolt, and I could hear the cartridges drop on the floor.”<sup>53</sup> After pausing for a few minutes, the three men ran downstairs. Norman and Jarman ran out of the front entrance of the building, where they saw Brennan, the construction worker who had seen the man in the window firing the gun, talking to a police officer, and they then reported their own experience.<sup>54</sup>

On March 20, 1964, preceding their appearance before the Commission, these witnesses were interviewed in Dallas. At that time members of the Commission’s legal staff conducted an experiment. Norman, Williams, and Jarman placed themselves at the windows of the fifth floor as they had been on November 22. A Secret Service agent operated the bolt of a rifle directly above them at the southeast corner window of the sixth floor. At the same time, three cartridge shells were dropped to the floor at intervals of about 3 seconds. According to Norman, the noise outside was less on the day of the assassination than on the day of the test.<sup>55</sup> He testified, “Well, I heard the same sound, the sound similar. I heard three something that he dropped on the floor and then I could hear the rifle or whatever he had up there.”<sup>56</sup> The experiment with the shells and rifle was repeated for members of the Commission on May 9, 1964, on June 7, 1964, and again on September 6, 1964. All seven of the Commissioners clearly heard the shells drop to the floor.

### At the Triple Underpass

In contrast to the testimony of the witnesses who heard and observed shots fired from the Depository, the Commission’s investigation has disclosed no credible evidence that any shots were fired from anywhere else. When the shots were fired, many people near the Depository believed that the shots came from the railroad bridge over the Triple Underpass or from the area to the west of the Depository.<sup>57</sup> In the hectic moments after the assassination, many spectators ran in the general direction of the Triple Underpass or the railroad yards northwest of the building. Some were running toward the place from which the sound of the rifle fire appeared to come, others were fleeing the scene of the shooting.<sup>58</sup> None of these people saw anyone with a rifle, and the Commission’s inquiry has yielded no evidence that shots were fired from the bridge over the Triple Underpass or from the railroad yards.

On the day of the motorcade, Patrolman J. W. Foster stood on the east side of the railroad bridge over the Triple Underpass and Patrolman J. C. White stood on the west side.<sup>59</sup> Patrolman Joe E. Murphy was standing over Elm Street on the Stemmons Freeway overpass, west of the railroad bridge farther away from the Depository.<sup>60</sup> Two other officers were stationed on Stemmons Freeway to control traffic as the motorcade entered the Freeway.<sup>61</sup> Under the advance preparations worked out between the Secret Service and the Dallas Police Department, the policemen were under instructions to keep “unauthorized” people away from these locations.<sup>62</sup> When the

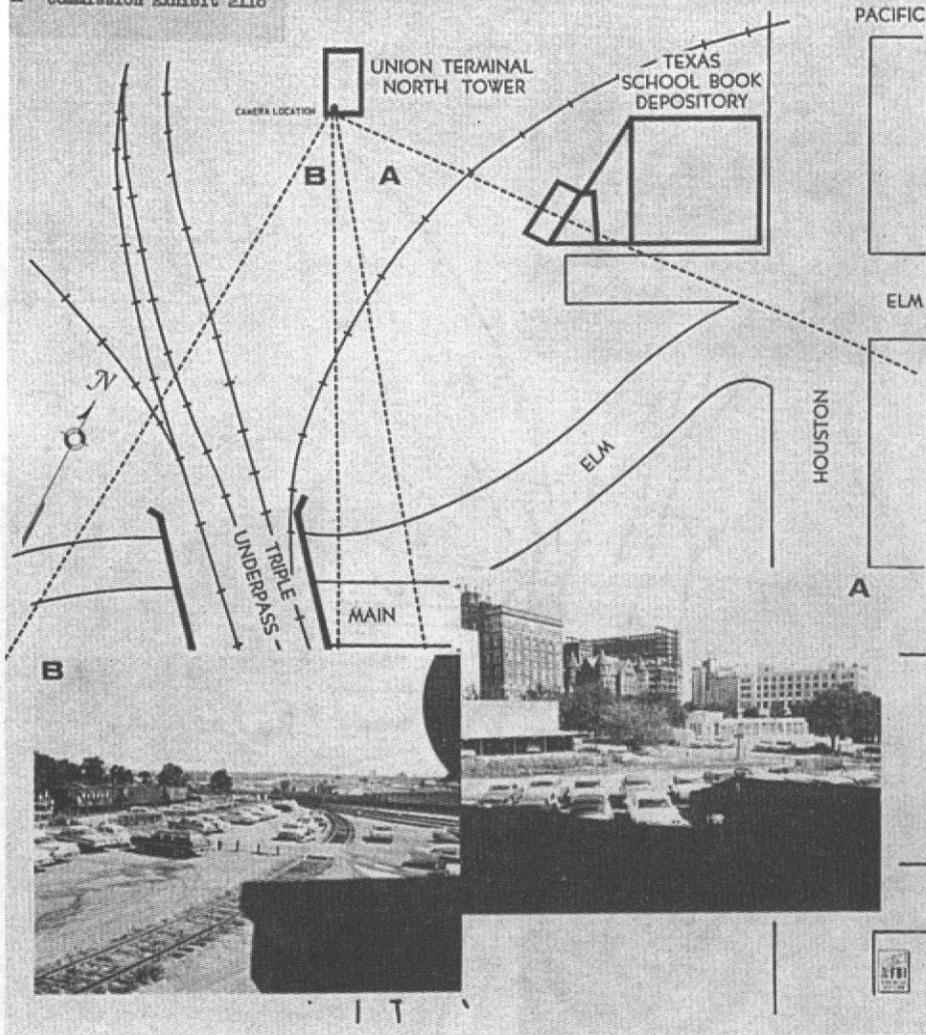
motorcade reached the intersection of Elm and Houston Streets, there were no spectators on Stemmons Freeway where Patrolman Murphy was stationed.<sup>63</sup> Patrolman Foster estimated that there were 10 or 11 people on the railroad bridge where he was assigned; <sup>64</sup> another witness testified that there were between 14 and 18 people there as the motorcade came into view.<sup>65</sup> Investigation has disclosed 15 persons who were on the railroad bridge at this time, including 2 policemen, 2 employees of the Texas-Louisiana Freight Bureau and 11 employees of the Union Terminal Co.<sup>66</sup> In the absence of any explicit definition of "unauthorized" persons, the policemen permitted these employees to remain on the railroad bridge to watch the motorcade. (See chapter VIII, pp. 446-447.) At the request of the policemen, S. M. Holland, signal supervisor for Union Terminal Co., came to the railroad bridge at about 11:45 a.m. and remained to identify those persons who were railroad employees.<sup>67</sup> In addition, Patrolman Foster checked credentials to determine if persons seeking access to the bridge were railroad employees.<sup>68</sup> Persons who were not railroad employees were ordered away, including one news photographer who wished only to take a picture of the motorcade.<sup>69</sup>

Another employee of the Union Terminal Co., Lee E. Bowers, Jr., was at work in a railroad tower about 14 feet above the tracks to the north of the railroad bridge and northwest of the corner of Elm and Houston, approximately 50 yards from the back of the Depository.<sup>70</sup> (See Commission Exhibit No. 2218, p. 73.) From the tower he could view people moving in the railroad yards and at the rear of the Depository. According to Bowers, "Since approximately 10 o'clock in the morning traffic had been cut off into the area so that anyone moving around could actually be observed."<sup>71</sup> During the 20 minutes prior to the arrival of the motorcade, Bowers noticed three automobiles which entered his immediate area; two left without discharging any passengers and the third was apparently on its way out when last observed by Bowers.<sup>72</sup> Bowers observed only three or four people in the general area, as well as a few bystanders on the railroad bridge over the Triple Underpass.<sup>73</sup>

As the motorcade proceeded toward the Triple Underpass, the spectators were clustered together along the east concrete wall of the railroad bridge facing the oncoming procession.<sup>74</sup> (See Commission Exhibit No. 2215, p. 75.) Patrolman Foster stood immediately behind them and could observe all of them.<sup>75</sup> Secret Service agents in the lead car of the motorcade observed the bystanders and the police officer on the bridge.<sup>76</sup> Special Agent Winston G. Lawson motioned through the windshield in an unsuccessful attempt to instruct Patrolman Foster to move the people away from their position directly over the path of the motorcade.<sup>77</sup> Some distance away, on the Stemmons Freeway overpass above Elm Street, Patrolman Murphy also had the group on the railroad bridge within view.<sup>78</sup> When he heard the shots, Foster rushed to the wall of the railroad bridge over the Triple Underpass and looked toward the street.<sup>79</sup> After the third shot, Foster ran toward the Depository and shortly thereafter informed

# VIEW FROM NORTH TOWER OF UNION TERMINAL COMPANY, DALLAS, TEXAS

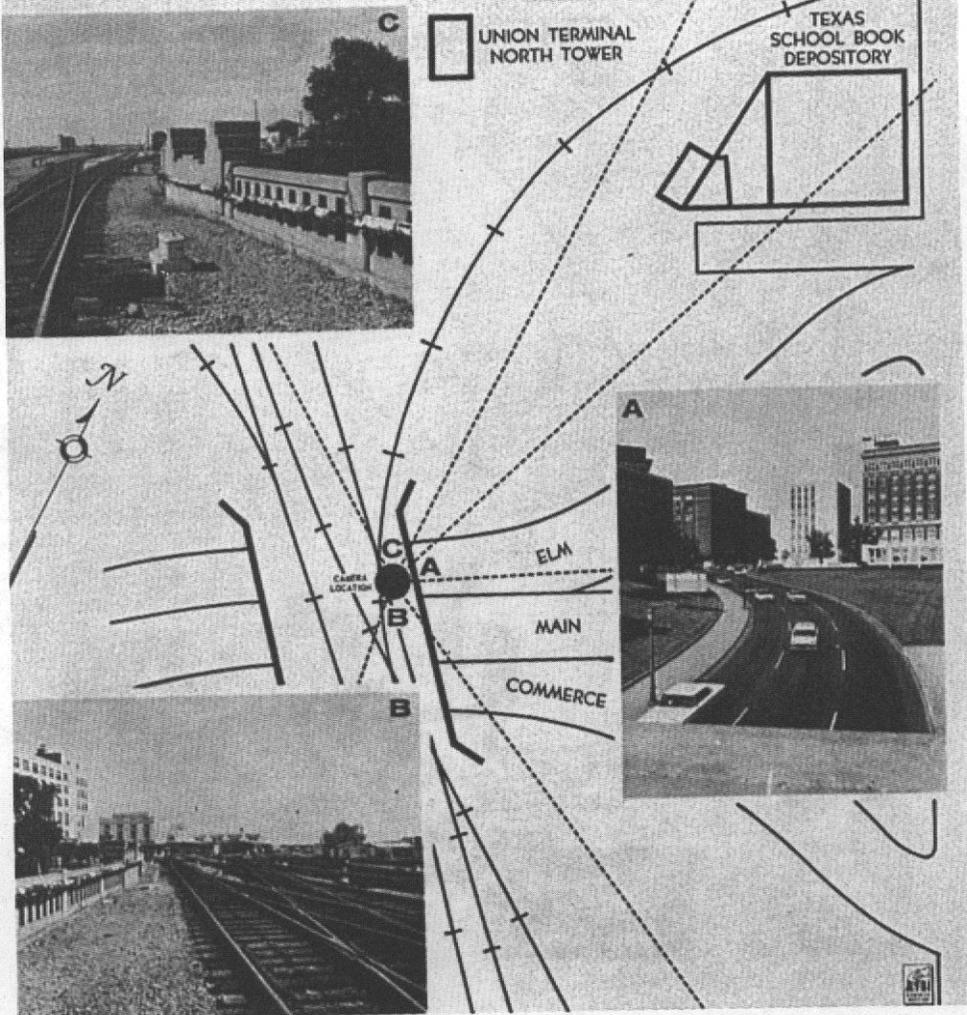
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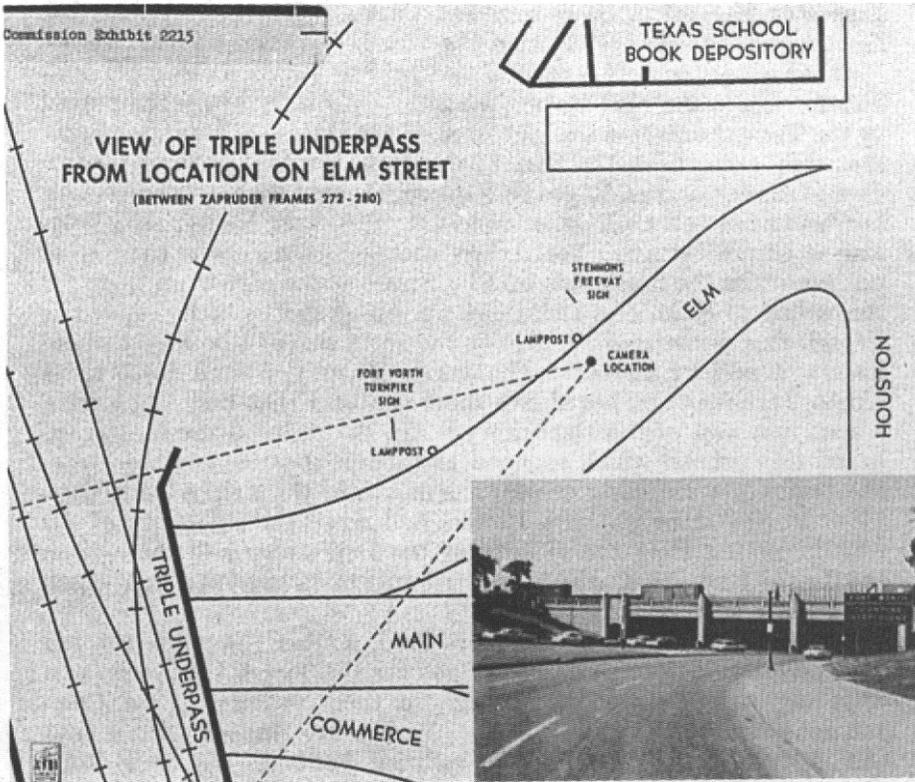
COMMISSION EXHIBIT No. 2118

