

to the head, as recorded in frames 313-314 of the Zapruder film. The panel further recognizes the possibility of the body stiffening, with an upward and backward lunge, which might have resulted from a massive downward rush of neurologic stimuli to all efferent nerves (those which stimulate muscles). The disparity in mass and strength between those muscles supporting the body on the back (dorsal surface) of the spine and those muscles on the front (ventral) surface could account, at least partially, for this type of motion, although it would be reasonable to expect that all muscles would be similarly stimulated.

(457) The panel suggests that the lacerations of a specific portion of the brain—the cerebral peduncles* as described in the autopsy report (89)—could be a cause of decerebrate rigidity,* which could contribute to the President's backward motion. Such decerebrate rigidity as Sherrington (90) described usually does not commence for several minutes after separation of the upper brain centers from the brain stem and spinal cord. It is, however, most intense in those muscles which normally counteract the effects of gravity.

(458) The panel is also aware of possible effects on motion that could be caused by the moving car within which the President sat.

(459) The panel concludes that the backward movement of the head following its forward movement occurred after the missile had already exited from the body and had created a large exit defect in the skull, and that it was most probably due to a reverse jet effect,* or a neuromuscular reaction, or a combination of the two. The short interval between the two motions supports this explanation.

(460) One panel member, Dr. Wecht, suspects that the backward head motion might be explained by a soft-nosed bullet that struck the right side of the President's head simultaneously with the shot from the rear and disintegrated on impact without exiting the skull on the other side. The remaining panel members take exception to such speculation, since they are unaware of any missile with such capabilities. Further, the X-rays taken prior to the autopsy show no evidence of a second missile, nor do the photographs of the head and brain show evidence of any injury to the left side.

SUMMARY OF THE FORENSIC PATHOLOGY PANEL'S CONCLUSIONS CONCERNING THE MISSILE WOUNDS OF PRESIDENT KENNEDY AND GOVERNOR CONNALLY

(461) Pathology is that specialty of medicine concerned with the investigation and evaluation of disease and other abnormalities in the human body. Forensic pathology is that area of pathology concerned with the legal aspects of death and injury, and the ability to present and evaluate the manifestations of death in courts of law and legal proceedings. Forensic pathologists are routinely asked to evaluate or develop hypotheses that involve pathological abnormalities and to suggest circumstances that could have produced them. Although it is often hoped that such evaluations can be made with absolute certainty, forensic pathologists can rarely state unequivocally that a given situation is explainable by one and only one hypothesis.

(462) More commonly the forensic pathologist makes a conclusion

that has a reasonable degree of medical certainty or states that the evidence is or is not consistent with any given hypothesis. In some cases, more than one hypothesis may explain the evidence.

Number, location, and nature of President Kennedy's wounds

(463) The majority of the forensic pathology panel (in each case, all members except Dr. Wecht) conclude that President Kennedy was struck by only two bullets, fired from some distance to the rear of his limousine. One bullet struck the President in the right upper midback and exited the front of the throat. This occurred prior to or during the segment in the Zapruder film of the assassination when the President is obscured from view by the Stemmons Freeway sign. This wound might have proven fatal.

(464) The second bullet struck the President in the upper back of the head and exited somewhat forward and to the right through the top, causing a massive defect in the skull. This second wound was fatal in and of itself. The wound in the upper right midback measures approximately 0.9 by 0.9 centimeter in maximum diameter and was located approximately 5 centimeters below the shoulder and 5 centimeters to the right of the midline of the back. The wound cannot be located more precisely from the available evidence because the autopsy pathologists failed to measure it with reference to standard fixed body landmarks and did not dissect the missile track.

(465) A red-brown to black area of skin surrounds the wound, forming what is called an abrasion collar. It was caused by the bullet's scraping the margins of the skin on penetration and is characteristic of a gunshot wound of entrance. The abrasion collar is larger at the lower margin of the wound, evidence that the bullet's trajectory at the instant of penetration was slightly upward in relation to the body.

