

# INVESTIGATION OF THE ASSASSINATION OF PRESIDENT JOHN F. KENNEDY

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## HEARINGS BEFORE THE SELECT COMMITTEE ON ASSASSINATIONS OF THE U.S. HOUSE OF REPRESENTATIVES NINETY-FIFTH CONGRESS SECOND SESSION

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SEPTEMBER 6, 7, AND 8, 1978

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# INVESTIGATION OF THE ASSASSINATION OF PRESIDENT JOHN F. KENNEDY

WEDNESDAY, SEPTEMBER 6, 1978

HOUSE OF REPRESENTATIVES,  
SELECT COMMITTEE ON ASSASSINATIONS,  
*Washington, D.C.*

The committee met at 9:05 a.m. pursuant to notice, in room 2172, Rayburn House Office Building, Hon. Louis Stokes (chairman of the committee) presiding.

Present: Representatives Stokes, Preyer, Fauntroy, Dodd, Fithian, Edgar, Devine, McKinney, and Sawyer.

Staff present: Clifford A. Fenton, Jr., chief investigator; Kenneth D. Klein, assistant deputy chief counsel; Gary T. Cornwell, deputy chief counsel; Leodis C. Matthews, staff counsel; Belford V. Lawson III, staff counsel; G. Robert Blakey, chief counsel; Elizabeth Berning, chief clerk; Michael Goldsmith, staff counsel; and Jane Downey, staff counsel.

Chairman STOKES. A quorum being present, at this time the committee will come to order.

This morning, the Select Committee on Assassinations begins its public hearings into the death of President John F. Kennedy. The committee has identified three main issues to investigate in order to fulfill its legislative mandate, which is found in House Resolution 222.

First: Who assassinated President Kennedy?

Second: Did Federal agencies perform adequately in the sharing of information prior to the assassination, in the protection of President Kennedy, and in their investigation of the assassination?

Third: Did the assassin or assassins have assistance; that is, was there a conspiracy?

In addressing these issues, the committee has made every effort to be fair and objective. As I said when the committee began its public hearing into the King assassination, we regard each of these issues to be equal in importance with the others. We are not, for example, more interested in conspiracy theories than in a balanced evaluation of agency performance. Moreover, while it is true that individual members of the committee may have reached some preliminary judgments on certain issues after many months of studying them, we are suspending judgment as a committee until all of the evidence is in.

This, then, brings me to a very important part of our assignment. We must, in the end, report our recommendations to the House of Representatives and to the American public. For this purpose, we have set aside a period in December to weigh the evidence in both

the Kennedy case and the King case. Only then will we be ready to reach conclusions, make them public, and propose new legislation, if we deem it appropriate. It will be then, too, that we will write our final report.

These hearings now are designed to present and to assess the credibility of the evidence the investigation has developed. If, in the process, new leads are uncovered, we are also prepared to pursue them.

Now, I would like to spend a minute explaining the important difference between these hearings and a criminal trial. The distinction is a fairly subtle one, and it would be easy for people to become confused. I suspect that some did during our hearings into the possible involvement of James Earl Ray in the death of Dr. King. It is necessary to appreciate the differences in order to understand the nature of our work.

There are several characteristics of a trial that do not apply to these congressional hearings:

First, there is no defendant.

Second, there is no prosecutor.

Third, there is no specific burden of proof, no requirement to demonstrate anything beyond a reasonable doubt.

And, fourth, there is no pending indictment.

Now, then, what are we doing here? This committee is evaluating evidence, and we are, in fact, willing to listen to evidence that some of our members may not ultimately be willing to credit. We want to examine all of the evidence, not just that which fits some predetermined mold. Unlike in a trial, we do not insist that evidence be vouched for in advance by either the staff or the committee.

Of course, a minimum test of credibility has been applied to evidence the staff presents, or the committee will permit to be publicly aired; that is to say, the committee will not listen to evidence that a reasonable person would dismiss out of hand. Indeed, that is the reason why the committee has examined much of the evidence it will receive in public session in executive session. We want a preliminary judgment of credibility. But the committee wants to be open minded. We want to be able to assess all of the key evidence on the relevant issues, leaving our ultimate decision to the public meetings to be held in December.

A further point. Those people who follow the hearings either in person or by way of the news media cannot expect each day's presentation to be self-contained. We may raise issues one day that cannot be resolved until testimony can be taken on a subsequent day. Indeed, certain issues may not be resolved at all, in the event some important evidence is not available to us or to anyone. Not all questions that can be asked can be answered.

It is also the intent of the committee to write a complete historic record, one designed to be read as a whole, when we have completed all of our work. It would be a mistake, therefore, for anyone to look for some sensation that makes a news headline each day that this committee meets. Those who do I am afraid will be disappointed. Indeed, some of our work may be dull, but necessary nevertheless. For one reason, we are not only concerned with the meaning of our work at this given moment, but hopefully for years ahead.

Today, and the rest of this week, we will address these subjects:

One. The facts and circumstances surrounding President Kennedy's trip to Dallas on November 22, 1963; and, two, a scientific analysis of the facts of the President's death, including the autopsy performed on the President's body, the effect of the missiles that hit him, and other ballistics evidence.

To begin the first phase of our hearing, I would like to at this time recognize Congressman Richardson Preyer, my distinguished colleague from the State of North Carolina, who as chairman of the Kennedy subcommittee has indeed worked tirelessly many long hours with the members of his subcommittee in order to prepare for these hearings that will now unfold. It is my pleasure at this time to recognize my distinguished colleague, Judge Preyer.

**OPENING STATEMENT BY REPRESENTATIVE RICHARDSON PREYER, NORTH CAROLINA, CHAIRMAN, SUBCOMMITTEE ON JOHN F. KENNEDY ASSASSINATION**

Mr. PREYER. Thank you, Mr. Chairman. In the hearings to be conducted throughout the month of September on the assassination of President Kennedy, we intend to develop three general themes.

First, we will consider the life and death of President Kennedy and the involvement in that death, if any, of Lee Harvey Oswald. The emphasis here will be on hard evidence, much of it old evidence we will reexamine, though in some instances new evidence that has been turned up by the committee. In either case, we will be assisted in the effort by science and technology that wasn't readily available to investigative agencies in 1964.

Second, we will present an evaluation of the performance of Federal agencies whose assignments have been related to the assassination or the investigation that followed it. These include the Secret Service, the Federal Bureau of Investigation, Central Intelligence Agency, Department of Justice, and the Warren Commission.

Third, we will review conspiracy theories, some specious, some sinister, some inconsistent with one another. In this effort, we will take into account the climate for conspiracy in 1963, and we will closely examine the possible involvement of certain groups or forces that had the motive, opportunity, and means—all three elements being essential—to seek the President's death.

It must be emphasized that as yet the committee has reached no final judgment of the validity of these theories. Indeed, the committee has not reached an ultimate judgment on any of the issues posed in any of the areas I have mentioned. It is for this very reason that as these hearings progress, the committee will at times be considering bodies of evidence that point in mutually contradictory directions. As I have noted, Mr. Chairman, this is particularly true in the area of conspiracy.

Now, I would like to talk for a minute about the course of this investigation to date. The evidence about to be presented is the product of over a year of effort by the subcommittee and a staff of 40 attorneys, investigators, and researchers. They have spent many man-hours sorting out a voluminous 15-year accumulation of information, interviewing hundreds of witnesses and helping the subcommittee conduct hearings in executive session.

The staff and committee members have found it necessary to go on the road to pursue leads and gather data. Cities like Miami, New Orleans, and, of course, Dallas were visited often, and there were trips to foreign cities—Havana, Mexico City, Paris, Madrid. In all, there were 385 trips to 564 points, taking into account return visits, over a total of 1,807 days traveled.

As for witness interviews, 1,548 of them were conducted, and a total of 75 witnesses were questioned in executive session.

I should note, Mr. Chairman, that these figures are based on statistics compiled as of the end of the first 6 months of this year. Since the investigation is ongoing to the end of the year, they will be revised upward.

Mr. Chairman, I realize, while statistics don't always lie, they seldom voluntarily tell the truth and I am not offering these statistics as a measure of the success of the investigation, but I think it is some measure of the effort that has gone into it.

One important measure of that effort, however, is hard to pinpoint. It is the hundreds of agency files the staff reviewed. It combed through over 500 files from the CIA, FBI, Secret Service, Departments of State and Defense, and others. But a file can range from a few pages to thousands. To get an idea of the size of the task, one should realize that the FBI file on Lee Harvey Oswald alone consists of 238 volumes that in turn contain 5,754 serials.

Finally, we employed several consultants in areas of the investigation that required very specialized knowledge and training. A panel of medical experts, for example, studied the autopsy X-rays and photographs. The results of their work will be the subject of tomorrow's hearing.

There have been 44 consultants under contract—in such diverse fields as ballistics, photography, pathology, handwriting, polygraph analysis, and medical illustrations.

It has been a concerted effort, Mr. Chairman. Now comes the real test, as we assess the quality of the evidence in these hearings.

Thank you, Mr. Chairman.

Chairman STOKES. Thank you, Judge Preyer. Now, I am pleased to recognize my colleague from Ohio, the distinguished ranking minority member of this committee, who has worked untiringly as a member of this full committee and also of the Kennedy Subcommittee, for such remarks as he cares to make at this time.

Mr. Devine.

Mr. DEVINE. Thank you, Mr. Chairman.

Very briefly, I would like to point out that our investigation will not end with these public hearings at the end of this month, at which time we still will have 3 months of hard work to do. Important aspects of the investigation will continue as we fit the last pieces into the mosaic that we are making. We expect to interview additional witnesses, to meet in executive session, and to complete the task of writing our final report.

Much of the effort that remains has to do with resolving seemingly minor points. The alternative to doing this would be to allow gaps to go unanswered and to publish a report that lacks unity. If we did that, we would fail the tests that surely will be applied to the job we do—the test of professionalism and the test of craftsmanship.



Thank you, Mr. Chairman,

Chairman STOKES. Thank you, Mr. Devine. The Chair would like to announce that close to the hour of 10 a.m., it will be necessary for the chairman of the committee, the ranking minority member, Mr. Devine, the chairman of the two subcommittees, Mr. Preyer and Mr. Fauntroy, to leave these hearings and appear before the House Administration committee relative to the balance of the funding for this committee. So when we depart, it will be for that reason. Of course, we will return to the hearing as soon as our work before another congressional committee has been completed.

The Chair at this time recognizes general counsel of the committee, Professor Blakey.

**NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND  
STAFF DIRECTOR**

Mr. BLAKEY. Thank you, Mr. Chairman.

As the committee begins its public hearings on the assassination of President Kennedy, it seems appropriate to reflect for a moment on the meaning of the life—and death—of our 35th President. Appropriate, because, as in the King assassination, ultimately this committee must face this question: Was the President's death unrelated to his life, a senseless act, or did it have meaning?

To begin to understand his death, it is perhaps instructive to refresh our memories of his life, to go back to a cold January morning in 1961 when he stood before the Nation that had just elected him and voiced these memorable words:

Let every nation know, whether it wishes us well or ill, that we shall pay any price, bear any burden, meet any hardship, support any friend, oppose any foe to assure the survival and success of liberty.

No words that could be written now more aptly portray the determination of John F. Kennedy as he assumed office. An articulate, confident new President—his mettle was yet to be tested—he confronted the issues that would put him in conflict with awesome forces abroad and at home.

The cold war was his foremost concern, as the United States and the Soviet Union stood poised to obliterate each other—or to coexist. Kennedy had come down hard in the campaign on a need to bolster military might, a position he would amplify by tacking an extra \$4 billion to the budget for defense that former President Eisenhower had approved.

There were, in fact, trouble spots in the world where the potential of hostilities was real, countries where the Communists were securing a foothold, including one only 90 miles away—Cuba.

Domestic issues had a potential for violence as well.

There was racial turmoil in the South—freedom rides and sit-ins—and there was no way a man like John F. Kennedy would or could stand on the sidelines.

And there was the menace of organized crime. The Justice Department, run by the President's brother, Robert F. Kennedy, was gearing for an all-out drive on the mob, which would include a concerted effort to send Teamster President James Hoffa to prison.

The President's popularity was high—he came into office with a 69-percent approval rating in the Gallup Poll. But his policies both

foreign and domestic were in for rough going. A trend against him, barely perceptible at first, was running in the country.

On the international scene, Kennedy had scarcely been in office for a formative 100 days when disaster struck. After long deliberation, he approved the landing of an invasion force of anti-Castro exiles on the southern coast of Cuba, a place whose name would signify failure in American foreign policy for years to come. It was called Baya Cochinos, the Bay of Pigs.

Responsibility for the fiasco was accepted by Kennedy shortly after the exiles were defeated by Castro's troops and when the United States could no longer disavow its role in the ill-fated expedition. But privately he blamed the CIA, reportedly vowing to "splinter the agency into a thousand pieces and scatter it to the winds."

Kennedy was a war hero with combative instincts. He would not soon forget the Bay of Pigs easily, for it had raised questions about him as a coolheaded leader and opened him to the criticism of friend and foe alike. But he was not a man to back down. His military policy was to beef up conventional forces—more footsoldiers and planes and ships to transport them—and he ordered a maximum effort in training troops for guerrilla warfare.

When the release of Cubans captured at the Bay of Pigs had been negotiated by late 1962, Kennedy greeted them at the Orange Bowl in Miami with a defiant promise to return their flag to them in a free Cuba.

Kennedy went to Europe in May, and in Vienna he talked cold war politics with Khrushchev for 12 hours. Nuclear testing, disarmament, and Berlin were the topics of discussion, but there was no indication of agreement.

Khrushchev's hard line stand on Berlin became clear within a month of the meeting. He told the Western Powers to get out of the city by the end of the year, threatening to sign a separate peace treaty with East Germany, one that would give the East Germans control of western access routes and end four-power control of Berlin, called for in the Potsdam Agreement.

With Russian determination to eliminate West Berlin seemingly as avowed as the U.S. commitment to preserve it, the prospect for world war III was greater than ever.

True to form, Kennedy did not back down. In July, he made a stirring address to the Nation on the will to fight, and he backed it up with a call for 217,000 more men in uniform. He ordered the draft doubled and tripled, if necessary, and he requested authority to activate Reserve and National Guard units. "In meeting my responsibilities in these coming months," he told the American people, "I need your good will and your support and, above all, your prayers."

Meanwhile, Kennedy was determined not to be blindsighted in his own hemisphere. His Alliance for Progress was designed to wipe out the seedbed of communism in Latin America by raising living standards. Throughout the summer of 1961, the leaders of Central and South American countries were coming to Washington for their share of the billions of dollars the United States was paying to contain Castro.

As 1962 opened, Kennedy was wrestling with the nasty decision of whether to resume atmospheric testing of nuclear weapons. The Russians had thrust it upon him by a series of surprise tests started the past September, despite an earlier promise by Khrushchev to join the United States in a no-test policy.

At the same time, the world's hotspots simmered:

In Berlin, Khrushchev had backed his threats by building the wall, but as successive deadlines passed, Western rights remained intact.

In South Vietnam, Kennedy had decided to take a stand against Soviet inspired "wars of liberation." He fortified this position by sending over 4,000 military specialists.

To add to international hazards, negotiations with the Russians on nuclear tests had stalled. So, in April, Kennedy made the agonizing decision to resume them, giving a go-ahead to a series of blasts over Christmas Island in the central Pacific. He told a writer it was his fate to "take arms against a sea of troubles and, by opposing, end them."

On a visit to Mexico in June, Kennedy was greeted with rousing enthusiasm that seemed to say his hemisphere policy was faring well. But then in October, he faced in Cuba a crisis of a dimension unparalleled during his brief Presidency. The world had not faced at any time before, nor has it since, a more immediate prospect for nuclear holocaust.

Kennedy had returned abruptly from a political trip to Chicago on October 20, using a sudden cold as a pretext for the surprise change in plans.

On Monday, the 22d, he revealed the real reason for the move—the United States had discovered from reconnaissance photographs that the Soviet Union had deployed ballistic missiles and jet bombers in Cuba. He announced he had ordered an air-sea quarantine on shipping into Cuba and promised more drastic action if the missiles and bombers were not removed.

It was a tense 5 days that led to a decision by Khrushchev to pull out his offensive hardware. Kennedy, for his part, agreed not to invade Cuba, and he lifted the blockade.

By the end of 1962, Khrushchev finally had come to realize that President Kennedy was not a toothless tiger. Kennedy, in turn, felt the momentum the Soviets had gained from the time they leaped out ahead in the space race had been braked by the outcome of the Cuban adventure, and he was satisfied that the foe in the Kremlin would be more cautious in the future.

Still there was an uneasiness over Cuba in 1963. The Soviet presence was symbolized by an attack of a Cuban Air Force Mig on an American shrimp boat. Some 17,000 Russian troops still occupied the country; 500 anti-aircraft missiles plus a large quantity of other Soviet armaments were emplaced there.

But a thaw in the cold war was perceptible, a result of Kennedy's foreign policy strategy which emphasized inch-by-inch progress. On June 10, he said in his memorable American University speech, "Let us focus on a peace based not on a sudden revolution in human nature but on a gradual evolution of human institutions." He announced the United States, Great Britain, and the Soviet Union would begin work on a treaty to outlaw nuclear tests.

The Nuclear Test Ban Treaty, a major achievement of the Kennedy administration, was initiated in Moscow on August 5 and ratified by the U.S. Senate on September 4.

On the domestic scene, the Kennedy administration's most noteworthy accomplishments were in civil rights, though the President would not live to see the passage of legislation he proposed, the most far reaching since Reconstruction.

Violence erupted soon after Kennedy took the oath of office. In Alabama, in May 1961, the Congress on Racial Equality staged a series of freedom rides for the purpose of integrating buses and terminals. Through a long night of rioting in Montgomery, quelled only after troops had been called out, Atty. Gen. Robert F. Kennedy was on the phone counseling one of the leaders of the civil rights movement in the country, Dr. Martin Luther King, Jr.

The freedom rides ended when the protesters were arrested in Mississippi, but the point had been made. The Attorney General soon petitioned the Interstate Commerce Commission, which the following September adopted rules banning segregation on interstate buses and in terminals.

There was another civil rights storm in October 1962. James Meredith, a 29-year-old black student, had tried to enroll at the University of Mississippi but had been refused, despite the orders of Federal courts. The Kennedy administration led a step-by-step campaign to force compliance by the State, whose Governor was equally determined to defy the courts. When Meredith arrived at Ole Miss on a Sunday, he was accompanied by 300 U.S. marshals, but they were no match for an angry mob of 2,500 students and outside extremists. Just as Kennedy went on the air to ask for calm, the campus exploded, and it took Federal troops to restore the peace. But Meredith was successfully enrolled.

The civil rights summer of 1963 began in Birmingham, Ala., in April. There, Dr. Martin Luther King, Jr., led an all-out attack on what he called "the most segregated city in the United States." On May 3, the demonstrators were attacked by police dogs and doused with firehoses, and pictures of these brutal tactics led to a worldwide outcry. When calm was restored, the movement for equal rights had triumphed. Birmingham became a rallying cry in cities across the South, as well as in Chicago and New York.

Kennedy addressed the Nation on June 11 to win support for his civil rights bill which, among other things, guaranteed blacks the right to vote and access to public accommodations. "We are confronted primarily with a moral issue," he said. "The fires of frustration and discord are burning in every city, North and South, where legal remedies are not at hand."

The menace of organized crime was another dominant issue of the Kennedy years. The President had first encountered it when, as a Senator, he became a member of a new Select Committee on Labor Racketeering. Bob Kennedy was chief counsel of the Rackets Committee, and later, as Attorney General, he would become the President's surrogate in an unprecedented campaign against the forces of the underworld.

There were dramatic developments in the war on organized crime just before and after Kennedy came to the White House. A roundup of hoodlums in Apalachin, N.Y., in 1957—followed by an

abortive prosecution of many of the leaders—served to show how lackadaisical the Federal effort had been. Then the Senate testimony of Mafia member Joseph Valachi helped to catalyze a renewed emphasis on that effort.

More than anything, though, the personal zeal of the Kennedy brothers meant hard times for the mob—the roughest period in the history of the Department of Justice. The historian, Arthur M. Schlesinger, Jr., wrote in a recent book about Robert Kennedy that due to his pressure “the National Government took on organized crime as it had never done before.”

Schlesinger observes:

In New York, Robert Morgenthau, the Federal Attorney, successfully prosecuted one syndicate leader after another. The Patriarca gang in Rhode Island and the DeCavalcante gang in New Jersey were smashed. Convictions of racketeers by the Organized Crime Section and the Tax Division steadily increased—96 in 1961, 101 in 1962, 373 in 1963. So long as John Kennedy sat in the White House, giving his Attorney General absolute backing, the underworld knew that the heat was on.

Bob Kennedy directed his big guns at targets he had pinpointed when he was with the Rackets Committee. One in particular was the alliance of top labor leaders and racketeering figures, one that to him was personified in the character of Teamster President James R. Hoffa. “The pursuit of Hoffa,” Schlesinger writes, “was an aspect of the war on organized crime.”

He adds:

The relations between the Teamsters and the syndicates continued to grow. The FBI electronic microphone, planted from 1961 to 1964 in the office of Anthony Giacalone, a Detroit hood, revealed Hoffa’s deep if wary involvement with the local mob. For national purposes a meeting place was Rancho La Costa Country Club near San Clemente, California, built with a \$27 million loan from the Teamsters pension fund; its proprietor, Morris B. Dalitz, had emerged from the Detroit underworld to become a Las Vegas and Havana gambling figure. Here the Teamsters and the mob golfed and drank together. Here, they no doubt reflected that as long as John Kennedy was President, Robert Kennedy would be unassailable.

In the beginning, Kennedy was an extremely popular President. Ironically, his ratings were highest in the aftermath of the Bay of Pigs—a remarkable 83 percent in the Gallup Poll. But by the fall of 1963, the fateful fall of 1963, he had dipped by 24 points, and he had begun to have misgivings about the political implications. In October, Newsweek reported that the racial issue alone had cost him 3.5 million votes, adding that no Democrat in the White House had ever been so disliked in the South.

For several reasons—politics among them—Kennedy was an active traveler. His diplomatic missions abroad were interspersed by trips around the country. In June 1963, he was in Germany, Ireland, and Italy, and later that summer he toured the Western United States—North Dakota, Wyoming, Montana, Washington, Utah, Oregon, Nevada, and California.

Not only did Kennedy like to be on the go, but, almost recklessly, he resisted the protective measures the Secret Service sought to press upon him. He would not allow blaring sirens, and only once—in Chicago in March 1963—did he permit his limousine to be flanked by motorcycle policemen. He once told the special agent in charge of the White House detail he did not want agents riding on the rear of his car.

He was philosophic about the danger. During the Texas trip, he told his special White House assistant:

\* \* \* if anybody really wanted to shoot the President, \* \* \* it was not a very difficult job—all one had to do was get a high building some day with a telescopic rifle, and there was nothing anybody could do to defend against such an attempt.

There has been dispute over why Kennedy would risk traveling to Texas at a time when the South had been the scene of violent incidents stemming out of the civil rights controversy. Why Dallas, in particular, where only a month before Kennedy's scheduled arrival on November 22, Adlai Stevenson had been booed and spat upon?

Some say Kennedy went to shore up his own political standing in a State he had won by an eyelash in 1960. Others cite a need perceived by Kennedy to remedy a splintering of liberal and conservative fractions within the State Democratic organization. Most agree, however, it was political.

Kennedy was fond of motorcades, because they afforded him an opportunity to get close to people. He made a special point of riding in one in Dallas on November 22, 1963, for he felt it would be his one chance that day to greet working people and members of minority groups.

In fact, it was his last chance.

Mr. Chairman, the witnesses we would like, with your permission, to call at this time are Mr. and Mrs. John B. Connally, who were riding in the limousine with President and Mrs. Kennedy at the time of the assassination. Wounded in the back, chest, wrist, and thigh by rifle fire, Governor Connally was rushed to Park Land Hospital where, though first listed in critical condition, he eventually recovered.

Mr. Connally was an administrative assistant to Senator Lyndon B. Johnson, and he served as Secretary of the Navy in the Kennedy administration. He was Governor of Texas from 1963 to 1969 and Secretary of the Treasury in the Nixon administration in 1971 and 1972. He was special advisor to President Nixon in 1973. He is presently with the Houston law firm of Vinson, Elkins, Searls, Connally & Smith.

It would be appropriate now, Mr. Chairman, to call Mr. and Mrs. Connally.

Chairman STOKES. The Chair calls Governor and Mrs. Connally. Governor, would you and Mrs. Connally stand and be sworn. Please, raise your right hands.

Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

Mrs. CONNALLY. I do.

Mr. CONNALLY. I do.

Chairman STOKES. Thank you. You may be seated.

Governor and Mrs. Connally, on behalf of the Select Committee on Assassinations, I want to extend to you our most sincere appreciation for your appearance during the beginning of these public hearings.

Our mandate from the U.S. House of Representatives requires this committee to investigate all of the facts and circumstances surrounding the assassination of President John F. Kennedy. As

you are well aware, this tragic and shocking event occurred during the President's visit to Dallas, Tex. Indeed, you, yourself, Governor Connally, were critically wounded during the barrage of gunfire. The President was visiting the fourth of a five-city visit on an appearance schedule that you were instrumental in planning.

The President had come to Texas at your invitation and you were his official host. Accordingly, to begin our inquiry into this area, we considered it appropriate to request your appearance to give testimony on the facts and circumstances surrounding President Kennedy's decision to visit Texas.

Your testimony should cover all of the subsequent events that occurred as well as the course of preparations and any considerations involved therein.

In addition, it will include all decisions leading up to the President appearing in the Dallas motorcade on a route through an area the world has so tragically come to remember as Dealey Plaza and the building known as the Texas School Book Depository.

At this time, I will ask your indulgence in our being excused and I will, at this time, ask my distinguished colleague from Connecticut, Mr. Dodd, to assume the chair.

Mr. DODD. At this time, I will ask Mr. Gary Cornwell, who is the deputy chief counsel for the Kennedy investigation, to ask you some questions, Governor and Mrs. Connally. Again, we appreciate your appearance here today.

**TESTIMONY OF MR. AND MRS. JOHN B. CONNALLY, DALLAS,  
TEX.**

Mr. CONNALLY. Thank you, Mr. Dodd.

Mr. CORNWELL. Thank you, Mr. Chairman.

Governor Connally, I would like to begin by asking you if it would be accurate to state that you had a leading role in the decisionmaking process that led to the President's trip to Dallas on November 22, 1963?

Mr. CONNALLY. Yes, Mr. Cornwell, it certainly would be accurate to say that.

Mr. CORNWELL. When did the possibility of that trip first become a matter of concern to you?

Mr. CONNALLY. Mr. Cornwell, I wouldn't characterize it as a matter of concern, but the possibility of a trip to Texas arose, as I recall, in the spring of 1962.

Mr. CORNWELL. What were you doing during that period of time?

Mr. CONNALLY. In 1962, I was running for Governor of Texas, in the midst of a campaign. Vice President Johnson told me then that President Kennedy wanted to come to Texas, he wanted to come to Texas to raise some money, have some fundraising affairs over the State.

I was not the least bit interested, very frankly, at that point in time, in trying to put together a trip, sponsoring a dinner, for a number of reasons.

First, I was in the midst of a primary battle. I was running against an incumbent Governor, an incumbent attorney general, and a number of other candidates. The first poll that came out after I announced my candidacy indicated that I had 4 percent of the votes. So, I had an uphill climb in the battle.

I fortunately led the primary campaign but went into a runoff with a young man, then the leader of the liberal element of the Democratic Party in Texas, named Don Yarborough. I was successful in the runoff in winning the primary runoff, but then was confronted with very, very determined, well-financed, extremely able opposition in the general election.

So frankly, I kept putting off any proposed trip to Texas, again, for a number of reasons. First, every hour, every bit of energy that any of us had was directed toward my own campaign that year. I didn't think we had the organization, I didn't think we had the time, I didn't think it was the appropriate time to try to bring the President into the State. I didn't think we could do credit to a visit, so I kept delaying it, notwithstanding the continuous and repeated suggestions from the Vice President who, frankly, was being needed by the President.

The President was making it quite clear to the Vice President, Mr. Johnson, that he wanted to come to Texas and he wanted to raise some money in Texas.

I can pause there, Mr. Cornwell.

Mr. CORNWELL. That answers the question. Let me ask you, if you were just beginning to run in the primaries, why was it that the President's desire to have a trip to Texas was brought to your attention? Why was it that you were asked at that point to take part in the trip?

Mr. CONNALLY. Well, I think first, I had known President Kennedy since the early 1950's. I had been vice chairman of the Texas delegation to the national convention in Chicago in 1956 when we supported Mr. Kennedy then, Senator Kennedy, as Vice Presidential nominee on the national ticket with Mr. Stevenson.

I had, as you know, as Mr. Blakey just recounted, I had been appointed by President Kennedy as Secretary of the Navy and had served in the year 1961 as Secretary of the Navy. I, as a matter of fact, not only talked to Mr. McNamara, but I had gone and talked to President Kennedy before I went home to run for Governor.

So I was certainly, at that point, probably the Texan, outside of Vice President Johnson, who was closest to the Kennedy administration, and I think it was normal and natural that they would expect me to become involved in it.

Mr. CORNWELL. Why, at that point in time, did you understand the President wanted to come to Texas?

Mr. CONNALLY. There was never any doubt in my mind about it. There was never any doubt in the President's mind or Vice President's mind. He wanted to come to Texas for two reasons: First, to raise money; second, to enhance his own political fortunes in Texas. No doubt about it. No other reason. Much has been written, much has been speculated, but I assure you over many, many months, it was very obvious, very clear that that was the purpose.

As a matter of fact, in 1963, after the—let me digress a moment. After the campaign was over in November 1962, and I had been successfully elected Governor, then I had only 60 days between November and January in order to build a staff and to develop a budget, to develop a legislative program to submit to the legislature on approximately January 20. This was my first legislative session of 120 days and, again, I resisted any proposed Presidential



trips to Texas because I was totally absorbed and consumed, all of my energies, all of my staff, with the legislative program.

It was obvious, though, that as soon as that was over, we were going to have to have a trip. I was perfectly willing, at this time, to undertake to organize one, but all during this period of time, it was quite clear that the President wanted to come for the purposes for which I have stated; namely, to raise money; second, to enhance his political fortunes in Texas.

I must say that at that point in time, I don't remember the figures exactly, but the President was not extremely popular in Texas, nor was he in the country. He wasn't unpopular. He had had a very bitter campaign in 1960. He carried Texas by 46,000 votes, approximately 46,200-some-odd votes, with Vice President Johnson on the ticket with him. So, it had been an extremely close, extremely hard-fought election.

The President had brought great elan, he had brought great culture, he brought great dignity and excitement to the White House, but in spite of that, his legislative program had not fared all that well. He was not that popular in the country and his popularity had diminished considerably, as a matter of fact.

He was already looking at 1964 and the campaign of 1964. He had been traveling all over the country. He made it quite clear that in 1964, if he didn't carry but two States, he wanted to carry Massachusetts and Texas, and he wanted to come to Texas. So, it was obvious to me—again, my reluctance in encouraging the trip, as a matter of fact, it was more than reluctance; I resisted the trip, very frankly; I didn't encourage it, I resisted it for the reasons that I have already explained.