# VIEW FROM TRIPLE UNDERPASS, DALLAS, TEXAS

Commission Exhibit 2214



COMMISSION EXHIBIT No. 2214



COMMISSION EXHIBIT No. 2215

Inspector Herbert J. Sawyer of the Dallas Police Department that he thought the shots came from the vicinity of Elm and Houston.<sup>80</sup>

Other witnesses on the railroad bridge had varying views concerning the source and number of the shots. Austin L. Miller, employed by the Texas-Louisiana Freight Bureau, heard three shots and thought that they came from the area of the Presidential limousine itself.<sup>81</sup> One of his coworkers, Royce G. Skelton, thought he heard four shots, but could not tell their exact source.<sup>82</sup> Frank E. Reilly, an electrician at Union Terminal, heard three shots which seemed to come from the trees "On the north side of Elm Street at the corner up there."<sup>83</sup> According to S. M. Holland, there were four shots which sounded as though they came from the trees on the north side of Elm Street where he saw a puff of smoke.<sup>84</sup> Thomas J. Murphy, a mail foreman at Union Terminal Co., heard two shots and said that they came from a spot just west of the Depository.<sup>85</sup> In the railroad tower, Bowers heard three shots, which sounded as though they came either from the Depository Building or near the mouth of the Triple Underpass. Prior to November 22, 1963, Bowers had noted the similarity of the sounds coming from the vicinity of the Depository and those from the Triple Underpass, which he attributed to "a reverberation which takes place from either location."<sup>86</sup>

Immediately after the shots were fired, neither the policemen nor the spectators on the railroad bridge over the Triple Underpass saw anything suspicious on the bridge in their vicinity. (See Commission Exhibit No. 2214, p. 74.) No one saw anyone with a rifle. As he ran around through the railroad yards to the Depository, Patrolman Foster saw no suspicious activity.<sup>87</sup> The same was true of the other bystanders, many of whom made an effort after the shooting to observe any unusual activity. Holland, for example, immediately after the shots, ran off the overpass to see if there was anyone behind the picket fence on the north side of Elm Street, but he did not see anyone among the parked cars.<sup>88</sup> Miller did not see anyone running across the railroad tracks or on the plaza west of the Depository.<sup>89</sup> Bowers and others saw a motorcycle officer dismount hurriedly and come running up the incline on the north side of Elm Street.<sup>90</sup> The motorcycle officer, Clyde A. Haygood, saw no one running from the railroad yards.<sup>91</sup>

## THE PRESIDENTIAL AUTOMOBILE

After the Presidential car was returned to Washington on November 22, 1963, Secret Service agents found two bullet fragments in the front seat. One fragment, found on the seat beside the driver, weighed 44.6 grains and consisted of the nose portion of a bullet.<sup>92</sup> The other fragment, found along the right side of the front seat, weighed 21.0 grains and consisted of the base portion of a bullet.<sup>93</sup> During the course of an examination on November 23, agents of the Federal Bureau of Investigation found three small lead particles, weighing

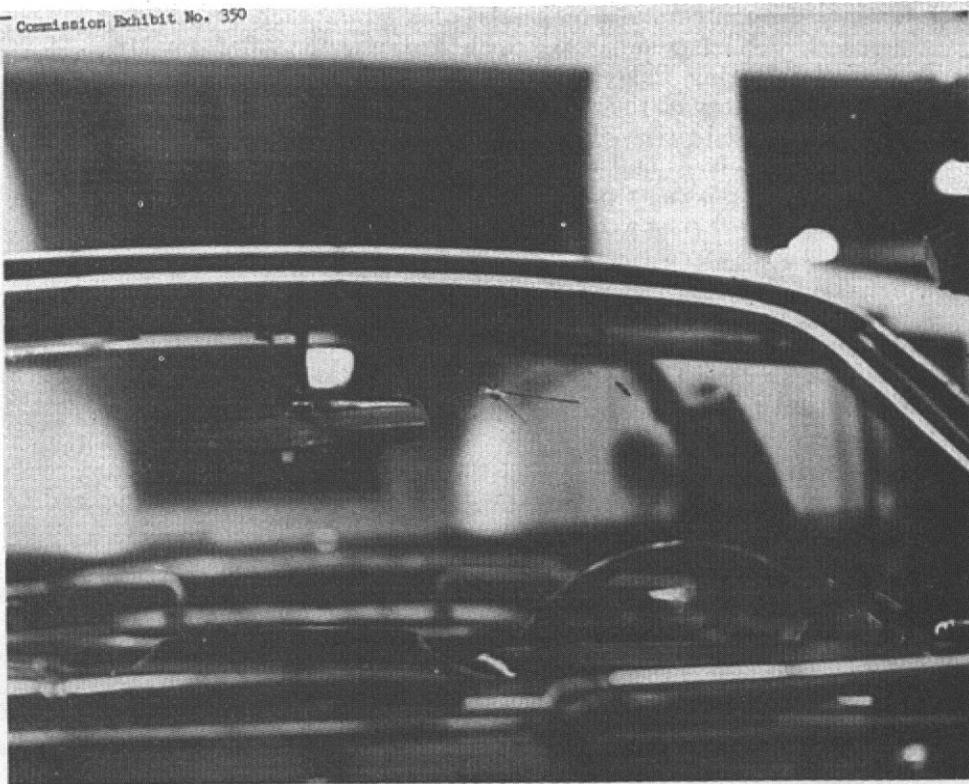
between seven-tenths and nine-tenths of a grain each, on the rug underneath the left jump seat which had been occupied by Mrs. Connally.<sup>94</sup> During this examination, the Bureau agents noted a small residue of lead on the inside surface of the laminated windshield and a very small pattern of cracks on the outer layer of the windshield immediately behind the lead residue.<sup>95</sup> There was a minute particle of glass missing from the outside surface, but no penetration. The inside layer of glass was not broken.<sup>96</sup> The agents also observed a dent in the strip of chrome across the top of the windshield, located to the left of the rear view mirror support.<sup>97</sup>

The lead residue on the inside of the windshield was compared under spectrographic analysis by FBI experts with the bullet fragments found on and alongside the front seat and with the fragments under the left jump seat. It was also compared with bullet fragments found at Parkland Hospital. All these bullet fragments were found to be similar in metallic composition, but it was not possible to determine whether two or more of the fragments came from the same bullet.<sup>98</sup> It is possible for the fragments from the front seat to have been a part of the same bullet as the three fragments found near the left jump seat,<sup>99</sup> since a whole bullet of this type weighs 160-161 grains.<sup>100</sup> (See app. X, pp. 555-558.)

The physical characteristics of the windshield after the assassination demonstrate that the windshield was struck on the inside surface. The windshield is composed of two layers of glass with a very thin layer of plastic in the middle "which bonds them together in the form of safety glass."<sup>101</sup> The windshield was extracted from the automobile and was examined during a Commission hearing.<sup>102</sup> (See Commission Exhibit No. 350, p. 78.) According to Robert A. Frazier, FBI firearms expert, the fact that cracks were present on the outer layer of glass showed that the glass had been struck from the inside. He testified that the windshield

could not have been struck on the outside surface because of the manner in which the glass broke and further because of the lead residue on the inside surface. The cracks appear in the outer layer of the glass because the glass is bent outward at the time of impact which stretches the outer layer of the glass to the point where these small radial or wagon spoke, wagon wheel spoke-type cracks appear on the outer surface.<sup>103</sup>

Although there is some uncertainty whether the dent in the chrome on the windshield was present prior to the assassination,<sup>104</sup> Frazier testified that the dent "had been caused by some projectile which struck the chrome on the inside surface."<sup>105</sup> If it was caused by a shot during the assassination, Frazier stated that it would not have been caused by a bullet traveling at full velocity, but rather by a fragment traveling at "fairly high velocity."<sup>106</sup> It could have been caused by either fragment found in the front seat of the limousine.<sup>107</sup>



COMMISSION EXHIBIT No. 350  
Windshield of Presidential limousine.

## EXPERT EXAMINATION OF RIFLE, CARTRIDGE CASES, AND BULLET FRAGMENTS

On the sixth floor of the Depository Building, the Dallas police found three spent cartridges and a rifle. A nearly whole bullet was discovered on the stretcher used to carry Governor Connally at Parkland Hospital. As described in the preceding section, five bullet fragments were found in the President's limousine. The cartridge cases, the nearly whole bullet and the bullet fragments were all subjected to firearms identification analysis by qualified experts. It was the unanimous opinion of the experts that the nearly whole bullet, the two largest bullet fragments and the three cartridge cases were definitely fired in the rifle found on the sixth floor of the Depository Building to the exclusion of all other weapons.

### Discovery of Cartridge Cases and Rifle

Shortly after the assassination, police officers arrived at the Depository Building and began a search for the assassin and evidence.<sup>108</sup> Around 1 p.m. Deputy Sheriff Luke Mooney noticed a pile of cartons in front of the window in the southeast corner of the sixth floor.<sup>109</sup> (See Commission Exhibit No. 723, p. 80.) Searching that area he found at approximately 1:12 p.m. three empty cartridge cases on the floor near the window.<sup>110</sup> When he was notified of Mooney's discovery, Capt. J. W. Fritz, chief of the homicide bureau of the Dallas Police Department, issued instructions that nothing be moved or touched until technicians from the police crime laboratory could take photographs and check for fingerprints.<sup>111</sup> Mooney stood guard to see that nothing was disturbed.<sup>112</sup> A few minutes later, Lt. J. C. Day of the Dallas Police Department arrived and took photographs of the cartridge cases before anything had been moved.<sup>113</sup>

At 1:22 p.m. Deputy Sheriff Eugene Boone and Deputy Constable Seymour Weitzman found a bolt-action rifle with a telescopic sight between two rows of boxes in the northwest corner near the staircase on the sixth floor.<sup>114</sup> No one touched the weapon or otherwise disturbed the scene until Captain Fritz and Lieutenant Day arrived and the weapon was photographed as it lay on the floor.<sup>115</sup> After Lieutenant Day determined that there were no fingerprints on the knob of the bolt and that the wooden stock was too rough to take fingerprints, he picked the rifle up by the stock and held it that way while Captain Fritz opened the bolt and ejected a live round.<sup>116</sup> Lieutenant Day retained possession of the weapon and took it back to the police department for examination.<sup>117</sup> Neither Boone nor Weitzman handled the rifle.<sup>118</sup>

### Discovery of Bullet at Parkland Hospital

A nearly whole bullet was found on Governor Connally's stretcher at Parkland Hospital after the assassination. After his arrival at the hospital the Governor was brought into trauma room No. 2 on a



Commission Exhibit No. 723

COMMISSION EXHIBIT No. 723

Shield of cartons around sixth floor southeast corner window.

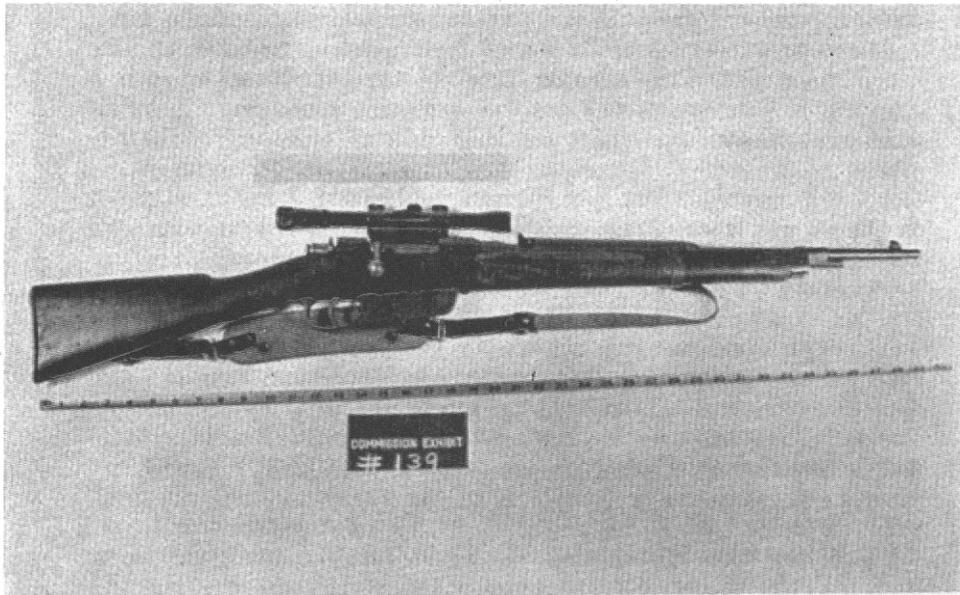
stretcher, removed from the room on that stretcher a short time later, and taken on an elevator to the second-floor operating room.<sup>119</sup> On the second floor he was transferred from the stretcher to an operating table which was then moved into the operating room, and a hospital attendant wheeled the empty stretcher into an elevator.<sup>120</sup> Shortly afterward, Darrell C. Tomlinson, the hospital's senior engineer, removed this stretcher from the elevator and placed it in the corridor on the ground floor, alongside another stretcher wholly unconnected with the care of Governor Connally.<sup>121</sup> A few minutes later, he bumped one of the stretchers against the wall and a bullet rolled out.<sup>122</sup>

