

- D33-27 of Lee Oswald and the Intourist guide, Rosa (last name unknown), right view.
- 13 Photograph of the Mannlicher-Carcano rifle found on the sixth floor of the TSBD. Photograph at the ID Bureau on November 22, 1963, with the rifle strap showing. Rifle resting on the scope.
  - 14 Photograph of the Mannlicher-Carcano rifle found on the sixth floor of the TSBD. Photograph at the ID Bureau of the Dallas Police Department on November 22, 1963, with the rifle upright.
  - 15 Set of 4 photographs of the Oswalds and friends in Russia. FBI Exhibit B3-1. Starting from the upper left corner, Lee Oswald; Marina Oswald; and Marina's aunt, Lobova Aksionova (her husband is Vasily Aksionov), taken in Minsk. The upper right photograph is of Lee Oswald and friend Alfred who is believed to be a Hungarian resident of Minsk. FBI Exhibit D33-24 and Commission Exhibit 2612. The lower left photograph of Anna Zieger, Mr. Zieger, June Oswald as a baby, Eleanor Zieger, and Lee and Marina Oswald in Minsk. FBI Exhibit B3-25 and Commission Exhibit 1529i. The lower right photograph of Marina Oswald on a train leaving Russia. FBI Exhibit D33-8.
  - 16 From the upper left a photograph of June Lee Oswald as a baby. From the upper right a photograph of Lee Oswald as a Marine. Lower left, a photograph of Lee Oswald's Social Security card. Lower right, a photograph of Oswald's "Fair Play for Cuba Committee, New Orleans Chapter" membership card signed Lee H. Oswald with A. J. Hidell as Chapter President. JFK Exhibit F-505.
  - 17 From the left side, a photograph of "Special Services Hotel" card from Tokyo, Japan. From the upper left side, a photograph of Marina and Lee Oswald on a train leaving Russia. FBI Exhibit B3-30 and Commission Exhibit 2629. From the upper right, a photograph of Pavel Golovachev in Moscow. From the lower left, a photograph of Lee Oswald and female friend in Russia. From the lower right, a photograph of Lee Oswald on the steps of a building in Minsk. FBI Exhibit D33-2.
  - 18 From the left, a photograph of the "Uniformed Services Identification and Privilege Card." On the right, a photograph of a piece of paper with the handwritten address of the U.S.S.R. Embassy in Washington.
  - 19 From the top, a photograph of Oswald's "Certificate of Service" card U.S. Marine Corps.

- 20 The second photograph of Alex James Hidell "Certificate of Service" card U.S. Marine Corps.
- 21 The bottom photograph of a complimentary card, "GA-JO EN KANKO" Hotel in Japan.
- 22 From the top, a photograph of Oswald's "Dallas Public Library" card. Exhibit F-505D.
- 23 The second photograph of Oswald's "U.S. Forces, Japan Identification Card."
- 24 The bottom photograph of Oswald's "Period of Active Duty" card.
- 25 From the top, a photograph of the reverse side of Oswald's "Dallas Library" card. Exhibit F-505D.
- 26 The second photograph of Oswald's "Fair Play For Cuba Committee" membership card. Signature of Lee H. Oswald with V. T. Lee as Executive Secretary.
- 27 The bottom photograph of an undated slip of paper with handwriting containing the address of "The Worke" and "The Worker."
- 28 From the top, a photograph of Oswald's May 8, 1958 "Identification card, U.S. Forces, Japan."
- 29 The second photograph of Oswald's "Selective Service System" card.
- 30 The bottom photograph of Oswald's "Selective Service System" card with the signature of Alek James Hidell.

[Author's note--The Texas Supplemental Report, Volume Seven, Outline refers to twenty-two photographs which is correct when taking into account that some of the stills contain three exposures on one still picture.]

Volume 8: "Trade Mart Aerial View and Trade Mart Floor Plans":

- 1 Aerial view of the Trade Mart area.
- 2 Trade Mart floor plans of the 1st floor.
- 3 Trade Mart floor plans of the 2nd floor.
- 4 Trade Mart floor plans of the 3rd floor.

5 Trade Mart floor plans of the 4th floor.

Volume 9: "Edwin A. Walker":

- 1 Wood fence along alley in rear of Walker's house. A shot was fired from this location. **Exhibit A.**
- 2 Picture shot from outside of window where bullet entered house. **Exhibit B.**
- 3 Picture made from the inside window where bullet entered house. **Exhibit C.**
- 4 Picture made of the hole made by bullet striking wall over Walker's head. **Exhibit D.**
- 5 Picture shows where the bullet exited from the wall into the living room and was found in a stack of papers. **Exhibit E.**
- 6 Picture shows that the shot was fired through this tree toward rear window of Walker's house. **Exhibit F.**
- 7 Picture of the tire track found in the alley behind Walker's house. **Exhibit G.**

Volume 11: "Aerial View of Downtown and Oak Cliff Sections of Dallas, Showing Oswald's Known and Probable Routes":

- 1 Aerial view of the downtown and Oak Cliff section of Dallas showing Oswald's known route with a solid mark line and Oswald's probable route with a broken mark line.

Volume 15: "Exterior and Interior of the Texas School Book Depository Building and Reconstruction":

- 1 6th floor of the Texas School Book Depository Building (hereafter referred to as TSBD), showing where the shots were fired from the window looking towards Houston Street. Commission Exhibit 722.
- 2 From Elm Street underpass, of the TSBD and the surrounding area.
- 3 From Elm Street underpass, of the TSBD and the surrounding area with a further view of the plaza.
- 4 From Main and Houston Street, of the TSBD frontal structure and surrounding area.

- 5 From Elm and Houston Street, of the TSBD frontal structure close-up view.
- 6 From the sixth floor assassin lair toward Elm Street and the triple underpass.
- 7 From the grassy knoll, during the Secret Service reconstruction of the shooting, of the car located where shot number 1 was fired.
- 8 Plat of Houston and Elm Street, by Robert West, showing the trajectory of bullets from window to street.
- 9 Reconstruction of Secret Service view of the car, showing the second and third shot fired at the limousine, taken from the knoll area.
- 10 Reconstruction, November 27, 1963, of the second and the third shot fired at the limousine, taken from the knoll area.
- 11 From the second floor of the TSBD, from the stairway to the first floor to door leading to lunchroom.
- 12 From the second floor of the TSBD, from the doorway, looking into the lunchroom.
- 13 From the second floor of the TSBD, inside of the lunchroom, looking towards the door leading to the stairway.
- 14 From the second floor of the TSBD, inside of the lunchroom, to the stairs leading to the third floor with the door closed.
- 15 From the second floor of the TSBD, from the third elevator to the door where stairs lead to the third floor.
- 16 From inside the elevator, on the second floor of the TSBD to the door where stairs lead to the third floor.
- 17 From the sixth floor of the TSBD, of the assassin lair of the position of the boxes. Commission Exhibit 734.
- 18 From the sixth floor of the TSBD, of the assassin lair, of the position of the boxes with a closer view. Commission Exhibit 733.
- 19 From the sixth floor of the TSBD, of the assassin lair of the position of the boxes. Similar to #18, but taken slightly farther away.

- 20 From the sixth floor of the TSBD, of the assassin lair taken 25 feet north of the window from where the shots were fired.
- 21 From the sixth floor of the TSBD, of the assassin lair taken 40 feet north of the front of the building towards the window, in the second aisle.
- 22 From the sixth floor of the TSBD, taken 40 feet from where the shots were fired.
- 23 From the sixth floor of the TSBD taken 85 feet north from where the shots were fired.
- 24 From the sixth floor of the TSBD, taken 25 feet north of the front of the TSBD, in the third aisle from Houston looking south.
- 25 From the sixth floor of the TSBD taken in the third aisle, from Houston looking west. Dr. Pepper bottle seen in this photograph.
- 26 From the sixth floor of the TSBD, taken 45 feet from the front windows from the third aisle, from Houston.
- 27 From the sixth floor of the TSBD, of the box on which the palm print was discovered. Gun wrapper found to the right of this box.
- 28 From the sixth floor of the TSBD of the location from which the gun wrapper was found in the corner.
- 29 From the sixth floor of the TSBD, taken towards the window from where the shots were fired. Including the boxes used for the gun rest in window. Spent shells on the floor.
- 30 From the sixth floor of the TSBD, from where the shots were fired. Including the boxes used for the gun rest and the spent shells.
- 31 From the sixth floor of the TSBD, taken by the window from where the shots were fired. Looking towards the spent shells on the floor.
- 32 From the sixth floor of the TSBD, taken in the seventh aisle from Houston, approximately 5 feet east of the west side of the TSBD looking towards the rifle.
- 33 From the sixth floor of the TSBD of which is a duplicate of #32 [#22 in accordance with document].

- 34 From the sixth floor of the TSBD, taken from the west wall of the TSBD looking towards the boxes where the rifle was found.
- 35 From the sixth floor of the TSBD, taken south in the seventh aisle near the stairway leading to the fifth floor where the rifle was found behind the taped boxes.
- 36 From the sixth floor, looking down the stairway to the fifth floor of the TSBD.
- 37 From the sixth floor looking down the stairway to the fifth floor of the TSBD. The rifle was found in the lower right corner of the picture.
- 38 From the sixth floor stairway to the fifth floor looking towards the service elevator.
- 39 From the sixth floor, from the sixth aisle from Houston looking west, the gun was found behind the boxes in the center of the picture with the stairway to the fifth floor.
- 40 From the sixth floor taken from the seventh aisle from Houston towards the window where the shots were fired from the front of the TSBD.
- 41 From the sixth floor taken 45 feet from the front of the TSBD in the fourth aisle from Houston.
- 42 From the sixth floor taken from the fifth aisle from Houston towards the front of the TSBD. 50 feet north of the windows.
- 43 From the sixth floor taken from the fifth aisle from Houston towards the stairway leading to the fifth floor. Gun was found behind the boxes in the center of the picture looking west.