In 1962, I was involved in the campaigning; the first 120 days of 1963, I was involved in legislative session and if he was coming, I wanted him to come to achieve the objectives that he wanted; namely, to raise the money; second, to structure the trip in such a way that he would benefit from it politically.

Mr. CORNWELL. During this approximate 1-year period, from the early part of 1961 through the period of the first part of 1962 when, as you described, you were engaged primarily with trying to put together a staff, being a new Governor, and getting your legislative program through the legislature, the hints continued to come that the President wanted to come to Texas, you continued to stall, why didn't the President just come on his own?

Mr. CONNALLY. He could have, but he obviously didn't want to. I had been elected in a rather, I guess I would have to describe it as a surprising election. I had frankly been elected by the people that President Kennedy needed the most, by the moderates and the conservatives of the State. He obviously had the most liberal wing of the party already for him. They had supported him. In 1960, in the campaign, they were still for him. What he was looking for and what he was really chafed about was the fact that the moderate and conservative elements of the country, not just Texas, but the whole country, were not supporting him, that he was characterized as being antibusiness, and part of that, I think, was the result of his actions with respect to steel prices.

But, nevertheless, I think this irritated him and he said so, and he didn't understand it, and he, on one occasion, said to me, that,

"If these business people are silly enough to think that I am going to dismantle this free enterprise system, they are crazy."

So, I think it was obvious that he wanted to come on a basis that he could talk to, and hopefully appeal to, the very people that had not supported him, because he was looking at a tough election, at least in our part of the country, in 1964.

Mr. CORNWELL. Well, if, then, he basically needed someone to help with the planning arrangements, to achieve the ends that he sought, which was fundraising and improving his political posture in the State, why didn't he just ask the Vice President, who was also from Texas, to arrange those matters for him?

Mr. CONNALLY. Well, for the simple reason that I had been able to build a pretty successful organization in Texas and the Governor is the titular head of the party of his State, and, frankly, the Governor of any State, regardless of his party, Republican or Democrat, is the titular head of the party and he sets the political tone of the State, and it would be inconceivable and President Kennedy was too good a politician to try to come to Texas without my wholehearted support, or at least tacit approval, and the Vice President certainly would not have done it.

For one of these trips, it is not just as simple as saying, let's go to Texas. This requires an incredible amount of planning, organization, detail, harassment, haranguing. We went through weeks and weeks and weeks and weeks of this. So the idea that they are just going to pick up and come, I don't think was attractive to them at all.

It was obvious that the President never seriously considered that. He obviously could have come any time he wanted to and so could the Vice President, and the Vice President was down during this period of time—1962-63—on a number of occasions. But they didn't want to attempt to arrange the type of affair that they were interested in without my personal involvement and without the involvement of the State party machinery that I had constructed.

Mr. CORNWELL. Did there come a time when you finally couldn't avoid or push back the hints any longer?

Mr. CONNALLY. Yes. The President was making a trip out through the West, in the summer, I believe, of 1963. He was going to Colorado, New Mexico, and perhaps other States. In any event, he was in El Paso and I met him in El Paso, and the minute I walked into the room where they were—

Mr. CORNWELL. What kind of room was it?

Mr. CONNALLY. A hotel room. I have forgotten. I believe the Casa Del Norte Hotel. The Vice President was there, President Kennedy was there, and several of the staff people. Kenny O'Donnell, as I recall, was there, and the President made some remark about, "Well, Lyndon, are we ever going to get this trip to Texas worked out?" Obviously he wasn't speaking to me, but he was speaking to me, but he was addressing Vice President Johnson.

Vice President Johnson said, "Well, the Governor is here, Mr. President, let's find out."

Mr. CORNWELL. At this point—

Mr. CONNALLY. I knew at that point my string had run out. I knew we were going to have a trip to Texas, and I was perfectly willing to do it because I had gotten through a legislative session in

fairly good order and we had the time, I had been able to rebuild the structure of the Democratic Party, and we were prepared to organize the trip.

So, I said, in effect, "Mr. President, when do you want to come?"

Then he said, he said, "Well, I think we ought to have four dinners," and I was in a state of shock. He said, "I think we ought to have four or five fundraising dinners," and he said, "What do you think about having it on Lyndon's birthday, August 27?" This was in June, as I recall.

And again I said, "Mr. President, I would like to think about that. Obviously the Vice President's birthday is always a time for celebration, but August is the worst month of the year to have a fundraising affair in Texas, for anybody. Too many people are gone, it is the dog days, it is the hottest month of the year, people are on vacation, they are not interested in politics, we can't get the support, and I think it would be a serious mistake to come in August."

Well, we didn't decide at that particular meeting in El Paso when the date would be, but I said, "We will think about it" and I said in effect, "Let me do some planning. Let me do some thinking and we will be back in touch with you and I will suggest a trip, a format of a trip that I think will achieve the purposes that you want to achieve."

Mr. CORNWELL. Would I understand your earlier description of the climate in the State of Texas and in the Nation to apply to this period of time? I know you described basically the way you perceived it when the hints first came to your attention in 1962. I take it the climate hadn't changed much by 1963, is that correct?

Mr. CONNALLY. No, they had not. I think the President was concerned about the campaign of 1964, his popularity. Your chief counsel, Mr. Blakey, just said it dropped from 83 percent down to about 60 percent, and was on a descending scale during this period of time, and I don't remember the precise figures the poll showed, but obviously he had lost considerable ground and he was concerned about it.

Mr. CORNWELL. Well, given that climate in the State of Texas and in the Nation, what, if anything, did you expect that you could personally gain or could be gained for your wing of the Democratic Party from the Texas trip?

Mr. CONNALLY. Well, I thought, first, that Texas is always, I think, a considerate and hospitable State to anyone, and most certainly they are to a President, and we were obviously going to be honored by a Presidential visit to Texas, and we wanted one. The President had really not been to Texas since the campaign of 1960 except for the one stop in El Paso. So, he had not been there for any purpose during the intervening years, and we were obviously all going to benefit by his presence. We were all at that point, we were Democrats, we were officeholders, the fortunes of one obviously affected the fortunes of all, and it was important to all of us that he be understood, that he be accepted, that he be supported, as much as we possibly could, and to that extent I would certainly benefit as an officeholder more than that.

President Kennedy's strongest supporters were not my strongest supporters. I had developed a base of support among the moderates

and conservatives in the State in the Democratic Party, whereas the people that had been most enthusiastic about President Kennedy really had supported my opponent, at least in the primary and in the runoff election. Most of them supported me in the general election in 1962.

So, if the President came, and the mere fact that he did come, and my association with him, and the fact that I had helped plan the trip, that I would be with him, Mrs. Connally and I would be with them, obviously was going to inure to my benefit, it seems to me, among the people who most supported President Kennedy. So there was never any question really about—my thinking was not influenced by whether or not I was going to benefit or not going to benefit.

My whole reluctance and resistance up until the summer of 1962 revolved around my fear that we couldn't put on the type of trip that I thought the President deserved and that we wanted him to have.

Mr. CORNWELL. You told us that at the meeting in El Paso, in the hotel suite of the President, in June 1963, you agreed to help him plan the trip, but that no specific agreement was reached as to the details of the trip or as to the date of the trip?

Mr. CONNALLY. That is correct.

Mr. CORNWELL. What happened next?

Mr. CONNALLY. Well, again Vice President Johnson, with whom I talked frequently during that period of time, told me the President was still interested in having four or five fundraising dinners, and I said to the Vice President, I said, "Well, that is a mistake," and he said, "Well, that is what he wants and you had better be prepared to do it or better be prepared to give him a real good reason why you can't do it," and I said, "All right, I will work out something and be back in touch with you."

I came to Washington in early October 1963, and went to see the President. I had an appointment before I came up here to see him to talk to him about this dinner, and at that point he still was talking about four or five fundraising dinners in the principal cities of Texas.

At that point, I just said to him, "Mr. President, I think that is a mistake; we want the money, yes, but we also need, it seems to me, on your first real visit to Texas, we need to posture you in such a way that you are going to politically benefit from it and it doesn't look like all you are interested in is the money that you are going to get out of the State, and frankly, if you come down and we try to put on five fundraising affairs in the principal cities of Texas, most people down there are going to think that all you are interested in is the financial rape of the State," and I used those words, and he said, "well, all right what do you suggest?" and at that point I said, "I would suggest, we have been giving a lot of thought to it, I talked to the State chairman, I talked to the members of the State legislature, talked to the other political leaders in the State," and I told him that I thought we ought to have a number of nonpolitical events for him to go to, that we ought to try to hit the major cities of Texas—Houston, Dallas, Fort Worth, and San Antonio—and that we ought to culminate it with a dinner in Austin.

We didn't go over all the details at this particular visit but that was the general outline of what I had proposed to him. He said all right, you work it out and get in touch with, as I recall, he said Kenny O'Donnell, and he will work this out, and we will pick a date, and obviously we were saying to him that he would have to pick the date of the visit.

He and I were in the Oval Office and he couldn't have been nicer, couldn't have been more friendly, he got up from behind his desk and came around and was extremely warm and cordial, as he always was. He sat in the rocking chair and I sat in one of those little couches there in the Oval Room and I frankly was a bit surprised that the Vice President wasn't there. But he wasn't. And later I heard about it, because after my visit with the President, I went out that evening to "the Elms," to the Vice President's home and he was considerably irritated with me, and he said so, and he said, "I suppose you think I don't have any interest in what is happening in Texas," and I said, "No, Mr. Vice President, I know you are extremely interested in what is happening in Texas."

He said, "Why didn't you tell me?" I said, "Mr. Vice President, I assumed you knew I was going to see the President," and I said, trying to alibi any way I could, because I recognized that he was really irritated about it, and I said, "After all, I made this appointment several days ago and it is not my prerogative to say who is in that Oval Office, I assumed if the President wanted you there you would be there."

"Well," he said, "you could have told me beforehand what you had in mind."

I said, "You have known basically what I had in mind. In any event, here is what we said," and I recounted to him that I proposed that we visit the five major cities, Dallas, Houston, Fort Worth, San Antonio, culminating in a dinner in Austin, and then I apologized to the Vice President and said, "I am sorry, I should have talked to you before I went in to see the President. Frankly, I assumed you would be there. When I got into the Oval Office and I was rather surprised that you weren't, but having the appointment I had no choice but to go ahead and discuss it," and then I said, "But here is what we said." I recounted the conversation as best I could and we proceeded from there.

Mr. CORNWELL. Were there any specific discussions with the President on this occasion early in October 1963, as to the groups or persons that he should meet with on his trip?

Mr. CONNALLY. Yes, we talked about that, as a matter of fact, as early as El Paso, and I told him I thought we ought to try to schedule the itinerary and plan the trip in such a way that he would be, particularly the nonpolitical events, where he could appear before groups, civic groups, basically nonpolitical groups, but groups composed of the moderate to conservative business leaders, political leaders of the State, who had not supported him, who were not enthusiastic about him, in order to try to give him a chance to convert those people, and he agreed with that. No question about that.

This trip progressed as they always do. This became quite an issue, simply because Senator Yarborough, Ralph Yarborough, was then in the Senate, he was being constantly harangued by his

supporters in Texas, they were saying, "well, they are structuring this thing trying to keep us away from the President and the President's supporters are not getting to see him," and Senator Yarborough was relaying those to the White House and to the advance people, and we were arguing about tickets and arguing about everything in the world.

It got to be a major hassle and part of this raised the question that has since been discussed in great length, that the President came to Texas to resolve the differences in the Democratic Party in Texas. Nothing could be further from the truth. The two individuals who were most involved in the split in the party were Senator Yarborough and Vice President Johnson, and both of them were in Washington, D.C. This is where the trouble was.

The trouble arose basically over Federal patronage and Federal appointees and Vice President Johnson was trying to get every Federal appointment he could get, and so was Senator Yarborough. Senator Yarborough was complaining constantly to the White House to President Kennedy, that Johnson was usurping his patronage rights of the Senate with respect to Federal judges, marshals, and so forth. This was the battle here.

And indeed if the President was interested in resolving that difficulty he had Vice President Johnson right across the street in the old Executive Office Building, he had Senator Yarborough right here on the Hill, and he could have gotten them together in 10 minutes. But that wasn't the purpose of his trip to Texas at all, it had nothing to do with it.

In the first place, he couldn't have settled the differences in the Democratic Party. They haven't been settled yet, and they are not going to be settled. As long as it is basically a one-party State you are going to have the division there that you have, and you are going to have the liberals and the conservatives. They have been fighting all my adult life, from the time I first went to a convention in Chicago in 1940, a national convention. We had fist fights on the floor within the delegations, and it hasn't improved a lot since then.

So the idea that he was going to go down and settle all of this is pure hogwash. He didn't intend to do it, he didn't want to do it, he was politician enough to know he couldn't do it, and he wasn't even going to try. That wasn't the point at all. But, nevertheless, that created difficulties, but these things shouldn't be taken out of context.

Any Presidential trip anywhere in the world arouses jealousies, differences. Every politician—and regardless of his title or position—wants to be close to the President; he wants to ride in the car; he wants to have a private meeting; he wants his group to be seen; he wants them to be heard. This is a constant hassle. I don't care where a President goes. So it is not unique to Texas, but we had our share of it, I will say that, and this plagued the Kennedy advance people and it plagued us, and I organized about an eight- or nine-man group, some who worked for me in my own Governor's office, others who were in the legislature, others in the State party, to put on this affair, and the President's trip.

As I say, it is not easy. The plans were constantly shifting and changing. We were trying to really get a mix of things, so that

people wouldn't feel left out. We had originally planned a 1-day trip and it was obvious that we were trying to cram too much into 1 day, because again I wanted to hit the four principal cities plus winding up in Austin. I wanted to see on the evening of the 22d, in Austin, the members of the legislature, all of them.

Mr. CORNWELL. If I might, let me show you an exhibit or two before we get to that explanation.

Mr. Chairman, may we admit into evidence at this time an exhibit which has been marked for identification as JFK exhibit F-17, which is a newspaper article from the Dallas Morning News dated September 26, 1963.

Mr. DODD. Without objection, so ordered.  
[JFK exhibit F-17 and facsimile follow:]

**The Dallas Morning News** THURSDAY, SEPTEMBER 24, 1963 - 38 PAGES OF 5 CENTS EACH

# House Passes Tax Cut Of 11 Billion Dollars

## U.S. Trims Ties After Latin Isle Kicks Out Bosch

### Refuses To Limit Spending

#### Presidium Ratifies Kennedy to Visit N-Treaty

#### Colombia Bombings Create Emergency

**Weather . . . Today's Index**

**Cost of Living Remains Level**

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**26**



FACSIMILE

THE DALLAS MORNING NEWS

DALLAS, TEXAS, THURSDAY, SEPTEMBER 26, 1963

(Front Page)

DALLAS INCLUDED

KENNEDY TO VISIT TEXAS NOV. 21-22

By Robert E. Baskin

News Staff Writer

JACKSON HOLE, Wyo. - White House sources told The Dallas News exclusively Wednesday night that President Kennedy will visit Texas Nov. 21 and 22.

The visit will embrace major cities of the state, including Dallas.

Kennedy is currently on a tour of the Midwest and West.

The White House sources said the Texas trip would be political, although they did not reveal the particular political mission.

The final White House decision to make the trip to Texas came late Tuesday night, these sources said.

Although specific details have not been worked out, it was considered likely that the President will visit Dallas, Houston, San Antonio and Fort Worth.

There has been speculation for some time that the President was contemplating a visit to Texas, but the final decision has just been reached, The News learned. It has been

known that numerous Texas Democratic leaders have urged Kennedy to come to the state to repair what they regard as a deteriorating party situation.

The presidential decision may have been prompted by what he has seen on his current tour: a strong trend toward conservation and Republicanism in the Western states. He is believed to feel that he must cope with this situation in preparation for the 1964 campaign.

Earlier Wednesday at Billings, Mont., Kennedy recaptured his old campaign oratory in his best-received appearance in two days of intensive, "nonpolitical" campaigning across the country.

In a straight-forward, rather far-reaching address to some 15,000 persons, Kennedy gave a resounding vote of confidence to Montana's veteran Mike Mansfield, Senate Democratic leader, and won cheers when he explained why he sought the nuclear test ban pact.

And he was obviously in high spirits as a result of the House's approval of the tax cut bill, news of which reached him just before he began his talk.

For the first time since he left Washington, he was applauded in the course of a speech. The subjects that won him applause, however, had nothing to do with conservation --

the announced reason for his 11-state tour. Foreign affairs got him his best hand.

Kennedy said Mansfield, up for re-election in 1964, was responsible for ratification of the test ban treaty Tuesday. He added that Senate GOP leader Everett M. Dirksen, Ill., had been helpful.

He recalled his confrontations with Soviet Premier Nikita S. Khrushchev in 1961 and 1962 and how war has been avoided.

"What we hope to do," the President said, "is to lessen the chance of a military collision between these two great powers which together have the power to kill 300 million people in a day. That is why I support the test ban treaty."

From Billings the President flew on to Jackson Hole for an overnight stop.

Earlier in the day at Cheyenne, Wyo., Kennedy claimed that his New Frontier administration "has been able to make a start...at getting our country moving again."

Mr. CORNWELL. You have described for us, Governor, the meeting you had with the President on October 4. Several days prior to that, the newspaper article, the front page of which is shown in the exhibit, appeared in the Dallas Morning News. The headline on the lower right portion of the page refers to the President's visit to Texas, and because the exhibit is blown up it is relatively small. Let me tell you what the first lines of it read:

White House sources told the Dallas News exclusively Wednesday night that President Kennedy will visit Texas November 21 and 22. The visit will embrace major cities of the State including Dallas. Kennedy is currently on a tour of the Midwest and West. The White House sources said the Texas trip would be political, although they did not reveal the particular political mission.

Were you aware of either that article or similar publicity prior to your trip to see the President on October 4?

Mr. CONNALLY. Well, I don't have any specific memory of it but I am sure I knew it.

Mr. CORNWELL. Do you know, apart from what the implication is in the article, who released that report?

Mr. CONNALLY. No, but it made no impact on me. I don't have any memory of this particular article at all, but it would not be surprising because we had made it clear to the President that he was going to have to pick the date for the trip, and I just assumed that is the date that probably they had chosen. We were constantly in touch back and forth during this period of time in the fall with the Vice President and with Kenny O'Donnell and others trying to plan the type of trip and without getting down to specific details, and we hadn't yet had the date, but I am sure I knew about this, yes.

Mr. CORNWELL. You have told us that after the October 4 trip, you went back to Texas and began the process of planning for the trip. Who all was involved in that process?

Mr. CONNALLY. Oh, gosh, a great many people. Everyone in my office was. My Executive Assistant, Howard Rose, certainly was. Eugene Lock, who I believe, from Dallas, still was Chairman of the State Democratic Party was. Pat O'Keefe, who was Executive Director of the State party was involved. Carol Abbott, who worked at the State party, was certainly involved. Bill Stenson, who was on my Governor's staff, was certainly involved. Representative Ben Barnes was involved; Frank Irwin was involved; Julian Reed was involved. There were 8 or 10 of us who spent a great deal of time on it.

Mr. CORNWELL. Let me ask Mrs. Connally, were you involved in that process, too?

Mrs. CONNALLY. Yes, I certainly was.

Mr. CORNWELL. What was your role?

Mrs. CONNALLY. I was shining that mansion up like you never saw. [Laughter.]

We were trying to get everything ready at the Governor's mansion for our first visit from a President and his Lady, so I had all the hassles of any housewife trying to get her house in order so it would be just right for the very special guests.

Mr. CONNALLY. I think, to put it in a little different context, I think the first thing we agreed on, and Nellie certainly was involved in intimate detail with the trip, because the one thing we

had agreed on we were going to try to wind up with the fundraising affair in Austin, Tex.

Because of the nature of the State, unless you do have four or five fundraising affairs you cannot choose another city in Texas and have as successful a fund-raising dinner as you can if you have it in Austin. Dallas doesn't want to support Houston; Houston doesn't want to go to Dallas; Dallas won't go to Fort Worth; Fort Worth doesn't want to go to Dallas. None of them will go to San Antonio, but all of them will go to Austin. So we decided that it was the capital, that what the President needed to do was to come to Austin.

This was the news center of the State, just like Washington is for the Nation. All the news media were there. We wanted him to meet the members of the legislature because they, in effect, were the thought leaders, the political thought leaders of the Democratic Party throughout the State. We thought that this would be like any politician. Any politician wants to know the President of the United States; he wants to say I know him, I shook his hand, I saw him; he wants to go home and tell his constituents that he saw them.

We planned—the one thing we had done, which we had agreed on early, was to have the dinner in Austin—a \$100-a-plate affair, because we had to start selling tickets. Then, Nellie and I agreed that probably the best place for a reception was to ask President and Mrs. Kennedy to come to the mansion, and to invite the entire legislature, 150 members of the house, 31 members of the senate, to come to the mansion to meet the President, and at that time we weren't sure Mrs. Kennedy was coming. In my visit with him I had expressed the hope that she would come, and he said well, I am not sure, but I will talk to her about it and I will ask her to come with me. And as I recall, he said, at the time I saw him, I believe he said she was in Europe. He said when she gets back I will ask her if she won't come with me.

I told him I thought that in all of these events there were going to be men and women; I thought it would contribute enormously if she came. The women wanted to see her; they read a great deal about her; they want to see her; they want to see what her hairdo looks like and what her clothes look like, and it is important to them. So he said, I agree with you, and I will talk to her about it when she gets back.

So in any event, we thought if we could have the President and Mrs. Kennedy at the mansion to meet all of the members of the State party machinery, the representatives and the senators, it would probably be as effective a thing as we could do to help him on his trip. Then from there we would go directly to the dinner at the Coliseum, where we planned to have 3,000 people at \$100 a plate.

Mr. CORNWELL. What were the other basic elements in your initial proposal to the President as to how the trip should be organized?

Mr. CONNALLY. Well, basically, we had to get a nonpolitical sponsorship and a nonpolitical activity in the four other major cities to give him a forum, to attract the type of audience, to give him some identity.

As I recall early on, we, in Fort Worth, we considered the idea of having Texas Christian University in Fort Worth confer an honorary degree on him and let him speak on the campus of Texas Christian University. That was thought of early.

In Houston, he really came up, I think, or the White House did, with the idea of going to the Albert Thomas dinner and this helped us because we were trying to cram everything into the day of the 22d, on Friday.

Well, just before the trip, as I recall, we didn't have but about 48 hours notice, not more than 72, he decided he would go to Houston. So, we restructured the whole thing. I had planned to, or had suggested that we go to San Antonio, Houston, Fort Worth, Dallas, and Austin, all in one day, but then, the Albert Thomas dinner—Albert Thomas was then chairman of the Appropriations Committee of the House of Representatives. He was one of the really powerful members of the Texas delegation.

He had been chairman of the Appropriations Committee since 1940. He was extremely well regarded in Houston, Tex. He was one of the strange—not strange—he was one of the unusual and unique politicians. Albert Thomas had the support of all the business community in Houston. He also had all the support of labor and most of the liberals in Houston. He was sick. He had a terminal illness and they were having this appreciation dinner for him the night of the 21st of November. And the President decided that he ought to go there and be there and obviously, Albert Thomas really wanted him to come and really put the arm on him to come.

No President, in his right mind, completely disregards the chairman of the Appropriations Committee. Since he was ill and since they were good friends, the President, I think, graciously said, "I'd like to come." So, this changed our whole format. Then, we were able to get him for a day and a half.

So, we moved the San Antonio affair to Thursday afternoon and then we decided to go on to Fort Worth that night, the night of the 21st, after the Albert Thomas dinner in Houston.

In the meantime, in trying to work out the itinerary and talking about an honorary degree from Texas Christian University, frankly, some of the trustees of Texas Christian University took a dim view of it and weren't enthusiastic about it, and we dropped the idea completely because the last thing we wanted to do was to get into any kind of dispute or hassle because we wanted his trip to be smooth; we wanted everything acceptable.

I personally went to Dallas. I talked to the leaders of the civic groups in Dallas, Citizens' Council, which is a group that for 40 years dominated the political leadership of Dallas. We got the Assembly, which is a group of young people; we got the Educational Research Center, Science Research Center, we got four or five groups in Dallas to cosponsor this luncheon, again, to give it a nonpolitical flavor so that he could go and make a speech.

We had done that in each of the places. The White House came up with the idea, or somebody did, that they would dedicate the Aerospace Medical Center in San Antonio, and it was a nonpolitical affair. The breakfast in Fort Worth was a nonpolitical affair. It was also sponsored by the Chamber of Commerce and other organizations.

But in working it all out, we had a motorcade in San Antonio. Again, over the period of time because the great tragedy occurred in Dallas, everybody talks about the President's trip to Dallas. The President made a trip to Texas. And we had been to San Antonio where we met the President. We had a motorcade through San Antonio and, again, this was an effort to be sure that he wasn't shielded from anybody, that he was out seeing people.

We had a motorcade right through the center of San Antonio; the reception was wonderful; the crowds were huge; the response was enthusiastic. We went from there—we spent about 30 minutes or 45 minutes at the Aerospace Medical Center, and he dedicated that building on the site of the old Brooks Army Air Force Base.

We left San Antonio, went to Houston, arriving there about 5 o'clock. We planned this simply because, again, we wanted every detail of the trip to be as perfect as we could make it.

Mr. CORNWELL. Your basic plan of meeting with various citizens groups and the representatives of the business community, did that meet any stiff resistance and, if so, from what area?

Mr. CONNALLY. No, I don't think it met any stiff resistance. I think the complaints came, as I said a moment ago, largely voiced by Senator Yarborough and some of the labor groups and some of the liberal groups on the grounds that not enough of their people were being included.

Now, the leadership among the labor, among the blacks, everybody else, they were being included in these affairs, even though they were not formally members of these organizations; they were being invited; they were being given tickets, but they were not being invited in mass numbers to the various affairs; they were there at the breakfast; they were there at the Albert Thomas dinner; they were there at the luncheon at the Trade Mart in Dallas; they certainly were there at the affair, or to be there at the affair in Austin that night, the \$100-a-plate dinner.

As a matter of fact, we sent all of them tickets. We said, "Please help us."

Mr. CORNWELL. Who did the conversations occur with where there were disagreements as to, at least, the emphasis that should be placed on various aspects?

Mr. CONNALLY. Very few of them with me. I was meeting intermittently with these eight or nine people that I had working on this trip, but—

Mr. CORNWELL. Who were your people meeting with?

Mr. CONNALLY. They were meeting with Hal [sic]<sup>1</sup> Bruno the President's advance man. We were getting information from all kinds of sources. We were getting direct calls from the top labor leaders in the State, and others. You know, we were getting a considerable feedback and frankly, considerable differences developed between the President's advance men and the people I had working on the trip and to the point where it got a bit testy.

Mr. CORNWELL. What were the main areas of disagreement?

Mr. CONNALLY. Just minutia details. Inevitably, these things happen about who is going to sit at the table, who's going to do this, who is going to do that. One of the biggest controversies arose

<sup>1</sup> The Governor later corrected his reference to Mr. Bruno, explaining that it was Jerry Bruno.

over whether or not we were going to have a motorcade in Dallas. That was one of the big ones. And we lost that one.

Finally, frankly, it got so bad with Hal Bruno and the President's advance people, that real differences developed between the people I had working on the trip and the President's advance people where Hal Bruno, I think, was pulled off, completely off of the trip and Bill Moyers came down as kind of a peacemaker.

Mr. CORNWELL. What was your view in opposing the motorcade in Dallas? You said there was a severe disagreement with the advance men on that subject.

Mr. CONNALLY. Basically, my reason for opposing the motorcade in Dallas were two. We were working the President very hard, I thought. Most people think that riding in a motorcade is easy. It's not. It's very tiring. It's exhausting. You assume that a person is just riding along so there shouldn't be any difficulty. But nevertheless, in a motorcade, the President of the United States is there, he is tense, he is smiling, he is exuding enthusiasm, he is trying to make, even in a fleeting second, he is trying to make contact with the thousands and tens of thousands of people along this parade route. He is looking one side and then the other.

Even if he just catches a human's eye for one fleeting second, there is a communication, and this is why in the car, Nelly and I had very little conversation with the President and Mrs. Kennedy. The conversations were extremely brief and desolatory because he was, in effect, working the crowd from the car and to a lesser extent, so was I.

You have to be in one. You have to experience it to understand precisely what I am saying. But I am telling you, it's a strain on him. We had him getting up early in the morning to attend a breakfast in Fort Worth. He made a speech on the parking lot in front of the Texas Hotel in Fort Worth. Then, we flew to Dallas. He had a speech there. We were going to take him to Austin where he had two receptions at the mansion for 181 members of the house and senate. Then, he had a speech that night. We were crowding him into about a 15-hour day.

What I wanted him to do—you know—you can work anybody to death. Ask any of these members of this committee. They will tell you when they go into a town or a county, the local campaign chairman—or into a precinct or a ward—he wants to work him from 7 in the morning to midnight. He doesn't care what happens tomorrow because he is going to be gone.

This local politician, he will go to sleep, he will sleep all the next day. But, unfortunately, the officeholder has to get up and go again on another 15-hour day.

And I was extremely conscious of that because I started in State politics in 1938. I managed President Johnson's campaign in 1941 and 1948 when he ran for the Senate, and I had been through enough of this. I had caught enough hell about overscheduling, so I didn't want to do the President that way and I wanted him to be sharp.

No human being can be up for 15 hours a day and all we were trying to do was allow him enough time in between events to where when he really got in front of an audience, when the cameras were on him, when the newsmen were watching him, that he



could look good, he would look fresh, his voice would be strong, he could really be able to exude warmth and enthusiasm. And, this is the whole reason; now—

There was one other reason, and that was simply that I thought, no more so really in Dallas than most places in Texas, but I thought we ran the risk of having some embarrassing placards or signs or a few pickets along the way. I frankly never had any fear of physical harm or violence. That never entered my mind, but the idea that we probably would encounter a sign or two did enter my mind and the thought we might have some pickets entered my mind because, again, President Johnson and Mrs. Johnson had had the difficulty down in front of the Baker Hotel in the campaign of 1960.

Then, as you recounted a moment ago, Ambassador Stevenson, Adlai Stevenson, came to Texas and had been hit over the head with a picket sign about a month before the President's trip. So, these things were not—I was not unconscious of them at the time, and we didn't want any of it. Well, the only thing we saw on any of the trips, Dallas did have one sign, there was a fellow up on an old house, like a turn of the century house, badly needing paint, I recall very well, he had a sign up on this balcony that said, "Kennedy, go home." But, it was on the left side of the car as we were traveling in the motorcade and the President was on the right side in the back seat, and I hoped he didn't see it, but he finally turned to Nelly and me and said, "Did you all see that sign?" I said, "Yes, Mr. President, but we were hoping you didn't." He said, "Well, I saw it. Don't you imagine he's a nice fellow?"