Although Tomlinson was not certain whether the bullet came from the Connally stretcher or the adjacent one, the Commission has concluded that the bullet came from the Governor's stretcher. That conclusion is buttressed by evidence which eliminated President Kennedy's stretcher as a source of the bullet. President Kennedy remained on the stretcher on which he was carried into the hospital while the doctors tried to save his life.<sup>123</sup> He was never removed from the stretcher from the time he was taken into the emergency room until his body was placed in a casket in that same room.<sup>124</sup> After the President's body was removed from that stretcher, the linen was taken off and placed in a hamper and the stretcher was pushed into trauma room No. 2, a completely different location from the site where the nearly whole bullet was found.<sup>125</sup>

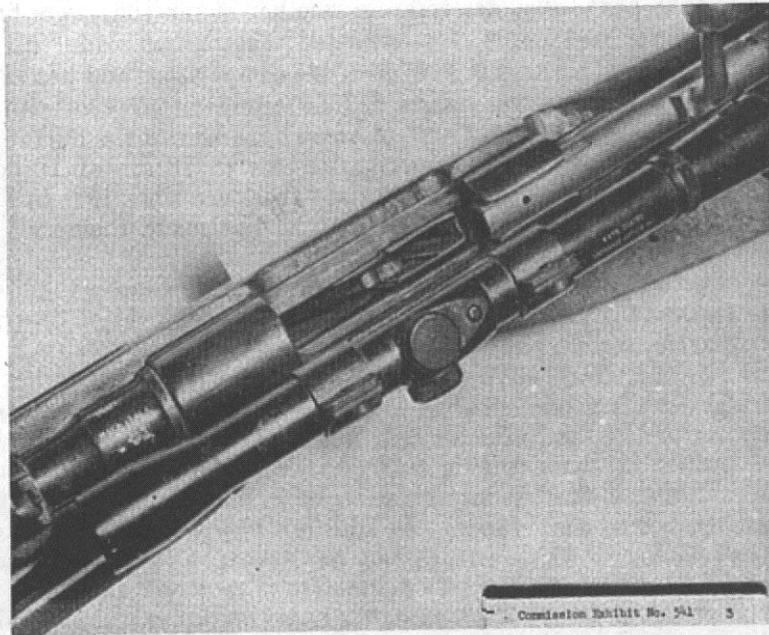
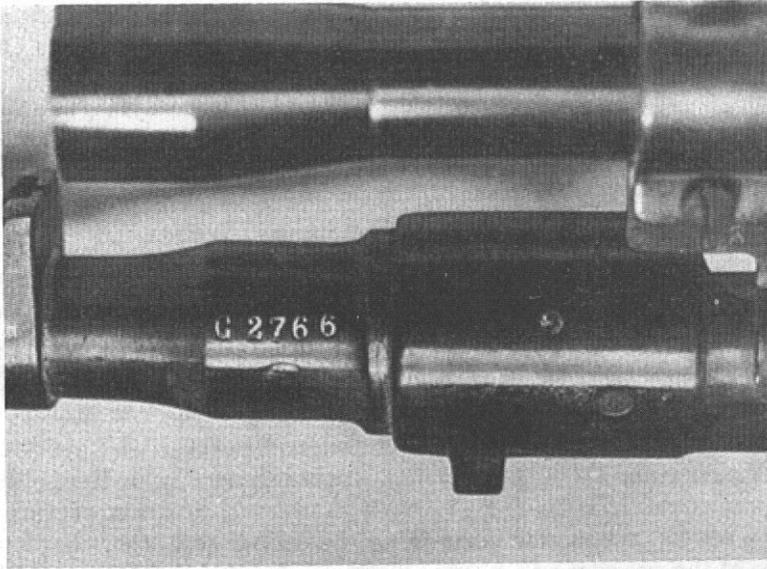
### Description of Rifle

The bolt-action, clip-fed rifle found on the sixth floor of the Depository, described more fully in appendix X, is inscribed with various markings, including "MADE ITALY," "CAL. 6.5," "1940" and the number C2766.<sup>126</sup> (See Commission Exhibit Nos. 1303, 541(2) and 541(3), pp. 82-83.) These markings have been explained as follows: "MADE ITALY" refers to its origin; "CAL. 6.5" refers to the rifle's caliber; "1940" refers to the year of manufacture; and the number C2766 is the serial number. This rifle is the only one of its type bearing that serial number.<sup>127</sup> After review of standard reference works and the markings on the rifle, it was identified by the FBI as a 6.5-millimeter model 91/38 Mannlicher-Carcano rifle.<sup>128</sup> Experts from the FBI made an independent determination of the caliber by inserting a Mannlicher-Carcano 6.5-millimeter cartridge into the weapon for fit, and by making a sulfur cast of the inside of the weapon's barrel and measuring the cast with a micrometer.<sup>129</sup> From outward appearance, the weapon would appear to be a 7.35-millimeter rifle, but its mechanism had been rebarreled with a 6.5-millimeter barrel.<sup>130</sup> Constable Deputy Sheriff Weitzman, who only saw the rifle at a glance and did not handle it, thought the weapon looked like a 7.65 Mauser bolt-action rifle.<sup>131</sup> (See chapter V, p. 235.)

The rifle is 40.2 inches long and weighs 8 pounds.<sup>132</sup> The minimum length broken down is 34.8 inches, the length of the wooden stock.<sup>133</sup>



COMMISSION EXHIBIT No. 1303



COMMISSION EXHIBITS Nos. 541(2) AND 541(3)  
Photograph of markings on C2766 Mannlicher-Carcano rifle.

(See Commission Exhibit No. 1304, p. 132.) Attached to the weapon is an inexpensive four-power telescopic sight, stamped "Optics Ordnance Inc./Hollywood California," and "Made in Japan."<sup>134</sup> The weapon also bears a sling consisting of two leather straps. The sling is not a standard rifle sling but appears to be a musical instrument strap or a sling from a carrying case or camera bag.<sup>135</sup>

### Expert Testimony

Four experts in the field of firearms identification analyzed the nearly whole bullet, the two largest fragments and the three cartridge cases to determine whether they had been fired from the C2766 Mannlicher-Carcano rifle found on the sixth floor of the Depository. Two of these experts testified before the Commission. One was Robert A. Frazier, a special agent of the FBI assigned to the FBI Laboratory in Washington, D.C. Frazier has worked generally in the field of firearms identification for 23 years, examining firearms of various types for the purpose of identifying the caliber and other characteristics of the weapons and making comparisons of bullets and cartridge cases for the purpose of determining whether or not they were fired in a particular weapon.<sup>136</sup> He estimated that he has made "in the neighborhood of 50,000 to 60,000" firearms comparisons and has testified in court on about 400 occasions.<sup>137</sup> The second witness who testified on this subject was Joseph D. Nicol, superintendent of the bureau of criminal identification and investigation for the State of Illinois. Nicol also has had long and substantial experience since 1941 in firearms identification, and estimated that he has made thousands of bullet and cartridge case examinations.<sup>138</sup>

In examining the bullet fragments and cartridge cases, these experts applied the general principles accepted in the field of firearms identification, which are discussed in more detail in appendix X at pages 547-553. In brief, a determination that a particular bullet or cartridge case has been fired in a particular weapon is based upon a comparison of the bullet or case under examination with one or more bullets or cases known to have been fired in that weapon. When a bullet is fired in any given weapon, it is engraved with the characteristics of the weapon. In addition to the rifling characteristics of the barrel which are common to all weapons of a given make and model, every weapon bears distinctive microscopic markings on its barrel, firing pin and bolt face.<sup>139</sup> These markings arise initially during manufacture, since the action of the manufacturing tools differs microscopically from weapon to weapon and since, in addition, the tools change microscopically while being used. As a weapon is used further distinctive markings are introduced. Under microscopic examination a qualified expert may be able to determine whether the markings on a bullet known to have been fired in a particular weapon and the markings on a suspect bullet are the same and, therefore, whether both bullets were fired in the same weapon

to the exclusion of all other weapons. Similarly, firearms identification experts are able to compare the markings left upon the base of cartridge cases and thereby determine whether both cartridges were fired by the same weapon to the exclusion of all other weapons. According to Frazier, such an identification "is made on the presence of sufficient individual microscopic characteristics so that a very definite pattern is formed and visualized on the two surfaces."<sup>140</sup> Under some circumstances, as where the bullet or cartridge case is seriously mutilated, there are not sufficient individual characteristics to enable the expert to make a firm identification.<sup>141</sup>

After making independent examinations, both Frazier and Nicol positively identified the nearly whole bullet from the stretcher and the two larger bullet fragments found in the Presidential limousine as having been fired in the C2766 Mannlicher-Carcano rifle found in the Depository to the exclusion of all other weapons.<sup>142</sup> Each of the two bullet fragments had sufficient unmutated area to provide the basis for an identification.<sup>143</sup> However, it was not possible to determine whether the two bullet fragments were from the same bullet or from two different bullets.<sup>144</sup> With regard to the other bullet fragments discovered in the limousine and in the course of treating President Kennedy and Governor Connally, however, expert examination could demonstrate only that the fragments were "similar in metallic composition" to each other, to the two larger fragments and to the nearly whole bullet.<sup>145</sup> After examination of the three cartridge cases found on the sixth floor of the Depository, Frazier and Nicol concluded that they had been fired in the C2766 Mannlicher-Carcano rifle to the exclusion of all other weapons.<sup>146</sup> Two other experts from the Federal Bureau of Investigation, who made independent examinations of the nearly whole bullet, bullet fragments and cartridge cases, reached the identical conclusions.<sup>147</sup>

## THE BULLET WOUNDS

In considering the question of the source of the shots fired at President Kennedy and Governor Connally, the Commission has also evaluated the expert medical testimony of the doctors who observed the wounds during the emergency treatment at Parkland Hospital and during the autopsy at Bethesda Naval Hospital. It paid particular attention to any wound characteristics which would be of assistance in identifying a wound as the entrance or exit point of a missile. Additional information regarding the source and nature of the injuries was obtained by expert examination of the clothes worn by the two men, particularly those worn by President Kennedy, and from the results of special wound ballistics tests conducted at the Commission's request, using the C2766 Mannlicher-Carcano rifle with ammunition of the same type as that used and found on November 22, 1963.

## The President's Head Wounds

The detailed autopsy of President Kennedy performed on the night of November 22 at the Bethesda Naval Hospital led the three examining pathologists to conclude that the smaller hole in the rear of the President's skull was the point of entry and that the large opening on the right side of his head was the wound of exit.<sup>148</sup> The smaller hole on the back of the President's head measured one-fourth of an inch by five-eighths of an inch (6 by 15 millimeters).<sup>149</sup> The dimensions of that wound were consistent with having been caused by a 6.5-millimeter bullet fired from behind and above which struck at a tangent or an angle causing a 15-millimeter cut. The cut reflected a larger dimension of entry than the bullet's diameter of 6.5 millimeters, since the missile, in effect, sliced along the skull for a fractional distance until it entered.<sup>150</sup> The dimension of 6 millimeters, somewhat smaller than the diameter of a 6.5-millimeter bullet, was caused by the elastic recoil of the skull which shrinks the size of an opening after a missile passes through it.<sup>151</sup>

Lt. Col. Pierre A. Finck, Chief of the Wound Ballistics Pathology Branch of the Armed Forces Institute of Pathology, who has had extensive experience with bullet wounds, illustrated the characteristics which led to his conclusions about the head wound by a chart prepared by him. This chart, based on Colonel Finck's studies of more than 400 cases, depicted the effect of a perforating missile wound on the human skull.<sup>152</sup> When a bullet enters the skull (cranial vault) at one point and exits at another, it causes a beveling or cratering effect where the diameter of the hole is smaller on the impact side than on the exit side. Based on his observations of that beveling effect on the President's skull, Colonel Finck testified: "President Kennedy was, in my opinion, shot from the rear. The bullet entered in the back of the head and went out on the right side of his skull \* \* \* he was shot from above and behind."<sup>153</sup>

Comdr. James J. Humes, senior pathologist and director of laboratories at the Bethesda Naval Hospital, who acted as chief autopsy surgeon, concurred in Colonel Finck's analysis. He compared the beveling or coning effect to that caused by a BB shot which strikes a pane of glass, causing a round or oval defect on the side of the glass where the missile strikes and a belled-out or coned-out surface on the opposite side of the glass.<sup>154</sup> Referring to the bullet hole on the back of President Kennedy's head, Commander Humes testified: "The wound on the inner table, however, was larger and had what in the field of wound ballistics is described as a shelving or coning effect."<sup>155</sup> After studying the other hole in the President's skull, Commander Humes stated: "\* \* \* we concluded that the large defect to the upper right side of the skull, in fact, would represent a wound of exit."<sup>156</sup> Those characteristics led Commander Humes and Comdr. J. Thornton Boswell, chief of pathology at Bethesda Naval Hospital, who assisted in the autopsy, to conclude that the bullet

penetrated the rear of the President's head and exited through a large wound on the right side of his head.<sup>157</sup>

Ballistics experiments (discussed more fully in app. X, pp. 585-586) showed that the rifle and bullets identified above were capable of producing the President's head wound. The Wound Ballistics Branch of the U.S. Army laboratories at Edgewood Arsenal, Md., conducted an extensive series of experiments to test the effect of Western Cartridge Co. 6.5-millimeter bullets, the type found on Governor Connally's stretcher and in the Presidential limousine, fired from the C2766 Mannlicher-Carcano rifle found in the Depository. The Edgewood Arsenal tests were performed under the immediate supervision of Alfred G. Olivier, a doctor who had spent 7 years in wounds ballistics research for the U.S. Army.<sup>158</sup>

One series of tests, performed on reconstructed inert human skulls, demonstrated that the President's head wound could have been caused by the rifle and bullets fired by the assassin from the sixth-floor window. The results of this series were illustrated by the findings on one skull which was struck at a point closely approximating the wound of entry on President Kennedy's head. That bullet blew out the right side of the reconstructed skull in a manner very similar to the head wound of the President.<sup>159</sup> As a result of these tests, Dr. Olivier concluded that a Western Cartridge Co. 6.5 bullet fired from the C2766 Mannlicher-Carcano rifle at a distance of 90 yards would make the same type of wound as that found on the President's head. Referring to the series of tests, Dr. Olivier testified:

It disclosed that the type of head wounds that the President received could be done by this type of bullet. This surprised me very much, because this type of stable bullet I didn't think would cause a massive head wound, I thought it would go through making a small entrance and exit, but the bones of the skull are enough to deform the end of this bullet causing it to expend a lot of energy and blowing out the side of the skull or blowing out fragments of the skull.<sup>160</sup>

After examining the fragments of the bullet which struck the reconstructed skull, Dr. Olivier stated that—

the recovered fragments were very similar to the ones recovered on the front seat and on the floor of the car.