Volume 16: "Oswald Shooting in the Basement":

- 1 Exhibit 6-A. Photograph of the shooting of Lee Oswald in the basement of the Dallas Police Station by Jack Ruby. Photograph by Jack Beers of the Dallas Morning News. Received on December 2, 1963, by Lt. P. G. McCaghren.
- 2 Exhibit 6-A. Photograph of the shooting of Oswald by Ruby. Photograph by Jack Beers. Received on December 7, 1963, by Lt. P. G. McCaghren. Negative exists for this photograph.
- 3 Exhibit 55-A. Photograph taken after the shooting of Oswald as Dallas police officers detain Ruby and gain control of Ruby gun. Photograph taken by

- Frank Johnson of United Press International. Received on December 11, 1963, from New York City.
- 4 Exhibit 6-A. Photograph taken after the shooting of Oswald and the removal of Jack Ruby from the basement of the Dallas Police Station.
  - 5 Exhibit 6-A. Photograph taken after the shooting of Oswald and the removal of Jack Ruby from the basement of the Dallas Police Station. Photograph by Jack Beers. Received by Lt. P. G. McCaghren on December 2, 1963.
  - 6 Exhibit 6-A. Photograph taken after the shooting. Photograph by Jack Beers. Received by Lt. P. G. McCaghren on December 2, 1963.
  - 7 Exhibit 6-A. Photograph taken of Oswald inside the ambulance inside the basement of the Dallas Police Station. Police officers assisting in closing the tailgate of the ambulance. Photograph by Jack Beers. Received by Lt. P. G. McCaghren on December 2, 1963.
  - 8 Exhibit 6-A. Photograph taken after the shooting. Dallas police officers and reporters recounting the shooting. Photograph by Jack Beers. Received on December 2, 1963, by Lt. P. G. McCaghren.
  - 9 Exhibit 6-A. Photograph of Oswald on the stretcher prior to placement on the ambulance. Photograph by Jack Beers. Received by Lt. P. G. McCaghren on December 2, 1963.
  - 10 Exhibit 55-A. Photograph of Oswald on the stretcher prior to placement on the ambulance. Includes Dallas police officers and newsmen watching out.
  - 11 Exhibit 53-A. Photograph of Oswald on the stretcher which is on the tailgate of the ambulance. Police officers assisting with the stretcher. Photograph by Bob Jackson of the Times Herald. Received on December 7, 1963, by Lt. P. G. McCaghren.
  - 12 Exhibit 6-A. Photograph taken following the shooting of Oswald as Dallas police officers struggle to regain control of the situation. Photograph by Jack Beers. Received on December 2, 1963, by Lt. P. G. McCaghren.
  - 13 Photograph of Oswald on a stretcher following the autopsy. Similar to the view released by the FBI along with the other autopsy photographs within the series. Slightly different flash pattern.

Volume 17: "Photographs of Oswald's Property":

- 1 Photographs by the FBI and developed by the Dallas Police Department. Included in this still: Oswald suitcase; **Hands Off Cuba!** leaflets; The Worker; various reading literature. Search warrant dated 11/23/63.
- 2 Photographs by the FBI and developed by the Dallas Police Department. Included in this still: picture taken of the backside of Walker's house; some still photographs, 6 boxes of slides, camera, binoculars, literature. Voluntarily given by Ruth Paine and Marina Oswald from the Paine residence in Irving, Texas, on November 22, 1963.
- 3 Photographs by the FBI and developed by the Dallas Police Department. Included in this still: a larger more complete photograph of the above still. Combines sequence stills #1 and #2.
- 4 Photograph by the FBI and developed by the Dallas Police Department. Included in this still: material from sequence #1 and additional literature books: The Nation; The New Republic; The Road to Socialism; The Right to Travel; The Revolution Must Be A School of Unfettered Thought, and numerous pamphlets.
- 5 Photograph by the FBI and developed by the Dallas Police Department. Included in this still, additional literature: 1984; Russian literature; some photographs. Search warrant for material recovered from Ruth Paine's residence on November 22, 1963.
- 6 Photograph by the FBI and developed by the Dallas Police Department. Similar to sequence #4 slightly larger and more complete still.
- 7 Photograph by the FBI and developed by the Dallas Police Department. Photograph of Oswald's clothing; shoes, luggage bag; Flash Cards sunglasses, and additional items seized by a search warrant on November 23, 1963, at 1026 N. Beckley.
- 8 Photograph by the FBI and developed by the Dallas Police Department. Similar to the above photograph which includes some additional clothing seized by the Dallas police on the same day.
- 9 Photograph by the FBI and developed by the Dallas Police Department. Included in this still: numerous photographic prints; **Hands Off Cuba!**; and literature.

- 10 Photograph by the FBI and developed by the Dallas Police Department. Similar to sequence #9 but with a closer view of the material. Includes numerous Russian literature.

Volume 18: "J. D. Tippit Area of Shooting and Location of Oswald's Arrest":

- 1 Officer Tippit's squad car heading east on the 400 block of 10th. Driver's side full length view of squad car #10.
- 2 Tippit squad car view from the front end looking west. Additional police cars and motorcycle officers are present.
- 3 Tippit squad car heading east on the 400 block of 10th. Rear left view of the squad car and police officers in the street.
- 4 Tippit squad car heading south. Right side view of the car.
- 5 Tippit squad car looking north. Close-up view of the front end of the car and where Officer Tippit fell to the street pavement after the shooting. View of Tippit's blood present.
- 6 Tippit squad car looking west. Another close-up view of the driver's side of the front end and the area of pavement where Tippit died. View of Tippit's blood present.
- 7 Jacket dropped by Oswald following the shooting of Officer Tippit near the parking lot. The jacket was found by the car with the Texas license plate N.L. 95.
- 8 The lobby of the Texas Theatre, where Oswald was arrested by the Dallas police.
- 9 The interior of the Texas Theatre and the seat (Dallas Police Officer pointing to the seat) where Oswald was sitting prior to his arrest.

Volume 19: "City Hall Basement":

- 1 Jail office looking east from the front of the jail elevator. Photograph taken on November 26, 1963.
- 2 Jail office showing southeast door.
- 3 Jail office showing elevator door.

- 4 City Hall basement showing southeast door to the jail and doors to the basement lobby.
- 5 Taken from the top of the Main Street entrance ramp City Hall basement.
- 6 City Hall basement showing southeast door to jail office and part of Main Street ramp.
- 7 City Hall basement showing southeast door to jail office.
- 8 Basement of City Hall taken from parking area showing southeast door to jail office and part of Main Street ramp.
- 9 City Hall basement taken from Commerce Street exit looking north.
- 10 Halfway down Main Street ramp basement of City Hall.
- 11 City Hall basement, showing Commerce Street ramp.
- 12 City Hall basement, showing parking area.
- 13 Taken halfway up Commerce Street ramp, looking north.

**Thomas, Larry**

**Sequence Number:**

- 1 Amateur whose edited footage was incorporated into President Kennedy's Final Hour.

**Towner, Robert**

**Sequence Number:**

- 1 Close-up of the presidential limousine seen at the corner of Main and Houston Street.
- 2 View of the grassy knoll immediately following the shooting. Included in the photograph, "The Umbrella Man."
- 3 View of the grassy knoll near the stockade fence following the shooting.
- 4 Crowd on Elm Street near the triple overpass.

**Towner-Barnes, Tina****Sequence Number:**

- 1 Presidential limousine turning off Houston onto Elm Street.
- 2 Presidential limousine in front of the TSBD.
- 3 CAM cars going down Elm Street following the shooting.
- 4 According to Barnes, the film counter was broken and she assumed that there was no additional film left for filming. However, upon removing the film packet additional unexposed film was left in the camera.

(U)

**Uhrbrock, Don****Sequence Number:**

- 1 One known photograph taken at the funeral of Lee H. Oswald showing Oswald casket and family.
- 2 It is assumed that additional series of Oswald's funeral exist; however, no additional information at this time.

**\*Underwood, James****Sequence Number:**

- 1 TSBD sign over the doorway of the building.
- \*2 Since Underwood and Sanderson shared the same camera, it is uncertain as to who filmed the sequence. Underwood borrowed the camera from Sanderson immediately after the shooting. After filming that sequence, Underwood returned the camera to Sanderson.
- 3 Refer to Sanderson for complete description.

**United Press International****Sequence Number:**

- 1 Presidential party at Love Field departing Air Force 1 prior to the start of the motorcade.
- 2 Presidential party welcome line at Love Field Airport. President and Mrs. Kennedy with Governor Connally.
- 3 Presidential party welcome line at Love Field Airport. President and Mrs. Kennedy, Mrs. Connally, Secret Service agents, and Air Force 1 in the background.
- 4 View of the spectators at Love Field Airport at Gate 28. Signs range from "Kennedy for President" to "All the Way with Jack!"--with the waving of a Confederate flag.
- 5 Close-up view of Jackie and John Kennedy at Love Field Airport.
- 6 Excellent view of President and Mrs. Kennedy in the back seat of the limousine with Governor Connally in the jumpseat. Clint Hill standing outside the limousine next to Mrs. Kennedy with the flight crew and Air Force 1 in the background.
- 7 Full length view of the limousine en route to the luncheon prior to Dealey Plaza from the left side. Commonly published view with a shop sign seen in the background, "Pepsi-Cola Soda Fountain."
- 8 Photograph taken in Dealey Plaza immediately following the assassination. Spectator newsmen on the ground, with cameramen Altgens, Craven and Weigman seen.
- 9 Close-up view of the Newmans on the ground.
- 10 View of the parking lot behind the grassy knoll following the assassination.
- 11 View of Dealey Plaza and of Elm Street from the grassy knoll.
- 12 From the grassy knoll, a view of the gathering spectators on the north side of the knoll off of Elm Street, which includes the Babushka Lady.
- 13 Crowd on the triple overpass, watching the motorcade exiting Dealey Plaza.
- 14 Immediately following the shooting as the crowd runs up the grassy knoll towards the triple overpass by the stockade fence. Sequence numbers 8 through 14, taken by Frank Cancellare.

- 15 Presidential limousine on Stemmons Freeway en route to Parkland Memorial Hospital.
- 16 Behind view of the presidential limousine parked at Parkland loading zone for ambulances only. The top has been placed on the car with Dallas police officials including Captain Jesse Curry and spectators.
- 17 A Negro girl crying outside at Parkland Hospital.
- 18 A Negro girl crying outside at Parkland Hospital.
- 19 Senator Ralph Yarborough talking to reporters outside at Parkland Hospital as he is wiping away tears from his eyes.
- 20 Lt. Montgomery carrying a paper bag out of the TSBD.
- 21 Dallas police officers outside of the TSBD, near the front entrance.
- 22 Mary Muchmore film footage of the assassination sold to United Press International [refer to Nix, Orville sequence for description of footage].
- 23 Orville Nix film footage of the assassination sold to United Press International [refer to Nix, Orville sequence for description of footage].
- 24 The outside of the TSBD of the right side showing the alleged assassin lair.
- 25 On the sixth floor of the TSBD, of the assassin lair.
- 26 Lt. Montgomery with the paper bag and the Dr. Pepper bottle outside the TSBD talking to reporters.
- 27 Lt. Day with the rifle outside the TSBD walking up Elm Street. Taken from behind.
- 28 Oswald in custody at the Dallas Police Station earlier in the day. Showing that he has been handcuffed.
- 29 Lt. Day with the rifle over his head allowing news-photographers a chance to photograph the rifle and interview him.
- 30 Captain Will Fritz of the Dallas Police being interviewed by the news media on Saturday night.