(466) The majority of the panel concludes that the bullet that struck the President in the back exited in the front of the neck, at approximately the third tracheal cartilage. The exit wound was almost obscured by a tracheotomy performed on the President at Parkland Hospital, but could still be observed afterward at the lower margin of the tracheotomy incision. This wound is located approximately at the point where the bullet would be expected to exit, given the nature of the entrance wound in the upper right back and the damage to the transverse process of the lower cervical and first thoracic vertebrae, which are situated on a line between the entrance and exit points.

(467) The panel believes that Parkland doctors mistakenly identified the defect in the neck as an entrance wound because of its small size, which is characteristic of an entrance wound but occurs not uncommonly in exit wounds caused by high velocity missiles that have passed through soft tissue. It is also possible that this exit wound may have been small because the tissues through which the missile exited were supported by clothing, inhibiting the normally extensive distortion or tearing often characteristic of an exit wound. In addition, the Parkland doctors had not looked at the President's back and did not realize there was another perforation.

(468) Compounding the oversight of the Parkland doctors was the lack of communication between them and the pathologists performing

the autopsy at Bethesda Naval Hospital who did not realize that the tracheotomy had been made through a bullet wound. The autopsy pathologists only saw the back wound. On learning the day after the autopsy that the incision had been made through an existing wound, the pathologists concluded that the missile which entered the upper back exited through the neck defect.

Location of the head wound

(469) The panel concludes unanimously that the head entrance wound was located approximately 10 centimeters above the external occipital protuberance and slightly to the right of the midline, near the upper convexity of the back of the head at the "cowlick" portion of the President's hair part. The external surface of the skin around the wound was very similar to that of the back wound.

(470) The autopsy pathologists did not describe this location in their report or in their testimony before the Warren Commission. It does correspond, however, to the location described by two separate teams of medical experts convened by Attorney General Ramsey Clark and the Rockefeller Commission, respectively, as well as by other independent medical examiners. Further, while testifying before this committee, Dr. Humes, the chief autopsy pathologist, changed his earlier testimony and supported the panel's conclusion as to the location of the wound.

(471) The panel notes that the skull X-rays, photographs of the head and photographs of the brain substantiate this location. The scalp wound, as it appears in the photographs, has many of the features described in the autopsy report, including size, an abrasion cuff which is more prominent on the lower margin than the upper, and linear tears extending radially from the upper margins of the wound. The scalp wound overlays skull damage characteristic of an entrance wound (inward beveling*), also described in the autopsy report.

Nature and trajectory of the missile striking the head

(472) The majority of the panel concludes that only one missile caused the damage to the head. The nature of the damage is consistent with that caused by a jacketed missile. The X-ray evidence indicates that the missile fragmented on impact, produced a number of outwardly radiating fractures, and proceeded in an essentially straight and forward path and to the right, paralleling the upper surface of the head. This type of missile fragmentation is consistent with a jacketed missile. The main core mass probably existed in a single fragment that remained intact until striking the automobile, causing it to fragment into several pieces. The small missile fragment present at the margin of the entrance wound was probably a portion of the missile jacket and indicates that the skull might have slightly deflected the course of the missile and its fragments through the head.

(473) The bullet exited in the top front area of the skull (right frontoparietal portion) adjacent to the coronal suture. There is a considerable loss of bone in the area where the bullet exited, with multiple fractures extending from the defect. In the photographs, part of the perimeter of the 2.5 centimeters, beveled exit hole is visible along the margin of the defect and is somewhat larger than the diameter of the bullet itself. On the basis of these photographs and simulated skull reconstruction, the panel was able to determine the location of the point of exit within a reasonable margin of error.

Deficiencies in the autopsy

(474) The panel unanimously concluded that the deficiencies of the autopsy contributed to the uncertainty over the locations of the entrance and exit wounds in the head. The pathologists did not describe the wounds with reference to fixed body landmarks, nor did they examine the brain adequately. The panel itself was unable to examine the brain because it is among certain autopsy materials which are unaccounted for. The majority of the panel is satisfied that the select committee made a diligent though unsuccessful, effort to locate these missing materials. The majority of the panel believes that examination of the materials would fully support its conclusions.