This, to me, indicates that those fragments did come from the bullet that wounded the President in the head.<sup>161</sup>

### The President's Neck Wounds

During the autopsy at Bethesda Naval Hospital another bullet wound was observed near the base of the back of President Kennedy's neck slightly to the right of his spine which provides further enlightenment as to the source of the shots. The hole was located approxi-

mately 5½ inches (14 centimeters) from the tip of the right shoulder joint and approximately the same distance below the tip of the right mastoid process, the bony point immediately behind the ear.<sup>162</sup> The wound was approximately one-fourth by one-seventh of an inch (7 by 4 millimeters), had clean edges, was sharply delineated, and had margins similar in all respects to those of the entry wound in the skull.<sup>163</sup> Commanders Humes and Boswell agreed with Colonel Finck's testimony that this hole—

\* \* \* is a wound of entrance. \* \* \* The basis for that conclusion is that this wound was relatively small with clean edges. It was not a jagged wound, and that is what we see in wound of entrance at a long range.<sup>164</sup>

The autopsy examination further disclosed that, after entering the President, the bullet passed between two large muscles, produced a contusion on the upper part of the pleural cavity (without penetrating that cavity), bruised the top portion of the right lung and ripped the windpipe (trachea) in its path through the President's neck.<sup>165</sup> The examining surgeons concluded that the wounds were caused by the bullet rather than the tracheotomy performed at Parkland Hospital. The nature of the bruises indicated that the President's heart and lungs were functioning when the bruises were caused, whereas there was very little circulation in the President's body when incisions on the President's chest were made to insert tubes during the tracheotomy.<sup>166</sup> No bone was struck by the bullet which passed through the President's body.<sup>167</sup> By projecting from a point of entry on the rear of the neck and proceeding at a slight downward angle through the bruised interior portions, the doctors concluded that the bullet exited from the front portion of the President's neck that had been cut away by the tracheotomy.<sup>168</sup>

Concluding that a bullet passed through the President's neck, the doctors at Bethesda Naval Hospital rejected a theory that the bullet lodged in the large muscles in the back of his neck and fell out through the point of entry when external heart massage was applied at Parkland Hospital. In the earlier stages of the autopsy, the surgeons were unable to find a path into any large muscle in the back of the neck. At that time they did not know that there had been a bullet hole in the front of the President's neck when he arrived at Parkland Hospital because the tracheotomy incision had completely eliminated that evidence.<sup>169</sup> While the autopsy was being performed, surgeons learned that a whole bullet had been found at Parkland Hospital on a stretcher which, at that time, was thought to be the stretcher occupied by the President. This led to speculation that the bullet might have penetrated a short distance into the back of the neck and then dropped out onto the stretcher as a result of the external heart massage.<sup>170</sup>

Further exploration during the autopsy disproved that theory. The surgeons determined that the bullet had passed between two large strap muscles and bruised them without leaving any channel, since the bullet

merely passed between them.<sup>171</sup> Commander Humes, who believed that a tracheotomy had been performed from his observations at the autopsy, talked by telephone with Dr. Perry early on the morning of November 23, and learned that his assumption was correct and that Dr. Perry had used the missile wound in the neck as the point to make the incision.<sup>172</sup> This confirmed the Bethesda surgeons' conclusion that the bullet had exited from the front part of the neck.

The findings of the doctors who conducted the autopsy were consistent with the observations of the doctors who treated the President at Parkland Hospital. Dr. Charles S. Carrico, a resident surgeon at Parkland, noted a small wound approximately one-fourth of an inch in diameter (5 to 8 millimeters) in the lower third of the neck below the Adam's apple.<sup>173</sup> Dr. Malcolm O. Perry, who performed the tracheotomy, described the wound as approximately one-fifth of an inch in diameter (5 millimeters) and exuding blood which partially hid edges that were "neither cleancut, that is, punched out, nor were they very ragged."<sup>174</sup> Dr. Carrico testified as follows:

Q. Based on your observations on the neck wound alone did you have a sufficient basis to form an opinion as to whether it was an entrance or an exit wound?

A. No, sir; we did not. Not having completely evaluated all the wounds, traced out the course of the bullets, this wound would have been compatible with either entrance or exit wound depending upon the size, the velocity, the tissue structure and so forth.<sup>175</sup>

The same response was made by Dr. Perry to a similar query:

Q. Based on the appearance of the neck wound alone, could it have been either an entrance or an exit wound?

A. It could have been either.<sup>176</sup>

Then each doctor was asked to take into account the other known facts, such as the autopsy findings, the approximate distance the bullet traveled and tested muzzle velocity of the assassination weapon. With these additional factors, the doctors commented on the wound on the front of the President's neck as follows:

Dr. CARRICO. With those facts and the fact as I understand it no other bullet was found this would be, this was, I believe, was an exit wound.<sup>177</sup>

Dr. PERRY. A full jacketed bullet without deformation passing through skin would leave a similar wound for an exit and entrance wound and with the facts which you have made available and with these assumptions, I believe that it was an exit wound.<sup>178</sup>

Other doctors at Parkland Hospital who observed the wound prior to the tracheotomy agreed with the observations of Drs. Perry and Carrico.<sup>179</sup> The bullet wound in the neck could be seen for only a short time, since Dr. Perry eliminated evidence of it when he performed

the tracheotomy. He selected that spot since it was the point where such an operation was customarily performed, and it was one of the safest and easiest spots from which to reach the trachea. In addition, there was possibly an underlying wound to the muscles in the neck, the carotid artery or the jugular vein, and Dr. Perry concluded that the incision, therefore, had to be low in order to maintain respiration.<sup>180</sup>

Considerable confusion has arisen because of comments attributed to Dr. Perry concerning the nature of the neck wound. Immediately after the assassination, many people reached erroneous conclusions about the source of the shots because of Dr. Perry's observations to the press. On the afternoon of November 22, a press conference was organized at Parkland Hospital by members of the White House press staff and a hospital administrator. Newsmen with microphones and cameras were crowded into a room to hear statements by Drs. Perry and William Kemp Clark, chief neurosurgeon at Parkland, who had attended to President Kennedy's head injury. Dr. Perry described the situation as "bedlam."<sup>181</sup> The confusion was compounded by the fact that some questions were only partially answered before other questions were asked.<sup>182</sup>

At the news conference, Dr. Perry answered a series of hypothetical questions and stated to the press that a variety of possibilities could account for the President's wounds. He stated that a single bullet could have caused the President's wounds by entering through the throat, striking the spine, and being deflected upward with the point of exit being through the head.<sup>183</sup> This would have accounted for the two wounds he observed, the hole in the front of the neck and the large opening in the skull. At that time, Dr. Perry did not know about either the wound on the back of the President's neck or the small bullet-hole wound in the back of the head. As described in chapter II, the President was lying on his back during his entire time at Parkland. The small hole in the head was also hidden from view by the large quantity of blood which covered the President's head. Dr. Perry said his answers at the press conference were intended to convey his theory about what could have happened, based on his limited knowledge at the time, rather than his professional opinion about what did happen.<sup>184</sup> Commenting on his answers at the press conference, Dr. Perry testified before the Commission:

I expressed it [his answers] as a matter of speculation that this was conceivable. But, again, Dr. Clark [who also answered questions at the conference] and I emphasized that we had no way of knowing.<sup>185</sup>

Dr. Perry's recollection of his comments is corroborated by some of the news stories after the press conference. The New York Herald Tribune on November 23, 1963, reported as follows:

Dr. Malcolm Perry, 34, attendant surgeon at Parkland Hospital who attended the President, said he saw two wounds—

one below the Adam's apple, the other at the back of the head. He said he did not know if two bullets were involved. It is possible, he said, that the neck wound was the entrance and the other the exit of the missile.<sup>186</sup>

According to this report, Dr. Perry stated merely that it was "possible" that the neck wound was a wound of entrance. This conforms with his testimony before the Commission, where he stated that by themselves the characteristics of the neck wound were consistent with being either a point of entry or exit.

*Wound ballistics tests.*—Experiments performed by the Army Wound Ballistics experts at Edgewood Arsenal, Md. (discussed in app. X, p. 582) showed that under simulated conditions entry and exit wounds are very similar in appearance. After reviewing the path of the bullet through the President's neck, as disclosed in the autopsy report, the experts simulated the neck by using comparable material with a thickness of approximately 5½ inches (13½ to 14½ centimeters), which was the distance traversed by the bullet. Animal skin was placed on each side, and Western Cartridge Co. 6.5 bullets were fired from the C2766 Mannlicher-Carcano rifle from a distance of 180 feet. The animal skin on the entry side showed holes which were regular and round. On the exit side two holes were only slightly elongated, indicating that the bullet had become only a little unstable at the point of exit.<sup>187</sup> A third exit hole was round, although not quite as regular as the entry holes.<sup>188</sup> The exit holes, especially the one most nearly round, appeared similar to the descriptions given by Drs. Perry and Carrico of the hole in the front of the President's neck.<sup>189</sup>

The autopsy disclosed that the bullet which entered the back of the President's neck hit no bony structure and proceeded in a slightly downward angle. The markings on the President's clothing indicate that the bullet moved in a slight right to left lateral direction as it passed through the President's body.<sup>190</sup> After the examining doctors expressed the thought that a bullet would have lost very little velocity in passing through the soft tissue of the neck, wound ballistics experts conducted tests to measure the exit velocity of the bullet.<sup>191</sup> The tests were the same as those used to create entry and exit holes, supplemented by the use of break-type screens which measured the velocity of bullets. The entrance velocity of the bullet fired from the rifle averaged 1,904 feet per second after it traveled 180 feet. The exit velocity averaged 1,772 to 1,798 feet per second, depending upon the substance through which the bullet passed. A photograph of the path of the bullet traveling through the simulated neck showed that it proceeded in a straight line and was stable.<sup>192</sup>

*Examination of clothing.*—The clothing worn by President Kennedy on November 22 had holes and tears which showed that a missile entered the back of his clothing in the vicinity of his lower neck and exited through the front of his shirt immediately behind his tie, nicking the knot of his tie in its forward flight.<sup>193</sup> Although the caliber of the bullet could not be determined and some of the clothing items

precluded a positive determination that some tears were made by a bullet, all the defects could have been caused by a 6.5-millimeter bullet entering the back of the President's lower neck and exiting in the area of the knot of his tie.<sup>194</sup>

An examination of the suit jacket worn by the President by FBI Agent Frazier revealed a roughly circular hole approximately one-fourth of an inch in diameter on the rear of the coat,  $5\frac{3}{8}$  inches below the top of the collar and  $1\frac{3}{4}$  inches to the right of the center back seam of the coat.<sup>195</sup> The hole was visible on the upper rear of the coat slightly to the right of center. Traces of copper were found in the margins of the hole and the cloth fibers around the margins were pushed inward.<sup>196</sup> Those characteristics established that the hole was caused by an entering bullet.<sup>197</sup> Although the precise size of the bullet could not be determined from the hole, it was consistent with having been made by a 6.5-millimeter bullet.<sup>198</sup>

The shirt worn by the President contained a hole on the back side  $5\frac{3}{4}$  inches below the top of the collar and  $1\frac{1}{8}$  inches to the right of the middle of the back of the shirt.<sup>199</sup> The hole on the rear of the shirt was approximately circular in shape and about one-fourth of an inch in diameter, with the fibers pressed inward.<sup>200</sup> These factors established it as a bullet entrance hole.<sup>201</sup> The relative position of the hole in the back of the suit jacket to the hole in the back of the shirt indicated that both were caused by the same penetrating missile.<sup>202</sup>

On the front of the shirt, examination revealed a hole seven-eighths of an inch below the collar button and a similar opening seven-eighths of an inch below the buttonhole. These two holes fell into alignment on overlapping positions when the shirt was buttoned.<sup>203</sup> Each hole was a vertical, ragged slit approximately one-half of an inch in height, with the cloth fibers protruding outward. Although the characteristics of the slit established that the missile had exited to the front, the irregular nature of the slit precluded a positive determination that it was a bullet hole.<sup>204</sup> However, the hole could have been caused by a round bullet although the characteristics were not sufficiently clear to enable the examining expert to render a conclusive opinion.<sup>205</sup>