- 31 Assistant District Attorney General Alexander holding the affidavit charging Oswald with the murder of President Kennedy.
- 32 Two Dallas police officers standing outside the doorway of the Homicide Bureau, Room 317, while officers interrogated Oswald. Deputy Sheriff Craig is seen in this frame.
- 33 Oswald in his white tee-shirt in the hallways of the Dallas Police Station with Dallas police officers and the news media.
- 34 Marina and Marguerite Oswald in a Dallas Police Station elevator while newsmen attempted an interview.
- 35 Oswald, Detective Leavelle, and other police officials, in the elevator in the basement of the Dallas Police Station.
- 36 Oswald, Detective Leavelle with police officials and the news media in the basement prior to the shooting of Oswald by Jack Ruby. Newsman Ike Pappas seen.
- 37 Oswald and Detective Leavelle passing reporters and spectators in the basement prior to the shooting.
- 38 Oswald and Detective Leavelle rounding the corner with Jack Ruby seen in the extreme right corner of the frame prior to the shooting.
- 39 Oswald and Detective Leavelle rounding the corner as Ruby moves in closer to shoot Oswald.
- 40 Seconds now, as Ruby aims his gun at Oswald.
- 41 Ruby firing the gun pointed at Oswald's stomach. Captain Fritz seen in the extreme left corner of the frame.
- 42 Oswald has fallen to the floor as Ruby steps forth and attempts to fire another round at Oswald, as the police officials now start to react from the shooting.
- 43 Photograph taken after the shooting of Oswald as Dallas police officers detain Ruby and gain control of his gun.
- 44 Close-up view of Jack Ruby after his arrest.
- 45 Sequences #35 through #43 taken from UPI Newsreel.

- 46 Numerous additional stills and motion footage taken in Dallas prior, during and after the shooting of President Kennedy.
- 47 Numerous additional stills and motion footage taken in Dallas prior, during and after the shooting of Oswald.
- 48 Numerous additional stills and motion footage taken of the arrival of Air Force 1 from Dallas.
- 49 Numerous additional stills and motion footage taken of the arrival of the body of President Kennedy to the White House.
- 50 Numerous additional stills and motion footage taken of the body of President Kennedy in the Capitol rotunda.
- 51 Numerous additional stills and motion footage taken at St. Matthew's Cathedral.
- 52 Numerous additional stills and motion footage taken during the motorcade to Arlington National Cemetery.
- 53 Numerous additional stills and motion footage taken at the grave site of the late President.

### Universal Newsreel

#### Sequence Number:

##### Reel 1

- 1 Various newsreel footage of the President and Mrs. Kennedy during his political life (some audio).
- 2 Air Force 1 at Love Field with the President and Mrs. Kennedy departing the plane.
- 3 The President and Mrs. Kennedy in the welcome line at Love Field Airport.
- 5 Footage from Mrs. Kennedy's side, of the approaching motorcade early in the parade.
- 6 Following the assassination of the TSBD, police cars pulling up to the front of the building, police officers armed with riot shotguns and activity in the streets.

- 7 Police officers and plainclothes officers entering the TSBD through the front doorway.
- 8 At Parkland Hospital following the arrival of the presidential party. Secret Service agent attaching the "bubble top" to the limousine, police officers blocking off the area and the crowd following the announcement of the death of the President.
- 9 The White House flag at half staff, the United Nations pays a silent tribute to the late President.
- 10 Lyndon B. Johnson being sworn in aboard Air Force 1 and the departure of the plane from the airport.
- 11 Air Force 1 arriving at Andrews Air Force Base with the casket being removed from the plane along with the presidential party.
- 12 The casket placed into the awaiting hearse and escort (live audio but no verbal words).
- 13 President Johnson and party departing Air Force 1 and making his speech to the nation (audio).
- 14 President Johnson and party departing the helicopter at the White House.

### Reel 2

- 1 Oswald in the hallway of the police station surrounded by police officers and reporters.
- 2 Lt. Day holding the rifle over his head for reporters and cameramen.
- 3 The shooting of Oswald by Ruby in the basement and the aftermath of the shooting.
- 4 The ambulance carrying Oswald arriving at Parkland Hospital and the removal of Oswald from the ambulance.

### Reel 3

- 1 From behind, the funeral march and the caisson proceeding to the Rotunda.
- 2 Inside the Rotunda with the view of family members and the flowers being placed at the head of the casket by President Johnson.

- 3 Mrs. Kennedy and daughter Caroline paying last respects to their husband, father and former leader of the country. This is one of the better known still photographic scenes of Mrs. Kennedy and Caroline reaching underneath the flag-covered casket.
- 4 Outside the Rotunda, the endless city blocks of spectators waiting to pay last respects to the President.
- 5 Attorney General Kennedy, Mrs. Kennedy and Senator Kennedy walking behind the caisson with world leaders following the funeral march.
- 6 The casket being removed from the caisson and taken inside the St. Matthew's Cathedral. Partial audio tape is included with this footage.
- 7 Various members of foreign countries ushered inside the St. Matthew's Cathedral. Partial audio tape is included with this footage.
- 8 The casket being brought into the cathedral.
- 9 Richard Cardinal Cushing performing the pontifical requiem mass. Partial audio tape is included with this footage.
- 10 The casket being placed onto the caisson following the pontifical requiem mass. Partial audio tape is included with this footage.
- 11 From the steps of the cathedral, John-John saluting the casket.
- 12 Motorcade proceeding to Arlington National Cemetery.
- 13 The casket being removed from the caisson at the cemetery. The Black Watch bagpipers can be heard in this part of the footage.
- 14 Members of the family, invited leaders with the playing of Taps and the final cannon salute can be heard in this part of the footage.
- 15 The flag is given to Mrs. Kennedy. The eternal flame is lit by Mrs. Kennedy, then by Attorney General Robert Kennedy and finally by Senator Edward Kennedy.
- 16 View of the casket and eternal flame as Mrs. Kennedy along with Robert and Edward Kennedy leaving the grave site.
- 17 Film identification number IFP: 97 A-C Universal News.

University of Texas Science Center of San AntonioSequence Number:

- 1 Photograph by the examination team on October 4, 1981, Figure A is of the mastoid process of Oswald.
- 2 Photograph by the examination team, Figure B shows the mastoid surgery performed on Oswald.
- 3 Photograph by the examination team, Figure 3 shows the dentition of Oswald of the mandibular teeth with an occlusal view.
- 4 Photograph by the examination team, Figure 4 shows the dentition of Oswald of the maxillary teeth with an occlusal view.
- 5 Photograph by the examination team, Figure 5 (a) shows the dentition of Oswald of the maxillary right quadrant.
- 6 Photograph by the examination team, Figure 5 (b) shows the dentition of Oswald of the mandibular right quadrant.
- 7 Photograph by the examination team, Figure 5 (c) shows the dentition of Oswald of the maxillary left quadrant.
- 8 Photograph by the examination team, Figure 5 (d) shows the dentition of Oswald of the mandibular left quadrant.
- 9 Photograph by the examination team, Figure 5 (e) shows the dentition of Oswald of the maxillary anterior teeth.
- 10 Photograph by the examination team, Figure 5 (f) shows the dentition of Oswald of the mandibular anterior teeth.
- 11 Dental radiographs made on March 27, 1958, Figure 6 of Oswald's right maxilla and mandible.
- 12 Dental radiographs made on March 27, 1958, Figure 7, of Oswald's left maxilla and mandible.
- 13 Prepared by the examination team, a dental stone cast of Lee H. Oswald.

Unknown/UnidentifiedSequence Number:Babushka Lady

- 1-1 Footage taken from the opposite side of Zapruder of the assassination of President Kennedy.
- 1-2 Footage of the TSBD and the grassy knoll could be included in this film footage.
- During the HSCA Hearings this film was alleged to have been shown to the Committee. One former Dallas resident named by a researcher in Dallas thought to be the Babushka Lady. However, a staff investigator for the HSCA had strong doubts in her testimony.
- 2-1 Unidentified photographer who appears in the William Allen frame #196.
- 3-1 Unidentified photographer who appears in the Muchmore movie frame 1.
- 4-1 Unidentified photographer who appears in the Martin movie frame 1.
- 5-1 Unidentified male photographer who was taking photographs from the triple overpass according to Dallas police officer.
- 6-1 Unidentified female photographer taking photographs according to assassination witnesses Howard Brennan.
- 7-1 Unidentified female photographer who appears in Altgens frame 1-4. Camera thought/believed to be some sort of sighting device such as opera glasses. No additional information.
- 8-1 Unidentified male photographer who appears in Murray frame at Houston and Elm.
- 8-2 Unidentified male photographer who appears in Murray frames 1-22, 1-23, 2-5, 2-6 and 2-7 near the TSBD doorway.
- 9-1 Unidentified male photographer who took photograph before the motorcade arrived on Elm Street.
- 10-1 Unidentified photographer of the presidential limousine early in the motorcade.

- 11-1 Unidentified male photographer from the upper floor of the Dal Tex Building with a movie camera. Secret Service Agent Sorrels confiscated footage. Refer to Sawyer testimony 6H324. The film was allegedly shown on local television show in New York. No additional information.

Unidentified

Sequence Number:

- 1 This unidentified photographer is in a photograph taken by William Allen.
- 2 This unidentified photographer was taking film footage from the upper floor of the Dal Tex Building according to Secret Service Agent Sorrels. Refer to documentation section regarding this document.
- 3 This unidentified female photographer appears in photograph 1-4 taken by James Altgens.
- 4 This unidentified female photographer was taking still photographs according to Brennan. Could be female photographer in 3.
- 5 This unidentified male photographer was taking still photographs from the overpass according to a Dallas police officer.
- 6 This unidentified male photographer appears in the photograph taken by Weaver on the corner of Houston and Main with the police station in the background.

(V)

Venso, Homer

Sequence Number:

- 1 Overall view of the basement inside the Dallas Police Station prior to the shooting of Oswald.
- 2 Close-up view of the shooting of Oswald by Ruby.
- 3 No additional information.

Volkland, AlSequence Number:

- 1 Color photograph taken from Stemmons Freeway of the presidential limousine en route to Parkland Hospital with the Secret Service back-up preceding.

(W)

Warren Commission ExhibitsExhibit Number:

- 1 Refer to Commission Exhibits.

WBAP-TVSequence Number:Darnell, James

- 1 Coverage of the arrival of Air Force 1 at Love Field Airport.
- 2 The presidential party at Love Field Airport.
- 3 The presidential motorcade in downtown Dallas from CAM 3.
- 4 Within one minute following the shooting of the activity on Elm Street.
- 5 Footage of the parking lot behind the grassy knoll.
- 6 Footage of the old man under arrest in front of the TSBD.
- 7 Inside the WBAP press room - Old County Court House Building with interviews of witnesses following the assassination.