And, I said, "Yes, I imagine he's a nice fellow." But that was about the only thing we saw, and frankly, there was less of that than I thought. The crowds were larger than I anticipated. They were more enthusiastic than I could even have hoped for. All the way through, in San Antonio, in Houston, in Fort Worth, it was drizzling rain; at 8:30 in the morning when the President went out—approximately 8:30—when he went out on a parking lot there across from the Texas Hotel and spoke to people in the rain, and there was a huge crowd there.

So, the trip had been absolutely wonderful, and we were heaving a sigh of relief because once we got through the motorcade at Dallas and through the Dallas luncheon, then everything else was pretty much routine.

Mr. CORNWELL. Let me ask you to go through the details of that trip perhaps more precisely. After the elaborate planning and the arguments over the details, I suppose there must have been some relief when the day finally came.

Mr. CONNALLY. Oh, yes.

Mr. CORNWELL. Let me ask, Mrs. Connally, you had an opportunity to meet the President and his wife at the airport; is that correct?

Mrs. CONNALLY. Yes.

Mr. CORNWELL. Where did you come from just immediately prior to that?

Mrs. CONNALLY. I came from Austin to San Antonio.

Mr. CORNWELL. What had you been doing in the immediate hours or day or two right before the arrival?

Mrs. CONNALLY. Well, the entrance hall in the Governor's mansion had sort of gold carpet, and since this house is open to the public, it gets a lot of traffic. So, I had had the carpet cleaned, but 2 days before the visit, I decided they didn't clean it well enough and I was having it cleaned again. So, I was having a talk with the carpet cleaners and I left the house in Austin and joined them in San Antonio.

Mr. CORNWELL. The Governor, as I understand, was in Houston that day and had to fly to San Antonio to meet the President's plane, so you both arrived in advance and were together; is that correct?

Mrs. CONNALLY. From different directions.

Mr. CORNWELL. Would you describe for us what your feelings were as the event took place and the President arrived into Texas for the first time?

Mrs. CONNALLY. Me?

Mr. CORNWELL. Yes, ma'am.

Mrs. CONNALLY. It was very exciting. It was the first time that we had been host to a President and his lady. Everybody was excited. We were excited and nervous—I tell you, I felt exactly like the mother of everybody. I wanted all the Texans to be so wonderful to them when they came and I wanted them to react in a good way, too. I just was nervous and excited and could hardly wait.

Mr. CORNWELL. Were the reactions from the people in Texas as you had hoped?

Mrs. CONNALLY. There was a tremendous roar when the plane put down and the door opened and out stepped Mrs. Kennedy, who looked beautiful, just like everybody expected, and then the handsome young President coming out behind her. I get goose pimples now thinking about it. It really was an exciting moment in our life.

Mr. CORNWELL. You went from the airport in a motorcade to downtown San Antonio?

Mrs. CONNALLY. Yes.

Mr. CORNWELL. Was the reception there as great?

Mrs. CONNALLY. Yes. Tell them about the reception. Everybody was excited. It just made you feel good.

Mr. CONNALLY. You couldn't have asked for more. The crowds were large, they were extremely warm, extremely enthusiastic. Just could not have been better.

Mr. CORNWELL. Did the activities in San Antonio, and for the rest of that day, go just as well? Was there anything about them which was disappointing?

Mrs. CONNALLY. Nothing that I know.

Mr. CONNALLY. No, it all went extremely well. We left San Antonio and went to Houston—got into Houston right at the—there were several thousand people at the airport to meet us. We went downtown right at the rush-hour traffic. Of course, cars were bumper to bumper almost four lanes wide, and they all stopped for just miles. As they were leaving town, we were going into town. As this motorcade passed, people were out, they were stopped, they were standing up, cardoors open, they were waving—

Mrs. CONNALLY. Cheering.

Mr. CONNALLY. Cheering. We got to the hotel. The President met that evening with a group of Mexican-American leaders, the

LULAC organization was having a big dance in the Rice Hotel where they were staying, and he and Mrs. Kennedy, Vice President and Mrs. Johnson went by there before they went to the Thomas dinner. The Thomas dinner was a complete sellout in the Coliseum. I guess they had 3,500 people there, and I watched because I knew these people and I knew the crowds. Frankly, I don't remember what the President said. I must confess, I didn't listen to him because I was concentrating almost totally on the crowd reaction.

I was looking and watching all through the crowd during his entire speech. He was indeed reaching these people; he was communicating with them. It just could not have been a better day in both San Antonio and Houston.

Mr. CORNWELL. After the Albert Thomas dinner and the meeting with the Mexican-American leaders had concluded, you flew, again, in Air Force One, this time to Fort Worth; is that correct?

Mr. CONNALLY. That's correct.

Mr. CORNWELL. Up until this point of the trip, had you had any opportunity, really, to speak to the President and to learn what his reaction was to the reception he had received in Texas?

Mrs. CONNALLY. Yes, don't you remember how excited he was about how everyone—they talked in the airplane, from San Antonio to Houston, and—the President seemed very pleased with how he had been received in San Antonio and said, "Well, that was a good one, John, do you think we will do as well at the next stop?"

Mr. CONNALLY. Unlike, I suppose, the often-repeated verbosity of some of us from Texas, the President was not given to extravagant statements, and I think he generally was known for the fairly terse comments of a New Englander and a Bostonian.

So, his praise would be couched in a different language than from my own. It is obvious that he was extremely pleased. I think Nelly can probably explain this better than I, but I think one of the significant things that occurred was the change that we saw in Mrs. Kennedy and her reaction to the trip.

In San Antonio, she was rather stiff, I thought, rather unused to this. She had not been traveling much and campaigning much with the President and she was not noticeably ill at ease at all, but nevertheless, reserved, quiet and perhaps a little bit—frightened is too strong a word—but apprehensive about this whole thing. Not apprehensive in the sense of being fearful of violence, but just not being used to it. She was a bit concerned about what she did. For instance, one time, in San Antonio, she was worried about her hair and her hat and she traded seats with me. We were all over that car. Normally, the President sits in the right-rear and his wife sits on his left. I was sitting in front of the President most of the time. Nelly was sitting in front of Mrs. Kennedy most of the time.

Particularly, in San Antonio, we changed seats because the wind was blowing, we were driving fairly fast at times, 30 and 40 miles an hour. She traded seats and got up on the jumpseat and I sat in the back seat with the President. The two ladies were in front.

Mrs. CONNALLY. The back seat was raised, so she would get more wind there.

Mr. CONNALLY. The President knew that really wasn't the right way to do it and he made her get back in the back seat, and I got back on the jump seat.

Mrs. CONNALLY. Where you belong.

Mr. CONNALLY. Where I belong. The next day, it was obvious that after the San Antonio and the Houston motorcades, the next day she was much, much more relaxed, wouldn't you say?

Mrs. CONNALLY. Yes, happily responding to the crowds.

Mr. CONNALLY. Marked difference in her reactions and her appearance between the afternoon of the 21st and the day of the 22d. Noticeably in Dallas.

Mrs. CONNALLY. And they were enjoying seeing her as much as they were the President. They were calling out their names and I think she really got in the spirit of it.

Mr. CORNWELL. You told us about the dispute which was long standing between Senator Yarborough and first Senator Johnson and then continuing into Vice President Johnson. Did that particular dispute come up at all? You said that it wasn't the reason the President came to Texas. Did it come up at all during the trip?

Mr. CONNALLY. Yes, oh, it was ever with us. It came up, I didn't know it. Everything had gone beautifully. We had gotten into Fort Worth about 11 o'clock at night at Carswell Air Force Base and drove into town in a light drizzle, and the President and Mrs. Kennedy and Vice President and Mrs. Johnson went up to their suites. When they were safely ensconced, I was so relieved that everything had gone well that I went down to the Texas Hotel coffeeshop to have some bacon and eggs and a glass of milk about midnight. That was the first then that I heard they had had quite a hassle in Houston, that Senator Yarborough refused to ride in the car with Vice President Johnson. So, I said well, you know, I don't care who rides in which car.

I didn't worry much about it, but nevertheless, it had happened and it was by that time the talk of the motorcade, the talk of the press and so I didn't think any more about it until the next morning.

And, the President, when he came back from his speech, the first thing he did when he got up—Mrs. Kennedy was not with him—Jim Wright, Congressman Jim Wright, who is now the majority leader of this Congress of the House, took him across the street from the Texas Hotel into this parking lot where he spoke to the crowds there, and then he came back into the Long Horn Room of the Texas Hotel and sat down and he motioned for me to come over.

I went over there and he said, "John, did you know Yarborough refused to ride with Lyndon yesterday?"

I said, "Yes, sir; I heard that last night."

And he said, "By God, he'll ride with him today or he'll walk."

So, I said OK. I did nothing about it. But then later, I saw him talking to Senator Yarborough, and indeed, that day Senator Yarborough rode in the car with Vice President Johnson in the Dallas motorcade. This is one of those things that is really, in the overall planning and the execution of this trip, was of no great consequence.

Mr. CORNWELL. So, that was the only part of what we might call the Yarborough-Johnson feud that was even taken up by the President on his trip; is that correct?

Mr. CONNALLY. Right.

In deference to my old home town of Fort Worth, Mr. Cornwell, and also to set the record straight, at least one publication in Fort Worth talked about a drab, sordid hotel room, the Presidential suite in which the President stayed. Well, it turned out it so happened that the Texas Hotel was, at that point, controlled by the Ammon Carter estate and C. D. Richardson estate. They had gone to great pains to do everything they could, once it was certain he was coming to Fort Worth, was going to stay at the Texas Hotel, to refurbish this suite and, as a matter of fact, Mrs. J. Lee Johnson III, Miss Ruth Carter Johnson, Mr. Ammon Carter's daughter had gone to the trouble to go to private homes around town and had borrowed paintings and Nelly helped me, but there was a Picasso in the suite, there was a Monet in the suite, a Van Gogh in the suite, and two or three more, so they probably had a couple million dollars worth of paintings just on the walls and I assure you they had done everything they could—the President was obviously impressed, and so was Mrs. Kennedy.

The first thing he did the next day was to call Mrs. Johnson, Mrs. J. Lee Johnson III, who lived in Fort Worth, and thank her for her kindness and for her trouble and for her consideration and to tell her how delighted they were with the accommodations in the hotel, all of which means nothing except to kind of clear the air and set the record straight because things get told and then they get repeated, and I think, in all fairness, we ought not to describe that suite as a rundown, sordid suite.

Mrs. CONNALLY. It makes me mad.

Mr. CORNWELL. The next morning, the one you have just been describing, of course, was November 22, 1963. The President had a breakfast and then a meeting with the chamber of commerce.

Mr. CONNALLY. A what?

Mr. CORNWELL. A breakfast scheduled; is that correct?

Mr. CONNALLY. Yes.

Mr. CORNWELL. And thereafter, he had a speech in the parking lot; is that correct?

Mr. CONNALLY. No, I believe he spoke in the parking lot first and then he came back into the hotel, then, Mrs. Kennedy joined him. She did not go across the street to the parking lot, but she did join him and then they came into the breakfast together. I would guess this is now 9:25, 9:30, something like that.



JFK EXHIBIT F-11

Mrs. CONNALLY. He came first and made the statement that Jackie was pulling herself together and then turned to Vice President Johnson and said, "Lyndon, nobody pays any attention to what we wear," which I thought was funny, didn't you?

Mr. CORNWELL. The morning, then, I take it, started off well; is that correct?

Mr. CONNALLY. Extremely well.

Mr. CORNWELL. The weather was somewhat drizzly, but apart from that, the schedule went well, the receptions, again, were as you described them on the previous day. Is that right?

Mr. CONNALLY. Yes, and there were 2,500 people in the breakfast that morning. So, the idea that he was meeting with a few exclusive, handpicked people is hardly true. That breakfast meeting alone, I think, had 2,500 people there.

Mr. CORNWELL. Thereafter, you all again boarded Air Force One and flew to Dallas?

Mr. CONNALLY. That's right.

Mr. CORNWELL. You told us previously what types of concerns you had had about the motorcade in Dallas, the incident with Adlai Stevenson. Is there anything else that you can recall for us that went through your mind during that period of time as you were approaching Dallas and preparing to enter the motorcade?

Mr. CONNALLY. No, not really. There had been an ad, I have forgotten what it said, in the morning paper that morning about the trip. It was a somewhat derogatory ad, but I really was not apprehensive about anything except, as I said, that we might see an embarrassing sign or some rude statement or a few pickets here or there. But I must say, as Air Force One landed at the airport in

Dallas, the Sun broke through, it was absolutely marvelous weather, could not have been better.



JFK EXHIBIT F-12

The crowd at the airport was several thousand people. It was, again, an extremely receptive group of people who were out there, enthusiastic group of people. I recall that after President and Mrs. Kennedy shook hands with those in the receiving line, they went over and Vice President and Mrs. Johnson accompanied them, and they went over for 5 minutes or so, walked up and down the fence where there were thousands of people gathered and shaking hands and greeting people who came to the airport to see them.

Mr. CORNWELL. Tell us then, if you would, in more detail, what happened as you all entered the limousine and began the motorcade.

Mr. CONNALLY. Well, as these things are normally done, it was timed fairly well and we immediately got into the cars, the motorcade started.

One thing I do recall, I said a moment ago that Mrs. Kennedy appeared to be much more relaxed, much more in the spirit of things. She was smiling more, obviously more at ease, but one little thing, the Sun was bright. It had come out bright and beautiful. The sky was beautiful, the clouds had dispersed and she put on her dark glasses. What did he say?

Mrs. CONNALLY. He said, "Take your glasses off, Jackie."



JFK EXHIBIT F-13

Mr. CONNALLY. "Take your glasses off, Jackie." She kept them off for awhile and she just unconsciously put them back on.

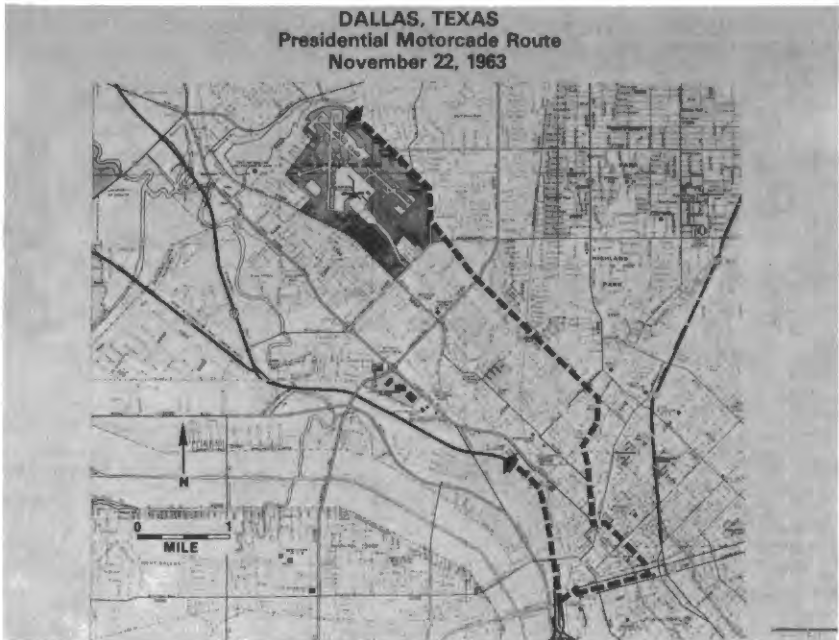
Mrs. CONNALLY. You could hear him again saying, "Take your glasses off, Jackie."

Mr. CONNALLY. This happened a third time. Then, I think she finally left them off. But on the way down in the motorcade—again, the crowds were large—were enthusiastic. We stopped two or three times. I remember twice—in particular, there was a little girl, I guess she was 8 years old, who had a placard that said, "President Kennedy," something like, "will you shake hands with me?" and held up this sign. Well, he immediately stopped the car and shook hands with this little girl, and of course, the car was mobbed. The minute the car stopped, here came the Secret Service. They got between the car, the limousine in which he was riding, and the mass of people who immediately surrounded the car. We extricated ourselves from this group and then went on.

The other stop, we were halfway downtown, I suppose, when there was a nun, a sister, with a bunch of schoolchildren, obviously from a parochial school there, right by the car. And he stopped and spoke to them, and to the sister and to the children. We stopped a third time, I believe, along the route. But, uh—

Mr. CORNWELL. What was the route, incidentally? Will you describe that for us? How did the motorcade go from the airport to its destination site, which is the Trade Mart?





JFK EXHIBIT F-9

Mr. CONNALLY. I think we went down Lemon Avenue to Turtle Creek and from Turtle Creek to Main and from Main to Houston, Houston to Elm, I believe.

Mr. CORNWELL. So, at least the idea was it was basically a route which took you down through the heart of downtown Dallas?

Mr. CONNALLY. Right through the heart of Dallas; no question about it. The further we got toward town, the denser became the crowds, and when we got down on Main Street, the crowds were extremely thick. They were pushed off of curbs; they were out in the street, and they were backed all the way up against the walls of the buildings. They were just as thick as they could be. I don't know how many. But, there were at least a quarter of a million people on the parade route that day and everywhere the reception was good. I told you a moment ago about the only sign we saw that was in the least bit unpleasant.



JFK EXHIBIT F-10A AND 10B



Mr. CORNWELL. Mrs. Connally, at any point in the motorcade, did you have a chance to speak to the President?

Mrs. CONNALLY. Yes, we were having such a wonderful reception, and we were all so excited, and we had had through all these other cities, and I had restrained myself up to that point from saying anything, but I could no longer stand it, so I turned around to the President and I said, "Mr. President, you can't say Dallas doesn't love you."

Mr. CORNWELL. And, where was that in the motorcade? At what point?

Mrs. CONNALLY. That was just as we were right approaching the book depository.

Mr. CONNALLY. Just before we turned.

Mrs. CONNALLY. Just before we turned.

Mr. CORNWELL. Mr. Chairman, at this time, I think I might suggest to you we take a brief break and set up a projector and then show a film of the motorcade, which has been marked "JFK F-8."

Chairman STOKES. So ordered.

At this time, we will take a brief break to set up the film portion.

[A brief recess was taken.]

Chairman STOKES. If everyone would take their seats again, the committee is ready to resume its sitting.

I also ask that the lights be dimmed at this time.

The Chair recognizes Professor Blakey for a narration and presentation of the film.

Mr. BLAKEY. Thank you, Mr. Chairman. I would note initially that this is a copyrighted film.

[At this point, a film began to be shown as Mr. Blakey described the events portrayed in it.]

Mr. BLAKEY. November 22, 1963, 11:40 a.m., central standard time.

President and Mrs. Kennedy arrive at Love Field, Dallas, on Air Force One after a brief flight from Fort Worth.

It is a bright, sunny day, though it had been raining earlier.

The President and First Lady greet well-wishers at Love Field.

Then, they join Gov. John B. Connally of Texas, and his wife Nelly.

The Kennedys and Connallys get into the open Presidential limousine for the trip to the city. Plans to have the Presidential party enclosed in the limousine's bubble-top were abandoned when the rain stopped.

There is no need for top coats or hats; the temperature is 68°.

Destination the International Trade Mart where the President is to deliver a luncheon address to an audience of businessmen. This is the last leg of the swing through Texas.

Yesterday, the Presidential party visited San Antonio and Houston.

Vice President Lyndon B. Johnson is riding in the limousine behind the President, along with Texas Senator Ralph Yarborough.

The motorcade left Love Field shortly after 11:50 a.m.

The crowds that line the route get thicker as it reaches the business district of the city.

Main Street: The motorcade is approaching Dealey Plaza, an area where open lawns are surrounded by express highways and tall buildings.

At the corner of Main and Houston, the motorcade makes a sharp 90° turn to the right and heads north for one block.

The Texas School Book Depository is directly in front of the Presidential limousine.

The book depository isn't shown. It is located to the immediate left of the picture.

As the limousine approaches the intersection of Houston and Elm Streets, Mrs. Connally, as she indicated, elated by the reception, says, "Mr. President, you can't say Dallas doesn't love you." The President replies, "That's obvious."

At Elm Street, the limousine makes a hairpin turn to the left and heads west passing the book depository.

The film shows police motorcycles leading the limousine as it goes by the depository. The building in the background is the book depository. The window at the extreme right at the top of the picture is the one where earlier investigations have concluded Lee Harvey Oswald is located at this moment.

It is about 12:30 p.m.

As the President waves to the crowds, shots ring out, the President and Governor Connally are wounded. The President is struck in the head. The limousine speeds up heading for the Stemmons Freeway. Its destination is now Parkland Memorial Hospital.

At approximately 1 p.m., the President will be pronounced dead. Chairman STOKES. May we have the lights back, please.

The Chair recognizes Mr. Cornwell, counsel for the committee.

Mr. CORNWELL. At this point, Mrs. Connally, I would like to ask you some questions about what your memory is of what happened on Elm Street after the limousine passed underneath the Texas School Book Depository.

What distance, after turning the corner, do you recall the car going before you noticed something was wrong?

Mrs. CONNALLY. Not very far. I don't really know how far. Do you want me to just tell you everything I remember?

Mr. CORNWELL. That will be fine.

Mrs. CONNALLY. I heard—you know how we were seated in the car, the President and Mrs. Kennedy, John was in front of the President and I was seated in front of Mrs. Kennedy—I heard a noise that I didn't think of as a gunshot. I just heard a disturbing noise and turned to my right from where I thought the noise had come and looked in the back and saw the President clutch his neck with both hands.

He said nothing. He just sort of slumped down in the seat. John had turned to his right also when we heard that first noise and shouted, "no, no, no," and in the process of turning back around so that he could look back and see the President—I don't think he could see him when he turned to his right—the second shot was fired and hit him. He was in the process of turning, so it hit him through this shoulder, came out right about here. His hand was either right in front of him or on his knee as he turned to look so that the bullet went through him, crushed his wrist and lodged in

his leg. And then he just recoiled and just sort of slumped in his seat.

I thought he was dead. When you see a big man totally defenseless like that, then you do whatever you think you can do to help most and the only thing I could think of to do was to pull him down out of the line of fire, or whatever was happening to us and I thought if I could get him down, maybe they wouldn't hurt him anymore. So, I pulled him down in my lap.

We learned later—I read a lot of stories that upset me later because they said we slipped down into the floor, that John slid off, fell over into my lap. Those little jump seats were not very big and there was no way that he could have slid to the floor, there is no way either of us could have got to the floor.

The only thing I could do was pull him down and by leaning over him, I hoped if anything else happened, they wouldn't hurt him anymore. I never looked back after John was hit. I heard Mrs. Kennedy say, "they have shot my husband."

Then, I heard a third shot and felt matter cover us and she said, "They have killed my husband, I have his brains in my hand."

I thought John was dead, and I heard the Secret Service man say, "Let's get out of here quick." So, we pulled out of the motorcade and we must have been a horrible sight flying down that freeway with those dying men in our arms and going to no telling where. We just see the crowds flashing by.

John said nothing. I said only to him from the time I saw one little movement, that maybe he is still alive, and, I kept whispering to him, "Be still, it is going to be all right, be still, it is going to be all right."

I have read stories where I screamed and he screamed and all these things. There was no screaming in that horrible car. It was just a silent, terrible drive. We got to the hospital, I guess it was the hospital, the car stopped and John was still in my lap, but I knew he was alive and people were swarming all around the car.

They were trying to get Mrs. Kennedy to get out so they could get the President out and she didn't seem to want to get out of the car. I sat there for what seemed to me an awfully long time, but probably was just a few minutes, wondering how long I had to sit there with this man dying in my arms before I could ask somebody to do something.

At that moment, John just sort of heaved himself up out of my arms and then just kind of collapsed in front of the door. And at that moment, the door opened and somebody picked him up and just ran off down the corridor and I ran along behind them.

We got into what later I found was trauma room 1 and trauma room 2. The President was on a stretcher right behind us, I guess. I still had never looked back. John was in the room on the right—well, as we approached, the President was on the right and John was on the left and I stood there, so alone. I never have felt so alone in my life, and there was much commotion racing around us.

I saw all sorts of artillery and weapons. I assume it was Secret Service or security, I don't know, racing up and down around the corridor. Finally, somebody brought two chairs and sat them outside these two doors, and I sat in one and Mrs. Kennedy sat in the other. I kept seeing all this commotion in the President's room, and

I wondered if—I knew the President was dead, but I wondered if they weren't all over there and nobody taking care of John. The only thing that would calm me a little was I would get up now and then and just push open the door in the room where he was, and if I could see any movement or hear them saying anything, then I was content to wait.

They sent me out one cuff link. Then they came out and took him down the corridor to the operating room and I just ran along behind the stretcher, not knowing what I was running to or what I was running from, but run I knew I must.

And all during the surgery, which was 3½ hours, I was in some little waiting room and the doctors were just wonderful.

They kept sending messages out to me to say John would be alright, that the bullet had missed all the vital organs and where he was in bad shape, he would be all right. What else?

Mr. CORNWELL. Thank you, very much.

Governor, let me ask you the same question. What is your memory of the events? What did you see and hear? What happened after the limousine started down Elm Street and passed underneath the Texas School Book Depository?

Mr. CONNALLY. Mr. Cornwell, we had just turned to Elm. We had gone, I suspect, oh, 150, 200 feet when I heard what I thought was a rifle shot and I thought it came from—I was seated right, as you know, the jump seat right in front of the President, and they have a fairly straight back on them so I was sitting up fairly erect. I thought the shot came from back over my right shoulder, so I turned to see if I could catch a sight of the President out of the corner of my eye because I immediately had, frankly, had fear of an assassination because I thought it was a rifle shot.

I didn't think it was a blowout or explosion of any kind. I didn't see the President out of the corner of my eye, so I was in the process of, at least I was turning to look over my left shoulder into the back seat to see if I could see him. I never looked, I never made the full turn. About the time I turned back where I was facing more or less straight ahead, the way the car was moving, I was hit. I was knocked over, just doubled over by the force of the bullet. It went in my back and came out my chest about 2 inches below and the left of my right nipple. The force of the bullet drove my body over almost double and when I looked, immediately I could see I was just drenched with blood. So, I knew I had been badly hit and I more or less straightened up. At about this time, Nelly reached over and pulled me down into her lap.

I was in her lap facing forward when another shot was fired. I only heard two shots. I did not hear the shot that hit me. I wasn't conscious of it. I am sure I heard it, but I was not conscious of it at all. I heard another shot. I heard it hit. It hit with a very pronounced impact, just [slap of hands] almost like that. Almost that loud a sound; it made a very, very strong sound.

Immediately, I could see blood and brain tissue all over the interior of the car and all over our clothes. We were both covered with brain tissue, and there were pieces of brain tissue as big as your little finger. It was something that was unmistakable. There was no question in my mind about what it was.

About this moment in time, Roy Kellerman, who was the Secret Service agent sitting in the right-front seat, pushed, apparently was pushing some buttons on the panel, doing what, I don't know. I heard him say, "Let's get out of here fast," and the car lurched forward then. Bill Greer was the driver. He accelerated it tremendously.

When I was hit, or shortly before I was hit—no, I guess it was after I was hit—I said first, just almost in despair, I said, "no, no, no," just thinking how tragic it was that we had gone through this 24 hours, it had all been so wonderful and so beautifully executed.

The President had been so marvelously received and then here, at the last moment, this great tragedy. I just said, "no, no, no, no." Then I said right after I was hit, I said, "My God, they are going to kill us all."

The shots came, in my judgment, the two shots I heard came from the same direction, back over my right shoulder, came from behind us. Very clear to me where they came from. I don't think any shots came from any other direction. I was conscious until we hit the Stemmons Freeway and then I faded into unconsciousness.

I revived when the car came to a stop at what was Parkland Hospital. Apparently, the braking of the car—we must have been traveling at an enormous rate of speed—the braking of the car brought me back to consciousness and you know it is strange what thoughts run through your mind.

The first thought that occurred to me was that I was in the jump seat, that the right door of the car was opposite my seat and that they couldn't reach the President. Well, I got out of the way and that is when I tried to raise myself up out of Nelly's lap and actually tried to get out of the car myself, so that they could get to him in the back seat.

I knew he was hit. I knew their first concern would be for the President. So, that was the reason why I lurched up, or tried to get up out of a reclining position. Of course, I couldn't. I wasn't able to. I got halfway up and just slumped again, as Nelly just told you.

Then, someone did pick me up and put me on a stretcher and took me into an emergency room or trauma room, whatever it was. I obviously didn't know what it was. At that point, I felt the first pain, really, that I had experienced and when I was on the stretcher, I was laid out. Then, there was excruciating pain in my chest. At the time I was hit, strangely enough, I felt no sharp pain. It was as if someone had come up behind me with a doubled up fist and just hit me in the back right between the shoulder blades. It was that kind of a sensation.

I would have to volunteer the very, very strong opinion, I know much has been written, much has been discussed, I was being a participant, I can only give you my impressions, but I must say to you, as I said to the Warren Commission, I do not believe, nor will I ever believe, that I was hit with the first bullet. I don't believe that. I heard the shot, I heard the first shot. I reacted to the first shot and I was not hit with that bullet. Now, there's a great deal of speculation that the President and I were hit with the same bullet, that might well be, but it surely wasn't the first bullet and Nelly doesn't think it's the second bullet. I don't know, I didn't hear the second bullet. I felt the second bullet. We obviously weren't hit by

the third bullet. I was down reclining in her lap at the time the third bullet hit.

Mr. CORNWELL. I am sorry, I didn't understand one statement. You said Mrs. Connally doesn't agree it was the second bullet or the same bullet?

Mr. CONNALLY. The second bullet.

Mrs. CONNALLY. That what?

Mr. CONNALLY. That hit me. That hit him and me—

Mrs. CONNALLY. No; I heard three shots, I had three reactions, three separate reactions. The first shot, then I looked and saw the President, the second shot, John, and third, all this matter all over us.

Mr. CORNWELL. So you agree that your recollection is it was the second shot that hit the Governor?

Mrs. CONNALLY. I know it was the second shot that hit the Governor.

Mr. CORNWELL. And, where you disagree is as to the possibility or the question of whether or not it was the same bullet that hit, is that accurate, in other words, the Governor has no knowledge on that subject matter, would that be accurate, since you didn't turn around to see the President, after the first noise, you don't know whether he was hit and Mrs. Connally's recollection is that she did turn and saw him hold his throat before you were hit, is that accurate?

Mrs. CONNALLY. I did.

Mr. CONNALLY. That is correct. I never saw him. I never saw Mrs. Kennedy after the shots were fired. I never saw either one of them, and I don't know when he was hit.

Mr. CORNWELL. And you have testified that of the two shots that you have a memory of hearing, they both, your immediate impression was they came from the right rear?

Mr. CONNALLY. That is correct.

Mr. CORNWELL. And I don't believe we heard what Mrs. Connally's recollection is on that. What was your impression as to the direction from which the three shots you heard came?

Mrs. CONNALLY. All from the right rear.

Mr. CORNWELL. Mr. Chairman, I have no further questions at this time.

Chairman STOKES. At this time, the Chair will recognize the gentleman from Ohio, Mr. Devine, for extensive questioning, after which the committee will go under the 5 minute rule for other members of the committee who have questions of the witnesses.

Mr. Devine.

Mr. DEVINE. Thank you, Mr. Chairman.

Governor and Mrs. Connally, I know this is very difficult for you to have to relive this situation again and again. I know that you, Governor, testified before the Warren Commission and I am not sure whether you did also.