When the President's clothing was removed at Parkland Hospital, his tie was cut off by severing the loop immediately to the wearer's left of the knot, leaving the knot in its original condition.<sup>206</sup> The tie had a nick on the left side of the knot.<sup>207</sup> The nick was elongated horizontally, indicating that the tear was made by some object moving horizontally, but the fibers were not affected in a manner which would shed light on the direction or the nature of the missile.<sup>208</sup>

### The Governor's Wounds

While riding in the right jump seat of the Presidential limousine on November 22, Governor Connally sustained wounds of the back, chest, right wrist and left thigh. Because of the small size and clean-cut edges of the wound on the Governor's back, Dr. Robert Shaw concluded that it was an entry wound.<sup>209</sup> The bullet traversed the Gov-

ernor's chest in a downward angle, shattering his fifth rib, and exited below the right nipple.<sup>210</sup> The ragged edges of the 2-inch (5 centimeters) opening on the front of the chest led Dr. Shaw to conclude that it was the exit point of the bullet.<sup>211</sup> When Governor Connally testified before the Commission 5 months after the assassination, on April 21, 1964, the Commission observed the Governor's chest wounds, as well as the injuries to his wrist and thigh and watched Dr. Shaw measure with a caliper an angle of declination of 25° from the point of entry on the back to the point of exit on the front of the Governor's chest.<sup>212</sup>

At the time of the shooting, Governor Connally was unaware that he had sustained any injuries other than his chest wounds.<sup>213</sup> On the back of his arm, about 2 inches (5 centimeters) above the wrist joint on the thumb side, Dr. Charles F. Gregory observed a linear perforating wound approximately one-fifth of an inch (one-half centimeter) wide and 1 inch (2½ centimeters) long.<sup>214</sup> During his operation on this injury, the doctor concluded that this ragged wound was the point of entry because thread and cloth had been carried into the wound to the region of the bone.<sup>215</sup> Dr. Gregory's conclusions were also based upon the location in the Governor's wrist, as revealed by X-ray, of small fragments of metal shed by the missile upon striking the firm surface of the bone.<sup>216</sup> Evidence of different amounts of air in the tissues of the wrist gave further indication that the bullet passed from the back to the front of the wrist.<sup>217</sup> An examination of the palm surface of the wrist showed a wound approximately one-fifth of an inch (one-half centimeter) long and approximately three-fourths of an inch (2 centimeters) above the crease of the right wrist.<sup>218</sup> Dr. Shaw had initially believed that the missile entered on the palm side of the Governor's wrist and exited on the back side.<sup>219</sup> After reviewing the factors considered by Dr. Gregory, however, Dr. Shaw withdrew his earlier opinion. He deferred to the judgment of Dr. Gregory, who had more closely examined that wound during the wrist operation.<sup>220</sup>

In addition, Governor Connally suffered a puncture wound in the left thigh that was approximately two-fifths of an inch (1 centimeter) in diameter and located approximately 5 or 6 inches above the Governor's left knee.<sup>221</sup> On the Governor's leg, very little soft-tissue damage was noted, which indicated a tangential wound or the penetration of a larger missile entering at low velocity and stopping after entering the skin.<sup>222</sup> X-ray examination disclosed a tiny metallic fragment embedded in the Governor's leg.<sup>223</sup> The surgeons who attended the Governor concluded that the thigh wound was not caused by the small fragment in the thigh but resulted from the impact of a larger missile.<sup>224</sup>

*Examination of clothing.*—The clothing worn by Governor Connally on November 22, 1963, contained holes which matched his wounds. On the back of the Governor's coat, a hole was found 1½ inches from the seam where the right sleeve attached to the coat and 7¼ inches to the right of the midline.<sup>225</sup> This hole was elongated in a horizontal direction approximately five-eighths of an inch in length

and one-fourth of an inch in height.<sup>226</sup> The front side of the Governor's coat contained a circular hole three-eighths of an inch in diameter, located 5 inches to the right of the front right edge of the coat slightly above the top button.<sup>227</sup> A rough hole approximately five-eighths of an inch in length and three-eighths of an inch in width was found near the end of the right sleeve.<sup>228</sup> Each of these holes could have been caused by a bullet, but a positive determination of this fact or the direction of the missile was not possible because the garment had been cleaned and pressed prior to any opportunity for a scientific examination.<sup>229</sup>

An examination of the Governor's shirt disclosed a very ragged tear five-eighths of an inch long horizontally and one-half of an inch vertically on the back of the shirt near the right sleeve 2 inches from the line where the sleeve attaches.<sup>230</sup> Immediately to the right was another small tear, approximately three-sixteenths of an inch long.<sup>231</sup> The two holes corresponded in position to the hole in the back of the Governor's coat.<sup>232</sup> A very irregular tear in the form of an "H" was observed on the front side of the Governor's shirt, approximately 1½ inches high, with a crossbar tear approximately 1 inch wide, located 5 inches from the right side seam and 9 inches from the top of the right sleeve.<sup>233</sup> Because the shirt had been laundered, there were insufficient characteristics for the expert examiner to form a conclusive opinion on the direction or nature of the object causing the holes.<sup>234</sup> The rear hole could have been caused by the entrance of a 6.5-millimeter bullet and the front hole by the exit of such a bullet.<sup>235</sup>

On the French cuff of the right sleeve of the Governor's shirt was a ragged, irregularly shaped hole located 1½ inches from the end of the sleeve and 5½ inches from the outside cuff-link hole.<sup>236</sup> The characteristics after laundering did not permit positive conclusions but these holes could have been caused by a bullet passing through the Governor's right wrist from the back to the front sides.<sup>237</sup> The Governor's trousers contained a hole approximately one-fourth of an inch in diameter in the region of the left knee.<sup>238</sup> The roughly circular shape of the hole and the slight tearing away from the edges gave the hole the general appearance of a bullet hole but it was not possible to determine the direction of the missile which caused the hole.<sup>239</sup>

*Course of bullet.*—Ballistics experiments and medical findings established that the missile which passed through the Governor's wrist and penetrated his thigh had first traversed his chest. The Army Wound Ballistics experts conducted tests which proved that the Governor's wrist wound was not caused by a pristine bullet. (See app. X, pp. 582-585.) A bullet is pristine immediately on exiting from a rifle muzzle when it moves in a straight line with a spinning motion and maintains its uniform trajectory with but a minimum of nose surface striking the air through which it passes.<sup>240</sup> When the straight line of flight of a bullet is deflected by striking some object, it starts to wobble or become irregular in flight, a condition called yaw.<sup>241</sup> A bullet with yaw has a greater surface exposed to the striking material or air, since the target or air is struck not only by the nose of the bullet, its smallest striking surface, but also by the bullet's sides.<sup>242</sup>

The ballistics experts learned the exact nature of the Governor's wrist wound by examining Parkland Hospital records and X-rays and conferring with Dr. Gregory. The C2766 Mannlicher-Carcano rifle found in the Depository was fired with bullets of the same type as the bullet found on the Governor's stretcher and the fragments found in the Presidential limousine. Shots were fired from a distance of 70 yards at comparable flesh and bone protected by material similar to the clothing worn by the Governor.<sup>243</sup> One of the test shots wounded the comparable flesh and bone structure in virtually the same place and from the same angle as the wound inflicted on Governor Connally's wrist. An X-ray and photograph of the simulated wrist confirmed the similarity.<sup>244</sup> The bullet which inflicted that injury during the tests had a nose which was substantially flattened from striking the material.<sup>245</sup> The striking velocity at 70 yards of seven shots fired during the tests averaged 1,858 feet per second; the average exit velocity of five shots was 1,776 feet per second.<sup>246</sup>

The conclusion that the Governor's wrist was not struck by a pristine bullet was based upon the following: (1) greater damage was inflicted on the test material than on the Governor's wrist;<sup>247</sup> (2) the test material had a smaller entry wound and a larger exit wound, characteristic of a pristine bullet, while the Governor's wrist had a larger entry wound as compared with its exit wound, indicating a bullet which was tumbling;<sup>248</sup> (3) cloth was carried into the wrist wound, which is characteristic of an irregular missile;<sup>249</sup> (4) the partial cutting of a radial nerve and tendon leading to the Governor's thumb further suggested that the bullet which struck him was not pristine, since such a bullet would merely push aside a tendon and nerve rather than catch and tear them;<sup>250</sup> (5) the bullet found on the Governor's stretcher probably did not pass through the wrist as a pristine bullet because its nose was not considerably flattened, as was the case with the pristine bullet which struck the simulated wrist;<sup>251</sup> and (6) the bullet which caused the Governor's thigh injury and then fell out of the wound had a "very low velocity," whereas the pristine bullets fired during the tests possessed a very high exit velocity.<sup>252</sup>

All the evidence indicated that the bullet found on the Governor's stretcher could have caused all his wounds. The weight of the whole bullet prior to firing was approximately 160-161 grains and that of the recovered bullet was 158.6 grains.<sup>253</sup> An X-ray of the Governor's wrist showed very minute metallic fragments, and two or three of these fragments were removed from his wrist.<sup>254</sup> All these fragments were sufficiently small and light so that the nearly whole bullet found on the stretcher could have deposited those pieces of metal as it tumbled through his wrist.<sup>255</sup> In their testimony, the three doctors who attended Governor Connally at Parkland Hospital expressed independently their opinion that a single bullet had passed through his chest; tumbled through his wrist with very little exit velocity, leaving small metallic fragments from the rear portion of the bullet; punctured his left thigh after the bullet had lost virtually all of its velocity; and had fallen out of the thigh wound.<sup>256</sup>

Governor Connally himself thought it likely that all his wounds were caused by a single bullet. In his testimony before the Commission, he repositioned himself as he recalled his position on the jump seat, with his right palm on his left thigh, and said:

I \* \* \* wound up the next day realizing I was hit in three places, and I was not conscious of having been hit but by one bullet, so I tried to reconstruct how I could have been hit in three places by the same bullet, and I merely, I know it penetrated from the back through the chest first.

I assumed that I had turned as I described a moment ago, placing my right hand on my left leg, that it hit my wrist, went out the center of the wrist, the underside, and then into my leg, but it might not have happened that way at all.<sup>257</sup>

The Governor's posture explained how a single missile through his body would cause all his wounds. His doctors at Parkland Hospital had recreated his position, also, but they placed his right arm somewhat higher than his left thigh although in the same alignment.<sup>258</sup> The wound ballistics experts concurred in the opinion that a single bullet caused all the Governor's wounds.<sup>259</sup>

## THE TRAJECTORY

The cumulative evidence of eyewitnesses, firearms and ballistic experts and medical authorities demonstrated that the shots were fired from above and behind President Kennedy and Governor Connally, more particularly, from the sixth floor of the Texas School Book Depository Building. In order to determine the facts with as much precision as possible and to insure that all data were consistent with the shots having been fired from the sixth floor window, the Commission requested additional investigation, including the analysis of motion picture films of the assassination and onsite tests. The facts developed through this investigation by the FBI and Secret Service confirmed the conclusions reached by the Commission regarding the source and trajectory of the shots which hit the President and the Governor. Moreover, these facts enabled the Commission to make certain approximations regarding the locations of the Presidential limousine at the time of the shots and the relevant time intervals.

### Films and Tests

When the shots rang out the Presidential limousine was moving beyond the Texas School Book Depository Building in a southwesterly direction on Elm Street between Houston Street and the Triple Underpass.<sup>260</sup> The general location of the car was described and marked on maps by eyewitnesses as precisely as their observations and recollections permitted.<sup>261</sup> More exact information was provided by motion

pictures taken by Abraham Zapruder, Orville O. Nix and Mary Muchmore, who were spectators at the scene.<sup>262</sup> Substantial light has been shed on the assassination sequence by viewing these motion pictures, particularly the Zapruder film, which was the most complete and from which individual 35-millimeter slides were made of each motion picture frame.<sup>263</sup>

Examination of the Zapruder motion picture camera by the FBI established that 18.3 pictures or frames were taken each second, and therefore, the timing of certain events could be calculated by allowing 1/18.3 seconds for the action depicted from one frame to the next.<sup>264</sup> The films and slides made from individual frames were viewed by Governor and Mrs. Connally, the Governor's doctors, the autopsy surgeons, and the Army wound ballistics scientists in order to apply the knowledge of each to determine the precise course of events.<sup>265</sup> Tests of the assassin's rifle disclosed that at least 2.3 seconds were required between shots.<sup>266</sup> In evaluating the films in the light of these timing guides, it was kept in mind that a victim of a bullet wound may not react immediately and, in some situations, according to experts, the victim may not even know where he has been hit, or when.<sup>267</sup>

On May 24, 1964, agents of the FBI and Secret Service conducted a series of tests to determine as precisely as possible what happened on November 22, 1963. Since the Presidential limousine was being remodeled and was therefore unavailable, it was simulated by using the Secret Service followup car, which is similar in design.<sup>268</sup> Any differences were taken into account. Two Bureau agents with approximately the same physical characteristics sat in the car in the same relative positions as President Kennedy and Governor Connally had occupied. The back of the stand-in for the President was marked with chalk at the point where the bullet entered. The Governor's model had on the same coat worn by Governor Connally when he was shot, with the hole in the back circled in chalk.<sup>269</sup>

To simulate the conditions which existed at the assassination scene on November 22, the lower part of the sixth-floor window at the southeast corner of the Depository Building was raised halfway, the cardboard boxes were repositioned, the C2766 Mannlicher-Carcano rifle found on the sixth floor of the Depository was used, and mounted on that rifle was a camera which recorded the view as was seen by the assassin.<sup>270</sup> In addition, the Zapruder, Nix, and Muchmore cameras were on hand so that photographs taken by these cameras from the same locations where they were used on November 22, 1963, could be compared with the films of that date.<sup>271</sup> The agents ascertained that the foliage of an oak tree that came between the gunman and his target along the motorcade route on Elm Street was approximately the same as on the day of the assassination.<sup>272</sup>