Jamison, J.

- 1 Footage of the shooting of Lee Oswald by Jack Ruby in the basement of the Dallas Police Station.
- 2 No additional information.

Owens, Dan

- 1 Activity around the front side of the TSBD following the assassination.
- 2 Interview of Sheriff Bill Decker in front of the TSBD.

Venso, Homer

- 1 Overall shot of the basement inside the Dallas Police Station prior to the shooting of Oswald.
- 2 Close-up view of the shooting of Oswald by Ruby.
- 3 No additional information.

WDSU-TVSequence Number:

- 1 Interview of Oswald at the Court House in New Orleans on August 12, 1963, following his court appearance for disorderly conduct. His theories on the various types of socialism throughout the world. Cameraman Jonathan Rush.
- 2 Footage of Oswald and his companions passing out leaflets: "**Hands Off Cuba**" taken on August 12, 1963, near the Trade Mart Building on Camp Street, New Orleans. Cameraman Jonathan Rush.
- 3 Interview with Oswald on August 21, 1963. Cameraman Lala.

Weaver, JackSequence Number:

- 1 The presidential limousine at the corner of Main and Houston Street. The TSBD sixth floor is seen in the background.

Weigman, DavidSequence Number:

- 1 Immediately following the assassination a view of the TSBD doorway from CAM 1.
- 2 Activity on the grassy knoll following the assassination.

- 3 Footage of the Newmans on the ground.
- 4 Congressional cars 1 and 2 moving down Elm Street.

Welch, Robert

Sequence Number:

- 1 Presidential limousine proceeding to Parkland Hospital.
- 2 No additional information.

Westfall, H. E.

Sequence Number:

- 1 Color photograph taken from Houston Street prior to the motorcade with the TSBD in the background.
- 2 Color photograph taken from Elm Street after the assassination (presumably early on the 23rd) with the TSBD in the background.

WFAA-TV

Sequence Number:

L'Hoste, A. J.

- 1 Police officer carrying shotgun towards the TSBD.
- 2 Sheriff Decker, Howard Brennan (witnesses to the assassination?) and police officer with a shotgun outside the TSBD doorway.
- 3 Similar to Willis #10 of the TSBD doorway.
- 4 From the ground level of the sixth floor window.
- 5 Larry Florer being led on Houston and Elm Street.
- 6 Sheriff Decker being interviewed in front of the TSBD.
- 7 Four police officers armed with shotguns with the Dal Tex Building in the background.

- 8 Larry Florer being led down Houston Street. Three additional photographers are seen in this frame.
- 9 Florer inside the garage entrance of the Sheriff's Building.
- 10 Two police officers escorting a Negro witness into the TSBD.
- 11 From the front of the TSBD, two men possibly under arrest being placed into a police car.
- 12 The above individuals being driven down Elm Street.
- 13 A Negro and Mexican being led to a police car on Elm Street.
- 14 The above individuals being placed inside the police car with another photographer present.

Couch, Malcolm

- 1 In CAM 3 of the presidential motorcade on Main Street approaching Houston Street.
- 2 The front of the TSBD with the crowd on the north side of Elm Street as CAM 3 rounds the corner of Houston and Elm Street.
- 3 CAM 1, CAM 2 and other photographers on the grassy knoll with the Newmans on the ground and the umbrella man. Officer Haygood approaching the north curb of Elm Street with Officer Hargis running to the police cycle south of Elm Street as CAM 3 continues down Elm Street.
- 4 Police officer with his revolver drawn on the south side of Elm Street.
- 5 Members of the crowd seen are: Brehm, Babushka Lady, Moorman, Summers and Tague, with a sweeping view to the overpass.
- 6 Photographers on the grassy knoll with the newsmen still on the ground.
- 7 Police Officer Haygood trying to jump his motorcycle over the curb on the north side of Elm Street. Photographers Weigman and Cancellare running to catch CAM 1.
- 8 From the arcade of the crowd on the north side of Elm Street.
- 9 From Houston and Elm, of the crowd on the north side of Elm Street.

- 10 Taken from a car driving on Elm Street, of the crowd on the north side of Elm Street (all footage above was filmed before 13:35 p.m.).
- 11 On the sixth floor of the TSBD, of several police officers looking outside.
- 12 From the center of the plaza of the TSBD. The zoom lens is on the sixth floor window as Couch pans down to the grassy knoll then to the corner of Houston and Elm and then back to the overpass as the Executive train is moving on the overpass.
- 13 Footage of the arcade with several people inside.
- 14 WFAA commentator shows the rifle and telescopic sight which is similar to Oswald's rifle lying in the plaza grass with a demonstration of the bolt action.
- 15 Footage from the grassy knoll of the center area of the plaza.
- 16 Sequence numbers #11 through #16 were taken between 3:00 p.m. and 4:00 p.m. With views of the cupola, the arcade and Zapruder's position during the assassination.

Reiland, Ron

- 1 In the Oak Cliff section of town, a frame building where men are sneaking about the structure trying to locate possible assassins.
- 2 Two police cars speeding through the residential streets in Oak Cliff, which shows the police entering the frame building.
- 3 Police officer holding up a grey jacket next door to a parking lot.
- 4 Taken near a used car lot, men talking in their shirtsleeves.
- 5 Of Officer Tippit shooting, several police and police cars, with a police officer running toward the police car holding the butt of his gun.
- 6 At the Tippit shooting scene a crowd gathers around Tippit's police car, a piece of paper or poster lying on the dashboard showing no detail.
- 7 Police officers examining Tippit's billfold. Police officer holding Tippit's service revolver with a police officer pointing to the note pad inside the patrol car (Reiland narrating).

- 8 Crowd gathering around Tippit's police car, frame is overexposed (refer to Reiland section concerning the over and underexposed footage).
- 9 Police car with an unknown person in the rear seat. Car drives away through the business section of the city.
- 10 Police cars approaching the Texas Theatre.
- 11 View of the Texas Theatre tower.
- 12 Police officers going inside the Texas Theatre with a car pulling away.
- 13 Inside the darkened theatre as police officers arrest Oswald and move him towards the inside doorway.
- 14 Crowd gathering around the police car as it pulls away with Oswald.

Alyea, Thomas

- 1 From the location of Houston and Main of the plaza and the knoll with the crowd moving toward the knoll.
- 2 Scene outside and around the TSBD.
- 3 Scene outside and around the TSBD.
- 4 Scene outside and around the TSBD.
- 5 Scene outside and around the TSBD.
- 6 Inside the TSBD on the sixth floor during the police search.
- 7 Police officer looking out the sixth floor window towards Houston Street.
- 8 Police officer's head sticking outside a window on the sixth floor TSBD.
- 9 Inside the TSBD on the sixth floor area showing the lunch sack and Dr. Pepper bottle.
- 10 Discovery of the rifle on the sixth floor between the boxes. Sheriff along with the police examining the area.
- 11 Close-up view of the rifle.

- 12 Policeman holding the rifle. Second policeman pointing to the bolt action.
- 13 Group near the alleged assassin lair. Newsmen taking notes.
- 14 Lt. Day dusting a live round for fingerprints with the round visible to the camera lens.
- 15 Sheriff's talking on the sixth floor.
- 16 From the main floor of the TSBD looking outside the front doors as a packet of film by Alyea is thrown out of the building.
- 17 Footage from the sixth floor which was edited by Alyea due to sprocket damage.

### **Wide World Photos, Incorporated**

#### **Sequence Number:**

- 1 Providing wire negatives of the assassination.
- 2 Holding company for photographs.
- 3 No information.

### **Williams, Lewis**

#### **Sequence Number:**

- 1 Color photograph of the Mayor's car in the parade.
- 2 Color photograph of vehicle car number 2 during the parade.
- 3 Color photograph of vehicle car number 3 during the parade.
- 4 Color close-up photograph of the presidential limousine in the motorcade.

### **Willis, Philip L.**

#### **Sequence Number:**

(The following list includes outtakes which were not included in the original series released by Willis.)

- 1-1 Motorcade escort cycles at Main and Houston Street.
- 1-2 Chief Curry's car at Main and Houston corner.
- 1-3 Presidential limousine and cycle escort at Main and Houston.
- 1-4 Close-up view of the presidential limousine on Houston.
- 1-5 Presidential limousine and escort cycles on Elm Street.
- 1-6 Close-up view of President Kennedy and Mrs. Kennedy on Elm Street.
- 1-7 Presidential limousine near the Stemmons sign with the grassy knoll in the background. Motorcade under fire.
- 1-8 Presidential limousine near the triple underpass spectators on Elm Street.
- 1-9 From the south knoll of the spectators on Elm Street.
- 1-10 Near the entrance of the TSBD police with a possible suspect.
- 1-11 Around the doorway of the TSBD with police and spectators.
- 1-12 View of the Dal Tex Building of spectators and cameraman.
- 1-13 Upper view of the TSBD facade and windows.
- 1-14 Near the entrance of the TSBD of the police and police cars.
- 1-15 Near the Dal Tex Building of the police at Elm and Houston Street.
- 1-16 Crowd and police gathering near the entrance of the TSBD.
- 1-17 At the corner of Elm and Houston Street of the police.
- 1-18 Near the Dal Tex Building of the police and a fire truck.
- 1-19 Near the TSBD, an extreme close-up of the crowd.
- 1-20 Crowd on Houston Street with the TSBD in the background.
- 1-21 From the south knoll, a view of the plaza with the TSBD in the background.
- 1-22 Police on the south knoll with the TSBD in the background.

- 1-23 From the south knoll/arcade, a view of the TSBD.
- 1-24 From Commerce Street of the plaza and the TSBD.

**Winfrey, Bill**

**Sequence Number:**

- 1-1 Photograph of Oswald at the Dallas Police Station immediately following his arrest.
- 1-2 No additional information.

**Wolfe, Frank**

**Sequence Number:**

- 1 The arrival of the presidential helicopter from Andrews Air Force Base to the White House. Full frame photograph of Mrs. Lyndon Johnson departing the helicopter with President Johnson following right behind Mrs. Johnson. Secret Service Agent Rufus Youngblood waiting on the White House lawn with a White House police officer.
- 2 Similar to the above frame. President Johnson and Mrs. Johnson exiting the helicopter.
- 3 President Johnson and Mrs. Johnson along with Agent Youngblood on the White House lawn with additional members of the Johnson party exiting the helicopter.
- 4 Closer view of the President and members of the party, McGeorge Bundy, Robert MacNamara, Bill Moyers, Walter Jenkins and Agent Youngblood near the tail section of the helicopter in conference.
- 5 Similar to frame sequence 4 but with the presidential party on the move towards the White House.
- 6 Extreme close-up view of the President and members of his party on the White House lawn moving towards the White House.
- 7 The presidential party still on the White House lawn moving away from the photographer. The tail section of the helicopter is seen to the left of the frame and to the right of the frame of three unidentified males waiting.