(475) The panel discussed the methods for and difficulty of determining the trajectory and origin of the missiles. It notes that inherent in the procedures is a margin of error because of (1) the difficulty of establishing the precise angles of the missile tracks through the President's head and body, and (2) the difficulty of knowing the exact time of impact and the exact position of the body at the time of impact. These problems are greater for the bullet passing through the President's back and neck because it is less clear exactly when it struck the President. The impact to the head appears clearly in the Zapruder film, and its timing has therefore been determined with a high degree of accuracy.

(476) As the panel noted, the locations of both sets of entrance and exit wounds are approximations and are less precise than can often be made. The autopsy pathologists used nonfixed body landmarks such as the mastoid process* to locate the wounds. The location of these landmarks will change with movement of the body; hence, the measurements to the wounds will vary depending on the position of the body when the measurement is taken.

(477) The position of the body itself when the bullets struck also affects the relationship of the entrance and exit wounds and the trajectory of the missiles. For example, if the President were moving his head to the left or right, the location of the entrance would relative to the landmarks used as reference points by the autopsy pathologists would vary. Similarly, the relationship of the exit wound to the entrance wound and the angle of the missile trajectory prior to striking the body would differ substantially.

(478) Finally, the autopsy doctors failed to dissect the upper back missile track. The panel is, therefore, unable to determine conclusively whether the missile's path was in a straight line from entrance to exit and whether this injury would necessarily have been fatal.

(479) The panel considered the value of disinterring the President's body to locate more precisely the various wounds and their relationships to one another and the pathways of the missiles. The majority concludes that an examination of the body would fully support its conclusions and thus would not further its investigative goals. Consequently, the majority of the panel decided against recommending disinterment.

Second head wound

(480) When questioned by panel members, the autopsy pathologists stated that the piece of brain tissue on the lower rear of the head just above the hairline covered the entrance wound they described in their

report. The majority of the panel concludes, however, that the brain tissue actually lies on top of the hair and does not obscure a wound of any kind. If the brain tissue were obscuring a wound, the X-rays of the underlying skull would show evidence of wound damage, as would the photographs of the brain. There is no such evidence.

(481) Dr. Wecht raises the possibility of a tiny wound of entrance or exit being present beneath the white piece of brain that would not necessarily show up in the X-rays or the photographs of the brain. Dr. Wecht is also unwilling to rule out the possibility of another wound having occurred almost simultaneously with the area of the defect in the right front of the head without examining the brain.

(482) The other panel members believe that a near simultaneous wound from another shot, occurring at the instant when the skin and underlying bone are separated as a result of the known shot, is unfounded speculation. We believe strongly that another missile did not enter the right front of the head within the area of the large defect. We find no evidence supporting this speculation in the photographs of the head or brain, or in any of the X-rays of either adjacent bone fragment or the left side of the head where, in such an event, one might expect such a missile to lodge. No other missile was found, and the majority knows of no bullet that would completely disintegrate on hitting the soft tissue of the brain, as Dr. Wecht suggests.

(483) The majority also points out the following excerpt from Dr. Wecht's testimony in public hearings before the select committee on September 7, 1978. He said that there is "[v]ery meager" evidence to support his minority view, that there is an "extremely remote" possibility that the President was shot in the head by a second bullet from the side or front. Later in his testimony he reiterated his position:

Mr. PURDY. Dr. Wecht, does the present state of available evidence permit the conclusion that to a reasonable degree of medical certainty there was not a shot from the side which struck the President?

Dr. WECHT. Yes, with reasonable medical certainty I would have to say that the evidence is not there. I have already said it is a remote possibility and I certainly cannot equate that with reasonable medical certainty. (91)

(484) The issue of a second bullet striking the head from the front or side originates in part from the pronounced backward and leftward motion of the President's head and shoulders after being shot, as seen in the Zapruder film. To some, this motion appears explainable only by a shot coming from the front or side.