[Mrs. Connally nods affirmatively.]

Mr. DEVINE. We appreciate the fact that we are trying to refresh your recollection on something that happened nearly 15 years ago, although it appears to be quite vivid in your mind, and the responsibility of this committee, as you know, on the mandate from the House is to see whether or not there are any unturned stones or



any evidence that has not been presented to the Warren Commission or that any different conclusions may result from the testimony of persons on the scene.

Relating specifically to your testimony, Mrs. Connally, you heard one shot and you turned to your right and witnessed the President grasping his throat with both hands. Was anything said by anyone at that time?

Mrs. CONNALLY. Nothing.

Mr. DEVINE. Then what is the next sound you heard? You were still looking back at the President. Did you hear another sound?

Mrs. CONNALLY. I heard the second shot; yes.

Mr. DEVINE. The second shot. Were you looking back at that time or were you looking forward again?

Mrs. CONNALLY. I don't know.

Mr. DEVINE. You don't recall.

That second shot is the one that you said hit your husband?

Mrs. CONNALLY. I was horror stricken when I looked back, and I may have still been just looking.

Mr. DEVINE. But at that time you heard the second shot?

Mrs. CONNALLY. A difficult thing to believe.

Mr. DEVINE. The second shot that you heard is the one that you believe hit Governor Connally?

Mrs. CONNALLY. I know it hit Governor Connally.

Mr. DEVINE. And then after you knew that he was hit, and you pulled him over in your lap, you then heard the third shot?

Mrs. CONNALLY. Yes.

Mr. DEVINE. And again from over your right shoulder?

Mrs. CONNALLY. Yes.

Mr. DEVINE. Did you look back at that time?

Mrs. CONNALLY. I never looked back after John was hit.

Mr. DEVINE. Have you had any experience at all with fire arms—

Mrs. CONNALLY. Yes.

Mr. DEVINE [continuing]. Over the years?

Mrs. CONNALLY. Yes.

Mr. DEVINE. Would you say in your judgement that shot you heard, or the shots that you hear, were from a rifle or hand gun?

Mrs. CONNALLY. Oh, no, I am not that much of an—

Mr. DEVINE. You don't know?

Mrs. CONNALLY. And, I'm not expert at all—

Mr. DEVINE. All right.

Mrs. CONNALLY [continuing]. In shooting.

Mr. DEVINE. Governor, I think you testified that you heard but two shots and that you don't think that you heard the shot that struck you; is that accurate?

Mr. CONNALLY. That is correct.

Mr. DEVINE. Both of these came from over your right shoulder?

Mr. CONNALLY. Yes, sir, from behind me and over my—back behind me over my right shoulder, that is correct.

Mr. DEVINE. The first shot that you hear which caused you to look to your right, I think you said you didn't get far enough around to see the President, is that accurate?

Mr. CONNALLY. That is correct.

Mr. DEVINE. Did you recognize any of the sound as being a rifle shot or hand gun shot?

Mr. CONNALLY. I thought it was a rifle shot.

Mr. DEVINE. Then you turned around and started to turn back around to look over your left shoulder to see what?

Mr. CONNALLY. To see if the President was all right, because immediately the thought flashed through my mind that if this was a rifle shot, which I believed it to be, that it was probably an assassination attempt and I was trying to see if anything had happened in the automobile.

Mr. DEVINE. Is that the time that you exclaimed, no, no, or was it later?

Mr. CONNALLY. No, it was a bit later, because I wasn't sure at that point in time that anything had happened, so it was a bit later when I said oh, no, no, no. This was after I realized I had been hit and, then I said my God, they are going to kill us all.

Mr. DEVINE. As you turned from looking over your right shoulder, you are about facing forward, in the process of turning to look over your left shoulder, when you were hit?

Mr. CONNALLY. Yes, sir.

Mr. DEVINE. But you heard no shot?

Mr. CONNALLY. No, sir, I did not.

Mr. DEVINE. That caused you to pitch forward?

Mr. CONNALLY. Yes, sir.

Mr. DEVINE. And you said you saw a great deal of blood?

Mr. CONNALLY. Yes, sir.

Mr. DEVINE. Were you aware at that time that you were hit in the hand and leg also?

Mr. CONNALLY. No, sir, I was not.

Mr. DEVINE. When did you first become aware of that, in the emergency room or elsewhere?

Mr. CONNALLY. No, I became aware of that when I regained consciousness on Sunday, I guess. On Sunday morning I woke up and regained consciousness to see my arm tied up in a sling and leg bandaged and I said what happened to my arm, and that is when I first learned that the bullet had gone through my chest and through my wrist and had broken all the bones in my wrist.

Mr. DEVINE. Reflecting back, do you have an opinion that you would have been able to physically remove your body from your position on the jumpseat to a different position in the limousine during the time lapse between the first sound and the impact that hit you?

Mr. CONNALLY. I am sorry, Congressman, do you mind—

Mr. DEVINE. To put it this way, I think either you or Ms. Connally said that the jumpseats were so close to the back of the front seat that there was no way that you could have slumped to the floor?

Mr. CONNALLY. Right.

Mr. DEVINE. And that the only position you could have ultimately moved into was to be over on Mrs. Connally's lap, is that accurate?

Mr. CONNALLY. I think that is a correct statement.

Mr. DEVINE. I believe you testified in response to Mr. Cornwell that you heard only two shots, they came from behind, there was not any from any other direction, is that accurate?

Mr. CONNALLY. That is correct.

Mr. DEVINE. Mrs. Connally, would you also make the same statement?

Mrs. CONNALLY. Except that I heard all three.

Mr. DEVINE. Is it possible that there could have been more than three shots, as far as you recollection is concerned?

Mrs. CONNALLY. I guess anything is possible, but I heard three shots.

Mr. DEVINE. You heard three definitely, no less, and probably no more, is that right?

Mrs. CONNALLY. That is all I heard.

Mr. DEVINE. Governor Connally, you said you heard two shots?

Mr. CONNALLY. That is right.

Mr. DEVINE. The one that hit you you apparently did not hear?

Mr. CONNALLY. That is correct.

Mr. DEVINE. I would take it then by negative implication that you heard no shots coming from your right front?

Mr. CONNALLY. No, sir, I did not.

Mr. DEVINE. In the area that has often been described as the grassy knoll?

Mr. CONNALLY. No, sir. And I don't believe any came from there.

Mrs. CONNALLY. We responded to all these shots, so if something came from the front we certainly would have responded to it, a noise from the front, I would think.

Mr. DEVINE. All right, getting back prior to the time of the actual shooting, I think you indicated earlier, Governor, that you had been in, or your people had been in, somewhat of a dispute with Mr. Bruno and others relative to even having a motorcade?

Mr. CONNALLY. Yes, sir. May I, Congressman Devine, at that point ask that the record be corrected. In testifying here you reach for times and events and names and unfortunately I have confused the situation, I suspect, to the bewilderment of one and the embarrassment of the other, and I said Mr. Hal Bruno. Mr. Hal Bruno is with Newsweek and now I understand with ABC, and it wasn't Hal Bruno at all, it was Jerry Bruno, who came down as advance man for President Kennedy, so I would hope the record would be clarified and corrected, because earlier I testified in response to Mr. Cornwell that Mr. Hal Bruno did so and so, it was not Mr. Hal Bruno, it was Mr. Jerry Bruno.

Mr. DEVINE. Fine. I am sure the record will be so corrected.

Governor, I think you testified earlier that you thought perhaps it would be well to avoid the motorcade because of the very trying day that the President was going through, the number of appearances he had to make, the number of speeches he had to make, and the pressures. Did you have any reason to believe that there might have been some incident on a motorcade route?

Mr. CONNALLY. None at all, Congressman Devine.

Mr. DEVINE. You had no prior information that would suggest that there may have been problems?

Mr. CONNALLY. None at all.

Mr. DEVINE. I think there was some testimony that there were, I don't think they used the word kooks, but some extremist that might display signs or make remarks that might be embarrassing to the President.

Mr. CONNALLY. When I said not at all, I was speaking in terms I had no indication, no knowledge, no reason to suspect that there would be any acts of violence. I assumed from the very beginning when the President came that somewhere along the route, San Antonio, Houston, Fort Worth, Dallas, Austin, somewhere that there might be pickets, there might be some embarrassing signs or something of that kind. Yes; I did assume we would encounter that and frankly we encountered only one that I remember, and that is far less than I anticipated.

Mr. DEVINE. I suppose you were also, at least in the back of your mind, aware of the incidents that had occurred to Ambassador Stevenson as well as General Walker?

Mr. CONNALLY. Yes, sir.

Mr. DEVINE. And these were matters of concern to you, but you still had no anticipation that anything of violence might occur, is that correct?

Mr. CONNALLY. No, sir, and my objection to the motorcade really was not based on any apprehension of violence, Congressman Devine, it was as I have testified earlier, in order to try to save the President the wear and tear of a motorcade and to basically conserve time.

Mr. DEVINE. At any juncture during the planning and scheduling did you specifically discuss with the Secret Service what possible harm might come to the President, and, if so, from what source? Either you or your people?

Mr. CONNALLY. Congressman, I don't think so. Some of our people might have raised that point with the Secret Service but I doubt it, because in none of our discussions or planning sessions did we dwell on that subject or make any point of it. It really was not a matter that we were fearful of, frankly.

Mr. DEVINE. But if you had had your way there would have been no motorcade through the downtown area, you would have gone directly to the—

Mr. CONNALLY. Trade Mart.

Mr. DEVINE. Trade Mart, right.

Mr. CONNALLY. Yes. As a matter of fact, it was quite a point of dispute, as I say, and we never did agree to it, and finally they not only said we are going to have a motorcade but we are going to publish the route of it, and I said, well, that is crazy, I said, because here again I was thinking only in terms of pickets or embarrassing signs or things of that sort, but indeed they did, they ran a map of the parade route 3 or 4 days, I think it was Tuesday before the Friday, in the Dallas papers. Full route of the motorcade.

Mr. DEVINE. Did the newspaper publish the exact route of the motorcade?

Mr. CONNALLY. I think it did. They might have altered the route a bit from that published map but I think it was a map, precise map of the motorcade.

Mr. DEVINE. That was published in sufficient time for someone with perhaps a sinister motive to have placed themselves in the book depository or elsewhere? Is that so?

Mr. CONNALLY. I think it was published on Tuesday and, of course, the event occurred on Friday, so they had that much time.

Mr. DEVINE. Mr. Cornwell has pretty well covered all other elements of the situation, Governor, and I again thank you for your cooperation, and you, Mrs. Connally, for being here.

Mr. CONNALLY. Thank you, Congressman.

Chairman STOKES. Time of the gentleman has expired. The Chair recognizes the gentleman from North Carolina, Mr. Preyer.

Mr. PREYER. Thank you, Mr. Chairman.

Governor Connally and Mrs. Connally, I know, as Mr. Devine said, that reliving this experience must be an emotional matter for you and all who have watched you cannot help but admire your courage in the way you have done that.

I don't know what the stories are that you refer to, Mrs. Connally, about your conduct after this, but anyone who heard you today certainly could have no questions about your courage and the character with which you faced this. I also think you brought back to us in a dramatic way the warmth and excitement of the Dallas reception, something that we have lost sight of through the years because of the way it ended in tragedy.

I only had one question following up what Mr. Devine asked, and it is along the line of what information and how early the information would have been known as to the President's route.

Lee Harvey Oswald went to work for the Dallas Book Depository on October 15, 1963. How soon after that, if you recall, Governor Connally, would he have known that the President was coming to Dallas?

Mr. CONNALLY. He could have known it before that time, I suspect. I believe the time of the publication of the Baskin story in the Dallas paper was September 26, when the story first appeared that November 21-22 had been chosen as the dates of the President's visit.

Mr. PREYER. So he would have known he was coming to Dallas perhaps even earlier than his employment date, but he would not have known the parade route until Tuesday?

Mr. CONNALLY. I don't think he could have, Congressman Preyer, because up until the very last, frankly, of that week, we were still arguing about it. We were still arguing, one, whether or not there would be a motorcade at all, two, if there was a motorcade, whether or not the route of the motorcade would be published. And frankly, those who were proponents of the motorcade and of the route wanted to get the maximum public exposure for the President, and that was the basic reason for the motorcade, but that issue was not settled until that week, the week of the visit, so I am sure he couldn't have known precisely prior to that time because I don't think anyone knew.

Mr. PREYER. Well, from your experience in Texas and national politics wasn't that the normal parade route through Dallas that was taken? Have you been involved in other parades?

Mr. CONNALLY. Yes, it is a normal and logical route to take, down Lemon to Turtle Creek. You can go down either Main or

Commerce depending on what your ultimate destination was. But since we were going to the Trade Mart, it was a logical way to go, although we could have chosen one of the other streets that runs parallel to Main and Commerce just as well, but probably we saw more people on the streets that we traveled.

Mr. PREYER. Thank you once again for your testimony.

Mr. CONNALLY. Thank you, Congressman Preyer.

Chairman STOKES. Time of the gentleman has expired. The Chair recognizes the gentleman from the District of Columbia, Mr. Fauntroy.

Mr. FAUNTROY. Thank you, Mr. Chairman, and thank you also, Governor and Mrs. Connally. We do appreciate you recalling the events in Dallas with such great detail.

I simply have a couple of questions dealing with the timing of the publication of the trip: Who knew what and when. I wonder, Governor Connally, can you tell us who could have been aware of your talks with the President on June 5 in El Paso?

Mr. CONNALLY. Well, namely, I would say there were only four of us, maybe five. The President, the Vice President, was there as I recall, well, I am sure Kenny O'Donnell was there, I was there. After that time, I am sure they talked about it, the White House, I am sure the Vice President talked to members of his staff about it. I certainly went home and talked to various members of my staff and the State Democratic Party machinery, because we were at that point in effect committed to a Presidential visit some time that fall, but the details certainly were not known then.

Mr. FAUNTROY. Do you recall whether you released publicity at that time about the President's desire to come to Texas?

Mr. CONNALLY. I don't believe there was any but I could be wrong about that, I don't recall any.

Mr. FAUNTROY. You set no tentative schedule at that time?

Mr. CONNALLY. No.

Mr. FAUNTROY. Was there any information at that time that a motorcade would or would not be used?

Mr. CONNALLY. No, I don't think so, Congressman; no.

Mr. FAUNTROY. Was Dallas listed as one of the cities that might be visited?

Mr. CONNALLY. I think from the very outset, from the time of the first announcement, which I don't think occurred that early, I think Dallas was listed as one of the cities; yes, as probably one of the cities that would be visited.

Mr. FAUNTROY. You had a visit to the White House on October 4?

Mr. CONNALLY. Yes, sir.

Mr. FAUNTROY. Do you recall now how much information had been disclosed to the public by that time?

Mr. CONNALLY. I think very little because it hadn't jelled really at that point, the details had not been worked out at that point.

Mr. FAUNTROY. On October 3 you met with members of the Texas delegation to the Congress here—and, do you recall what details about the Presidential visit were discussed with them?

Mr. CONNALLY. No, I don't, but I suspect no details other than the fact that there probably was going to be a Presidential visit, because when I went in on October 4, really the President was still

talking about the four or five fundraising dinners and we really had not made the ultimate decision about the visit.

Mr. FAUNTROY. Mr. Chairman, I want to thank the gentleman and Mrs. Connally, and I will yield back the balance of my time at this time.

Chairman STOKES. Time of the gentleman has expired.

The Chair recognizes the gentleman from Connecticut, Mr. McKinney.

Mr. MCKINNEY. Governor, nice to see you again. I want to thank both you and Mrs. Connally for coming and helping us.

When was the final decision made or when did you finally get your way that the speech would be made at the Trade Mart instead of the Women's Building?

Mr. CONNALLY. I don't remember, Congressman, the precise date, but I would guess it was a couple of weeks before the visit.

Mr. MCKINNEY. Basically, that was a decision on your part so that the President could appeal to the conservative faction of the party in Texas?

Mr. CONNALLY. Yes, well basically, the Women's Building is in the fairground part of the city. The Trade Mart at that time was a new, exciting building, out on the Stemmons Freeway, it is a magnificent facility, it is a beautiful facility. I thought it was the type of thing that particularly reflected the flare and the style of both President and Mrs. Kennedy. It was a new building, it is a tremendous thing with an enormous vaulted ceiling.

The Secret Service had some doubts about it because it had balconies around, but we filled all those balconies with tables. And it was just a better facility, better parking, easier to get to for everyone, because you get to it off the Stemmons Freeway, and I thought it just frankly was a much better facility in order to accommodate the crowd that we wanted to have, 1,800, 2,000 people there, to hear the President.

I didn't know at the time there was a big argument about whether we go to the Women's Building or the Trade Mart. I didn't go to either of them at the time. Most of these arguments arose at the staff level and those that they couldn't settle I would finally hear about and get a hold of and sometimes I would just make a decision we are going to do thus and so and sometimes I would call somebody at the White House and get it worked out, but this went on constantly.

Mr. MCKINNEY. In any event, at either building, the motorcade would have had to go through some part of Dealey Plaza?

Mr. CONNALLY. Well, in any event the motorcade certainly would have gone through downtown. It would not necessarily have had to go through Dealey Plaza, no, sir. If the Women's Building had been chosen, it could have gone another route, and probably would have gone another route.

Mr. MCKINNEY. I see. If you had gone through Dealey Plaza to the Women's Building, Mrs. Kennedy would have been literally in the line of fire, rather than the President. Is that correct?

Mr. CONNALLY. Yes, if you had gone by the school book depository, that is correct.

Mr. MCKINNEY. Thank you very much.

Chairman STOKES. Time of the gentleman has expired.

The Chair recognizes the gentleman from Connecticut, Mr. Dodd.  
Mr. DODD. Thank you, Mr. Chairman.

Governor and Mrs. Connally, to repeat what my colleagues have said, we do appreciate your being here this morning, particularly in recounting what must have been one of the most agonizing if not the most agonizing moments of your lives.

I would like to just go back over, if I could, those seconds at the time that the shots rang out. Let me try and repeat what I understood to be your testimony, you correct me if I am wrong anywhere in terms of my understanding of the sequence of events as they occurred.

First, you, Mrs. Connally, because there is a bit of a difference as I heard both of your responses.

You heard a shot, what appeared or sounded like a shot, a sharp noise, to you? You turned to your left or your right?

Mrs. CONNALLY. My right.

Mr. DODD. You turned to your right. As you turned around and saw the President, you saw him clutching his throat?

Mrs. CONNALLY. I saw him reach up to his throat.

Mr. DODD. Both hands were on his throat?

Mrs. CONNALLY. Yes, sir.

Mr. DODD. Did you see any blood at all?

Mrs. CONNALLY. No.

Mr. DODD. Then did you turn back or did you hear the second shot?

Mrs. CONNALLY. See, I don't know, I don't know.

Mr. DODD. You don't know which you did first?

Mrs. CONNALLY. What do you mean?

Mr. DODD. Well, you saw him clutch.

Mrs. CONNALLY. I looked back and I guess I just stayed looking back until I heard the second shot.

Mr. DODD. So, you are still looking at the President and it is your recollection that you then heard what sounded like a second shot?

Mrs. CONNALLY. Yes.

Mr. DODD. Is that correct?

Mrs. CONNALLY. Yes. What was a second shot.

Mr. DODD. At that point your husband, Governor Connally, slumped over in your direction?

Mrs. CONNALLY. No, he lunged forward and then just kind of collapsed

Mr. DODD. And, then collapsed.

Mrs. CONNALLY. But not just straight up.

Mr. DODD. And then you heard a third shot or what appeared to be a third shot?

Mrs. CONNALLY. After I pulled him down.

Mr. DODD. You did hear—

Mrs. CONNALLY. I did hear a third shot.

Mr. DODD. At that point you then noticed the material?

Mrs. CONNALLY. All over.

Mr. DODD. The blood and so forth?

Mrs. CONNALLY. Yes.

Mr. DODD. When you turned and saw the President holding his throat, as I understood your testimony, the President didn't utter any sound or any word at all, to your recollection?



Mrs. CONNALLY. Nothing.

Mr. DODD. Now, Governor, as I understood it from what your testimony was, you heard what sounded like a shot?

Mr. CONNALLY. That is correct.

Mr. DODD. And you turned to your right?

Mr. CONNALLY. Right.

Mr. DODD. But you did not see the President when you turned around?

Mr. CONNALLY. That is correct, I didn't turn all the way around, I was sitting, basically facing forward. I heard the shot, I looked over my right shoulder, I did not see the President out of the corner of my eye, and I mentally said I will turn to my left and see if I can see him, and I never made that full turn, I got halfway back facing forward when I was hit.

Mr. DODD. And did I understand your testimony correctly when you stated that you didn't actually hear a second shot but rather you felt the impact as if someone had punched you almost in the back, a sharp blow to your back?

Mr. CONNALLY. That is absolutely correct.

Mr. DODD. But you did not hear that?

Mr. CONNALLY. I was not conscious of hearing the second shot.

Mr. DODD. Did you hear what could have been a second or a third shot? That was the only shot you heard, was the one that caused you to turn to your right?

Mr. CONNALLY. No, I heard another shot which was the shot that was fired after Nellie had pulled me down into her lap. It was the second shot I heard, the third shot she heard.

The second shot I heard was the one that hit the President in the head.

Mr. DODD. OK. You did not immediately go unconscious?

Mr. CONNALLY. No, I did not. I knew exactly what was happening in the car and I didn't testify to a moment ago but I should because I remember precisely what my wife remembers. I heard Mrs. Kennedy say "they have killed my husband," and then she said, in just an incredulous voice, "I have got his brains in my hand." I heard that. I was still conscious. I heard Roy Kellerman say to Bill Green, the driver, and perhaps to others, get out of here fast. Those things, that is all that was said in that car.

Mr. DODD. Recognizing, of course, we are now asking you to recall something that occurred this many years ago, but if I could ask you to quantify in a frame of time, how long a period would it have been between the time you heard that first noise, that sounded to you as if it were a shot, you turned right, and the period in which you felt the impact in your back?

Mr. CONNALLY. Congressman, you know, I think it is impossible for me to say with precision, but obviously a very short period of time, a matter of seconds, because it was, you know, I think undoubtedly a fairly fluid movement. I heard the shot, I reacted by looking, I saw nothing, and I was in the process of turning when I felt the impact. I guess 6, 8, or 10 seconds, in that range, but I certainly couldn't be more precise than that, but it wasn't long.

Mr. DODD. Could it have been a second? What you are telling me it is more like 2, 3, 4 seconds. It wasn't something that happened almost instantaneously?

Mr. CONNALLY. No, it was not. It could not have been 1 second.

Mr. DODD. Thank you both.

Mr. Chairman, I have no further questions.

Chairman STOKES. Time of the gentleman has expired.

The Chair recognizes the gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman. Governor and Mrs. Connally, welcome; under the circumstances, we deeply appreciate your help.

Governor, the two shots you heard, did they sound exactly alike, as nearly as you can remember?

Mr. CONNALLY. Did they sound exactly—

Mr. FITHIAN. Exactly alike?

Mr. CONNALLY. Yes. I found, I remember no distinction, Congressman Fithian, between the two shots.

Mr. FITHIAN. And the shot that struck you, just in that split second, before you heard that or felt that impact, did you hear any other impact like the third shot made? Was there any sound in the split second before impact somewhere else before it hit you?

Mr. CONNALLY. No.

Mr. FITHIAN. Now, if I understand your summary, Mrs. Connally, the first shot would have come through the President's throat, and that was, you said—

Mrs. CONNALLY. I assumed when I saw him.

Mr. FITHIAN. And it was the second shot that hit the Governor?

Mrs. CONNALLY. Yes.

Mr. FITHIAN. And it wasn't until after the third shot that you saw the brain matter, and so forth?

Mrs. CONNALLY. Instantly, the shot, the car was covered, it was like buckshot falling all over us.

Mr. FITHIAN. So your clear recollection is that you can account for something happening with each of the three shots that you heard fired?

Mrs. CONNALLY. Yes, sir.

Mr. FITHIAN. Governor, you testified earlier, I believe, that you thought that both shots fired were rifle shots. You feel that you are able to distinguish between a rifle and pistol shot?

Mr. CONNALLY. I guess you could simulate circumstances under which I would probably fail the test, Congressman, but I think I can distinguish the difference. At least at that point in time I thought it was a rifle shot to me, and I haven't in all the intervening years, have not run any tests, I have not listened to any tests, but to me a pistol shot has a flatter, louder kind of a bang type of sound to it. A rifle shot has a rather singing crack to it. It is more like a crack and then you get a kind of singing sound with a rifle shot, and it is an entirely different sound from a pistol, from a shotgun, from a rifle.

Mr. FITHIAN. One last question, Mr. Chairman. When you heard any of the two shots that you heard, Governor, or any of the three that you heard, Mrs. Connally, was there any echo; did you hear any echo from the building, or was there any sort of a sound effect along with it?

Mrs. CONNALLY. No.

Mr. CONNALLY. Congressman, I wasn't conscious of any echoes. I am sure there probably were some but I certainly was not aware of them.

Mr. FITHIAN. What you heard was a very clear distinct shot, period; that is your recollection?

Mr. CONNALLY. Yes, sir, absolutely.

Mr. FITHIAN. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Governor and Mrs. Connally I recognize that you probably don't view yourselves as a ballistics expert, by any means, but I assume you have done some hunting and you are familiar with firearms, from the way you talk?

Mr. CONNALLY. Yes, I have done a great deal.

Mr. SAWYER. So we are not talking to someone totally inexperienced when we are talking about whether or not you can identify a rifle shot?

Mr. CONNALLY. No, sir, I have shot a rifle all my life and have done a great deal of hunting.

Mr. SAWYER. I suppose, too, that—I have just been thinking since I heard your testimony and I am sure you have thought about it, many, many more times, and without either being a medical expert or a ballistic expert, I presume it is reasonable to assume that with a Mannlicher/Carcano traveling at least twice the speed of sound, the projectile must be 2,200 feet per second, or more, I assume, that the bullet would reach you before the sound would reach you, and with that kind of an impact on your nervous system, whether conscious or not, you probably wouldn't have registered the sound, if there was one, of the bullet that hit you?

Mrs. CONNALLY. I think that is precisely what happened, Congressman, no question about it. That is why I don't think there is anyway the first bullet hit me. I heard that sound. And I had not been hit, I heard the first rifle shot, and I did not hear, was not conscious of the shot that hit me, and obviously the bullet reached me before the sound did. So the shock of the hit that I took, I was just totally unconscious of the sound, yet by the third shot, when Mrs. Connally pulled me down in her lap, I was awake, my eyes were open, I heard the shot fired, I heard it hit, and I saw the results, very clearly and you know—you have a lot of expert testimony, and I am delighted with the work of this committee, because hopefully we can clear up some of the speculation and the questions that have been asked over the years, but let me assure you that we may be wrong in what we say, we may be wrong in our impression, we may be wrong when asked precise questions about time, whether it is 2 seconds or 10 seconds under those circumstances I can't say with certainty the precise second that things happen, but the things that we do remember, and the things that we are testifying to here today, Congressman, are as indelibly etched in our minds as anything could ever be, and I will merely ask you to give yourselves the test, ask any adult person, over the age of 30, in this country, or over the age of 35 we will say, where they were when they first heard the news of the assassination. They can tell you where they were, what they were doing, and who they were with. I have not asked one human being in the world,

not anywhere in the world, that hasn't been able to tell me where they were, what they were doing, and who they were with at the time they first heard the news.

The only point I am making is that there are certain impacts on human consciousness, on the human mind, that are indelibly etched there, now, and these things are engraved in our minds, beyond any doubt.

I can't, I am not going to argue with a ballistic expert or acoustics expert about the precise time or the frame of the Zapruder films, I can't tell you precisely whether it is frame 231 or 234, when the first evidence shows that I am reacting to the shot, but what we are saying to you, the things that we say to you with certain definiteness, it is because we are absolutely sure, at least in our own minds, that that is what happened and that is what we remember.

Mr. SAWYER. I want to join the rest of my colleagues in expressing our appreciation to you, Governor and Mrs. Connally, for coming up, and I want to compliment you on the obvious frankness touched with a little humor, as best you can in this kind of situation, and your warmth coming across, I appreciate it very much. It kind of gave me a perspective on this that somebody there can only give. You got across as good a communication of it, at least to me, as I have heard.

Chairman STOKES. Mr. Edgar.

Mr. EDGAR. Thank you, Governor and Mrs. Connally. I, too, want to welcome you here and to compliment you on your frankness in sharing your firsthand knowledge of this tragic event.

I just have two lines of questioning, which will be very brief. I noted in the schedule that on November 21 there was a motorcade through Houston; is that correct?

Mr. CONNALLY. Well, there was a motorcade; yes, in a sense. We went from the airport, Havre Airport, where the plane landed, down the Gulf Freeway to downtown Houston and we had, as I say, we rather planned it this way because it was a way to automatically assure yourself of a crowd.

Mr. EDGAR. Were the crowds similar in Houston as they were in Dallas?

Mr. CONNALLY. No; they were not because it was not the same type of event. We didn't plan a motorcade of that type. What occurred in Houston was we were going against the grain of the traffic, the Gulf Freeway was four lanes wide bumper to bumper leaving Houston going out past Havre Airport. We were going into town so there were literally thousands of cars on the freeway and all the traffic just stopped when they saw the motorcade, they knew who it was, they knew the President was coming.

So people were standing on their fenders, if they had fenders, if not, they opened the door, stood inside the car, they were in the pickups, shouting and waving and that sort of thing. There was not the mass number of people that we saw at either San Antonio or Dallas.

Mr. EDGAR. And the speed of the motorcade was different?

Mr. CONNALLY. Was entirely different. I would say in Houston we were traveling at least probably 50 miles an hour.

Mr. EDGAR. The motorcade in Dallas on the 22d was for a slightly different purpose, it was not just to arouse the crowds but was in fact to be worked by the President in a slow moving motorcade?

Mr. CONNALLY. That is correct.

Mr. EDGAR. Were the automobiles in both motorcades identical?

Mr. CONNALLY. I think so. I think the President's car was flown from one place to another. I think we were riding in the same car.

Mr. EDGAR. Do you know if the President's car was equipped with any kind of facility to have visual sighting of the President even with the top down?

Mr. CONNALLY. Yes; I think we had a bubble top but it was never used.

Mr. EDGAR. Do you know whose decision it was not to use the bubble top?

Mr. CONNALLY. No, sir.

Mr. EDGAR. And the bubble top was not used in Houston either?

Mr. CONNALLY. No, sir.

Mr. EDGAR. Were there any different security procedures that you know of for the Dallas motorcade?

Mr. CONNALLY. I don't think so, Congressman. If there were any there were probably more people involved simply because of the nature of the visit to Dallas, we were going to have the motorcade, it was going to be a motorcade where we were traveling at 25 miles an hour, as opposed to 50 miles an hour on the Gulf Freeway in Houston, for instance, so I think there were a great many more security people involved up and down the parade route in Dallas than there were in Houston.

That was a normal thing, I don't think it was unusual because of any anticipated difficulties.

Mr. EDGAR. But you were not approached by the Secret Service to do anything special?