**Woods, John II****Sequence Number**

- 1-1 Oswald/FBI Miller Funeral Home photographs [refer to the FBI photographic section].
- 2-1 Oswald/Parkland Hospital autopsy photographs [refer to the FBI photographic section].
- 3-1 Shel Hershorn contact sheets [refer to the National Archives photographic section].
- 4-1 Art Rickerby contact sheets [refer to the National Archives photographic section].
- 5-1 Approximately four thousand photographs relating to the assassination of President John Kennedy.
- 6-1 James Murray Contact Sheet

**WWL-TV****Sequence Number:**

- 1-1 Oswald outside the Trade Mart in New Orleans distributing the "HANDS OFF CUBA!" leaflets.
- 1-2 Oswald and associate distributing the "HANDS OFF CUBA!" leaflets in front of the Trade Mart in New Orleans.

**Zapruder, Abraham****Sequence Number:**

- 1-1 Footage of the arcade and pergola of bystanders waiting for the presidential motorcade.
- 1-2 Tri-cycles turning onto Houston and Elm extension.
- 1-3 Police cycle escort turning onto Elm Street with the presidential limousine following.

- 1-4 Presidential limousine on Elm Street heading down Elm coming towards Zapruder.
- 1-5 Presidential limousine prior to the Stemmons street sign.
- 1-6 Presidential limousine reappearing from the Stemmons street sign.
- 1-7 The presidential limousine moving down Elm Street both Connally and Kennedy hit by gunfire.
- 1-8 President Kennedy hit in the head by gunfire.
- 1-9 President Kennedy's body reacting to the fatal hit to the head.
- 1-10 Jacqueline Kennedy scrambling onto the trunk of the limousine.
- 1-11 Secret Service Agent Clint Hill moving from the Secret Service back-up limousine to the president's car.
- 1-12 S.S. Agent Hill climbing on the trunk of the limousine pushing Jacqueline Kennedy back into the car.
- 1-13 The presidential limousine entering the triple underpass and disappearing.
- 1-14 Panning around the triple underpass and the grassy knoll section.

**PART II  
THE REPORTS**

The House Select Committee on Assassinations, Volume VI

**REPORT OF THE PHOTOGRAPHIC EVIDENCE PANEL<sup>a</sup>**

**I. INTRODUCTION**

(1)<sup>b</sup> The events in Dealey Plaza, Dallas, Texas, on November 22, 1963, surrounding and including the assassination of President John F. Kennedy, were recorded in a substantial body of photographic evidence. More than 510 photographs that related directly to the assassination were taken by approximately 75 photographers, in addition to substantial other relevant photographic evidence pertaining to events that did not involve the actual assassination.<sup>1</sup>

(2) This photographic evidence provided the Warren Commission with a basis for attempting to resolve important issues such as the number, timing, and source of the shots fired at President Kennedy. The generally poor quality of portions of the material, however, has resulted in many interpretative questions regarding matters that the Warren Commission purported to resolve. In the years since the Warren Commission, independent researchers have criticized its findings that were based upon photographic evidence as incomplete and unsubstantiated.<sup>2</sup>

(3) It is clear that the Warren Commission's investigation was limited for a number of reasons:

(4) 1. It did not have access to all critical photographic materials, such as those from the autopsy;

2. Potentially important photographs were not located;

3. The Commission did not have its own investigators and analysis, but had to rely on other Government agencies, thereby bringing the credibility of its report, if not the quality into question; and

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<sup>a</sup>Materials submitted for this report by the photographic panel were compiled by HSCA staff members Michael Goldsmith and Jane Downey.

<sup>b</sup>Arabic numerals in parentheses at the beginning of paragraphs indicate the paragraph number for purposes of citation and referencing; superscripted Arabic numerals in the middle or at the end of sentences indicate references which can be found at the end of Part II.

4. Photographic enhancement technology was not as sophisticated or effective in 1963-64 as it has since become.

(5) In contrast, the House Select Committee on Assassinations, because of the independent status established by its congressional mandate, was able to select its own panel of photographic experts who had access to files and photographic records that, for one reason or another, were not available to the Warren Commission. The committee was also able to secure access, and have its panel review, independent studies that have been conducted in the years since the Warren Commission.

(6) The sciences associated with photography have been advanced significantly in recent years. New processes in chemistry and radio chemistry and new films make possible sensitivity to changes in the light and dark tones of an image and in the recording of small details.<sup>3</sup> Another important development has been the use of computer technology for the enhancement of photographic picture quality.<sup>4</sup>

(7) Accordingly, the panel was ultimately expected to apply, within the given time and monetary constraints, the most sophisticated photographic technology available to resolve outstanding issues related to the photographic evidence. These issues included the number, timing, and source of the shots, the identification of the murder weapon(s), the identity of the assassin(s) and possible co-conspirators, the authentication of both the Kennedy autopsy materials and several incriminating photographs of Oswald with the alleged murder weapon, and the validity of the "second Oswald" theory.

#### A. Selection of the Photographic Experts

(8) Early in 1978, after consulting officers and members of the American Society of Photographic Scientists and Engineers, the committee convened a panel of experts with varied backgrounds in the photographic sciences to study the available photographic evidence related to the assassination and to advise on the newest analytical and scientific procedures which could be effectively applied.<sup>c</sup> The panel included a broad range of technological expertise, covering such diverse areas as photographic image enhancement, photogrammetry, photointerpretation, and forensic photography.<sup>d</sup> The photographic evidence panel was composed of the following

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<sup>c</sup>Initially, an effort was made to limit membership on the photographic evidence panel to individuals who had never done any work for the U.S. intelligence community. Nevertheless, after spending weeks contacting various photographic specialists, it became apparent that most of the leading photographic scientists in this country have done some intelligence-related work. Accordingly, a previous affiliation with an intelligence agency was not considered to be an automatic basis for precluding someone from membership on the panel.

<sup>d</sup>Each of these terms has a particular meaning or technical trade usage among photographic scientists. The terms have been defined in the Dictionary of Contemporary Photography (L.

individuals:

Harry C. Andrews, Ph.D., Image Processing Institute, University of Southern California, Los Angeles, California.

Richard J. Blackwell, B.S., M.S., Jet Propulsion Laboratory, Pasadena, California.

Thomas N. Canning, B.S., M.S., National Aeronautics and Space Administration, Moffett Field, California.

Robert Chiralo, B.S., M.S., The Aerospace Corporation, Los Angeles, California.

Bob R. Hunt, B.S., M.S., Ph.D., Professor, Systems and Industrial Engineering and Optical Sciences, University of Arizona, Tucson, Arizona.

Donald H. Jenney, Ph.D., Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico.

Ellis Kerley, B.S., M.S., Ph.D., Chairman, Department of Anthropology, University of Maryland, College Park, Maryland.

Sgt. Cecil W. Kirk, Mobile Crime Lab, Metropolitan Police Department, District of Columbia.

Charles J. Leontis, B.S., M.S., The Aerospace Corporation, Los Angeles, California.

C. S. McCamy, B.C.E., M.S., Vice President, Science and Technology, Macbeth Division, Kollmorgen Corporation, Newburgh, N.Y.

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Stroebel and H. N. Todd, Morgan and Morgran, Inc., publishers, Dobbs Ferry, N.Y., 1974):

Forensic photography - The specialization of making photographs for law enforcement or related purposes.

Image enhancement - Any process by which a photographic record is improved, as by increase in sharpness or contrast, or by reduction in noise.

Photogrammetry - The technology of using photographic methods to make accurate measurements. The term, initially applied to aerial surveying and cartography, et cetera, has been extended to include other types of mensuration, even to photographic methods of fitting garments to a person. Also see photometry.

Photointerpretation - The process (usually visual) of obtaining qualitative or quantitative information from a photograph. The term initially had a military connotation but has been extended to other areas, such as geodetic, agricultural, climatic, and population studies.

David B. Eisendrath, B.A., Consultant in Technical and Scientific Photography, Brooklyn, N.Y.

Robert H. Selzer, B.S., M.S., M.A., Jet Propulsion Laboratory, Los Angeles, California.

Ronald Francis, Ph.D., School of Photographic Sciences, Rochester Institute of Technology, Rochester, N.Y.

Bennett Sherman, B.S., M.S., Consultant on Optics and Allied Sciences, Elmhurst, N.Y.

William K. Hartmann, B.S., M.S., Ph.D., Senior Scientist, Planetary Science Institute, Tucson, Arizona.

Philip N. Slater, B.S., Ph.D., Professor, Optical Sciences, University of Arizona, Tucson, Arizona.

Everett Merritt, Retired Scientist in Analytical Photogrammetry, Geodesy, and Astrophysics, Ridge, Maryland.

George W. Stoke, B.S., Ph.D., Former Professor of Medicine, Biophysics and Electrical Sciences at Harvard University and State University of New York, Stony Brook, N.Y.

Paul G. Roetling, B.A., Ph.D., Principal Scientist, Image Processing Area, Xerox Corporation, Rochester, N.Y.

Clyde C. Snow, B.S., M.S., Ph.D., Chief, Physical Anthropology Division, Civil Aeromedical Institute, Federal Aviation Administration, Oklahoma City, Oklahoma.

Frank Scott, B.S., M.S., the Perkin-Elmer Corporation, West Redding, Connecticut.

### C. Source Materials for Enhancement

(39) Image enhancement can result in dramatic photographic clarification, but the extent of improvement is limited by the quality of the original images. That is, an image may be so severely degraded that no combination of enhancement techniques can improve it. One parameter already mentioned that limits enhancement is image noise.

(40) Any photographic copying process will introduce some noise into a copy. In most cases, this new noise will not be detrimental. Moreover, in general, there are so many other potential difficulties in image copying such as loss of sharpness and resolution, loss of contrast, and loss of gray tones that it is undesirable to attempt to enhance these copies. The Panel made a decision to work only with original images for enhancement.

(41) The Panel also adopted a policy of working with transparency images as much as possible as distinct from prints that are on an opaque base. An important property of any image is the dynamic range of values of brightness from smallest to largest. Given a certain level of photographic noise, an image with a wide dynamic range is preferable to one with a narrow dynamic range because the accuracy of brightness representation increases as the dynamic range increases. In effect, the wider the dynamic range, the less interference is occasioned by image

noise. Because under proper processing the dynamic range of images recorded on transparency film is much greater than with opaque film (for example, photographic print paper), transparency film images are preferable as source material for image enhancement.