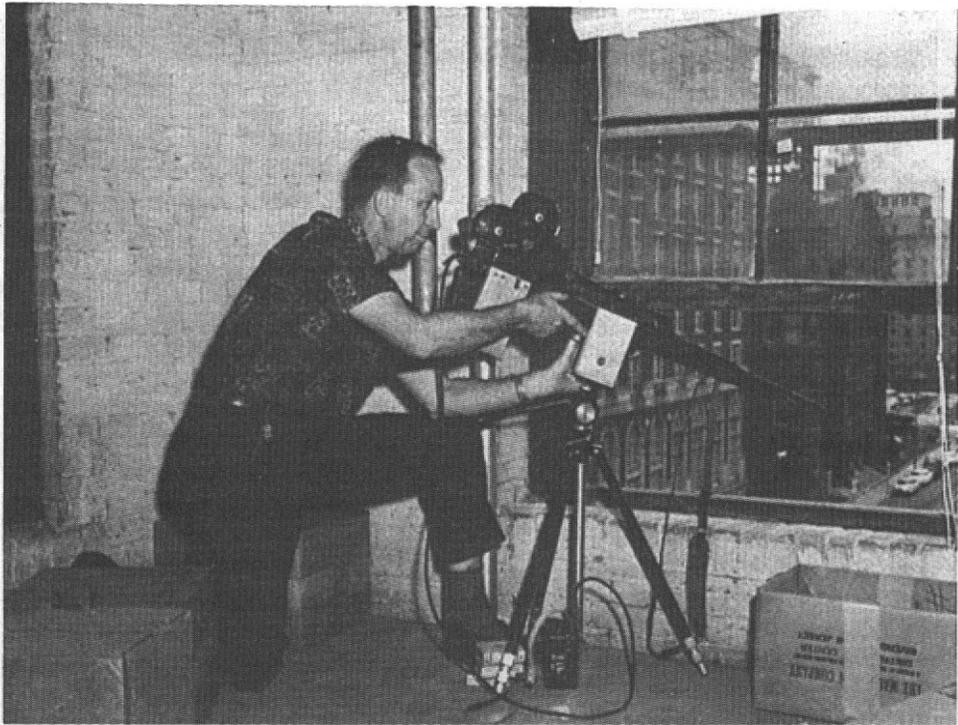
### The First Bullet That Hit

The position of President Kennedy's car when he was struck in the neck was determined with substantial precision from the films and

onsite tests. The pictures or frames in the Zapruder film were marked by the agents, with the number "1" given to the first frame where the motorcycles leading the motorcade came into view on Houston Street.<sup>273</sup> The numbers continue in sequence as Zapruder filmed the Presidential limousine as it came around the corner and proceeded down Elm. The President was in clear view of the assassin as he rode up Houston Street and for 100 feet as he proceeded down Elm Street, until he came to a point denoted as frame 166 on the Zapruder film.<sup>274</sup> These facts were determined in the test by placing the car and men on Elm Street in the exact spot where they were when each frame of the Zapruder film was photographed. To pinpoint their locations, a man stood at Zapruder's position and directed the automobile and both models to the positions shown on each frame, after which a Bureau photographer crouched at the sixth-floor window and looked through a camera whose lens recorded the view through the telescopic sight of the C2766 Mannlicher-Carcano rifle.<sup>275</sup> (See Commission Exhibit No. 887, p. 99.) Each position was measured to determine how far President Kennedy had gone down Elm from a point, which was designated as station C, on a line drawn along the west curblin of Houston Street.<sup>276</sup>

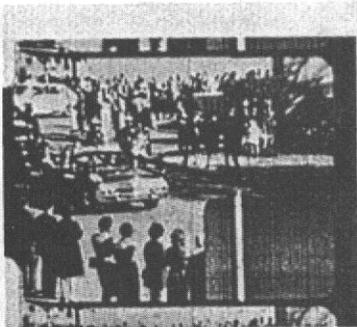
Based on these calculations, the agents concluded that at frame 166 of the Zapruder film the President passed beneath the foliage of the large oak tree and the point of impact on the President's back disappeared from the gunman's view as seen through the telescopic lens.<sup>277</sup> (See Commission Exhibit No. 889, p. 100.) For a fleeting instant, the President came back into view in the telescopic lens at frame 186 as he appeared in an opening among the leaves.<sup>278</sup> (See Commission Exhibit No. 891, p. 101.) The test revealed that the next point at which the rifleman had a clear view through the telescopic sight of the point where the bullet entered the President's back was when the car emerged from behind the tree at frame 210.<sup>279</sup> (See Commission Exhibit No. 893, p. 102.) According to FBI Agent Lyndal L. Shaneyfelt, "There is no obstruction from the sixth floor window from the time they leave the tree until they disappear down toward the triple overpass."<sup>280</sup>

As the President rode along Elm Street for a distance of about 140 feet, he was waving to the crowd.<sup>281</sup> Shaneyfelt testified that the waving is seen on the Zapruder movie until around frame 205, when a road sign blocked out most of the President's body from Zapruder's view through the lens of his camera. However, the assassin continued to have a clear view of the President as he proceeded down Elm.<sup>282</sup> When President Kennedy again came fully into view in the Zapruder film at frame 225, he seemed to be reacting to his neck wound by raising his hands to his throat.<sup>283</sup> (See Commission Exhibit No. 895, p. 103.) According to Shaneyfelt the reaction was "clearly apparent in 226 and barely apparent in 225."<sup>284</sup> It is probable that the President was not shot before frame 210, since it is unlikely that the assassin would deliberately have shot at him with a view obstructed by the oak tree when he was about to have a clear opportunity. It is

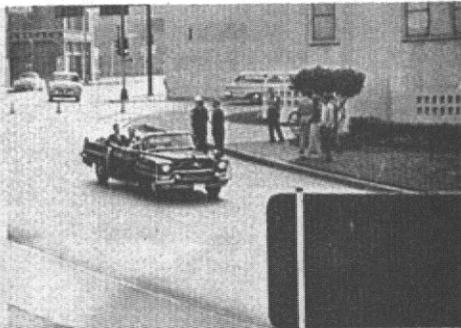


COMMISSION EXHIBIT No. 887

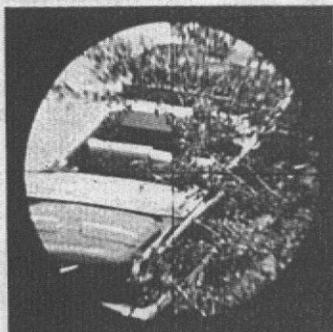
Photograph taken during reenactment showing C2766 rifle with camera attached.



PHOTOGRAPH FROM ZAPRUDER FILM



PHOTOGRAPH FROM RE-ENACTMENT

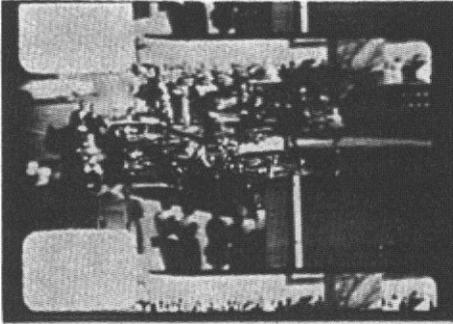


PHOTOGRAPH THROUGH RIFLE SCOPE

DISTANCE TO STATION C ..... 95.6 FT.  
DISTANCE TO RIFLE IN WINDOW ..... 138.2 FT.  
ANGLE TO RIFLE IN WINDOW ..... 26°52'  
DISTANCE TO OVERPASS ..... 391.5 FT.  
ANGLE TO OVERPASS ..... 0°07'

## FRAME 166

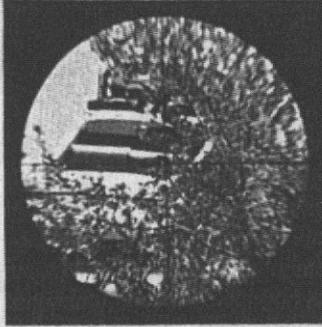
COMMISSION EXHIBIT No. 889



PHOTOGRAPH FROM ZAPRUDER FILM



PHOTOGRAPH FROM RE-ENACTMENT

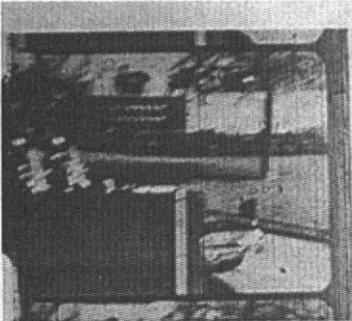


PHOTOGRAPH THROUGH RIFLE SCOPE

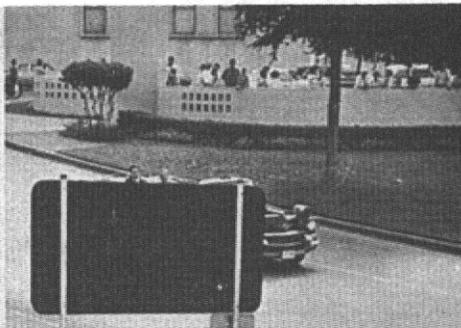
DISTANCE TO STATION C .....	116.3 FT.
DISTANCE TO RIFLE IN WINDOW .....	156.3 FT.
ANGLE TO RIFLE IN WINDOW .....	24°03'
DISTANCE TO OVERPASS .....	371.7 FT.
ANGLE TO OVERPASS .....	-0°03'

# FRAME 186

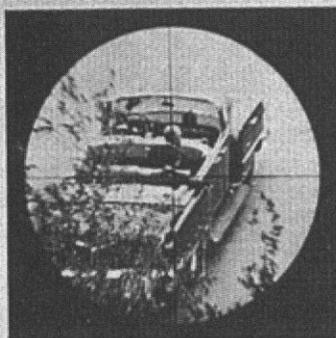
COMMISSION EXHIBIT No. 891



PHOTOGRAPH FROM ZAPRUDER FILM



PHOTOGRAPH FROM RE-ENACTMENT

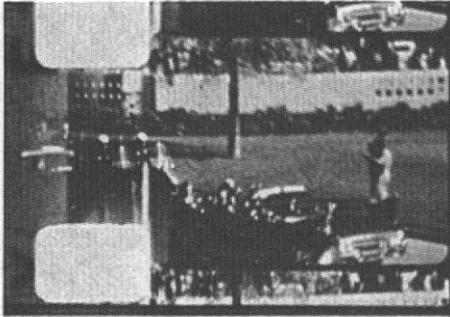


PHOTOGRAPH THROUGH RIFLE SCOPE

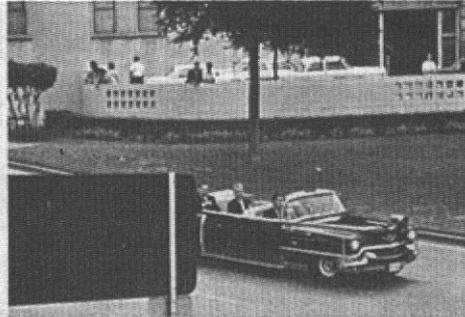
DISTANCE TO STATION C .....	138.9 FT.
DISTANCE TO RIFLE IN WINDOW .....	176.9 FT.
ANGLE TO RIFLE IN WINDOW .....	21°34'
DISTANCE TO OVERPASS .....	348.8 FT.
ANGLE TO OVERPASS .....	-0°22'

# FRAME 210

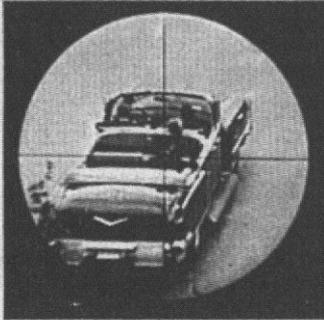
COMMISSION EXHIBIT No. 893



PHOTOGRAPH FROM ZAPRUDER FILM



PHOTOGRAPH FROM RE-ENACTMENT



PHOTOGRAPH THROUGH RIFLE SCOPE

DISTANCE TO STATION C .....	153.8 FT.
DISTANCE TO RIFLE IN WINDOW .....	190.8 FT.
ANGLE TO RIFLE IN WINDOW .....	20°11'
DISTANCE TO OVERPASS .....	334.0 FT.
ANGLE TO OVERPASS .....	0°26'

## FRAME 225

COMMISSION EXHIBIT No. 895



COMMISSION EXHIBIT No. 697

Photograph of Presidential limousine taken during motorcade.

also doubtful that even the most proficient marksman would have hit him through the oak tree. In addition, the President's reaction is "barely apparent" in frame 225, which is 15 frames or approximately eight-tenths second after frame 210, and a shot much before 210 would assume a longer reaction time than was recalled by eyewitnesses at the scene. Thus, the evidence indicated that the President was not hit until at least frame 210 and that he was probably hit by frame 225. The possibility of variations in reaction time in addition to the obstruction of Zapruder's view by the sign precluded a more specific determination than that the President was probably shot through the neck between frames 210 and 225, which marked his position between 138.9 and 153.8 feet west of station C.<sup>285</sup>