Mr. CONNALLY. No, the Secret Service were working with department of public safety and the Dallas Police Department and I don't recall any real difficulties with respect to security.

Mr. EDGAR. Thank you. Just one final question.

I was wondering about the injuries that you have received, the shot through the right shoulder and the wrist injury and the leg injury, are they recurring problems for you at this time?

Mr. CONNALLY. No, sir. The shoulder injury, the back injury, was healed fairly well. The bullet split my right lung and as I recall, the doctor told me it was like it had been cut with a knife, they took out, I believe, the fifth and sixth ribs, but I learned something new, the ribs grew back, which I didn't realize they would do.

So the only thing I have had over the years, and that is my fault, not any medical problem, my right shoulder and arm have been a bit weaker than the left simply because I think I didn't do enough exercising with it after the injury to rebuild the muscles and at least one muscle was cut in the process by either the shot or the operation.

The wrist is fine. Dr. Gregory, when he set the wrist, told me that he thought it would not heal properly because he had no bone to tie to, and he would do his best, that we would probably have to rebreak the wrist and reset it after some of the bones healed because it broke every bone in the wrist, but after about 90 days,

when they finally took the cast off, the wrist had healed sufficiently to where we weren't about to break that wrist, and I have substantially all the use of it, the only thing I can't do is to turn my wrist over.

Mrs. CONNALLY. He can't take change but I can pick it up for him.

Mr. CONNALLY. It is strange, little things like that. This is where you recognize it. To take change I have to do this kind of thing, to flatten my hand, because normally you can hold your elbow on the table and flip your hand over. I can't do it. There is a stiffness in the wrist but there is no pain associated with it, no disability at all, and the leg has caused me no trouble. So I am in fine shape.

Mr. EDGAR. There is absolutely no doubt in your mind that all of the injuries that occurred to you occurred by one bullet passing through your body.?

Mr. CONNALLY. I think beyond any question it did. Congressman, probably I should add in response to your question that one of the reasons I may have had the wrist injury, I had a hat that day, and sometimes I had the hat on and sometimes I didn't, and when I didn't have it on I was holding the thing, and, of course, the President never wore one.

When I held it, I normally held it in pretty much this position. I held it in front of me and I suspect that one of two things happened, and I don't remember precisely, that I was either holding my hat, so that when that bullet came out of my chest right here and went right into my arm and down into my leg, or that is one explanation of why my wrist was broken, or in the process of turning perhaps I had put my right arm on my left leg to make it turn to my left, as I testified, I would not have done that to look over my right shoulder, it would have been the reverse type of movement, my right arm would have been to my right, looking over my right shoulder, but in the process of turning to look over my left shoulder, it is a logical thing to move your arm, and maybe I put it on my wrist, and maybe I had my hat in my hand, but in any event, the wrist happened to be right in front of the place where the bullet came out.

Mr. EDGAR. Thank you.

I have no further questions, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from the District of Columbia, Mr. FAUNTROY, for additional questions.

Mr. FAUNTROY. Yes sir, Mr. Chairman, thank you.

I just have one question on the firing. Governor, and Mrs. Connally, both of you are familiar with the single bullet theory, are you not? My question, Governor Connally, is, given Mrs. Connally's recollection that there were three shots: The first of which hit the President, the second of which hit you, and the third of which hit the President; I wonder if it is your impression that the first shot that you heard missed, or whether it is your impression that the first shot which you heard was the first shot which Mrs. Connally heard, which in her view caused the President to grab his throat?

Mr. CONNALLY. Do you want to answer that?

Mrs. CONNALLY. No.

Mr. CONNALLY. I will answer it. I don't know what the first shot did. All I know, all I am certain of in my own mind is that the first shot did not hit me. Now, according to Mrs. Connally's testimony, the first shot did hit the President and that is when she turned around and saw him grasp his throat.

Mrs. CONNALLY. And later, the doctors said that there was a bullet that went through the fleshy part of his neck, that would not have killed the President, had that been the only shot he took. So obviously that is why he was reaching up for his throat.

Mr. FAUNTROY. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired. The gentleman from Indiana.

Mr. FITHIAN. One quick followup question.

When you turned, Mrs. Connally, and saw the President, do you remember seeing the Governor, seeing where he was looking?

Mrs. CONNALLY. No; I heard the noise, I turned in the direction of the noise, and I observed the President and I was horrified.

Mr. FITHIAN. Thank you.

Chairman STOKES. The time of the gentleman has expired.

Mr. Cornwell, anything further?

Mr. CORNWELL. No, Mr. Chairman.

Chairman STOKES. Governor Connally and Mrs. Connally, under the rules of our committee, any witness appearing before our committee giving testimony is to be extended 5 minutes at the conclusion of their testimony, for the purpose of explaining or in any way amplifying or expanding upon their testimony before the committee. I wish to extend to both of you at this time 5 minutes in order to make any further comments that you so desire?

Mrs. CONNALLY. I have nothing.

Mr. CONNALLY. Mr. Chairman, let me, for both of us, express our gratitude to you, Chairman Stokes, and to all the members of the committee, to the staff of the committee, for what has been an obvious workman-like approach that staff has used in trying to develop all of the facts relating to this tragic event in the life of this Nation.

Unfortunately, I think for the peace of mind of a great many people, much speculation has arisen, many rumors have flowed, many theories have been advanced. This committee is going to be faced, I think, with the same task that the Warren Commission was faced with; namely, how do you prove a negative, how do you prove there was no conspiracy? I think that is the task that you have.

You have assembled a staff of obviously competent people with a determination to try to adduce all of the evidence that is available in the world, to properly analyze it and to properly present it, and to that extent I think the committee is undertaking a task which I am fearful will not answer all of the problems but, nevertheless, your report will undoubtedly shed a great deal of light on the tragedy that this Nation had and that this Nation will live with.

I wish I could believe that all of the speculation will end, that all the answers will be given, all the rumors dispelled, all the theories dissipated, but I don't believe that, and it won't be the fault of the staff nor the fault of this committee, I think it will be a mere result of circumstances that are incapable of proof.

But for your effort and for your time, for your obvious dedication, we are grateful because we have obviously been a part of this event and we will always be a part of it, and so the more that the American people can understand I think the better the Nation is.

I would make one other comment, Mr. Chairman, that is a gratuitous comment, that I hope is not inappropriate at this moment.

Part of your task is to analyze the effectiveness of the Secret Service, the FBI, the other police agencies in the furtherance of their duties with respect to this tragic occurrence. As Secretary of the Treasury, as you know, I had jurisdiction over the Secret Service. On many occasions, I talked to them about the problem of personal security of a President, of visiting dignitaries, and others. I happen to be of the view very much as your chief counsel, Mr. Blakey, said of President Kennedy, if there is a determined assassin, that beyond any question he can be successful. I don't think there is enough protection that any man in public life is going to surround himself with that will preclude a determined assassin from carrying out his mission.

I can only say to you that I think the Secret Service was determined and dedicated to protect the life of the President, and unfortunately they failed. Senator Kennedy had security but they were unable to cope with his assassin.

President Ford, if you will recall, also had security, a great amount of security, but they probably would have failed, too, if the young lady had known how to use a gun.

So, that finally, I am simply saying to you I don't know that any political figure in this country can be spared an assassin's bullet if indeed there is a dedicated assassin. So I would hope that the American people would understand that the mere fact that the Secret Service failed was not a failure of desire, not a failure of dedication, not a failure of talent, but rather a failure of an evitable circumstance.

Finally, again, let me express for Mrs. Connally and myself our appreciation for your kindness and for your courtesy and for the tremendous task that you have undertaken.

Chairman STOKES. Governor, if I can just say to both you and Mrs. Connally on behalf of this committee, and the House of Representatives, we are indeed grateful to you for having appeared here today. Both of you in a very articulate way have made a contribution to our work, for which we are indeed grateful, and we thank you for having been here.

Thank you very much.

Mrs. CONNALLY. Thank you, sir.

Chairman STOKES. Our hearing is now recessed until 2 p.m. this afternoon.

[Whereupon, at 12:30 p.m., the committee was recessed, to reconvene at 2 p.m., the afternoon of the same day.]

#### AFTERNOON SESSION

Chairman STOKES. The committee will come to order.  
The Chair, at this time, recognizes Professor Blakey.



**NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND  
STAFF DIRECTOR**

Mr. BLAKEY. Thank you, Mr. Chairman.

The Warren Commission, for the most part, conducted its investigation in executive sessions, just as this committee has. But unlike this committee is doing today, the Warren Commission did not hold extensive public hearings. It published an account of its findings and how they were arrived at in a report, with 26 volumes of backup material. The Commission then went out of existence, and it has remained officially silent since.

In the 14 years that have followed, the investigation of the Kennedy assassination has become the subject of literally thousands of works of critical commentary. No official response has been forthcoming, since the Commission was no longer in being.

For these reasons as much as any, the American public has found it difficult to credit the conclusions of the Commission. Indeed, the select committee probably owes its very existence to the process by which the critics raised issues by questioning the work of the Commission.

The critical community is composed of writers and researchers, who, for years, have been examining the Warren Commission's work, perceiving some important issues that either were not addressed or were resolved, in the researchers judgment, inadequately.

Some of the critics have acted reasonably and responsibly, motivated by an honest desire to find facts; others seem to have been impelled by a desire to capitalize on a sensational event, the murder of a President.

The select committee has attempted to derive maximum benefit from the work of all of the critics. In September 1977, several of them were invited to a conference in Washington to present to the committee their opinions of what issues should be addressed in the investigation. The committee profited greatly from their views.

Robert Groden, a photo-optical technician, has been one of the most active Kennedy assassination researchers. For the past 13 years, he has been analyzing the photographic evidence, and the results of his study played no small part in convincing many Members of the Congress that the Kennedy case should be reopened.

Since the committee was established, Mr. Groden has served as a consultant to it, advising the committee on issues raised by the photographic evidence.

Groden, 32, has given numerous lectures on his photo analyses, and his enhanced version of the Zapruder film, in part, witnessed this morning, has been widely shown publicly, including on ABC network. He is the author of "JFK: The Case for Conspiracy." He lives in New Jersey with his wife and two children.

Mr. Groden is in a unique position to present to the committee the state of the knowledge of the critical community prior to the work of the committee and to articulate for it and the American people the crucial issues raised by the critical community, particularly as they were rooted in the photos available of the assassination.

Mr. Chairman, it would be appropriate now to call Mr. Groden. Chairman STOKES. The committee now calls Mr. Groden.

Sir, will you stand and raise your right hand to be sworn.

Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

Mr. GRODEN. I do.

Chairman STOKES. Thank you. You may be seated.

### TESTIMONY OF ROBERT GRODEN

Chairman STOKES. The Chair recognizes Mr. Mickey Goldsmith, counsel for the committee.

Mr. GOLDSMITH. Mr. Groden, would you please state your name and occupation for the record?

Mr. GRODEN. Robert Groden, photo-optics technician.

Mr. GOLDSMITH. Mr. Groden, would you move the mike closer to you. Thank you.

Now, Mr. Groden, in your capacity as a consultant to this committee, what has been your major responsibility?

Mr. GRODEN. My major responsibility was to present to the committee those issues dealing with photographic evidence that it was felt could be scientifically addressed, perhaps improved upon as the knowledge of the critics has lasted through these years and perhaps give new information relating to those particular photographs and films.

Mr. GOLDSMITH. Mr. Groden, to what extent, if any, has the information you have been giving to this committee been limited to those issues that you personally thought to have merit?

Mr. GRODEN. No, all of the issues to which I felt there was merit, I was given freedom to address, but also, additional issues which, perhaps, were not of my belief but certainly were raised by credible critics as well.

Mr. GOLDSMITH. So basically, then, you saw your responsibilities as a consultant to advise the committee generally, and not just with regard to those issues with which you had worked; is that correct?

Mr. GRODEN. That's correct, sir.

Mr. GOLDSMITH. Have you had an opportunity to express your opinion about these issues to the committee?

Mr. GRODEN. Very freely, yes.

Mr. GOLDSMITH. In what way did you express these opinions, sir?

Mr. GRODEN. I have been invited down to address the scientific panels of the committee, the staff members, the committee itself on at least a dozen or more occasions.

Mr. GOLDSMITH. And specifically, have you had contact with the committee's photography panel and medical panel?

Mr. GRODEN. Yes, I have.

Mr. GOLDSMITH. During the course of your contact with these scientific panels and with the committee staff, have the opinions that you had previously concerning the issues raised by the photographic evidence changed in any manner?

Mr. GRODEN. In various issues, they have changed quite drastically and in others, they have remained unchanged through the entire course.

Mr. GOLDSMITH. Has the committee asked you to present today your opinions about the issues raised by the photographic evidence?

Mr. GRODEN. Yes, they have.

Mr. GOLDSMITH. It is my understanding, Mr. Groden, that the committee has invited you here today to testify about the issues in general without specifically referring to your own personal opinion; is that correct?

Mr. GRODEN. That is correct.

Mr. GOLDSMITH. So, to emphasize that point for purposes of clarification, you will be testifying about the issues generally as they existed prior to the formation of this committee?

Mr. GRODEN. That is true. Any change of opinion that I have will not be reflected at this time.

Mr. GOLDSMITH. Mr. Groden, what general types of issues raised by the photographic evidence have been presented to the committee's scientific panels?

Mr. GRODEN. Again, the issues that were presented by myself to the panels were those which I felt could be addressed scientifically that perhaps further enhancement or research or anything of that nature might be able to give us a broader view or a more realistic view other than the limited resources we had at the time.

Mr. GOLDSMITH. Have you had occasion to discuss with the committee questions concerning the number, timing, and direction of the shots fired at the President?

Mr. GRODEN. Yes, I have.

Mr. GOLDSMITH. Have you also discussed with the committee staff issues raised by the photographic evidence pertaining to crowd photographs?

Mr. GRODEN. I have, as well; yes.

Mr. GOLDSMITH. Have questions pertaining to authentication of photographs been raised with the committee's scientific panels?

Mr. GRODEN. It has been a primary issue, yes.

Mr. GOLDSMITH. Turning now to the first of these areas, specifically the number, timing, and direction of the shots fired at the President, would you please state for the record your knowledge as to the Warren Commission's conclusions concerning the number, timing and direction of the shots?

Mr. GRODEN. The Warren Commission conclusions reflected three shots being fired; the timing being somewhere between 4.8 and 7.9 seconds, depending on which of the three shots missed. They concluded that three were fired, only two hit. If the first and third hit, then the total time-span would have been approximately 5.6 seconds. If either the first or the third missed, then the time would be conceivably greater, as long as perhaps 7.9 or greater than that.

Mr. GOLDSMITH. Am I correct in summarizing your testimony to be that the Warren Commission's conclusion was that the timing range of the shots was between 4.8 and 7.9 seconds, depending upon which shot missed?

Mr. GRODEN. Yes, sir; that's true.

Mr. GOLDSMITH. Now, what technical basis did the Warren Commission have for being able to determine the timing of the shots?

Mr. GRODEN. They used the Zapruder film which we are going to see in a little while, as a clock. The film was tested and the camera

was tested, and it was found it ran at an average running speed of 18.3 frames per second. Assuming that all of the shots came from behind, as the Commission did, and using this as a clock, it was determined this was the most accurate way to reconstruct the assassination.

Mr. GOLDSMITH. Fine. Now, you have indicated that the Warren Commission was unable to determine exactly the timing sequence of the shots and that was because the Warren Commission was unable to conclude which shot actually missed. In the Zapruder film itself, what is the time that elapses from the moment the President is first showing a reaction until the head shot?

Mr. GRODEN. The first noticeable reaction on the film occurs at the first frame where he reappears from behind the road sign which is Zapruder frame number 225. The head shot occurs at 313. The difference between the two frames would give the time-span of which the Warren Commission claimed it happened, which would be, indeed, 5.6 seconds.

Mr. GOLDSMITH. It is on that basis that the Warren Commission said that if either the first shot or the third shot missed, you would add approximately 2.3 seconds to the overall range; is that correct?

Mr. GRODEN. This is correct, because the mechanical minimum operating time for the rifle alleged to be used during the assassination was an absolute minimum of 2.3 seconds to fire a shot, cycle the rifle, that is pull back the bolt, automatically reinserting another bullet, closing the bolt and pulling the trigger again, without taking aim or anything else, the minimum firing time of 2.3 seconds, that's how they arrived at that figure.

Mr. GOLDSMITH. Fine. Now, Mr. Groden, what wounds, to your knowledge, did the Warren Commission attribute to the two bullets that hit the occupants of the limousine?

Mr. GRODEN. The second of the two bullets, which it was felt hit occupants of the limousine, was, of course, the fatal moment when the President's head explodes. The earlier shot striking anyone in the car, according to the Commission, first hit the President in the back passing through his body, exiting from his chest or the lower part of his neck.

The bullet then went on to hit Governor Connally in the right shoulder, exiting the right side of his chest, entering and exiting his right wrist and eventually burying itself in his left thigh.

Mr. GOLDSMITH. Is this the bullet that has become the source of what has been referred to as the "single bullet theory?"

Mr. GRODEN. Yes; indeed, it has.

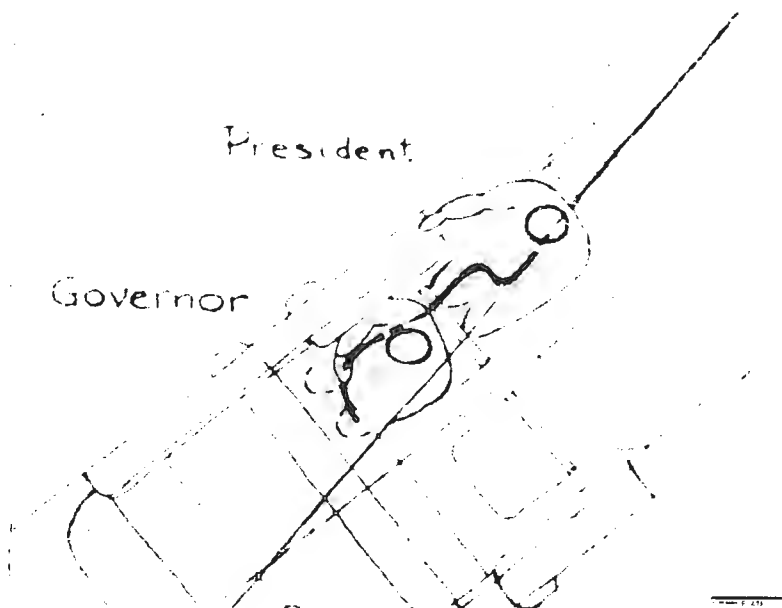
Mr. GOLDSMITH. In other words, one bullet passing through both the President and Governor Connally?

Mr. GRODEN. That is correct.

Mr. GOLDSMITH. Mr. Chairman, at this time, I would like to refer to JFK exhibit F-273. It has been marked as an exhibit and I would like to have it offered into the record.

Chairman STOKES. Without objection, it will be entered into the record at this point.

[The above referred to exhibit follows:]



JFK EXHIBIT F-273

Mr. GOLDSMITH. Prior to proceeding, Mr. Chairman, I would like to indicate for the record that the young lady sitting to Mr. Groden's left is Mrs. Chris Groden.

Chairman STOKES. The record may so show.

Mr. GOLDSMITH. Mr. Groden, examining exhibit F-273, would you please identify that for the record?

Mr. GRODEN. This is a chart depicting the relative positions of the two men, Governor Connally and President Kennedy at approximately the time where the Warren Commission established, in all probability, the first bullet struck.

It was drawn by a Warren Commission critic. And to the best of my knowledge, it is quite accurate.

Mr. GOLDSMITH. That chart, then, is based upon photographic evidence?

Mr. GRODEN. Indeed, it is. The Zapruder film, basically, except for the moment behind the road sign, showed the position of the two men through the entire shooting sequence.

Mr. GOLDSMITH. What was the Warren Commission's conclusion as to the time the first bullet struck President Kennedy?

Mr. GRODEN. They concluded, because of a large tree, a live oak tree growing between the window Oswald was alleged to have fired from and the point the President was in the car during the motorcade route, that no shot would have been fired before frame 210 because the view is obstructed by the tree. It can be seen very clearly from the Zapruder film that by the time the President re-emerges behind the sign at 224 to 225, that indeed he has already been hit and he is responding to the wound in a clutching motion.

Therefore, they deduced the first bullet hit between frames 210 and 224.

Mr. GOLDSMITH. Mr. Groden, what question about the single bullet theory is raised by this chart?

Mr. GRODEN. The basic problem with what the chart represents is the alinement of the two men, both on a horizontal and a vertical plane. If, indeed, the bullet—I am sorry, did I answer the question?

Mr. GOLDSMITH. That is fine.

Mr. GRODEN. I was going to suggest, the single-bullet theory that one bullet went on through both men would have to follow a flight path from that particular window, if Oswald was the assassin. Therefore, the bullet coming down, hitting the President in the back, exiting his throat, would have to have made some alteration in its flight path in order to hit Governor Connally at the angle in which it did indeed strike him. And it would seem the bullet would have had to make somewhat of a zig-zag type of situation; that is, the bullet going through the President perhaps doing something, illogically as it sounds, stopping in mid-air or being deflected somewhere along its route, hitting Governor Connally, going through his body, making a slight right-hand turn to hit him in the right wrist and then being deflected off the wrist almost 90 degrees to bury itself in his left thigh.

This is the single-bullet theory, not as presented, but at the time the shot was supposed to happen, from that entire sequence from 210 to 224, for that bullet to have done this particular amount of damage, it must have taken a similar flight path to what I just described.

Mr. GOLDSMITH. In summary, then you are suggesting according to this chart, which is based upon photographic evidence, the relative alinement of the two men in the vehicle was not consistent with the flight path of a single bullet?

Mr. GRODEN. It would seem so, yes, sir.

Mr. GOLDSMITH. Going beyond this chart, what questions, if any, about the single-bullet theory have been raised by the Zapruder film?

Mr. GRODEN. Outside of the alinement of the two men, basically, it is the timing of the shots or the reactions of the two men.

As mentioned before, when the President reemerges from behind the road sign, he does show definite signs of responding to a shot. Visually, at least, the Zapruder film shows no such evidence where Governor Connally is concerned.

Mr. GOLDSMITH. Can you explain at this time in what way the single-bullet theory is relevant to the Warren Commission's conclusion that the President was shot by a single gunman?

Mr. GRODEN. Very simply, I would say it is this: If the President were hit between 210 and 224, it was requiring a minimum firing time of 2.3 seconds or I believe it is 43 frames. That is, if the President were hit, let's say, at frame 210, Governor Connally could not have been hit by a separate bullet until 253. Also, if the President were not hit until 224, we would have to add 43 frames to that to the point where Governor Connally would be hit.

However, the Governor shows a very marked reaction by frame 237 to 238, which is only 1.8 seconds away, too soon for another shot to have been fired.

Mr. GOLDSMITH. To clarify your testimony, I believe you said that if the President had been hit by frame 210 and based upon the 18.3 seconds standard, or 18.3 frames per second standard, and the fact that the rifle needed 2.3 seconds to be discharged, according to your testimony, you said the Governor could not have been hit by a separate bullet until frame—

Mr. GRODEN. 253.

Mr. GOLDSMITH. 253. But really, what you meant, I think, is he couldn't have been hit by a separate bullet fired by the same gunman.

Mr. GRODEN. That is correct. I am sorry if I didn't make that clear. Assuming a single gunman using that particular weapon, the one attributed to belong to Lee Harvey Oswald.

Mr. GOLDSMITH. Now we are about to view the Zapruder film. I would like you to explain to the committee whether any special techniques have been applied to this film for the purpose of improving its quality.

Mr. GRODEN. Two techniques have been involved. The first that you will see is merely a straight runthrough of the film. No special techniques have been involved in this except to color-correct it slightly.

Right after that, we will be viewing a special version of the film which has been slowed down and it has been subjected to a technique called rotoscoping. That is, each frame is shot individually, repositioning the men in the car to eliminate the shakiness of the hand-held camera. This is done by using an optical printer, centering the point of interest, in this particular case the President and Governor Connally, so that they fill the frame eliminating all of the excess material on the film so we can simply follow their movements, their reaction times in relationship to each other and to the car and the surrounding scenery.

Mr. GOLDSMITH. As we view this film, what particular points should we be looking for?

Mr. GRODEN. In the first runthrough, we will be getting a logical feeling for the film. It will be going slower than live speed so it is easier for anyone viewing it to, indeed, get the feeling and the visual response that was on the film.

During the second runthrough, we will see various aspects of the film in highlighted detail. What we should be looking for is as the President reemerges from behind the sign, that immediately upon reemergence, his arms go up in a clutching, protective motion toward his throat; not actually grabbing his throat, but much of a defensive-type attitude.

Then, momentarily after that, there is a slight forward motion and push to the President downward and forward and then a few frames after that, we will see Governor Connally's right shoulder buckle sharply, his cheeks will puff out and his hair will become immediately dissheveled, all in one frame. I believe we will be showing that twice, one after the other, so that if it goes by too quickly the first time, it will be seen again.

Mr. GOLDSMITH. Fine, now before the film is viewed, Mr. Chairman, I would like to state for the record that this film is copyrighted. The copyright date is 1967 and the owner of the copyright is LMH, Inc. The film has been marked for identification as JFK F-148.

I have also been requested to state that the film does show the head wound to the President very vividly and for this reason, viewing is not advised for persons who will be particularly sensitive to this type of violence.

Can we please show the film at this time.

Mr. GRODEN. May I also, before we do show it, suggest that the TV cameras who will be filming it allow a black border at the bottom because a great deal of the action happens at the extreme bottom of the frame and much of it might be lost.

Mr. GOLDSMITH. Thank you, Mr. Groden.

[Showing of Zapruder film.]

Mr. GOLDSMITH. Lights, please.

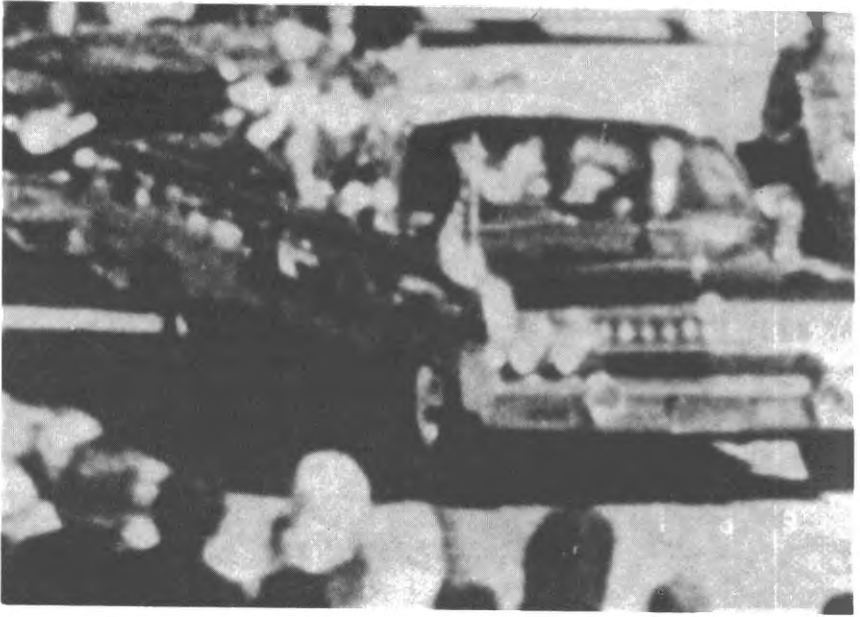
Mr. Chairman, may we have JFK exhibits F-209 through F-247, F-249 through F-265, F-272, and F-274, which are enlargements of selected frames of the film just shown, entered into the record?

Mr. PREYER. Without objection, they may be entered.