(42) Following is a list of the most important original (Unless otherwise indicated) photographic materials studied for possible enhancement and analysis purposes. Each item is identified by its photographer's name:

1. Oswald "backyard picture" materials (for list of items, see paragraphs 366-370, infra.).

2. Kennedy autopsy photographs (color and black and white), transparencies and X-rays.

3. Color photographs:

Wilma Bond	Jim Towner
Robert Croft*	Phillip Willis
James Powell	

4. Black and white photographs:

William Allen	Tom Dillard
James Altgens	Joe Laird*
Jack Beers*	Mary Moorman
Hugh Betzner*	Jim Murray*
Richard Bothun	Arthur Rickerby
Tom Cabluck*	George Smith*
Frank Cancellare*	George Weaver*
Malcolm Couch* (movie stills)	David Weigman* (movie stills)

5. Motion picture films:

Thomas Alyea\*  
Mark Bell

Dallas Cinema Associates combined sequences taken by 18 photographers, including John Martin and Charles Mentensana; for others, see H. Weisberg, Photographic Whitewash: Suppressed Kennedy Assassination Pictures (published by author, 1967), page 254.

NOTE: Initially, Robert Groden, a photographic consultant to the committee, advised the panel as to pertinent photographic issues and related materials. Committee investigators located many of the suggested films and photographs, however, some items were never

located, i.e., the Babushka Lady film, a color photograph taken by Norman Similas, and the original negative of the Betzner photograph.

\*Copy prints.

#### **D. Panel Procedures**

(43) The Photographic Evidence Panel was responsible for establishing the guidelines and procedures under which all of the committee's photographic enhancement and analytic work was to be accomplished. Because of the large quantity of material to be examined, it contracted with several laboratories to perform, under its general direction, all necessary photographic enhancement work and, on occasion, some analytic work as well.

(44) Photo-optical/photo-chemical enhancement was undertaken by a team of professor at the Rochester Institute of Technology, and digital image processing was performed by the University of Southern California Image Processing Institute, the University of California Los Alamos Scientific Laboratory and The Aerospace Corporation. Once these contractors had completed their work, the results were submitted to the Panel for interpretation and its own independent analysis.

(45) The Photographic Evidence Panel first met with the committee and representatives of the laboratories in February 1978. At that time, the Panel was apprised of the issues that the photographic evidence touched upon, and assigned the overall task of examining the photographic material compiled by the committee.

(46) After the Panel had reviewed these materials, enhancement and analytic projects were outlined and assigned to the laboratories. Analytic studies were also assigned to individuals and groups within the Panel, according to their respective specialties. The work was conducted with periodic reviews by the Panel, between February and mid-July, when the Panel held its final conference to evaluate all the results.

## **II. The Number, Timing, and Source of the Shots Fired at the Presidential Limousine**

### **A. Warren Commission Findings**

(47) The Warren Commission concluded that three bullets had been fired at the presidential limousine from the sixth floor, southeast corner window, of the Texas School Book Depository. Finding that the first pierced the President's neck, the Commission also indicated that "[a]lthough . . . not necessary to any essential findings . . . there is very persuasive evidence from the experts to indicate that [this] . . . same bullet . . . also caused Governor Connally's

wounds."<sup>12</sup> A second bullet caused a massive and fatal wound to the President's head<sup>13</sup>; a third bullet was believed to have missed the car and its occupants.<sup>14</sup>

(48) The Commission was unable to establish conclusively which of the three bullets missed, and hence the precise time span of the shots was not definitively determined. By studying the Zapruder movie film, it was found that the President's back wound occurred between frames 210 and 225, and that the head wound occurred at frame 313.<sup>15</sup> Based upon the 18.3 frame-per-second average rate of speed at which film was exposed in Zapruder's camera, the Commission then calculated that "there was an interval of from 4.8 to 5.6 seconds" between those two shots.<sup>16</sup> If the second bullet was the one that missed, then this interval was the time span for all the shots. If, however, either the first or third bullet missed, the minimum time span would have been 7.1 to 7.9 seconds (derived from the previous calculation of 4.8 to 5.6 seconds plus 2.3 seconds, the minimum time in which Oswald's Mannlicher-Carcano rifle could be fired).<sup>17</sup>

(49) To support its conclusion that the President's and Governor's wounds were caused by shots that were fired from the sixth floor, southeast corner window, of the Texas School Book Depository, the Warren Commission relied on an FBI reenactment. Using the Zapruder film as the point of reference, the FBI placed the limousine and its occupants in their approximate positions at the time of the shots and then determined the angles from the wound entry point on President Kennedy to "the end of the muzzle of the rifle positioned where it was believed to have been held by the assassin."<sup>18</sup> The average result of 17°43'30", allowing for a downward street grade of 3°9', was concluded by the Commission to be "consistent with the trajectory of a bullet passing through the President's neck and then striking Governor Connally's back . . ."<sup>19</sup>

(50) Although each of these findings has been criticized, the Commission's statement that the bullet which caused President Kennedy's neck injury was also responsible for Governor Connally's wounds has caused the most controversy. Warren Commission critics have asserted that in the Zapruder film, Governor Connally first reacts to his wounds at frame 234 or 238, 0.5 to 1.5 seconds after the President (who the Commission found was struck between frames 210-225) and, therefore, could not have been hit by the same bullet. Moreover, given the 2.3-second minimum firing time for a Mannlicher-Carcano rifle, they assert that another gunman must have been involved in the assassination.<sup>20</sup>

(51) Critics have also questioned the Commission's "single bullet theory" because they find that, given the wounds, the relative alignment of the President and the Governor within the limousine was inconsistent with the path of a single bullet.<sup>21</sup> They claim that the Commission's trajectory analysis was self-serving, since it assumed a particular location for the gunman and then merely sought to verify that the angle from rifle muzzle to the limousine occupants was consistent with the trajectory of a bullet passing through the two men.

## 2. VISUAL EVIDENCE DERIVED FROM OBSERVATIONS OF PERSONS IN THE ZAPRUDER FILM<sup>e</sup>

### (a) Issues

- (57) The Panel was requested by the committee to address, at a minimum, three questions:
- (58) (a) When did Kennedy first show a reaction to some severe external stimulus?
- (59) (b) When did Connally first show a reaction to some severe external stimulus?
- (60) (c) Was the relative alignment of Kennedy and Connally within the limousine consistent with the single-bullet theory?

### (b) Materials and procedures

(61) The Zapruder film was studied with care at each of the Panel's conferences.<sup>f</sup> At the final conference, which took place in July 1978, the film was closely scrutinized by more than 20 photographic scientists who were either members of the Panel or contractors responsible for much of the committee's laboratory work (i.e., photographic enhancement, restoration, etc.). At the Panel's request, a specially enhanced version of the Zapruder film had been obtained which stabilized and enlarged the images of Kennedy and Connally. The Panel was also given access to four frames which showed the presidential limousine going behind a sign; these had previously been spliced out of the original Zapruder film.<sup>22</sup> Finally, computer assisted enhancements of relevant frames from the Zapruder film were made available to Panel members, but these were not reviewed until later.

(62) In total, the Zapruder film was viewed by this group on a frame-by-frame basis and at various speeds approximately 100 times.<sup>g</sup> A special analytical projector was used to facilitate this task. Because the quality of most of this film generally precluded analysis of facial expression, primary emphasis was given to attempting to detect gross changes in body movements. As each frame was analyzed, proper consideration was given to the Zapruder film's exposure rate through the camera of 18.3 frames per second.<sup>23</sup> In this manner, changes in body movements between frames could be better understood and, at time, even quantified.

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<sup>e</sup>This section prepared under the direction of C. S. McCamy, Frank Scott and Bennett Sherman. For the related public hearing testimony of C. S. McCamy, 9/12/78, see HSCA-Hearings, vol. II, pp. 142-54, 349-72.

<sup>f</sup>For reference to Zapruder frames discussed herein, see JFK exhibits F-209-274. HSCA-JFK Hearings, vol. I, pp. 69-97.

<sup>g</sup>It is difficult to state this figure with precision because various segments of the film were continuously replayed while others received considerably less attention.

(63) After completing its review of the film, the Panel took a vote with regard to each of the issues that had been raised by the committee.<sup>b</sup> The Panel's vote focused on those reactions to severe external stimuli that may have been suggestive of impacting bullets.

### (c) Conclusions

(64) (a) By a vote of 12 to 5, the Panel determined that President Kennedy first showed a reaction to some severe external stimulus by Zapruder frame 207, as he is seen going behind a street sign that obstructed Zapruder's view.

(65) (b) By a vote of 11 to 3, the Panel determined that Governor Connally first showed a reaction to some severe external stimulus by Zapruder frame 224, virtually immediately after he is seen emerging from behind the sign that obstructed Zapruder's view.

(66) (c) By a vote of 15 to 1, the Panel determined that the relative alignment of President Kennedy and Governor Connally in the limousine was consistent with the single bullet theory.

(67) (d) At least two shots, spaced approximately 6 seconds apart, were fired at the presidential limousine. Nevertheless, based only on its review of the reactions of persons shown in the Zapruder film, there was insufficient evidence to reach any conclusion concerning additional shots.

## 3. THE PANNING ERROR--BLUR ANALYSIS OF THE ZAPRUDER FILM<sup>i</sup>

### (a) Issues

(81) (a) Can any of the panning errors indicated as blurs or "jiggles" on the Zapruder film reasonably be attributed to the photographer's involuntary startle reaction to the sound of gunshots?

(82) (b) If so, is it possible to determine from such panning error blurs the number, and to estimate the timing, of the shots that were fired at the presidential limousine?

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<sup>b</sup>Because the film was not viewed simultaneously by all participants, some of whom occasionally had to leave the room to perform other tasks, and as the voting was conducted at different times for each issue, the same number of votes was not cast on each issue.

<sup>i</sup>This section prepared under the direction of William K. Hartmann. For Dr. Hartmann's related public hearing testimony, 9/11/78, see HSCA-JFK Hearings, vol. II, pp. 4-16.

### b. Procedures and materials employed

(83) Originally, a blur study of the Zapruder film was to involve an analysis of not only the Zapruder, but also the Nix and Muchmore films, to determine whether startle reactions by the photographers were present and simultaneous for each photographer. Nevertheless, neither the Nix nor the Muchmore films included any extensive footage prior to the time of the head shot. Thus, only the Zapruder film, which showed the entire motorcade scene immediately prior to and during the assassination, was subjected to this analysis.<sup>j</sup>

(84) The measurement of blur, or jiggle, essentially involved a measure of Zapruder's error in panning his camera as he filmed the presidential limousine. Two sets of measurements were made independently by Photographic Evidence Panel members William Hartmann and Frank Scott. Hartmann measured the length of images of small highlights on the presidential car in each frame; these were generally small and round on the sharpest frame but highly elongated on frames that were blurred by camera motion during the time that the shutter was open. The amount of elongation was measured to determine the panning error. (See Fig. II-1.)