According to Special Agent Robert A. Frazier, who occupied the position of the assassin in the sixth-floor window during the reenactment, it is likely that the bullet which passed through the President's neck, as described previously, then struck the automobile or someone else in the automobile.<sup>286</sup> The minute examination by the FBI inspection team, conducted in Washington between 14 and 16 hours after the assassination, revealed no damage indicating that a bullet struck any part of the interior of the Presidential limousine, with the exception of the cracking of the windshield and the dent on the windshield chrome.<sup>287</sup> Neither of these points of damage to the car could have been caused by the bullet which exited from the President's neck at a velocity of 1,772 to 1,779 feet per second.<sup>288</sup> If the trajectory had permitted the bullet to strike the windshield, the bullet would have penetrated it and traveled a substantial distance down the road unless it struck some other object en route.<sup>289</sup> Had that bullet struck the metal framing, which was dented, it would have torn a hole in the chrome and penetrated the framing, both inside and outside the car.<sup>290</sup> At that exit velocity, the bullet would have penetrated any other metal or upholstery surface of the interior of the automobile.<sup>291</sup>

The bullet that hit President Kennedy in the back and exited through his throat most likely could not have missed both the automobile and its occupants. Since it did not hit the automobile, Frazier testified that it probably struck Governor Connally.<sup>292</sup> The relative positions of President Kennedy and Governor Connally at the time when the President was struck in the neck confirm that the same bullet probably passed through both men. Pictures taken of the President's limousine on November 22, 1963, showed that the Governor sat immediately in front of the President.<sup>293</sup> Even though the precise distance cannot be ascertained, it is apparent that President Kennedy was somewhat to the Governor's right. The President sat on the extreme right, as noted in the films and by eyewitnesses, while the right edge of the jump seat in which the Governor sat is 6 inches from the right door.<sup>294</sup> (See Commission Exhibit No. 697, p. 104.) The President wore a back brace which tended to make him sit up straight, and the Governor also sat erect since the jump seat gave him little leg room.<sup>295</sup>

Based on his observations during the reenactment and the position of Governor Connally shown in the Zapruder film after the car

emerged from behind the sign, Frazier testified that Governor Connally was in a position during the span from frame 207 to frame 225 to receive a bullet which would have caused the wounds he actually suffered.<sup>296</sup> Governor Connally viewed the film and testified that he was hit between frames 231 and 234.<sup>297</sup> According to Frazier, between frames 235 and 240 the Governor turned sharply to his right, so that by frame 240 he was too far to the right to have received his injuries at that time.<sup>298</sup> At some point between frames 235 and 240, therefore, is the last occasion when Governor Connally could have received his injuries, since in the frames following 240 he remained turned too far to his right.<sup>299</sup> If Governor Connally was hit by a separate shot between frames 235 and 240 which followed the shot which hit the President's neck, it would follow that: (1) the assassin's first shot, assuming a minimum firing time of 2.3 seconds (or 42 frames), was fired between frames 193 and 198 when his view was obscured by the oak tree; (2) President Kennedy continued waving to the crowd after he was hit and did not begin to react for about 1½ seconds; and (3) the first shot, although hitting no bones in the President's body, was deflected after its exit from the President's neck in such a way that it failed to hit either the automobile or any of the other occupants.

Viewed through the telescopic sight of the C2766 Mannlicher-Carcano rifle from the sixth-floor window during the test, the marks that simulated the entry wounds on the stand-ins for the President and the Governor were generally in a straight line. That alinement became obvious to the viewer through the scope as the Governor's model turned slightly to his right and assumed the position which Governor Connally had described as his position when he was struck. Viewing the stand-ins for the President and the Governor in the sight of the C2766 Mannlicher-Carcano rifle at the location depicted in frames 207 and 210, Frazier testified: "They both are in direct alinement with the telescopic sight at the window. The Governor is immediately behind the President in the field of view."<sup>300</sup> (See Commission Exhibit No. 893, p. 102.) A surveyor then placed his sighting equipment at the precise point of entry on the back of the President's neck, assuming that the President was struck at frame 210, and measured the angle to the end of the muzzle of the rifle positioned where it was believed to have been held by the assassin.<sup>301</sup> That angle measured 21°34'.<sup>302</sup> From the same points of reference, the angle at frame 225 was measured at 20°11', giving an average angle of 20°52'30" from frame 210 to frame 225.<sup>303</sup> Allowing for a downward street grade of 3°9', the probable angle through the President's body was calculated at 17°43'30", assuming that he was sitting in a vertical position.<sup>304</sup>

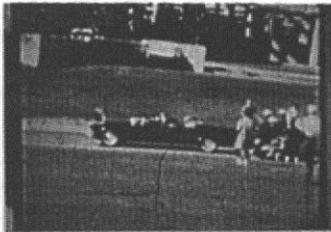
That angle was consistent with the trajectory of a bullet passing through the President's neck and then striking Governor Connally's back, causing the wounds which were discussed above. Shortly after that angle was ascertained, the open car and the stand-ins were taken by the agents to a nearby garage where a photograph was taken to determine through closer study whether the angle of that shot could have accounted for the wounds in the President's neck and the Gov-

ernor's back.<sup>305</sup> A rod was placed at an angle of  $17^{\circ}43'30''$  next to the stand-ins for the President and the Governor, who were seated in the same relative positions.<sup>306</sup> The wounds of entry and exit on the President were approximated based on information gained from the autopsy reports and photographs.<sup>307</sup> The hole in the back of the jacket worn by the Governor and the medical description of the wound on his back marked that entry point.<sup>308</sup> That line of fire from the sixth floor of the Depository would have caused the bullet to exit under the Governor's right nipple just as the bullet did. Governor Connally's doctors measured an angle of declination on his body from the entry wound on his back to the exit on the front of his chest at about  $25^{\circ}$  when he sat erect.<sup>309</sup> That difference was explained by either a slight deflection of the bullet caused by striking the fifth rib or the Governor's leaning slightly backward at the time he was struck. In addition, the angle could not be fixed with absolute precision, since the large wound on the front of his chest precluded an exact determination of the point of exit.<sup>310</sup>

The alinement of the points of entry was only indicative and not conclusive that one bullet hit both men. The exact positions of the men could not be re-created; thus, the angle could only be approximated.<sup>311</sup> Had President Kennedy been leaning forward or backward, the angle of declination of the shot to a perpendicular target would have varied. The angle of  $17^{\circ}43'30''$  was approximately the angle of declination reproduced in an artist's drawing.<sup>312</sup> That drawing, made from data provided by the autopsy surgeons, could not reproduce the exact line of the bullet, since the exit wound was obliterated by the tracheotomy. Similarly, if the President or the Governor had been sitting in a different lateral position, the conclusion might have varied. Or if the Governor had not turned in exactly the way calculated, the alinement would have been destroyed.

Additional experiments by the Army Wound Ballistics Branch further suggested that the same bullet probably passed through both President Kennedy and Governor Connally. (See app. X, pp. 582-585.) Correlation of a test simulating the Governor's chest wound with the neck and wrist experiments indicated that course. After reviewing the Parkland Hospital medical records and X-rays of the Governor and discussing his chest injury with the attending surgeon, the Army ballistics experts virtually duplicated the wound using the assassination weapon and animal flesh covered by cloth.<sup>313</sup> The bullet that struck the animal flesh displayed characteristics similar to the bullet found on Governor Connally's stretcher.<sup>314</sup> Moreover, the imprint on the velocity screen immediately behind the animal flesh showed that the bullet was tumbling after exiting from the flesh, having lost a total average of 265 feet per second.<sup>315</sup> Taking into consideration the Governor's size, the reduction in velocity of a bullet passing through his body would be approximately 400 feet per second.<sup>316</sup>

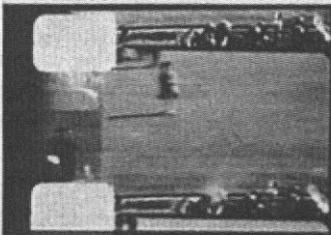
Based upon the medical evidence on the wounds of the Governor and the President and the wound ballistics tests performed at Edge-



PHOTOGRAPH FROM NIX FILM



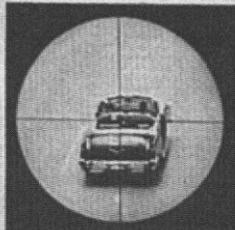
PHOTOGRAPH FROM RE-ENACTMENT



PHOTOGRAPH FROM ZAPRUDER FILM



PHOTOGRAPH FROM RE-ENACTMENT



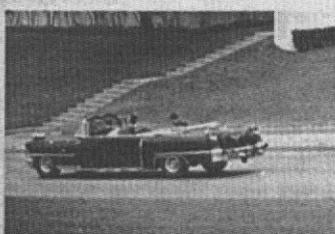
PHOTOGRAPH THROUGH RIFLE SCOPE

DISTANCE TO STATION C .....	230.0 FT.
DISTANCE TO RIFLE IN WINDOW .....	265.3 FT.
ANGLE TO RIFLE IN WINDOW .....	12°21'
DISTANCE TO OVERTAKE .....	260.0 FT.
ANGLE TO OVERTAKE .....	1°20'

**FRAME 313**



PHOTOGRAPH FROM MICHMORE FILM



PHOTOGRAPH FROM RE-ENACTMENT

**COMMISSION EXHIBIT No. 902**

wood Arsenal, Drs. Olivier and Arthur J. Dziemian, chief of the Army Wound Ballistics Branch, who had spent 17 years in that area of specialization, concluded that it was probable that the same bullet passed through the President's neck and then inflicted all the wounds on the Governor.<sup>317</sup> Referring to the President's neck wound and all the Governor's wounds, Dr. Dziemian testified: "I think the probability is very good that it is, that all the wounds were caused by one bullet."<sup>318</sup> Both Drs. Dziemian and Olivier believed that the wound on the Governor's wrist would have been more extensive had the bullet which inflicted that injury merely passed through the Governor's chest, exiting at a velocity of approximately 1,500 feet per second.<sup>319</sup> Thus, the Governor's wrist wound suggested that the bullet passed through the President's neck, began to yaw in the air between the President and the Governor, and then lost more velocity than 400 feet per second in passing through the Governor's chest. A bullet which was yawing on entering into the Governor's back would lose substantially more velocity in passing through his body than a pristine bullet.<sup>320</sup> In addition, the bullet that struck the animal flesh was flattened to a greater extent than the bullet which presumably struck the Governor's rib,<sup>321</sup> which suggests that the bullet which entered the Governor's chest had already lost velocity by passing through the President's neck. Moreover, the large wound on the Governor's back would be explained by a bullet which was yawing, although that type of wound might also be accounted for by a tangential striking.<sup>322</sup>

Dr. Frederick W. Light, Jr., the third of the wound ballistics experts, who has been engaged in that specialty at Edgewood Arsenal since 1951, testified that the anatomical findings were insufficient for him to formulate a firm opinion as to whether the same bullet did or did not pass through the President's neck first before inflicting all the wounds on Governor Connally.<sup>323</sup> Based on the other circumstances, such as the relative positions of the President and the Governor in the automobile, Dr. Light concluded that it was probable that the same bullet traversed the President's neck and inflicted all the wounds on Governor Connally.<sup>324</sup>

### The Subsequent Bullet That Hit

After a bullet penetrated President Kennedy's neck, a subsequent shot entered the back of his head and exited through the upper right portion of his skull. The Zapruder, Nix and Muchmore films show the instant in the sequence when that bullet struck. (See Commission Exhibit No. 902, p. 108.) That impact was evident from the explosion of the President's brain tissues from the right side of his head. The immediately preceding frame from the Zapruder film shows the President slumped to his left, clutching at his throat, with his chin close to his chest and his head tilted forward at an angle.<sup>325</sup> Based upon information provided by the doctors who conducted the autopsy, an artist's drawing depicted the path of the bullet through the President's head, with his head being in the same approximate position.<sup>326</sup>

By using the Zapruder, Nix and Muchmore motion pictures, the President's location at the time the bullet penetrated his head was fixed with reasonable precision. A careful analysis of the Nix and Muchmore films led to fixing the exact location of these cameramen. The point of impact of the bullet on the President's head was apparent in all of the movies. At that point in the Nix film a straight line was plotted from the camera position to a fixed point in the background and the President's location along this line was marked on a plat map.<sup>327</sup> A similar process was followed with the Muchmore film. The President's location on the plat map was identical to that determined from the Nix film.<sup>328</sup> The President's location, established through the Nix and Muchmore films, was confirmed by comparing his position on the Zapruder film. This location had hitherto only been approximated, since there were no landmarks in the background of the Zapruder frame for alinement purposes other than a portion of a painted line on the curb.<sup>329</sup> Through these procedures, it was determined that President Kennedy was shot in the head when he was 230.8 feet from a point on the west curblin on Houston Street where it intersected with Elm Street.<sup>330</sup> The President was 265.3 feet from the rifle in the sixth-floor window and at that position the approximate angle of declination was  $15^{\circ}21'$ .<sup>331</sup>

## NUMBER OF SHOTS

The consensus among the witnesses at the scene was that three shots were fired.<sup>332</sup> However, some heard only two shots,<sup>333</sup> while others testified that they heard four and perhaps as many as five or six shots.<sup>334</sup> The difficulty of accurate perception of the sound of gunshots required careful scrutiny of all of this testimony regarding the number of shots. The firing of a bullet causes a number of noises: the muzzle blast, caused by the smashing of the hot gases which propel the bullet into the relatively stable air at the gun's muzzle; the noise of the bullet, caused by the shock wave built up ahead of the bullet's nose as it travels through the air; and the noise caused by the impact of the bullet on its target.<sup>335</sup> Each noise can be quite sharp and may be perceived as a separate shot. The tall buildings in the area might have further distorted the sound.