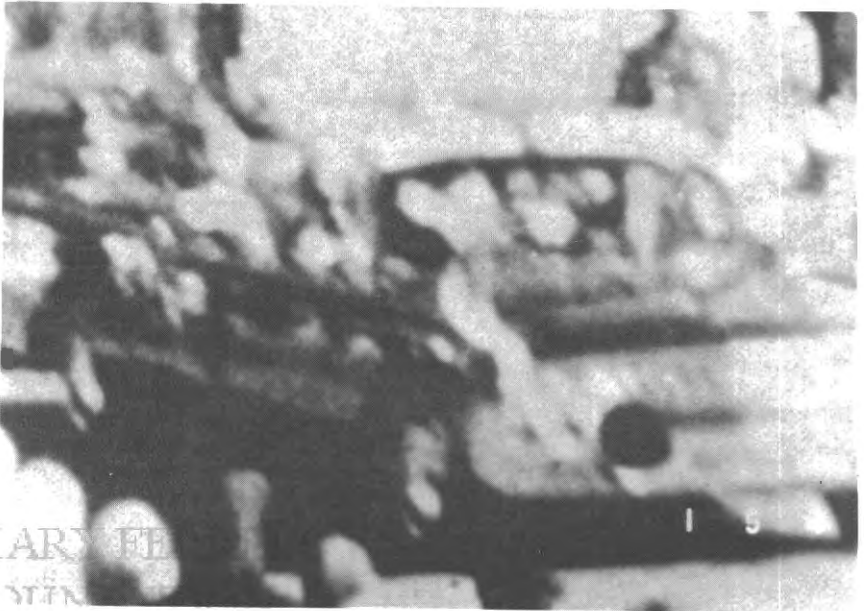
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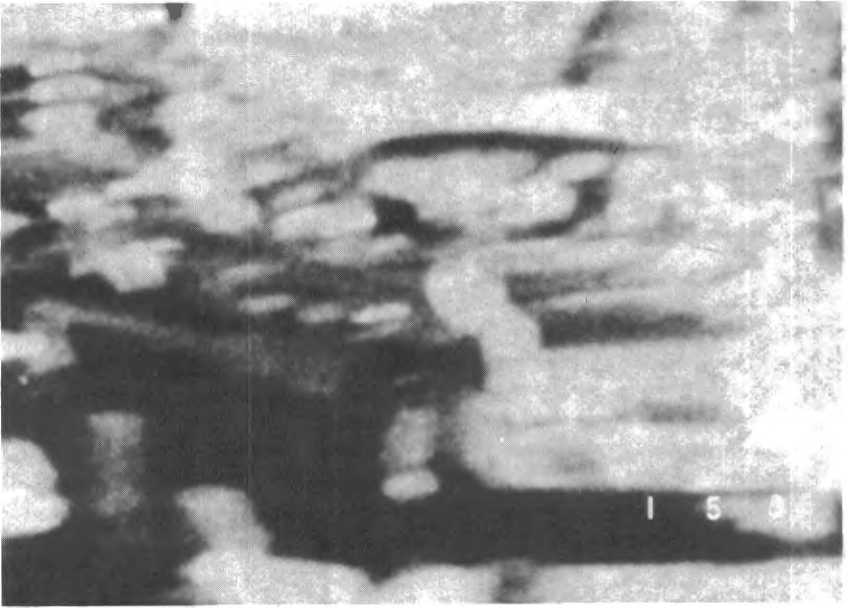
JFK EXHIBIT F-209



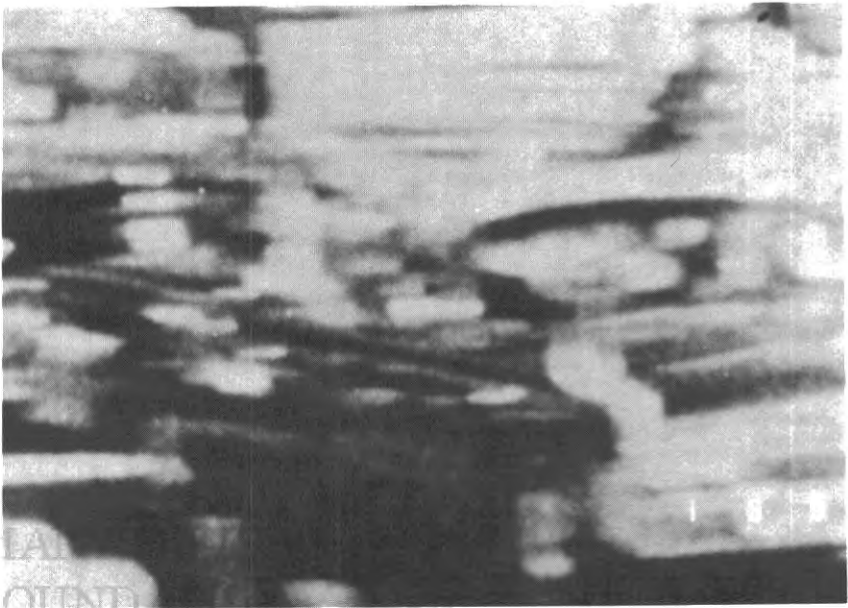
JFK EXHIBIT F-210



JFK EXHIBIT F-212



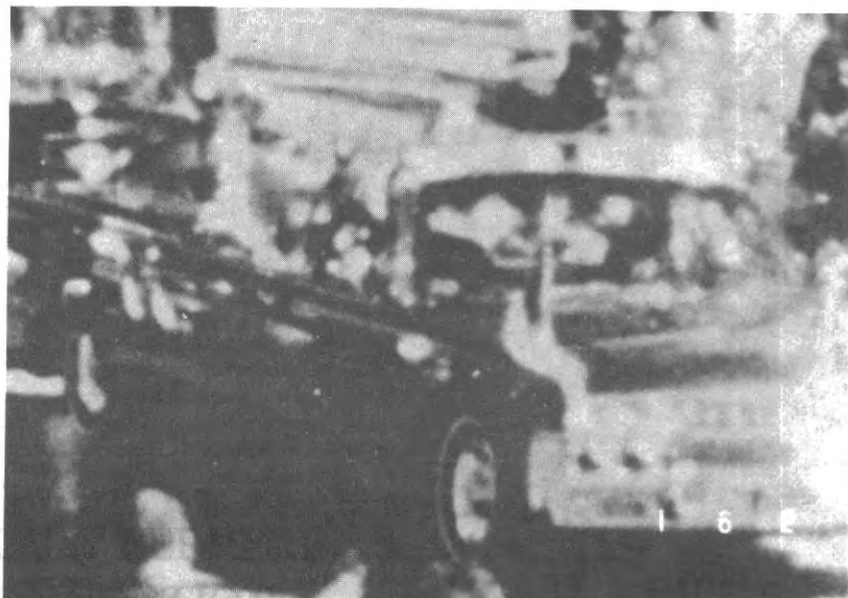
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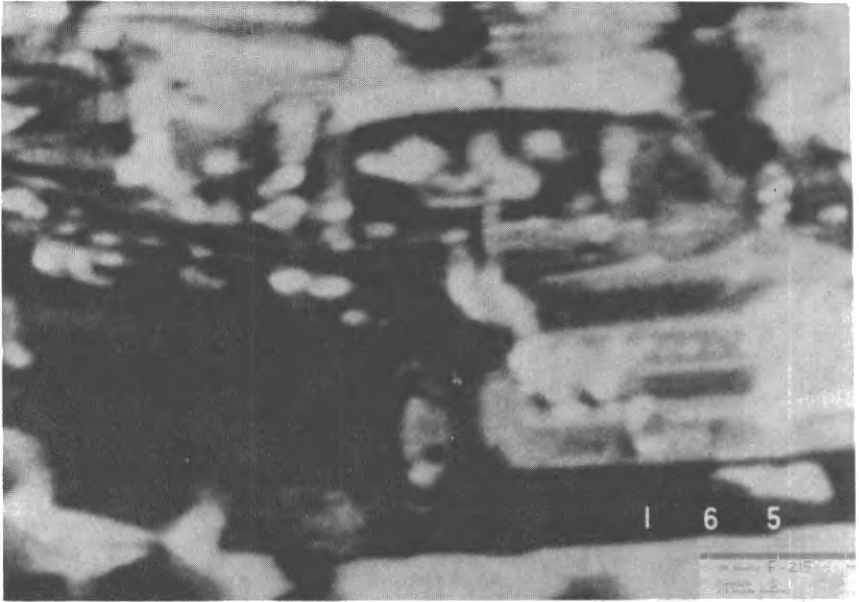
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JFK EXHIBIT F-214



ЖК ЕХНІВІТ F-215



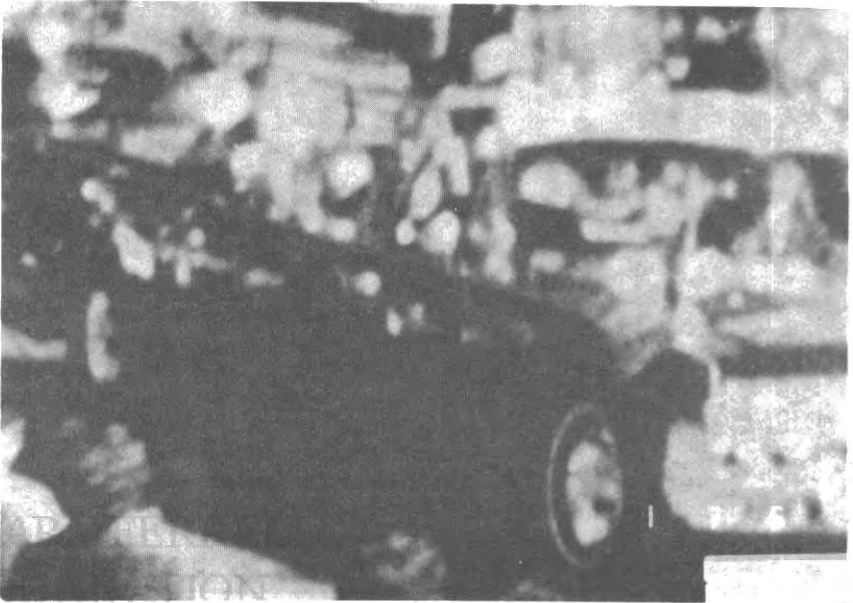
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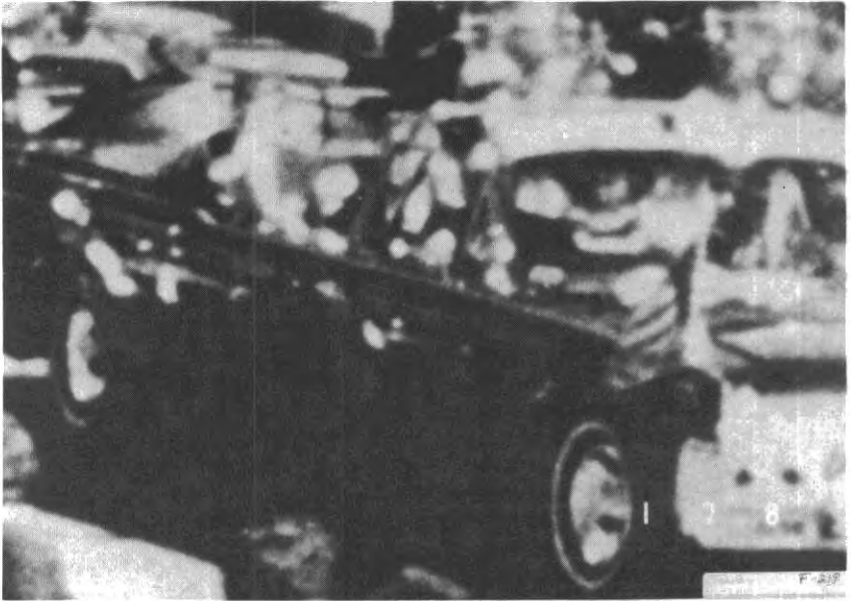
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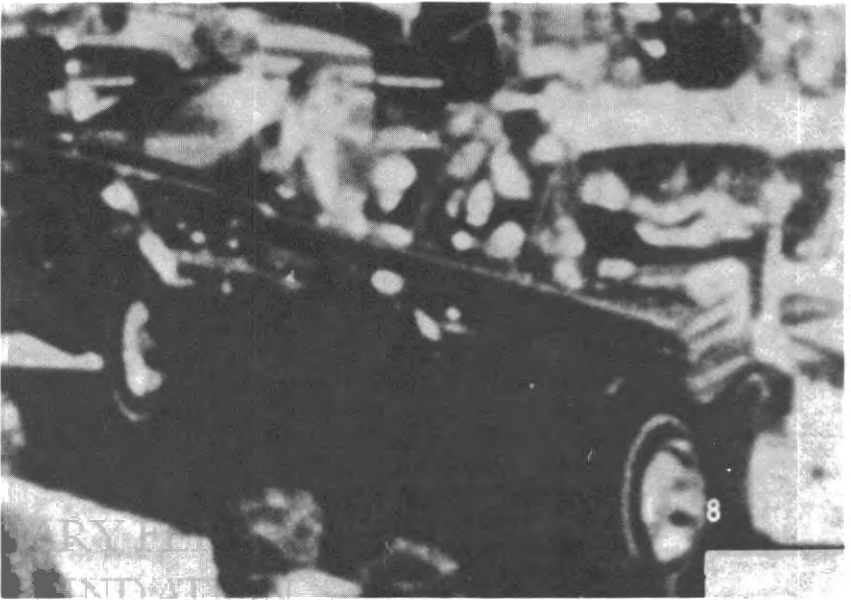
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JFK EXHIBIT F-219



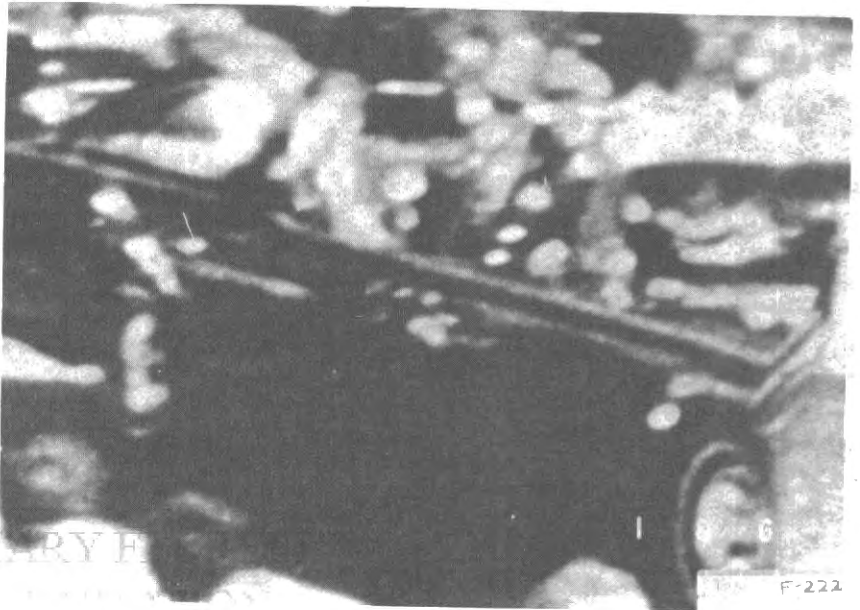
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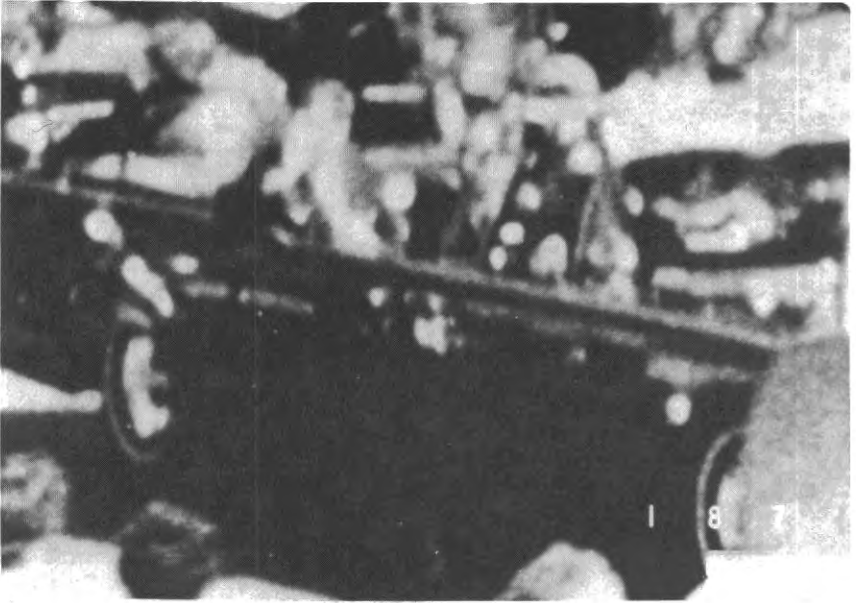
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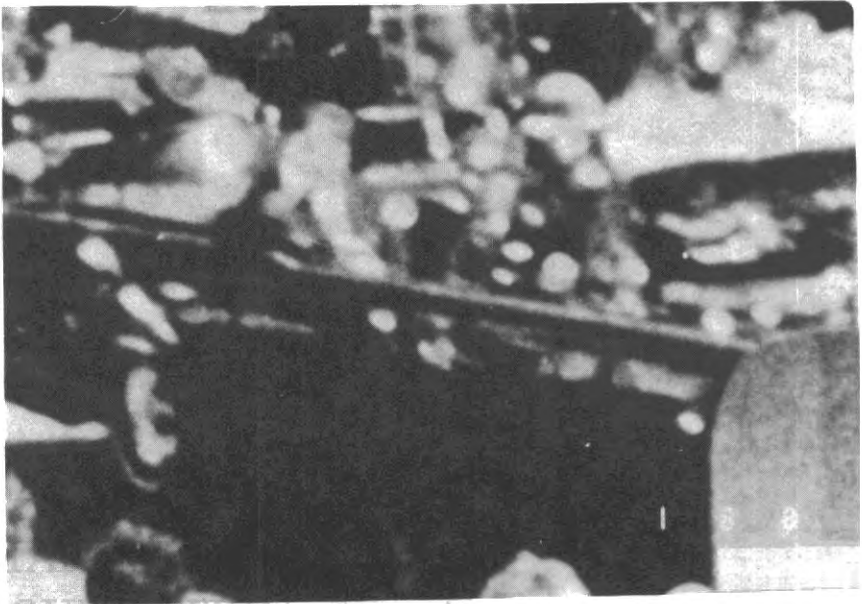
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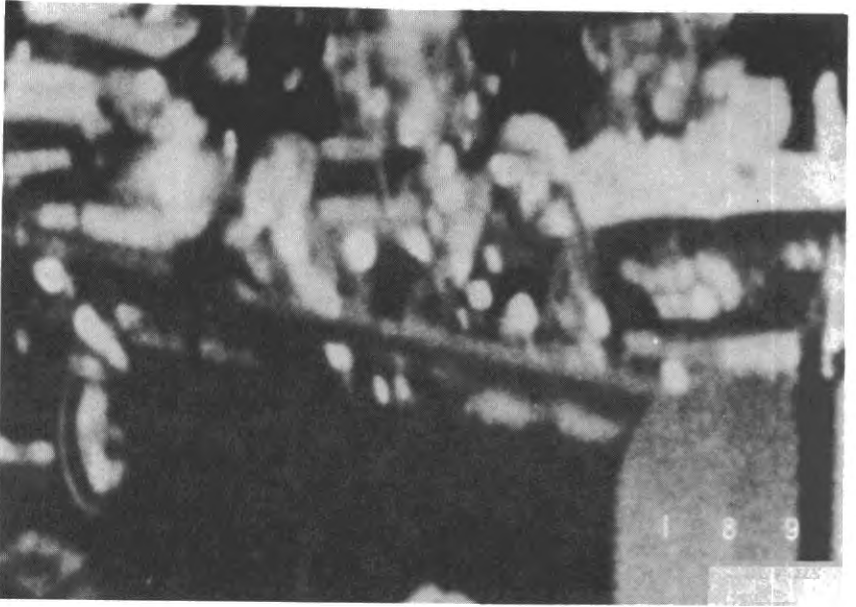


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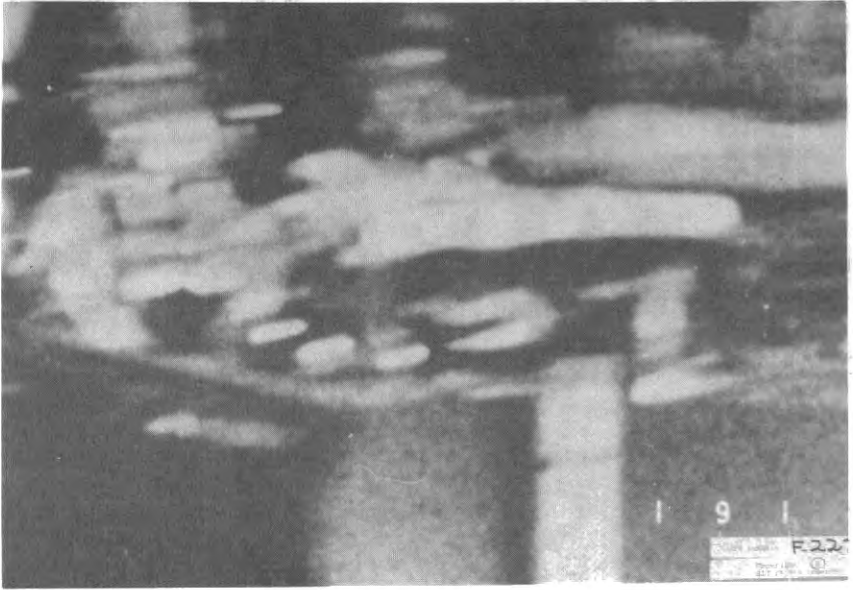
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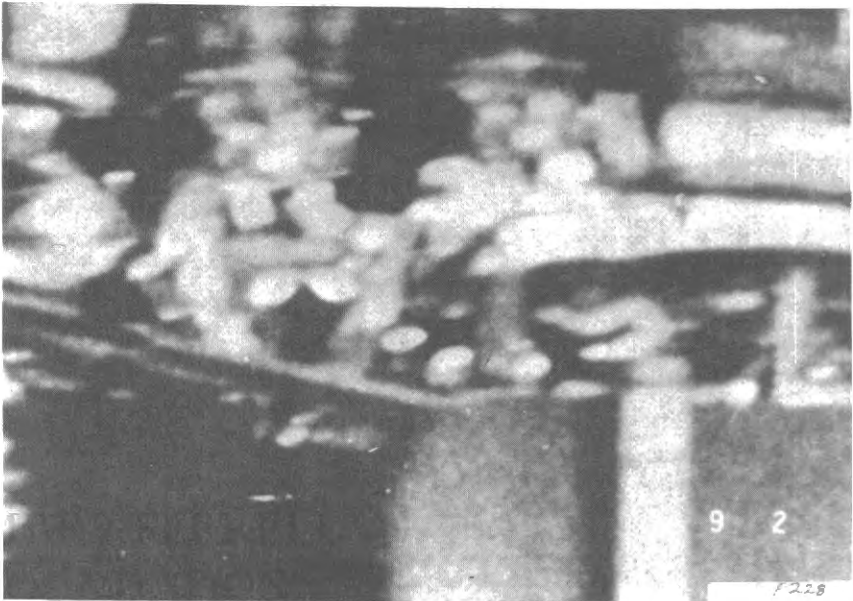
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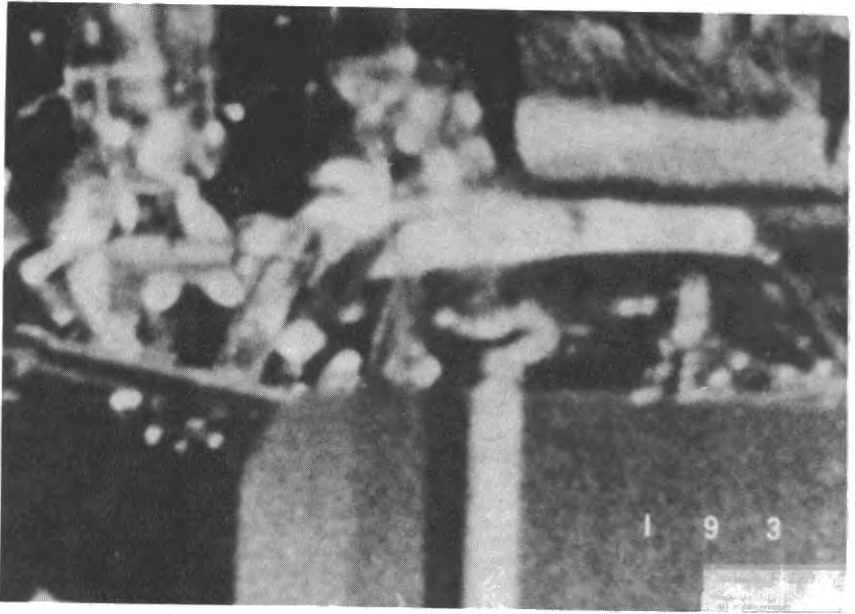
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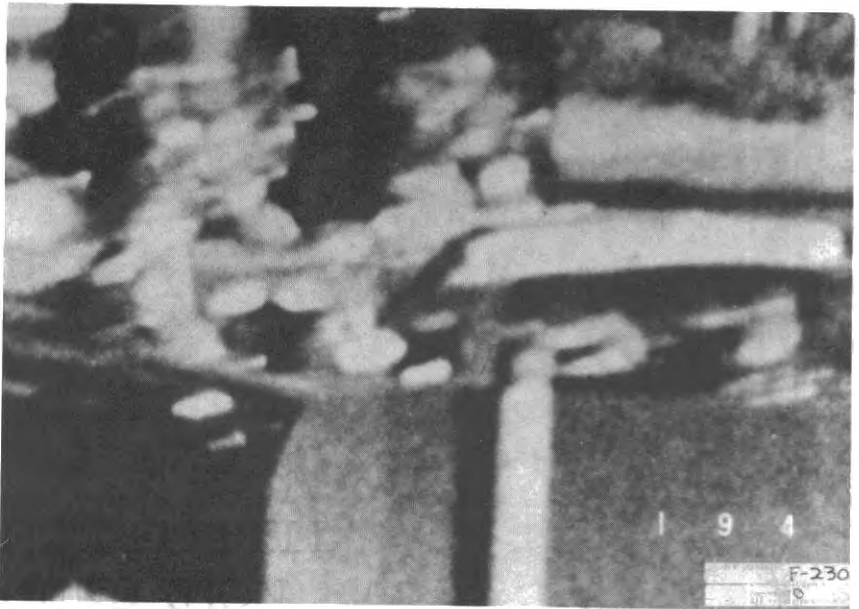
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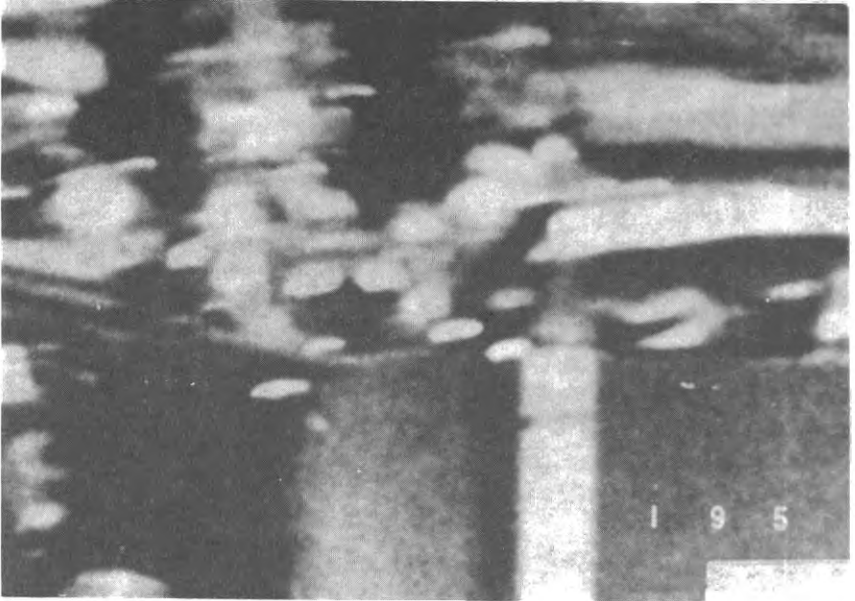
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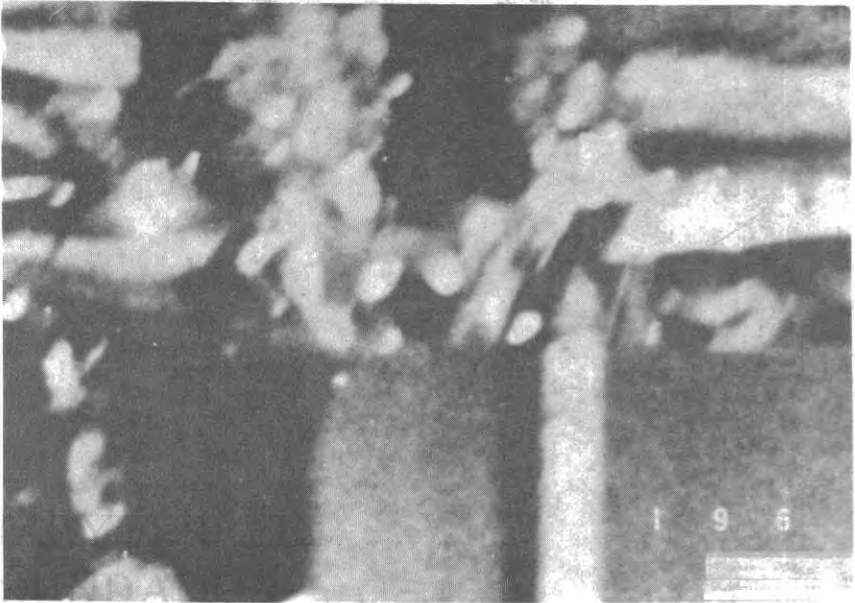
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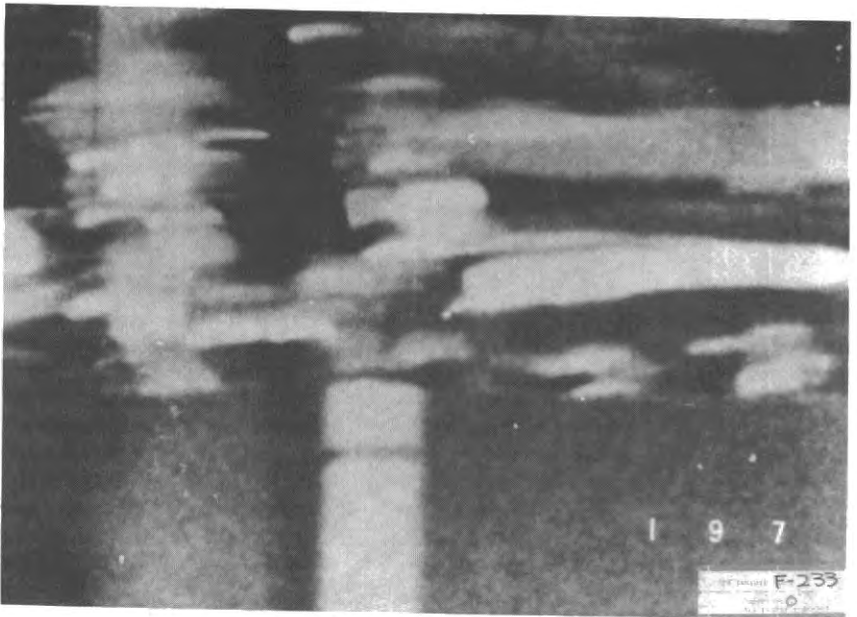
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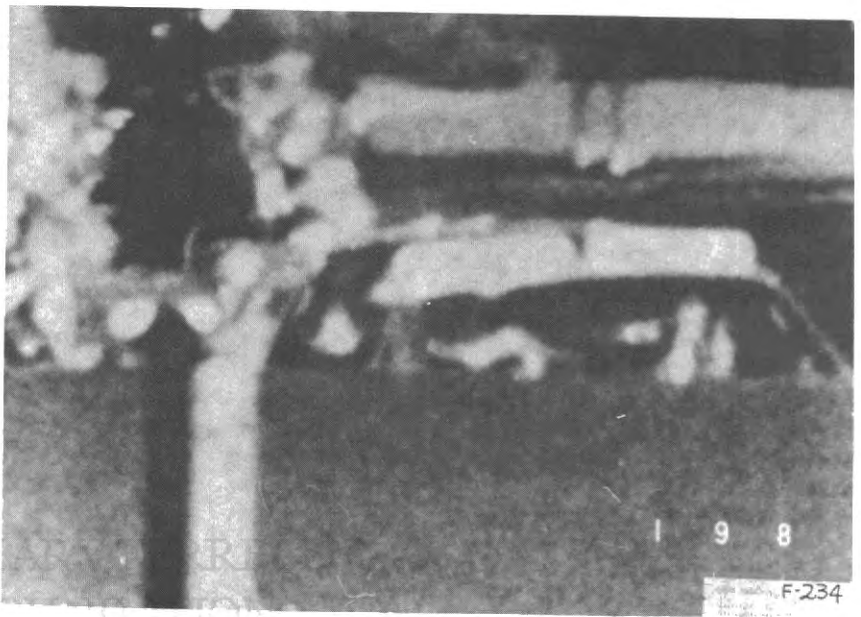
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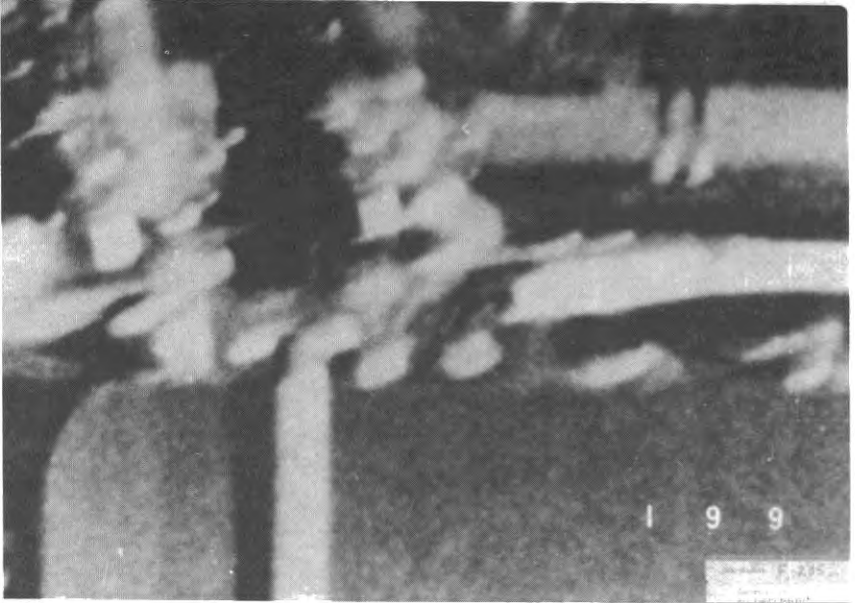
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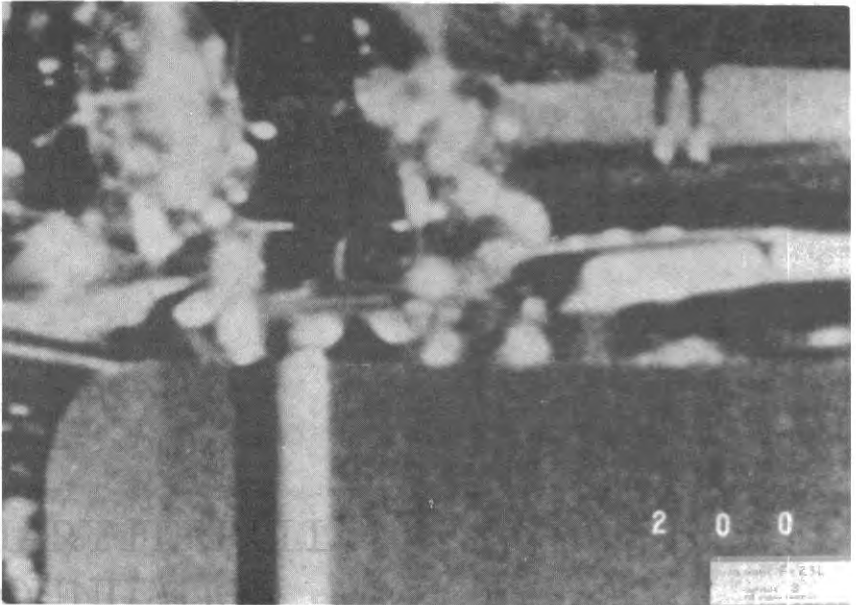
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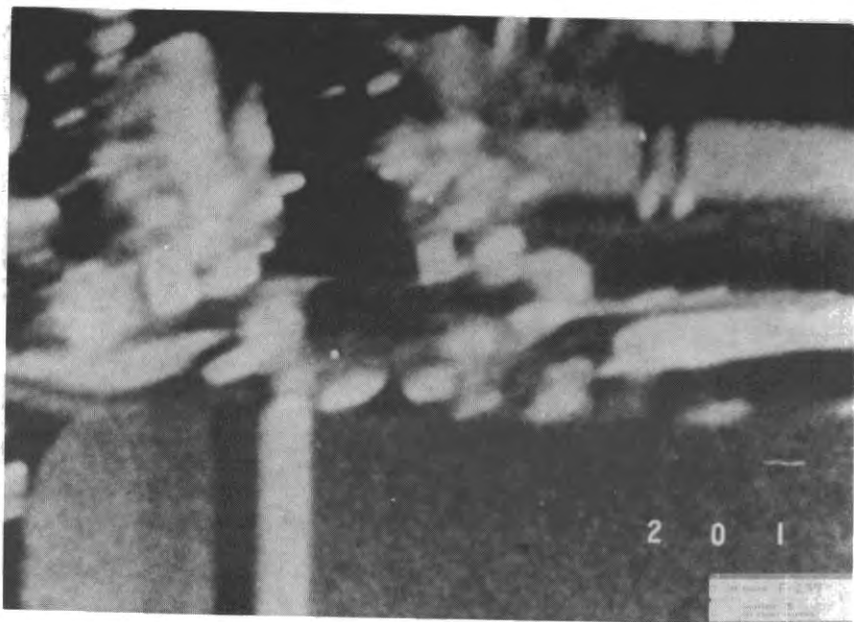
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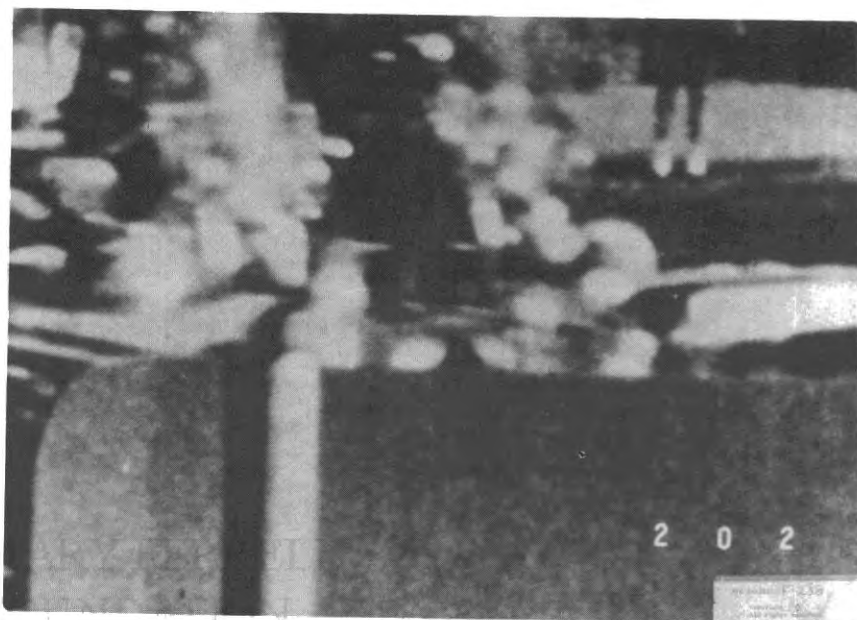
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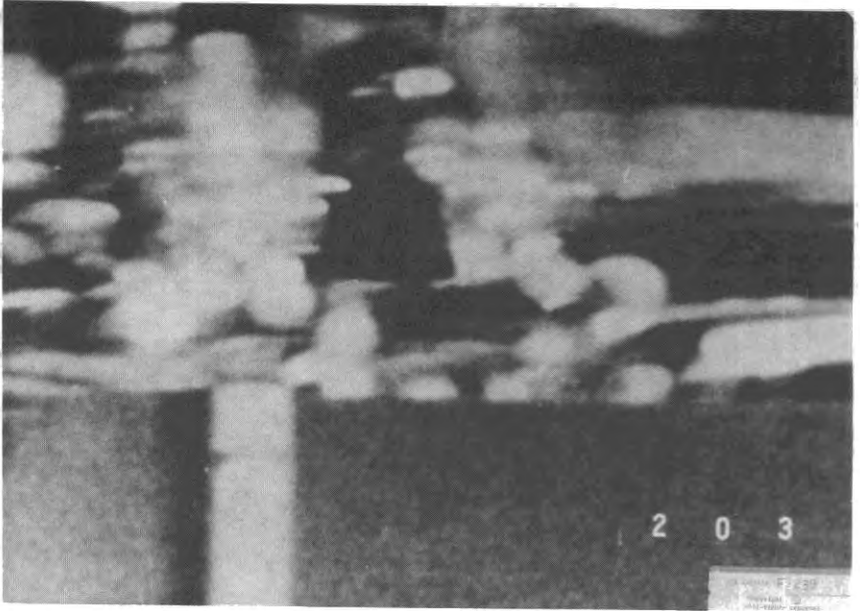
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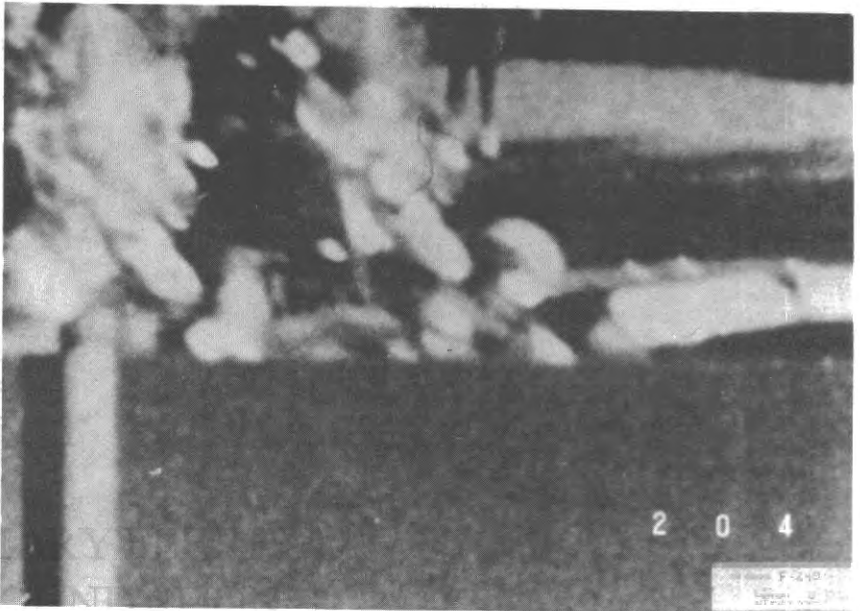
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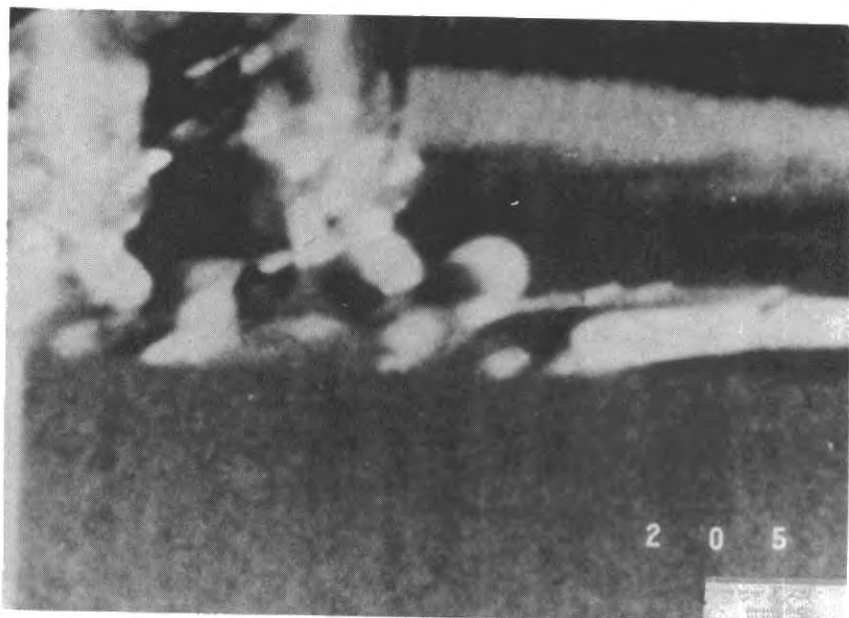