(85) Scott followed background details from frame to frame. These details indicated a direction in which the camera pointed during each frame. The sequence of these camera point directions would have defined a smooth, relatively straight line had the camera panned in a perfectly uniform manner (see Fig. II-2, JFK Exhibit F-371); discrepancies were revealed by erratic spacing of camera pointing directions (see Fig. II-3, JFK Exhibits F-372-372).

### PANNING OR JIGGLE RECORD OF ZAPRUDER FILM

#### EXPLANATION

IF ZAPRUDER PANNED HIS CAMERA PERFECTLY, THE JIGGLE RECORD WOULD LOOK LIKE THIS:

. . . . .

START

END

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<sup>j</sup>In addition, the Nix and Muchmore films were taken from a distance of about 2.7 and 2.1 times, respectively, farther away from President Kennedy than the Zapruder film.

IF ZAPRUDER PANNED HIS CAMERA PERFECTLY, EXCEPT FOR A RAPID MOVEMENT WHERE HE MOVED HIS CAMERA DOWNWARD, THE JIGGLE RECORD WOULD LOOK LIKE THIS:



IF ZAPRUDER PANNED HIS CAMERA PERFECTLY, AND MAINTAINED GOOD HORIZONTAL PANNING BUT DID NOT PAN SMOOTHLY, THE JIGGLE RECORD WOULD LOOK LIKE THIS:



FIGURE II-2. - Illustration of technique used by Frank Scott. If Zapruder had made no panning errors, the background points from frame to frame would have been plotted as illustrated.

These were transformed into quantitative measurements by a vector subtraction process: A 20-frame running average of the rate of angular motion was used to predict the point where the camera should be aimed in frame  $n$ , based on the place where it was directed in frame  $n-1$ . A subtraction was then made between the  $n-1$  to  $n$  vector which should have appeared and the vector that actually did appear. This vector difference was then measured to determine the panning error between frames.

(86) The results of these measurements were then plotted to illustrate visually the time of greatest panning error in a manner similar to Figure II-1. (See Fig. II-4.) In both Figure II-1 and Figure II-4, a threshold line was then drawn horizontally across the graph to separate visually the areas of greatest (i.e., unusual) blur from the "noise," or the normal panning errors that occurred throughout the filming simply because the camera was hand held. Any such threshold line, of course, must to some extent be arbitrarily placed. The extent of blur that resulted from an unusual external stimulus (e.g., a gunshot) may not, therefore, always be precisely delineated by the line. Zapruder's true startle reactions may have begun a frame or two earlier, or later, than indicated by the placement of the threshold line that was chosen, but blurs above the threshold line are well above the average.

(87) Following our measurement of blur by these two different methods of the panning errors, the results of Luis Alvarez' study, reported in the American Journal of Physics, vol. 44, p. 813 (1976), were also reviewed. Instead of measuring the blur itself, Dr. Alvarez measured the difference in blur between frames and calculated the rate of change in blur, thus providing a

sensitive record of any unusually erratic movement by Zapruder. All three sets of measurements were plotted on a single graph and used in the subsequent analysis. (See Fig. II-5.)

(88) To assist in the analysis, a time-scale in seconds was added to Figures II-1, -4 and -5. The zero point in the time scale was chosen to coincide with the moment when the trigger was pulled on the fatal head shot. This was estimated to have been frame 310, based on estimates of the average running speed of Zapruder's camera in conjunction with other scientific evidence.

(89) Specifically, Zapruder reported that his camera was fully wound when he started filming the motorcade as it turned onto Elm Street. In 1964, the FBI tested the camera and found that during the first 30 seconds of its operation (after being fully wound) Zapruder's camera ran at between 18.0 and 18.5 frames per second, with the average estimated to be 18.3. Note that the range 18.0 to 18.5 indicates a range of 3 percent uncertainty in all time intervals measured from the Zapruder film.<sup>25</sup>

(90) Fragmentary material from the President's head is seen flying upward and outward in frames 313 and 314. The fragments are already airborne and in motion in 313. Extrapolation backwards indicated that the explosion began in frame 312 rather than 313, since this would be the frame nearest to the moment when the fragments left the head. Other scientific evidence, such as wound measurements, and trajectory analysis, indicated that the fatal head shot was fired from a Mannlicher-Carcano rifle located in the southeast corner window of the sixth floor of the Texas School Book Depository.<sup>26</sup> The distance from that window to the limousine at frame 312 is approximately 265 feet.<sup>27</sup> Since a Mannlicher-Carcano bullet travels at approximately 2000 feet per second,<sup>28</sup> the bullet flight time would have been 0.13 second, or the passage of approximately 2.4 frames in Zapruder's camera. Subtracting these two frames from frame 312, it is apparent that the fatal shot was fired at approximately frame 310.

(91) Using frame 310 as the time of the trigger pull, it is possible to determine that the sound from that shot would have reached Zapruder at frame 313-314: Zapruder was standing approximately 270 feet from the Texas School Book Depository window; sound travels slightly more than 1,100 feet per second.<sup>29</sup> and the sound of the shock wave from the bullet itself reached Zapruder slightly before the sound of the muzzle blast from the window.

Finally, the pattern of jiggles that was discovered was compared with the results of the committee's acoustics study. The correlation between the jiggle analysis and the acoustics tests is treated separately in an addendum to this report.

### (c) Conclusions

(92) 1. Two pronounced series of jiggles or blurs on the Zapruder film, one during frames 189-197, a time when other visual evidence suggests that President Kennedy was first shot<sup>30</sup>, and another during frames 312-334, following impact of the head shot, may reasonably be attributed to the photographer's startle reaction to the sound of gunshots.

(93) 2. The timing of the shots associated with these two sets of blurs can reasonably be determined to be approximately 6 to 7 seconds apart.

(94) 3. Other blurs, which might relate to gunshots, appear on the film between these two sets and elsewhere. Due to the absence of other visual evidence associated with these blurs, the Panel made no finding as to their cause.

#### 4. THE TRAJECTORY ANALYSIS<sup>k</sup>

##### (a) Introduction

(110) A trajectory is the path taken through space by an object such as a missile or bullet. In general, the trajectories of missiles are curved because of factors such as gravity and aerodynamic forces. Nevertheless, in the case of high speed bullets traveling short distances, the curvature is typically slight.<sup>40</sup> In such cases, the effect of aerodynamic forces is small both because the projectile flies almost perfectly nose-on through the air and because any small side-to-side movement tends to cancel one another by virtue of the bullet's spin.<sup>41</sup> The effect of gravity is similarly slight and can be easily calculated. For a total flight path of 200 feet at 2000 feet per second (the speed of a bullet from a moderate performance rifle), the time in flight is one-tenth of a second. During this period, gravity deflects the flight path only two inches.<sup>42</sup> A high performance rifle bullet would be deflected even less because it is traveling faster and its time in flight is shorter. It is, therefore, permissible to characterize the trajectory of each bullet fired at the President as a straight line extending between rifle and victim.

##### (b) Issues

(111) In connection with the trajectory analysis, the Panel undertook to answer three questions:

(112) 1. What were the trajectories of the bullets that struck the President?

(113) 2. Is the trajectory of the bullet that caused the President's back and neck wounds consistent with the single bullet theory?

(114) 3. Given the trajectories, from where were the bullets fired?

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<sup>k</sup>This section was prepared under the direction of Thomas N. Canning, with the assistance of Clyde C. Snow and C. S. McCamy. For the related public hearing testimony of Canning and McCamy, see HSCA-JFK Hearings, 9/12/79, vol. II, pp. 142-203.

(c) Procedures

(115) A straight line trajectory can be constructed once any two points the missile is known to have passed have been established. In the present study, the inshoot and outshoot wounds inflicted by the bullets that struck President Kennedy and Governor Connally were used as the two points.

(116) In order to calculate the trajectory based on these wound pairs, it was necessary to establish the position of each entry and exit point in space at the time it was inflicted. This requires that three determinations be made:

(117) 1. The location of the wounds relative to recognizable reference features of the victim had to be established. Ideally, this information could be expressed in terms of a measured distance left or right from the midplane of the body along well-defined directions in reference to clear external features such as an ear or elbow.

(118) 2. It was necessary to determine the angular orientation of the wounded part of the victim relative to his immediate surroundings - that is to say, in what direction he was facing, what his inclination was forward or backward, and to which side he was leaning and by how much.

(119) 3. It was necessary to know where the victim was located relative to his surroundings, i.e., the location of the victim within the limousine and the location of the limousine relative to known landmarks in Dealey Plaza.

(120) The requisite information for undertaking this particular trajectory analysis could not be accurately obtained from any single source. Consequently, the committee asked its various scientific consultants to provide input from their areas of expertise. The Forensic Pathology Panel was responsible for providing, to the extent possible, the precise locations of the wounds sustained by Kennedy and Connally.<sup>1</sup> It relied on enhanced postmortem photographs and X-rays of President Kennedy which were produced by the Photographic Evidence Panel. Enhanced photography was further used in the effort to determine the precise orientation of President Kennedy at the time of the assassination. The Photographic Evidence Panel also assisted in the interpretation of motorcade photographs of Kennedy and Connally and in providing photogrammetrically derived measurements of critical aspects of the photographs. Finally, the actual placement of the presidential limousine in the Dealey Plaza area at the time of the shots

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<sup>1</sup>While the Forensic Pathology Panel did provide this information, the actual measurements related to wound locations were determined by the NASA scientist who was responsible for supervising the trajectory project. He was in frequent consultation with members of the Forensic Pathology Panel and with forensic anthropologist from both the FAA's Civil Aeromedical Institute and the Smithsonian Institute.

was established through a photogrammetric analysis conducted by the U.S. Geological Survey (USGS).<sup>m43</sup>

(121) All the preceding information was compiled under the supervision of Thomas N. Canning, an engineer from the Space Project Division of NASA, who then was responsible for constructing the actual trajectories. In contrast to the trajectory analysis performed by the Warren Commission<sup>44</sup>, the investigative procedures and analyses in this instance were governed by the hypothesis that there was no other evidence (e.g., the discovery of bullet cartridges and a rifle in the Texas School Book Depository) concerning the source of the shots.