(485) The majority of the panel believes that there is a possibility that this movement may have been caused by neurologic response to the massive brain damage caused by the bullet, or by a propulsive effect resulting from the matter that exited through the large defect under great pressure, or a combination of both. Whatever the cause of the President's movement, the majority of the panel concludes that only one bullet struck the President's head and that it entered at the rear and exited from the right front.

Governor Connally's wounds

(486) The majority of the panel concludes that the evidence on the nature of the wounds suffered by Governor Connally to his torso, wrist

and thigh provides strong support for the conclusion that the wounds were caused by one bullet. The ovoid shape of the entrance wound on Governor Connally's back, described by one of the doctors at Parkland Hospital who treated the Governor, was most probably caused by a yaw* or tumble* in the flight of the bullet, which was deviating from its normal flight characteristics and path because of passing through President Kennedy. The majority does not feel, however, that the evidence is sufficient to eliminate entirely the possibility that the wobble was caused by a different intervening object.

(487) The medical evidence alone does not provide the panel with sufficient information to state with absolute certainty that the bullet that struck Governor Connally was the same one which had previously struck President Kennedy in the upper right back, exiting through his neck. The majority believes, however, that the medical evidence is consistent with this hypothesis and much less consistent with other hypotheses. Further, the panel considered other nonmedical evidence that strongly indicates that a single bullet injured both men. This evidence includes: The position of the two men, as shown in the Zapruder film; the fact that the two men can be alined consistent with the trajectory of one bullet; photographs of the seat locations in the limousine; the actual distortion of the so-called "pristine bullet"; the failure to recover any other bullet from the limousine or body; ballistics studies of the ammunition involved; and the results of neutron activation analysis of the bullet fragments conducted by Vincent P. Guinn, Ph. D. (These factors are discussed in the reports of other expert panels convened by the select committee.)

(488) The panel notes the interval between the observable reactions of the President and the Governor at the time of their injuries, as seen in the Zapruder film. Some observers have contended that the interval is too long to permit the conclusion that a single bullet struck both men.

(489) The majority of the panel believes that the interval is consistent with the single-bullet theory. At issue is the time delay between bullet impact and the observable reactions of each man to his injury, which in turn is determined by many factors, including whether or not their reactions were voluntary or involuntary. If involuntary, they would have occurred almost simultaneously with the injuries. If voluntary, there is often a slight delay in reacting.

(490) The first visual evidence that the President was struck was the movement of his hands to a position in front of his neck and his facial expressions. The majority of the panel construes these movements to have been voluntary, although it recognizes that they could have been involuntary had the bullet caused sufficient shock to his spine and spinal cord. The majority cannot say definitely, based on the available evidence, whether this more serious injury occurred and precisely when the President was struck.

(491) Similarly, the panel cannot determine precisely when Governor Connally was struck from either the medical evidence or his reactions as seen in the film: the puffing of his cheeks and the dropping of his shoulders. The majority believes that the nature of his injuries could have resulted in a voluntary motion, which would mean a delayed reaction. Thus, the majority believes that there could have been suffi-

cient delay in Governor Connally's reaction to account for the interval seen in the film and to permit the conclusion that a single bullet injured both men, notwithstanding its inability to determine whether President Kennedy's reaction was voluntary or involuntary.

(492) Panel members have differing views as to how soon Governor Connally would be expected to drop the hat he was holding in his right hand following the injury to his right wrist, but generally agree that there is little empirical data on which to determine with confidence what specific reaction should be expected from this type of wound.

Autopsy procedures

(493) As noted earlier, the panel unanimously concludes that the autopsy was faulty for a number of important reasons, some of which contributed to the speculation and controversy concerning the medical evidence. The panel believes that many of the difficulties are a result of inexperience with or neglect of the standard procedures which should be followed in forensic autopsies. The purpose of the medicolegal autopsy, as described in detail elsewhere in this report, is to answer anticipated or actual questions about the manner of death and to document the findings and answers in such a way that independent examiners may review the findings and procedures and reach their own conclusions.

(494) The panel urges unanimously that procedures such as those outlined elsewhere in this report be adopted as a model to be followed in the event of the suspicious death or obvious homicide of high Government officials.