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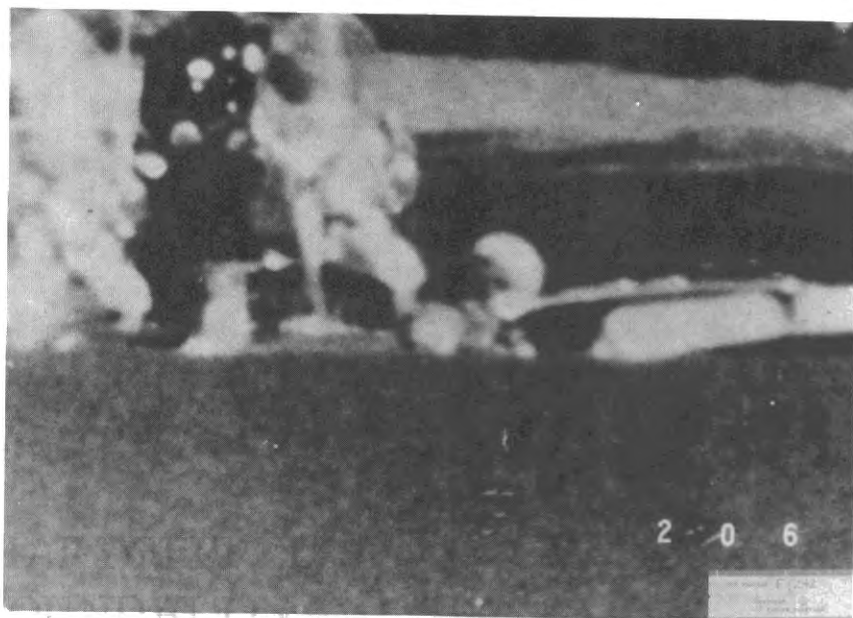




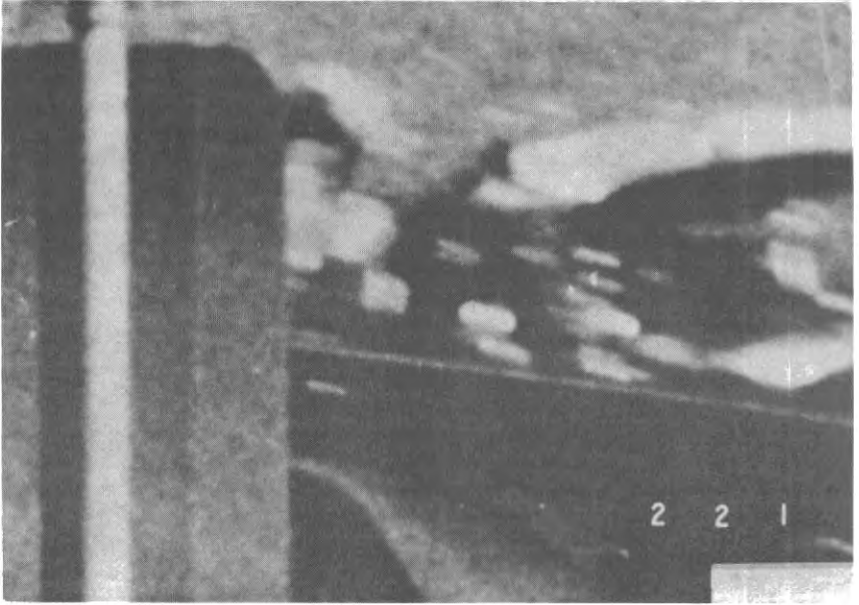
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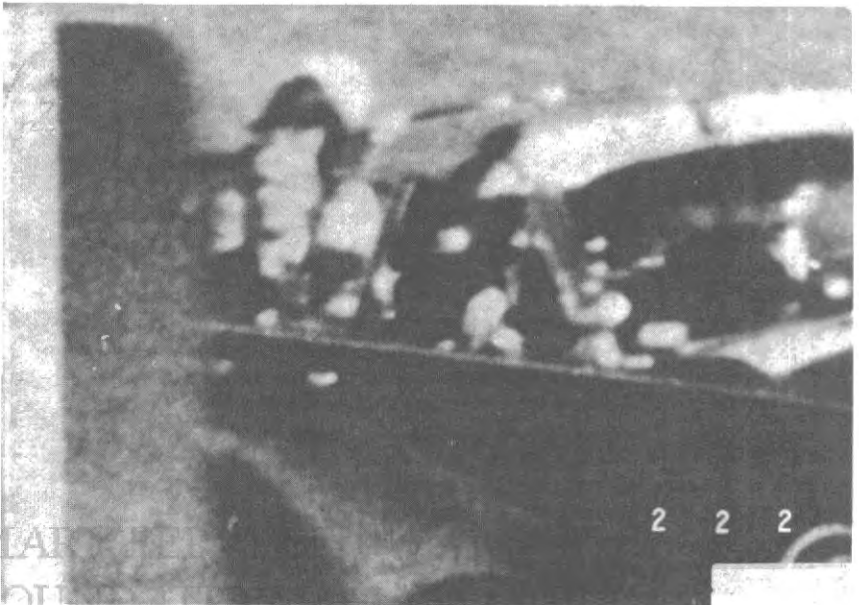
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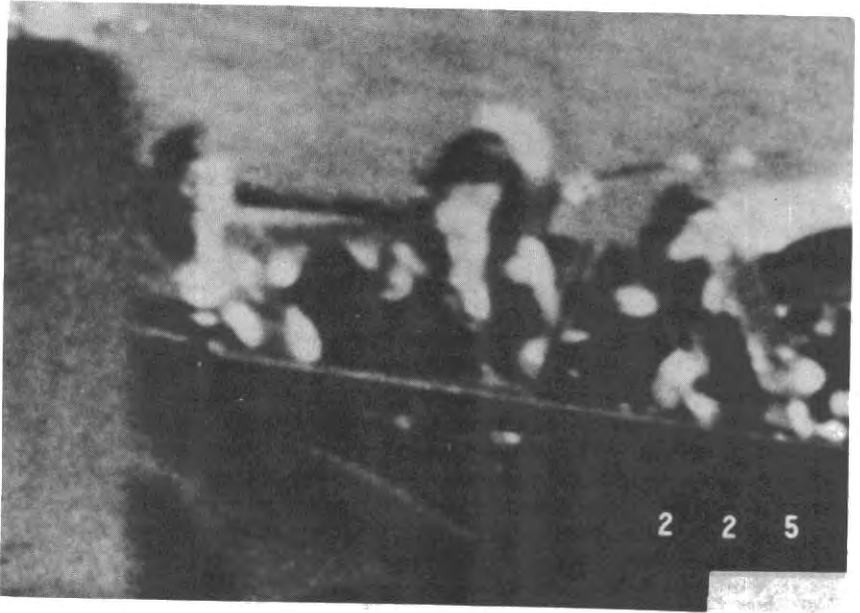
JFK EXHIBIT F-243



JFK EXHIBIT F-272



JFK EXHIBIT F-244



JFK EXHIBIT F-245



JFK EXHIBIT F-246



JFK EXHIBIT F-247



JFK EXHIBIT F-249



JFK EXHIBIT F-250



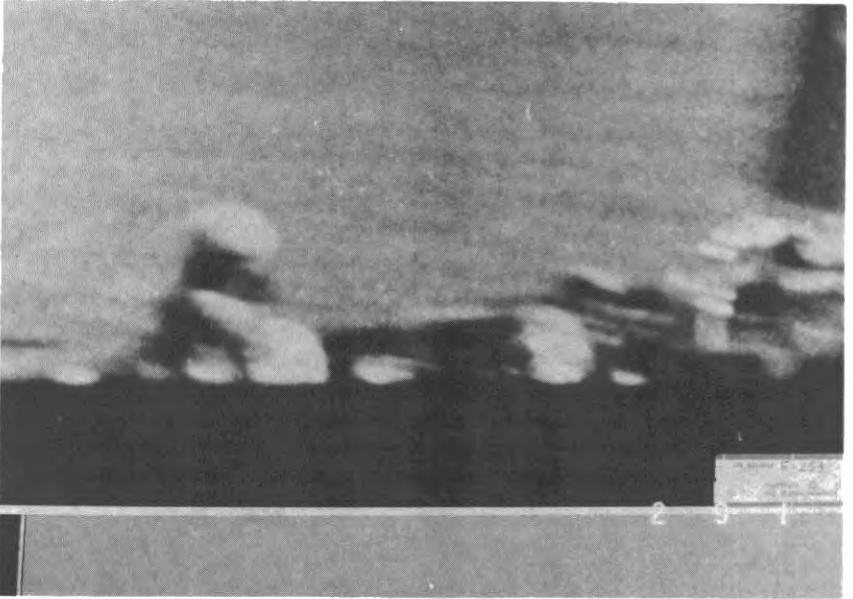
ЖФК ЕХНІВІТ F-251



ЖФК ЕХНІВІТ F-252



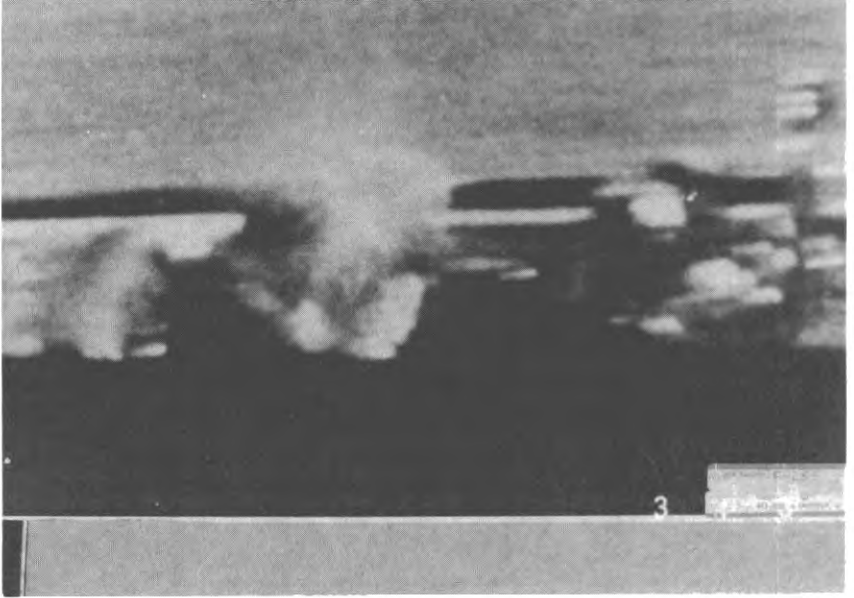
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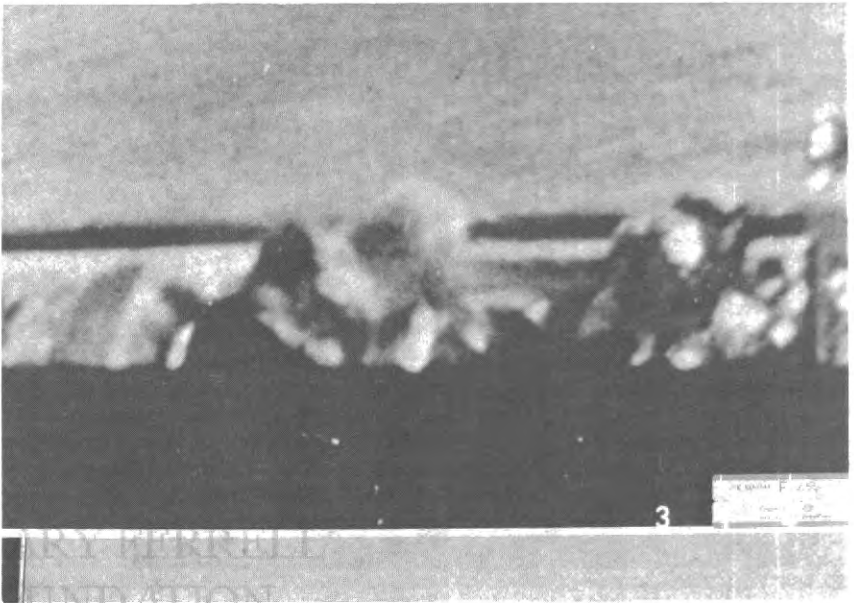
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JFK EXHIBIT F-255



JFK EXHIBIT F-256





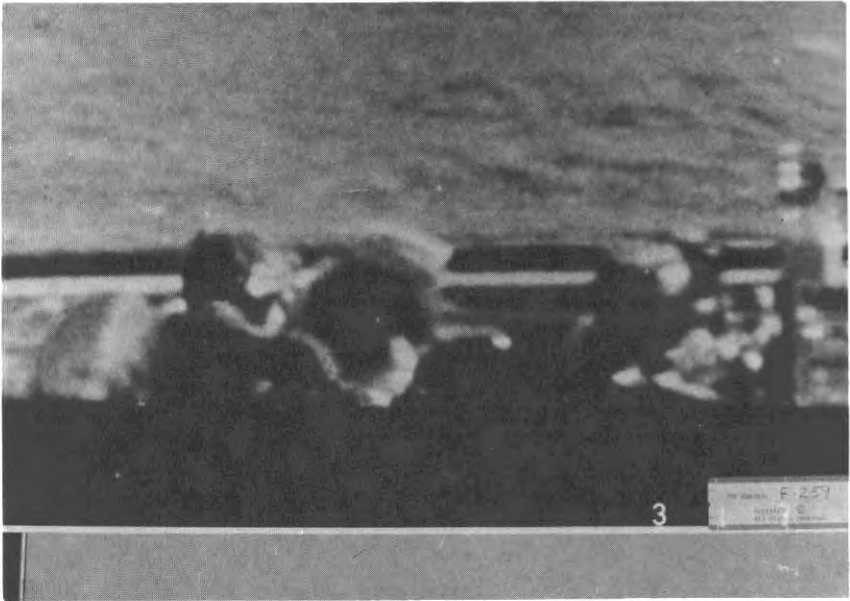
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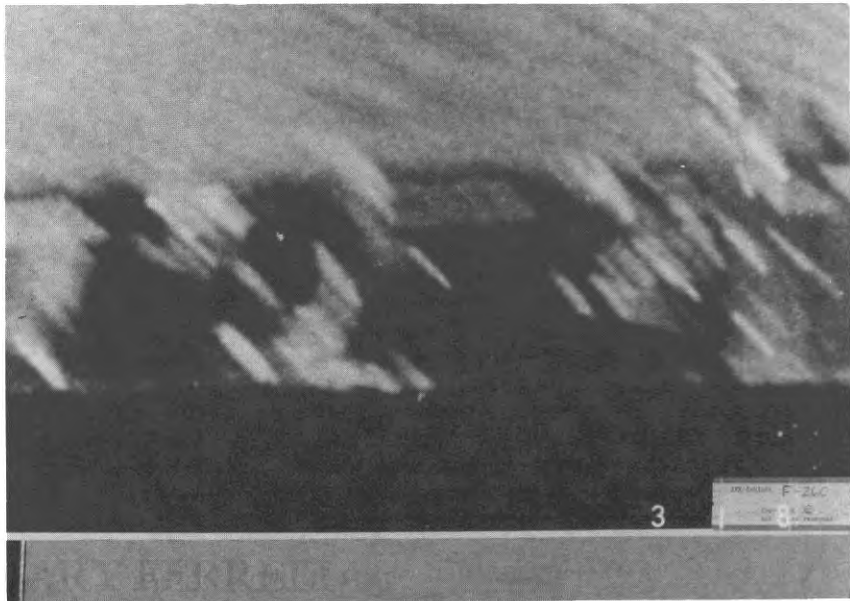
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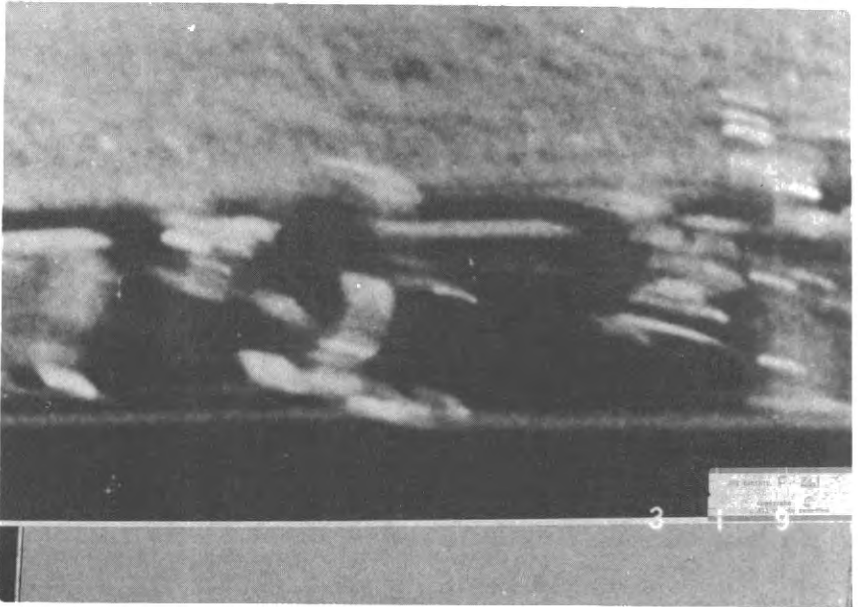
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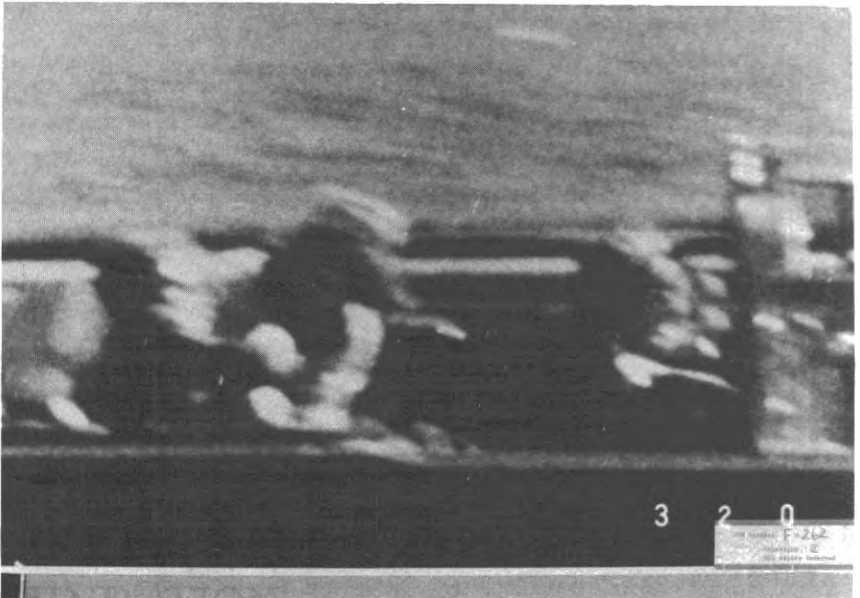
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JFK EXHIBIT F-261



JFK EXHIBIT F-262



JFK EXHIBIT F-263



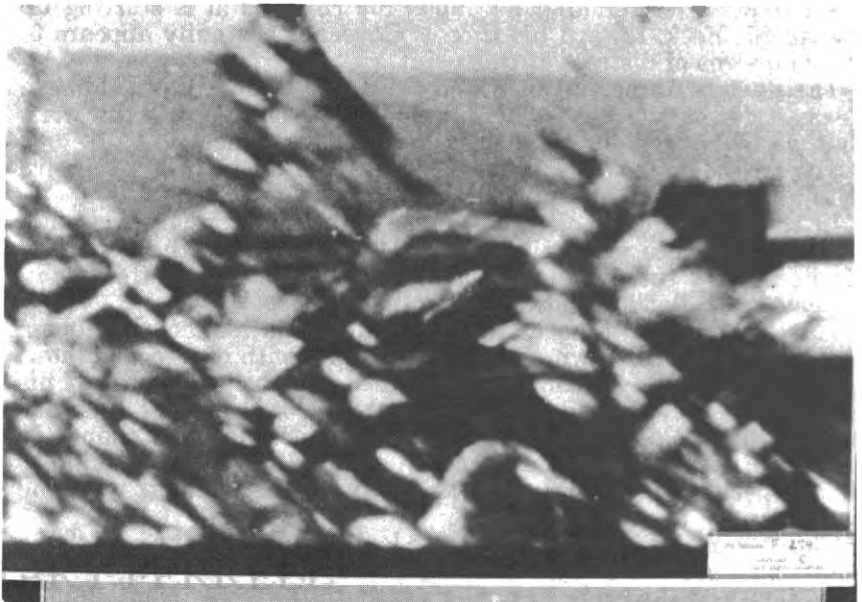
JFK EXHIBIT F-264



ЖФК Ехпівит F-265



ЖФК Ехпівит F-274



Mr. GOLDSMITH. Mr. Groden, has this film been the subject of extensive photo analysis by the committee's scientific panels?