(122) Although all of the available scientific evidence indicated that President Kennedy and Governor Connally were struck by a total of two bullets, one hitting President Kennedy in the back and continuing through to enter Governor Connally after exiting President Kennedy's neck, and the other hitting President Kennedy's head, three different trajectories were constructed: One based on the entry and exit wounds to President Kennedy's head, another on President Kennedy's back-neck wounds, the last on the exit wound to President Kennedy's neck and the entry wound to Governor Connally's back.<sup>n</sup> The first two trajectories were constructed for the purpose of determining whether the two shots were fired from the same location and the third to determine whether the relative alignment of President Kennedy and Governor Connally in the limousine was consistent with the single bullet theory.

#### (d) Conclusion<sup>o</sup>

(123) Kennedy's head wounds. The bullet that caused Kennedy's head wounds at Zapruder frame 312 came from a point 29° to the right of true north from the President. The bullet was descending at an angle of 16° below horizontal as it approached him. This trajectory intercepted the plane of the Texas School Book Depository approximately 11 feet west of the southeast corner of the building at a point 15 feet above the sixth floor windowsills.

(124) Kennedy's back and neck wounds. The bullet that caused President Kennedy's back and neck wounds came from a point 26° to the right of true north from the President. It was descending at an angle of 21° below horizontal as it approached him. Extending this trajectory

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<sup>m</sup>USGS was asked to determine the position of the limousine at times corresponding to Zapruder frames 150, 190, 285, 313 and 413; however, because some of these frames did not provide the required visual coordinates, the nearest frame with sufficient reference points was used.

<sup>n</sup>No trajectory analysis based solely on the wounds suffered by Connally was attempted because the bullet that struck him in the back hit at least two bones (at oblique angles) and was consequently significantly deflected.

<sup>o</sup>Explanatory diagrams supporting these conclusions are set forth in the analysis section of this report.

from the position President Kennedy occupied at the time of Zapruder frame 190, the trajectory intercepted the plane of the Texas School Book Depository approximately 11 feet west of the southeast corner and 2 feet lower than the sixth floor windowsill.

(125) Kennedy neck and Connally back wounds. The bullet which caused President Kennedy's neck wound and Governor Connally's back wound came from a point 27° to the right of true north from the President and was descending at an angle of 25° below horizontal.

(126) Given the position of the two men at the time of Zapruder frame 190, the trajectory intercepted the plane of the Texas School Book Depository 2 feet west of the southeast corner and 9 feet above the sixth floor windowsill. Because this trajectory falls within the trajectory range established when President Kennedy's back-neck wounds are used as the reference points for the trajectory line, the Panel concludes that the relative alignment of President Kennedy and Governor Connally within the limousine is consistent with the single bullet theory. Further, since each of these trajectories intersects the plane of the Texas School Book Depository in the vicinity of the southeast corner of the sixth and seventh floors, it is highly probable that the bullets were fired from a location within this section of the building.<sup>p</sup>

### III. The Assassin

#### A. The Alleged Assassination Weapon<sup>q</sup>

##### 1. INTRODUCTION

(186) The Warren Commission concluded that CE 139, a Mannlicher-Carcano rifle, was used to assassinate President Kennedy.<sup>65</sup> This rifle was linked by the Commission to Lee Harvey Oswald by both fingerprint and cloth fiber analysis, and by two photographs taken in Oswald's backyard that depict him holding the weapon.<sup>66</sup> These findings, however, have been questioned on the basis of observation relative to post-assassination photographs of the alleged murder weapon.

(187) It has been observed that when various post-assassination photographs of the rifle are enlarged, so that the images of the rifle are the same length, the respective images do not coincide. One picture may show the rifle as having a longer barrel and shorter stock than

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<sup>p</sup>The above conclusions differ to some extent from the testimony given by Thomas N. Canning before the H.S.C.A. on September 12, 1978; in each case, the differences reflect new information or analysis resulting from work concluded subsequent to the presentation of preliminary findings at the heading.

<sup>q</sup>This section was prepared under the direction of C. S. McCamy and Cecil W. Kirk; technical appendices by McCamy and Kirk are included. For related public hearing testimony, Sept. 14-15, 1978, see HSCA-JFK Hearings, vol. II, pp. 349, 397.

another photograph, and frequently the components parts do not align.<sup>67</sup> The Photographic Evidence Panel was asked to address this issue and to attempt to determine whether CE-139 could be photographically linked to Lee Harvey Oswald.

## 2. ISSUES

(188) a. Are the dimensions of CE-139, the alleged murder weapon that is in the National Archives, consistent with the dimensions of the rifle that Oswald is shown holding in the backyard pictures and with the alleged murder weapon, purportedly seized by the Dallas Police Department after the assassination, that is shown in numerous post-assassination photographs?

(189) b. Can CE-139 be established to be both the same weapon that Oswald is shown holding in the backyard pictures and that was the subject of numerous post-assassination photographs.

## 3. MATERIALS AND PROCEDURES

(190) The Photographic Evidence Panel reviewed the analysis that asserted that the relative dimensions of the rifle(s) depicted in these photographs were inconsistent, and perceived immediately that his analysis failed to consider the effect of perspective on the manner in which an image depicted in a photograph. The camera lens projects an image of the three-dimensional world onto a two-dimensional film plane. This projection usually causes parallel lines in space to be imaged as converging lines, and causes equally spaced intervals on a line that recedes from the camera to be imaged progressively shorter along the receding line.

(191) When a long object, such as a rifle, is tilted toward the camera axis, so that one end is farther away than the other, the nearer parts are imaged larger relative to the central parts and the more distant parts are imaged smaller. The degree of difference depends on the angle of tilt. This effect is illustrated in Figure III-1 (JFK Exhibit F-389), where the rifle is represented by a straight line and the camera is represented by the two essential parts, the lens and the film. Point A is at one end of the rifle, point B is at the center, and point C is at the other end. The size of the image can be found by assuming that light passes straight through the center of the lens.<sup>68</sup> Light from A goes to A', from B to B', and from C to C'. Figure III-1 demonstrates that although the length from A to B equals the length from B to C, the length from A' to B' is less than half the distance from B' to C'. The photographic effect of tilt attributable to perspective is further demonstrated by Figure III-2 (JFK Exhibit F-207), where five photographs of one particular rifle depict its relative dimensions differently, depending on the manner in which the weapon was tilted.

(192) Realizing that the failure to consider the effect of tilt was probably responsible for the observed discrepancies, the Photographic Evidence Panel conducted a study that took the tilt factor into account. In this study the tilt angle, distance from rifle to lens and distance from lens

to film<sup>7</sup> were found that would bring the images of the two ends of the rifle and the rear flat of the rear sight into conformance with proportions of the Archives rifle. Then, using the same constants, the locations of 10 other points on the rifle were computed from distances measured on the photographs. The two end points of the rifle and the rear sight served as anchor points for the calculation, and consequently were not regarded as measured values. Ten other points were measured for each of 12 photographs on which the points were visible. The mean value was computed for each point. The average deviation of the values from the mean of each point was computed, and the deviation of the mean value from the value for the Archives rifle was computed.

(193) When the tilt was thus taken into account, the proportions of all the rifles photographed matched the proportions of CE-139 remarkably close. The precise procedures followed and calculations employed are set forth in the appendix to this report in a manner that can be duplicated by any competent mathematician. The photographs that served as the basis for this analysis are listed in Table 1 of the appendix.

(194) In addition, 21 photographs were taken of the rifle in the National Archives in Washington, D.C., on April 18, 1978. The point of view and type of illumination were varied to simulate some of the conditions under which the rifle had been photographed at the time of the assassination. See Figures III-4a-u in appendix. These photographs were then compared with the preceding pictures taken in 1963 for the purpose of determining whether any similar identifying marks could be found on the rifle depicted in both sets of photographs.

(195) It was, of course, understood that not all marks would show on all of the pictures because a given picture shows only one view. Further, different lighting reveals different scratches and other marks. For this reason, it could not be concluded that a given mark was not on the rifle at the time of an earlier photograph just because it was not visible on the photograph. The 22 identifying marks that were detected and the photographs taken in 1963, in which they are shown, are set forth in Table 7 of the appendix. Only one of these, the largest and most prominent, a gouge mark on the rifle's forestock, was visible on any of the backyard pictures. Nevertheless, this mark was considered sufficiently distinctive to be a reliable identifying feature. See addendum D for a discussion of random patterning.

The Panel's complete analysis regarding this issue is set forth in the appendix.

#### 4. CONCLUSIONS

(196) a. A comparison of the relative lengths of parts of the alleged assassination rifle that is in the National Archives, with corresponding parts of what purports to be that rifle as shown

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<sup>7</sup>These factors provided the mathematical basis for photogrammetric computations that brought these photographic images of the rifle into proportional conformance with the Archives rifle.

in various photographs taken in 1963, indicates that the dimensions of the rifle(s) depicted are entirely consistent. b. A comparison of identifying marks that exist on the rifle as shown in photographs today, with marks shown on the rifle in photographs taken in 1963, indicates both that the rifle in the Archives is the same weapon that Oswald is shown holding in the backyard picture, and the same weapon, found by Dallas police, that appears in various post-assassination photographs.

#### IV. Conspiracy Questions

##### A. Alleged Gunmen in Dealey Plaza<sup>†</sup>

###### 1. INTRODUCTION

(241) A number of commentators and critics of the Warren Commission have asserted that photographic evidence exists which demonstrates that more than one gunman was present in Dealey Plaza.<sup>79</sup> The evidence includes an assortment of still-and-motion-picture photography taken by amateur and professional photographers present in the Plaza that day. If these films and pictures were ideal in quality, the questions they have raised might have been answered long ago. Nevertheless, there are limitations inherent in any photographic image<sup>‡</sup>, and many of the issues concerning the number of gunmen in Dealey Plaza have arisen from interpretation of details that approach these inherent limitations. In some, the quality is too poor to allow an unambiguous interpretation of the images, resulting in differences of opinion.

(242) Because of the advances that have been made in the photographic sciences associated with image enhancement<sup>80</sup>, an effort was made to resolve the issues raised in photographs of the assassination by applying modern technology. It was understood, however, that because of inherent limitations to this technology not all image enhancement attempts would necessarily be successful and that, even when successful, the clarification obtained might not be sufficient to answer the questions that have been raised.<sup>81</sup>

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<sup>†</sup>This section was prepared under the direction of Bob R. Hunt, with the assistance of Harry Andrews, Robert Chiralo, Donald Janey, and Charles Leontis. For related public hearing testimony of Hunt, September 25, 1978, see HSCA-JFK Hearings, vol. IV, pp. 387, 420.

<sup>‡</sup>The limitations inherent to photography can be classified as optical and photochemical, the former referring to the optical components which form an image, the latter to the processes which capture and permanently record the image. See J. C. Dainty and R. Shaw, *supra* note 2.