The physical and other evidence examined by the Commission compels the conclusion that at least two shots were fired. As discussed previously, the nearly whole bullet discovered at Parkland Hospital and the two larger fragments found in the Presidential automobile, which were identified as coming from the assassination rifle, came from at least two separate bullets and possibly from three.<sup>336</sup> The most convincing evidence relating to the number of shots was provided by the presence on the sixth floor of three spent cartridges which were demonstrated to have been fired by the same rifle that fired the bullets which caused the wounds. It is possible that the assassin carried an empty shell in the rifle and fired only two shots, with the witnesses hearing multiple noises made by the same shot. Soon after the three

empty cartridges were found, officials at the scene decided that three shots were fired, and that conclusion was widely circulated by the press. The eyewitness testimony may be subconsciously colored by the extensive publicity given the conclusion that three shots were fired. Nevertheless, the preponderance of the evidence, in particular the three spent cartridges, led the Commission to conclude that there were three shots fired.

## THE SHOT THAT MISSED

From the initial findings that (a) one shot passed through the President's neck and then most probably passed through the Governor's body, (b) a subsequent shot penetrated the President's head, (c) no other shot struck any part of the automobile, and (d) three shots were fired, it follows that one shot probably missed the car and its occupants. The evidence is inconclusive as to whether it was the first, second, or third shot which missed.

### The First Shot

If the first shot missed, the assassin perhaps missed in an effort to fire a hurried shot before the President passed under the oak tree, or possibly he fired as the President passed under the tree and the tree obstructed his view. The bullet might have struck a portion of the tree and been completely deflected. On the other hand, the greatest cause for doubt that the first shot missed is the improbability that the same marksman who twice hit a moving target would be so inaccurate on the first and closest of his shots as to miss completely, not only the target, but the large automobile.

Some support for the contention that the first shot missed is found in the statement of Secret Service Agent Glen A. Bennett, stationed in the right rear seat of the President's followup car, who heard a sound like a firecracker as the motorcade proceeded down Elm Street. At that moment, Agent Bennett stated:

\* \* \* I looked at the back of the President. I heard another firecracker noise and saw that shot hit the President about four inches down from the right shoulder. A second shot followed immediately and hit the right rear high of the President's head.<sup>337</sup>

Substantial weight may be given Bennett's observations. Although his formal statement was dated November 23, 1963, his notes indicate that he recorded what he saw and heard at 5:30 p.m., November 22, 1963, on the airplane en route back to Washington, prior to the autopsy, when it was not yet known that the President had been hit in the back.<sup>338</sup> It is possible, of course, that Bennett did not observe the hole in the President's back, which might have been there immediately after the first noise.

Governor Connally's testimony supports the view that the first shot missed, because he stated that he heard a shot, turned slightly to his right, and, as he started to turn back toward his left, was struck by the second bullet.<sup>339</sup> He never saw the President during the shooting sequence, and it is entirely possible that he heard the missed shot and that both men were struck by the second bullet. Mrs. Connally testified that after the first shot she turned and saw the President's hands moving toward his throat, as seen in the films at frame 225.<sup>340</sup> However, Mrs. Connally further stated that she thought her husband was hit immediately thereafter by the second bullet.<sup>341</sup> If the same bullet struck both the President and the Governor, it is entirely possible that she saw the President's movements at the same time as she heard the second shot. Her testimony, therefore, does not preclude the possibility of the first shot having missed.

Other eyewitness testimony, however, supports the conclusion that the first of the shots fired hit the President. As discussed in chapter II, Special Agent Hill's testimony indicates that the President was hit by the first shot and that the head injury was caused by a second shot which followed about 5 seconds later. James W. Altgens, a photographer in Dallas for the Associated Press, had stationed himself on Elm Street opposite the Depository to take pictures of the passing motorcade. Altgens took a widely circulated photograph which showed President Kennedy reacting to the first of the two shots which hit him. (See Commission Exhibit No. 900, p. 113.) According to Altgens, he snapped the picture "almost simultaneously" with a shot which he is confident was the first one fired.<sup>342</sup> Comparison of his photograph with the Zapruder film, however, revealed that Altgens took his picture at approximately the same moment as frame 255 of the movie, 30 to 45 frames (approximately 2 seconds) later than the point at which the President was shot in the neck.<sup>343</sup> (See Commission Exhibit No. 901, p. 114.) Another photographer, Phillip L. Willis, snapped a picture at a time which he also asserts was simultaneous with the first shot. Analysis of his photograph revealed that it was taken at approximately frame 210 of the Zapruder film, which was the approximate time of the shot that probably hit the President and the Governor. If Willis accurately recalled that there were no previous shots, this would be strong evidence that the first shot did not miss.<sup>344</sup>

If the first shot did not miss, there must be an explanation for Governor Connally's recollection that he was not hit by it. There was, conceivably, a delayed reaction between the time the bullet struck him and the time he realized that he was hit, despite the fact that the bullet struck a glancing blow to a rib and penetrated his wrist bone. The Governor did not even know that he had been struck in the wrist or in the thigh until he regained consciousness in the hospital the next day. Moreover, he testified that he did not hear what he thought was the second shot, although he did hear a subsequent shot which coincided with the shattering of the President's head.<sup>345</sup> One possibility, therefore, would be a sequence in which the Governor heard the first shot, did not immediately feel the penetration of the bullet,

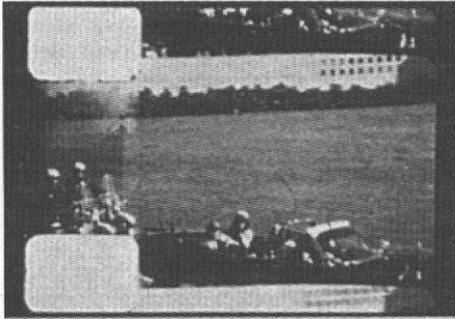


PHOTOGRAPH BY AP PHOTOGRAPHER



PHOTOGRAPH FROM RE-ENACTMENT

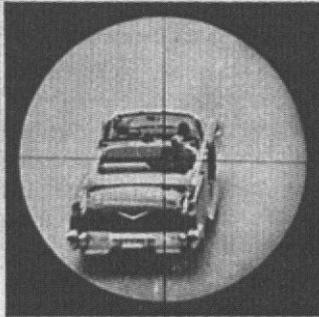
COMMISSION EXHIBIT No. 900



PHOTOGRAPH FROM ZAPRUDER FILM



PHOTOGRAPH FROM RE-ENACTMENT



PHOTOGRAPH THROUGH RIFLE SCOPE

DISTANCE TO STATION C .....	181.9 FT.
DISTANCE TO RIFLE IN WINDOW .....	218.0 FT.
ANGLE TO RIFLE IN WINDOW .....	18°03'
DISTANCE TO OVERPASS .....	307.1 FT.
ANGLE TO OVERPASS .....	-0°44'

# FRAME 255

COMMISSION EXHIBIT No. 901

then felt the delayed reaction of the impact on his back, later heard the shot which shattered the President's head, and then lost consciousness without hearing a third shot which might have occurred later.

### The Second Shot

The possibility that the second shot missed is consistent with the elapsed time between the two shots that hit their mark. From the timing evidenced by the Zapruder films, there was an interval of from 4.8 to 5.6 seconds between the shot which struck President Kennedy's neck (between frames 210 to 225) and the shot which struck his head at frame 313.<sup>346</sup> Since a minimum of 2.3 seconds must elapse between shots, a bullet could have been fired from the rifle and missed during this interval.<sup>347</sup> This possibility was buttressed by the testimony of witnesses who claimed that the shots were evenly spaced, since a second shot occurring within an interval of approximately 5 seconds would have to be almost exactly midway in this period. If Altgens' recollection is correct that he snapped his picture at the same moment as he heard a shot, then it is possible that he heard a second shot which missed, since a shot fired 2.3 seconds before he took his picture at frame 255 could have hit the President at about frame 213.

On the other hand, a substantial majority of the witnesses stated that the shots were not evenly spaced. Most witnesses recalled that the second and third shots were bunched together, although some believed that it was the first and second which were bunched.<sup>348</sup> To the extent that reliance can be placed on recollection of witnesses as to the spacing of the shots, the testimony that the shots were not evenly spaced would militate against a second shot missing. Another factor arguing against the second shot missing is that the gunman would have been shooting at very near the minimum allowable time to have fired the three shots within 4.8 to 5.6 seconds, although it was entirely possible for him to have done so. (See ch. IV, pp. 188-194.)

### The Third Shot

The last possibility, of course, is that it was the third shot which missed. This conclusion conforms most easily with the probability that the assassin would most likely have missed the farthest shot, particularly since there was an acceleration of the automobile after the shot which struck the President's head. The limousine also changed direction by following the curve to the right, whereas previously it had been proceeding in almost a straight line with a rifle protruding from the sixth-floor window of the Depository Building.

One must consider, however, the testimony of the witnesses who described the head shot as the concluding event in the assassination sequence. Illustrative is the testimony of Associated Press photographer Altgens, who had an excellent vantage point near the President's car. He recalled that the shot which hit the President's head "was the last shot—that much I will say with a great degree

of certainty.”<sup>349</sup> On the other hand, Emmett J. Hudson, the groundskeeper of Dealey Plaza, testified that from his position on Elm Street, midway between Houston Street and the Triple Underpass, he heard a third shot after the shot which hit the President in the head.<sup>350</sup> In addition, Mrs. Kennedy’s testimony indicated that neither the first nor the second shot missed. Immediately after the first noise she turned, because of the Governor’s yell, and saw her husband raise his hand to his forehead. Then the second shot struck the President’s head.<sup>351</sup>

Some evidence suggested that a third shot may have entirely missed and hit the turf or street by the Triple Underpass. Royce G. Skelton, who watched the motorcade from the railroad bridge, testified that after two shots “the car came on down close to the Triple Underpass” and an additional shot “hit in the left front of the President’s car on the cement.”<sup>352</sup> Skelton thought that there had been a total of four shots, either the third or fourth of which hit in the vicinity of the underpass.<sup>353</sup> Dallas Patrolman J. W. Foster, who was also on the Triple Underpass, testified that a shot hit the turf near a manhole cover in the vicinity of the underpass.<sup>354</sup> Examination of this area, however, disclosed no indication that a bullet struck at the locations indicated by Skelton or Foster.<sup>355</sup>

At a different location in Dealey Plaza, the evidence indicated that a bullet fragment did hit the street. James T. Tague, who got out of his car to watch the motorcade from a position between Commerce and Main Streets near the Triple Underpass, was hit on the cheek by an object during the shooting.<sup>356</sup> Within a few minutes Tague reported this to Deputy Sheriff Eddy R. Walthers, who was examining the area to see if any bullets had struck the turf.<sup>357</sup> Walthers immediately started to search where Tague had been standing and located a place on the south curb of Main Street where it appeared a bullet had hit the cement.<sup>358</sup> According to Tague, “There was a mark quite obviously that was a bullet, and it was very fresh.”<sup>359</sup> In Tague’s opinion, it was the second shot which caused the mark, since he thinks he heard the third shot after he was hit in the face.<sup>360</sup> This incident appears to have been recorded in the contemporaneous report of Dallas Patrolman L. L. Hill, who radioed in around 12:40 p.m.: “I have one guy that was possibly hit by a ricochet from the bullet off the concrete.”<sup>361</sup> Scientific examination of the mark on the south curb of Main Street by FBI experts disclosed metal smears which, “were spectrographically determined to be essentially lead with a trace of antimony.”<sup>362</sup> The mark on the curb could have originated from the lead core of a bullet but the absence of copper precluded “the possibility that the mark on the curbing section was made by an unutilized military full metal-jacketed bullet such as the bullet from Governor Connally’s stretcher.”<sup>363</sup>

It is true that the noise of a subsequent shot might have been drowned out by the siren on the Secret Service followup car immediately after the head shot, or the dramatic effect of the head shot might have caused so much confusion that the memory of subsequent events was blurred.

Nevertheless, the preponderance of the eyewitness testimony that the head shot was the final shot must be weighed in any determination as to whether it was the third shot that missed. Even if it were caused by a bullet fragment, the mark on the south curb of Main Street cannot be identified conclusively with any of the three shots fired. Under the circumstances it might have come from the bullet which hit the President's head, or it might have been a product of the fragmentation of the missed shot upon hitting some other object in the area.<sup>364</sup> Since he did not observe any of the shots striking the President, Tague's testimony that the second shot, rather than the third, caused the scratch on his cheek, does not assist in limiting the possibilities.

The wide range of possibilities and the existence of conflicting testimony, when coupled with the impossibility of scientific verification, precludes a conclusive finding by the Commission as to which shot missed.

### TIME SPAN OF SHOTS

Witnesses at the assassination scene said that the shots were fired within a few seconds, with the general estimate being 5 to 6 seconds.<sup>365</sup> That approximation was most probably based on the earlier publicized reports that the first shot struck the President in the neck, the second wounded the Governor and the third shattered the President's head, with the time span from the neck to the head shots on the President being approximately 5 seconds. As previously indicated, the time span between the shot entering the back of the President's neck and the bullet which shattered his skull was 4.8 to 5.6 seconds. If the second shot missed, then 4.8 to 5.6 seconds was the total time span of the shots. If either the first or third shots missed, then a minimum of 2.3 seconds (necessary to operate the rifle) must be added to the time span of the shots which hit, giving a minimum time of 7.1 to 7.9 seconds for the three shots. If more than 2.3 seconds elapsed between a shot that missed and one that hit, then the time span would be correspondingly increased.

### CONCLUSION

Based on the evidence analyzed in this chapter, the Commission has concluded that the shots which killed President Kennedy and wounded Governor Connally were fired from the sixth-floor window at the southeast corner of the Texas School Book Depository Building. Two bullets probably caused all the wounds suffered by President Kennedy and Governor Connally. Since the preponderance of the evidence indicated that three shots were fired, the Commission concluded that one shot probably missed the Presidential limousine and its occupants, and that the three shots were fired in a time period ranging from approximately 4.8 to in excess of 7 seconds.