Mr. GRODEN. Yes, it has.

Mr. GOLDSMITH. I would like, at this time, to refer to what have been marked as JFK exhibits F-244, 245, 246, 247, and F-249. They correspond with selected frames from the Zapruder motion picture.

Mr. GOLDSMITH. Mr. Groden, would you please identify each of these exhibits?

Mr. GRODEN. From the left, the first exhibit is Zapruder frame 225. Do you want me to describe them or do you want me to identify them first?

Mr. GOLDSMITH. Please identify them first.

Mr. GRODEN. It will be 225, 230, 237, 238, and 274.

Mr. GOLDSMITH. Before you proceed, how were the frames numbered? In other words, the numbering sequence, what is it based upon?

Mr. GRODEN. The sequence that is commonly used in dealing with the frames of this film relate to a count that was done on the original film for the Warren Commission and for the FBI analysis, starting with the first frame in which any of the motorcade appears.

There is a segment of film before the President's car appears which is frame 1, that's where that begins. The first frame showing the President is frame 133. The last one is frame 486.

Mr. GOLDSMITH. Referring to each of these exhibits, would you please indicate what points each one raises about the single bullet theory?

Mr. GRODEN. From the left at frame 225, this is the first frame where we see the President reemerging from behind the road sign. His left hand is clutching his lapel, his right hand is starting up toward his neck, toward his throat. Governor Connally appears to show no signs of distress at this point.

The next is frame 230 in which Governor Connally is holding a Texas-style Stetson hat in his hand. That wrist again is the wrist that was shattered during the assassination sequence.

The President, at this time, has his arms up in this protective motion I described before toward his throat.

In the next one, frame 237, we see Governor Connally responding, or so it appears visually anyway, to the sound of the first shot. He does show some signs of distress. His shoulder, at this point, appears quite flat in relationship to the ground.

His cheeks are of a normal attitude, although his mouth is open, and his hair is still down and flat. One-eighteenth of a second later, or frame 238, his shoulder has buckled violently downward, his cheeks have now puffed out, his mouth is closed and his hair has become disheveled. This is the only such detectible rapid change in the Governor in this entire sequence of the film that I was able to detect, perhaps indicating that this may be the moment when he was struck.

The last of the five frames we are looking at here, the one of the right is frame 274 and in this, we are about to lose much of the President and Governor Connally's body to the lower frame line of the film, but we can see Governor Connally's right wrist, the one that was shattered, the distal radius bone, which was shattered.

We see the white cuff of the sleeve and we see that he is indeed still holding the rim of the hat in his hand.

Again, this is about 2½ seconds after the point the President has first shown his reaction in frame 225.

Mr. GOLDSMITH. Thank you, Mr. Groden.

Turning now to the question of the direction of the bullets, what questions does the Zapruder film raise about the Warren Commission's conclusion that all three shots were fired at the President from behind?

Mr. GRODEN. Dealing with various interpretations of the film, there is very little raised as to the direction in most portions of the film, except that at the moment of the head shot. At the moment of the head shot, we see the President thrown violently backward to the rear and to his left which would seemingly indicate a shot from the right front, from the area of the grassy knoll. The grassy knoll is mentioned here because a great many witnesses felt that at least one of the shots came from that area.

The film shows the President going to the rear and the left on a direct axis from this point, therefore, many people have concluded that what we may be seeing is the result of a shot from the right front, striking the President in the head.

Mr. GOLDSMITH. We are about to review the film a second time. At what point in the film specifically should the viewer be looking for the backward motion to the left by the President?

Mr. GRODEN. It is in the later portion of the film. The President and the Governor will have received their nonfatal wounds, all of the nonfatal wounds inflicted that day. There will be a traveling time which will run, considering the slow-down speed that we will see here, of about 8 seconds.

In actual time, it is 5.6 seconds in actual running time. The President will have just passed a light pole and then several witnesses, including a lady in a red dress—I am sorry, a red coat. Her name is Jean Hill. She is a witness and she was standing there. As soon as we see the red coat go by, we will count maybe two seconds or a second and a half in actual running time.

The President's head will seemingly explode and then we will see the violent reaction of the President being thrown to the rear. It will be on the left side of the screen.

Mr. GOLDSMITH. Mr. Groden, this time when we show the film, I would like to ask you if you would be so kind as to narrate the film for the committee.

Mr. GRODEN. I shall indeed.

Mr. GOLDSMITH. Thank you. Can we have the lights, please.  
[Showing of film.]

Mr. GRODEN. This is the lead portion of the film. The President waving to the crowd and we see the road sign as he approaches it; disappears behind the sign and upon reemergence, we see his response and then Governor Connally's shoulder buckling. There's the light pole, the witnesses, and then the fatal shots now throwing him to the rear, or at least to the time when he moves toward the rear.

Mrs. Kennedy, in a shock reaction, climbing out on the rear deck of the car and the car now begins to speed up and heads down to

the triple underpass on the Stemmons Freeway and to Parkland Hospital in an attempt to save the President's life.

We are going to view the rotoscope version at this point, which will steady the image that we almost lost before.

The President wiping a lock of hair off his forehead; he turns from his left to his right, looking toward us and Governor Connally turns as well. The President waves; the road sign; reemergence from the sign the President, now the shoulder buckle of Governor Connally, and we notice his wrist and then we lose them at the bottom frame line and the fatal head shots at the moment throwing the President to the rear.

I should describe that perhaps not as the fatal head shot or shots, but rather, the impact on the President's head would probably be a more accurate statement at this point.

We will view it one more time.

The President is looking to his left and he turns to his right, looking toward us, then will begin to wave; the road sign; re-emergence from the sign, and we see the President thrown slightly forward; Governor Connally still holding the hat in his hand and now the fatal head shot or the impact on the President's head throwing him to the rear; and Mrs. Kennedy's response, climbing on the rear deck lid of the car.

Mr. GOLDSMITH. Thank you. Can we have the lights now?

Mr. Groden, was the President's backward motion apparent from the reprint of the frames from the Zapruder film in the Warren Commission report?

Mr. GRODEN. No; it wasn't apparent at all from the reprint.

Mr. GOLDSMITH. What is the reason for that, sir?

Mr. GRODEN. The reason for that is in volume 18 of the Warren Commission appendix volumes, on pages 70 and 71, the frames, including the head shot and immediately following, are printed; they are labeled top to bottom and then left to right, 313, 314, 315, and 316. This is not, in fact, what we have here.

We have 313, 315, 314, then 316. A reversal of the two frames following the shot to the President's head.

Mr. GOLDSMITH. Do you know when this reversal was first discovered?

Mr. GRODEN. It was discovered sometime after the Warren volumes were printed and it was not an issue for the Warren Commission, itself. It was discovered by a critic of the Warren report. And I believe the comment was made officially and the answer was that it was an inadvertent reversal of frames.

The effect of this reversal of frames, however, would make it appear as though the President was thrown forward for two frames after the shot, quite markedly forward when, in fact, the reverse was the case.

Mr. GOLDSMITH. Mr. Groden, do you know whether there is any photographic evidence that bears upon the Warren Commission's conclusion that Lee Harvey Oswald fired at the President from the Texas School Book Depository?

Mr. GRODEN. I am sorry, could you repeat the question?

Mr. GOLDSMITH. Certainly. Is there any photographic evidence that touches upon the Warren Commission's conclusion that



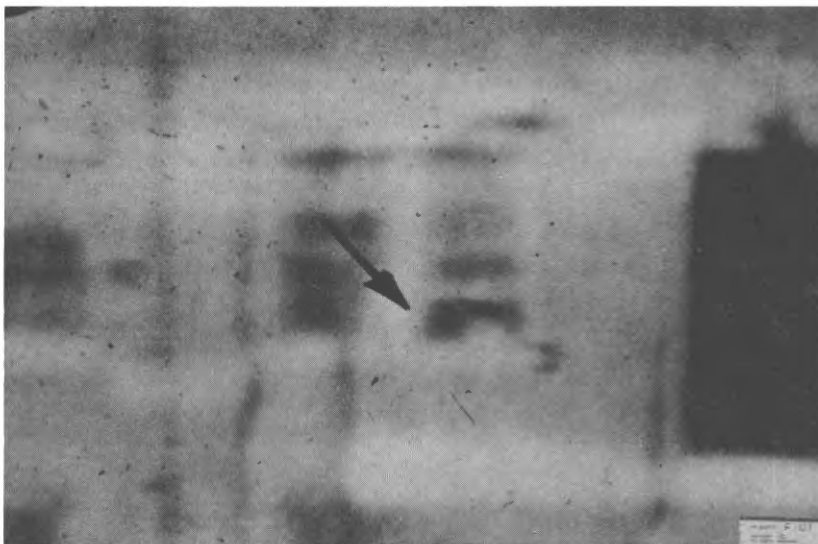
Oswald fired at the President from the school book depository building?

Mr. GRODEN. There are various photographs taken of the depository at the time of the shooting just before and just after. Some showing the doorway of the depository, others showing the windows, some showing the whole face of the depository. Some of these were among the issues that were raised for the scientific panels.

Mr. GOLDSMITH. Mr. Chairman, at this time, I would like to refer to what has been marked as JFK exhibits F-121, F-122, and F-123. They are blowups of photographs taken by photographers in Dealey Plaza and I move they be admitted into the record.

Chairman STOKES. Without objection, they may be entered into the record.

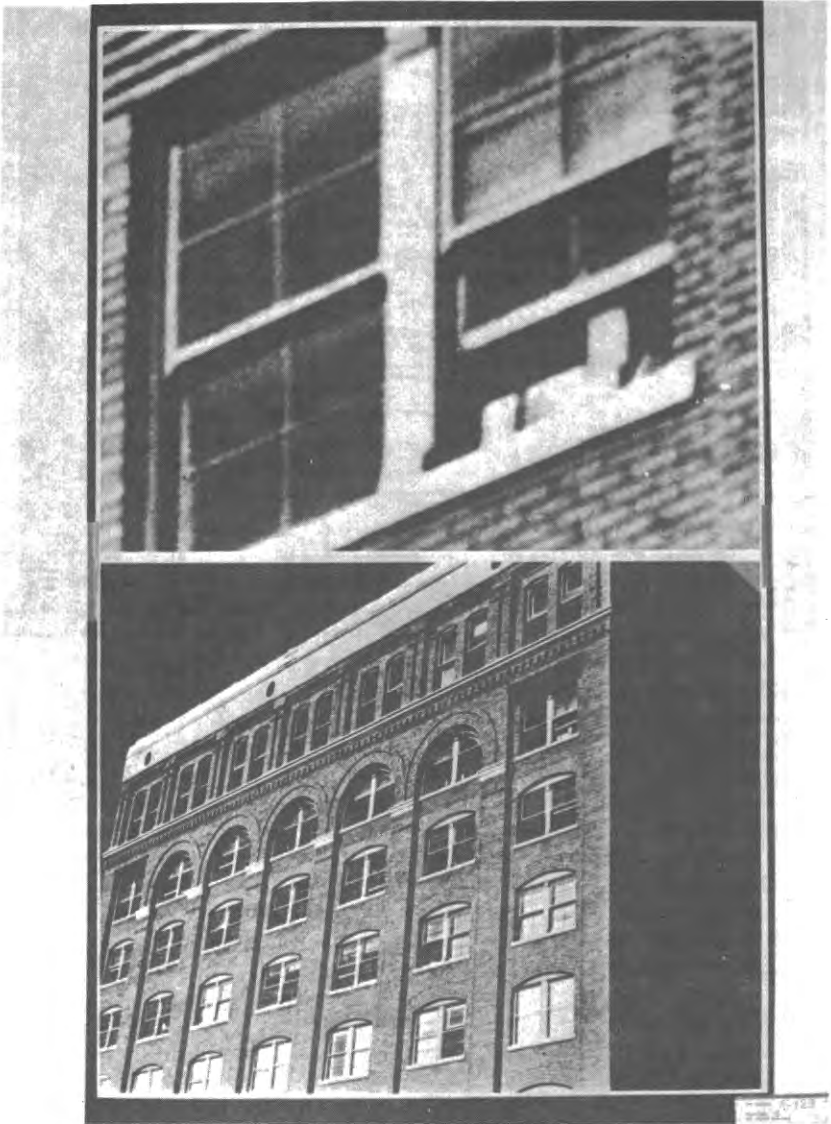
[The above referred to exhibits follow:]



JFK ЕХНІВІТ F-121



JFK Ехнівіт F-122



JFK EXHIBIT F-123

Mr. GOLDSMITH. Thank you.

Mr. Groden, would you please identify each of these exhibits?

Mr. GRODEN. The exhibit on the left, on the top part of the left photograph, is a motion picture frame, one single frame taken from the film by Robert Hughes. Just as the President's car was about to turn off of Houston Street on to Elm.

On the bottom is a blowup of the window which was supposed to have been the window used by the assassin during the shooting which will begin within seconds of this frame being taken.

The photograph in the center was taken by a man named Tom Dillard, who is a professional photographer; it is a newspaper photograph and it shows the entire wall of the depository; this section which we see here is somewhat cropped to highlight the window, again, the same window the assassin was supposed to have used.

It was taken an estimated 3 seconds after the final shot was fired, but that is probably a loose figure. Within seconds would be a more accurate statement.

The final photograph, the one on the right, on the bottom, was a very similar photograph taken by an Army intelligence man by the name of Powell, who was standing diagonally across the corners of Houston and Elm looking up. He took this photograph somewhere between 30 seconds and several minutes after the assassination. I am not clear as to the actual time.

On the top, we see a blowup of the window in question, which is the easternmost window on the south wall of the sixth floor of the Texas School Book Depository.

Mr. GOLDSMITH. Mr. Groden, do any of these exhibits show a clear image of Lee Harvey Oswald in the sixth floor window?

Mr. GRODEN. They do not. The photographs, as we see them here, do not show a clear image of anybody.

Mr. GOLDSMITH. For what purpose did you bring these photographs to the attention of the committee?

Mr. GRODEN. In the case of the Hughes film on the left, when the film is viewed in motion, it is clearly evident that at least the appearance of movement is within the window which Oswald is said to have used. There is also movement in the next set of windows.

I felt that perhaps enhancement of this particular film and relevant frames of this entire sequence might show a comparison indicating movement within both windows and perhaps that it could be clarified enough or enhanced enough, we might be able to pick out something such as the color of a shirt or clothing.

I would not think that it would be clear enough to show anything in the way of features of an individual's face.

The one in the middle, the other photograph, could conceivably, since it was taken seconds after the shot was fired, could conceivably, from this angle, show some detail of someone still in that window in what was described as the sniper's nest, if, indeed, that's what it was.

Again, I felt, given scientific analysis which had not been done before, to my knowledge, that if there were an image back there in the shadows, it could be enhanced to the degree of bringing out such an image and it might show, due to the clarity of this particular photograph, if it was or was not Lee Harvey Oswald.

In the final photograph, the one on the right, it had been charged that that shape, that whitish shape we see in the window, could very well be the face and/or head or portion of the body of the assassin.

Therefore, I felt that with what was available to the public at that time, which was a very fuzzy black and white still, we might be able to determine whether that shape was or was not an assassin or someone in that window.

Mr. GOLDSMITH. To your knowledge, Mr. Groden, did the Warren Commission ever have the opportunity to do any sophisticated photoenhancement work on these materials?

Mr. GRODEN. I would say they did not. There is absolutely nothing in the record indicating that they did on these specific photographs.

Chairman STOKES. Excuse me just a moment. I understand members of the committee are having some difficulty understanding you. Since your head is sort of turned away from your mike, could you pull your mike up closer?

Mr. GRODEN. Is that better?

Chairman STOKES. That is much better. Thank you.

Mr. GRODEN. Do you want me to repeat what I just said?

Chairman STOKES. Would you, please?

Mr. GRODEN. Certainly. The question—would you repeat the question?

Mr. GOLDSMITH. My question was whether the Warren Commission had occasion to conduct any photoenhancement work on these materials.

Mr. GRODEN. And my answer to the question was, to the best of my knowledge, they did not and there is no indication in the record, they ever did.

Mr. GOLDSMITH. I would like, at this point, Mr. Groden, to turn to another area of Dealey Plaza, other than the Texas School Book Depository. I would like to ask you whether there is any photographic evidence that bears upon the Warren Commission's conclusion that there were no other gunmen in Dealey Plaza other than Lee Harvey Oswald?

Mr. GRODEN. Do you have a specific exhibit?

Mr. GOLDSMITH. Certainly. I will be glad to show you some exhibits.

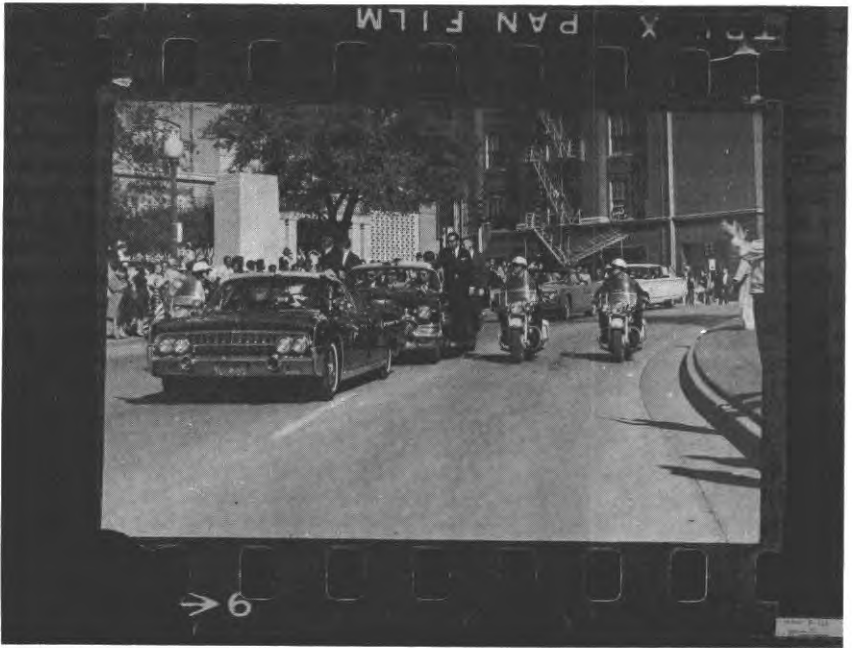
Mr. Chairman, at this time, I would like to refer to what has been marked as JFK exhibits F-126, F-128, F-129, F-155, F-267, and F-274. We are going to be looking at exhibits F-126 and F-128 right now.

I ask that all of the exhibits that I just referred to be admitted into the record.

Chairman STOKES. Without objection, they may be entered into the record.

[JFK exhibit F-274 was entered previously.]

[The above referred to exhibits follow:]

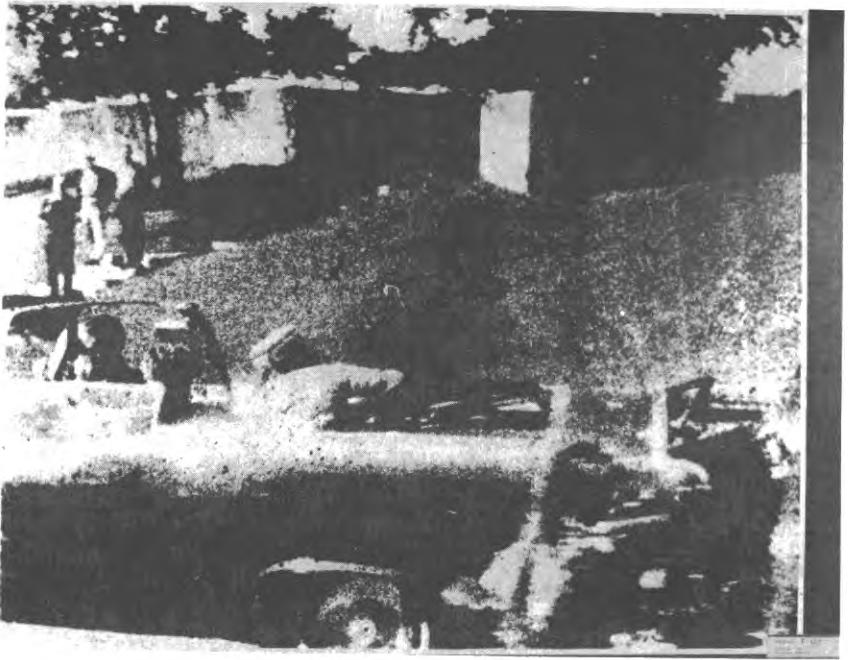


JFK EXHIBIT F-126



JFK Exhibit F-128

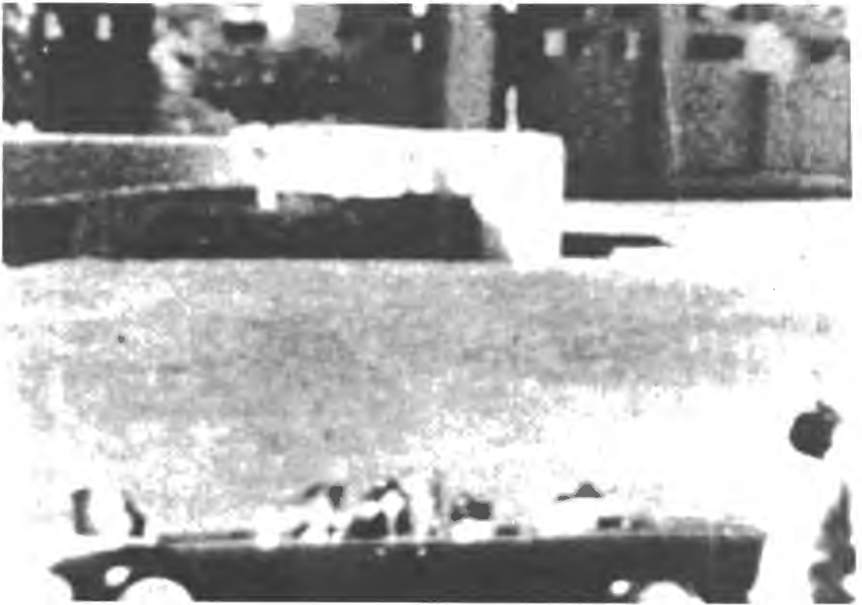




JFK ЕХНІВІТ F-129



JFK ЕХНІВІТ F-155



JFK EXHIBIT F-267

Mr. GOLDSMITH. I would also like to indicate for the record that Mr. Groden is going to be asked to discuss a series of exhibits. However, they are only a sample of the photographs that have been made available to this committee.

Mr. Groden, would you please identify these two exhibits?

Mr. GRODEN. These two exhibits are photographs taken from the same negative. A professional photographer for the Associated Press, James Altgens, took a series of five photographs, numbered 2, 3, 4, 5, 6, 7, and 8. There were seven photographs, I believe. This is negative No. 6, or the fifth in the sequence. On the photograph we see the entire photograph, including the sprocket holes of the film, and the borders of the entire image; and on the right, we see an extreme blowup of an area that includes the fire escape on what at the time was known as the Dallas Textile Building, and it shows a fire escape, and there is a man sitting on the fire escape, it is a black man with a white shirt on and dark trousers, and directly below him is an open window of a broom closet.

There is a shape coming out of the bottom of that window diagonally, from upper right to bottom left. It is difficult. A little bit further down, down and a little to the left, down a little farther. There we go. That is the image, and the question that has been raised by various critics of the Warren report was this a rifle or some weapon being projected through the window, and one of the reasons for asking this question is the shape does not appear later on in other photographs and the man who is sitting on the fire escape appears to be in some form of distress in relationship to other photographs which show him sitting on that fire escape just moments earlier.

Mr. GOLDSMITH. Thank you.

At this time, I would like to have the witness make reference to JFK exhibits F-129 and F-155.

Mr. Groden, would you identify these exhibits and then indicate what issues they posed to the committee's photographic evidence panel?

Mr. GRODEN. The photograph on the left is a print from a polaroid photograph taken by a witness named Mary Moorman. This is the second of two photographs which she took that day. It was taken the moment of the explosion of the President's head, or a fraction of a second after that. In the foreground, we see the Presidential limousine, Mrs. Kennedy is the lightish area there, and the President is right next to her.

In the foreground on the right we see part of the image of the flanking motorcycles. In the background, we see the area that has become known as the grassy knoll. On the left, at the top of the grassy knoll over three bystanders we see the stockade fence, on the top of the knoll which borders a parking lot, and on the left, from the center to the left we see, a little more to the right, there we go, from here to the right edge of the particular print we see a cement retaining wall, which is the front border of a set of steps.

The three witnesses in the background, Emmett Hudson, and two others, that are on the left, are standing on the steps that lead up behind that wall. On the right, we see a photograph taken by Phillip Willis, it is his fifth photograph, and it was taken at about the time of the first shot, and in the background we see the same information that we see in the other photograph, the Moorman photograph on the left.

Of course, here we see more of the limousine and more of Dealey Plaza in general.

Mr. GOLDSMITH. Now, specifically, what issue is raised by these photographs?

Mr. GRODEN. Behind the corner of that retaining wall, a little bit more to the left, there we go, at this point on the Moorman photograph, and at the end of the wall in the same position, right there, in the Willis photograph, there is a figure. This figure was standing in line almost to the degree in relationship to the rearward motion of the President's head. The figure is on the grassy knoll, has never been identified, at least to my knowledge, as to identity of this figure, and after the assassination, there is some testimony in the record as to this figure running away to the west or to the north and being chased by other witnesses.

The possibility that this could be a gunman on the grassy knoll is the reason why I raised the issue in the first place. There is somebody there. The question is, who was he and what was he doing there, and I felt that sufficient photoanalysis of these and other photographs of the same person on the knoll, there are some half dozen, at least, might give some clue as to his identity so he could be questioned in this matter.

Mr. GOLDSMITH. Thank you.

At this time, I would like to make reference to JFK exhibits F-267 and F-274. Again, Mr. Groden, I would ask you to identify these photographs and indicate what issues they raise.

Mr. GRODEN. The photograph on the right is the 413th frame of the Zapruder film. It may be difficult to see because the bottom of

the easel is covering up part of it. But in the foreground of this photograph is a head, the head of somebody. This photograph, what we are seeing here, is a cropping of the fullframe. At the bottom of the frame we see branches of a tree, and leaves of a tree. Through the tree and 54 feet away from Zapruder camera is this head shape at the bottom of the photograph. The man is not in or anywhere near the tree.

I would like to state that for the record. That at the end of the retaining wall, 54 feet away, I believe this to be the same man who appeared in the Moorman and Willis photographs that we just viewed a few moments ago.

Coming from the figure of the head, there appears to be a straight object, from the lower right, by the head, heading upward and to the left to about that point, not quite that far, a little bit farther down, down—right there no down along that line on the same axis. There seems to be a shape that resembles a rifle. It could be a rifle, it could be a branch of a tree, it could be a broomstick handle, it is unclear as to what it is.

And I felt that perhaps enhancement of this photograph might give some clue as to whether or not there is someone there with a rifle.

Mr. GOLDSMITH. Mr. Groden, before you proceed, can you explain what effect there is in the quality of the photograph when it is enlarged from a standard size to the size of an exhibit?

Mr. GRODEN. Well, the first obvious thing that happens is the grain of the film is enlarged along with the image and, therefore, it gets fuzzier and fuzzier. It also tends to build up contrast with generations, and the finer areas tend to either overshadow or be washed out.

For instance, at the diagonal shape going upward to the left, at the tip of it there is a somewhat larger appendage, just above that line, yet it seems to close in around it. The skin tones of the bottom of the neck and the ear of this man tend to change slightly in enlargement.

Mr. GOLDSMITH. Does enlarging a photograph make it easier or more difficult to look for detail?

Mr. GRODEN. Far more difficult. This is just representative of the fact there was an issue raised in relationship to this specific frame, which is one of 18 consecutive frames. It is the clearest of the 18 consecutive frames showing this figure or the back of a man's head.

Mr. GOLDSMITH. I understand. Would you now refer to the exhibit on the left, and again Mr. Groden, I would ask you to speak up somewhat.

Mr. GRODEN. OK. This is a frame from the film taken by Orville Nix. It corresponds to the 313th frame of the Zapruder film, or the moment of impact on the President's head.

In the background, in the center, we see Abraham Zapruder and his Secretary, Marian Sitzman, as they are taking the film from the other side of the street, and on the extreme left, by the cement wall of a structure which we call a cupola, is what appears to be a man in a classic military firing position.

The film itself is of poor quality, the camera was not an expensive one, and the lens was not particularly sharp. The figure is there, does appear to be in motion, and in a later sequence of the

film seems to have disappeared. I felt that perhaps the allegation of whether this is or is not a gunman on the grassy knoll might be addressed scientifically by the photographic panel.

Mr. GOLDSMITH. Thank you.

Again, Mr. Groden, I would like to ask you, have any of the exhibits which have just been reviewed, to your knowledge, been subjected to sophisticated photo-enhancement techniques?

Mr. GRODEN. Prior to this time, I do not believe so, at least to the best of my knowledge.

Mr. GOLDSMITH. Mr. Groden, what issues presented to the committee's scientific panels have been raised by the various photographs depicting the crowd in Dealey Plaza at the time of the assassination and shortly thereafter?

Mr. GRODEN. Basically, the two major issues deal with possible co-conspirators or other unidentified witnesses that may be identified now, that is No. 1, and No. 2 is a possible alibi for Lee Harvey Oswald.

Mr. GOLDSMITH. I am sorry, I did not hear your second answer.

Mr. GRODEN. A possible alibi for Lee Harvey Oswald, that is, if he were viewed on the first floor, or in a crowd downstairs at the time of the shooting, he could not have been upstairs on the sixth floor firing at the same time.

Mr. GOLDSMITH. I understand, and we will get into that in more detail in a moment.

You made reference a moment ago to questions pertaining to conspiracy. What types of questions related to conspiracy were raised by the photographic evidence?

Mr. GRODEN. Well, the two major issues were relating to a man who has become known as the umbrella man, and one dealing with a character by the name of, or I should say a person by the name of Joseph Milteer. Photographic evidence has been presented in the past, through the last few years, dealing with these individuals asking questions but giving no answers, and I felt that perhaps enhancement of these photographs for anthropological examination or just photo-enhancement itself might give us a clue, positive or negative, relating to these individuals and a few others.

Mr. GOLDSMITH. At this time I would ask that what has been marked as JFK F-130 be shown to the witness, and, Mr. Chairman, I ask that this exhibit be entered into the record.

Chairman STOKES. Without objection it may be entered into the record.

Mr. GOLDSMITH. Thank you.

[The above referred to exhibit JFK F-130, follows:]



JFK EXHIBIT F-130

Mr. GOLDSMITH. Mr. Groden, I would ask you to identify this exhibit and then to indicate what questions this exhibit raises about the individual whom you refer to as the umbrella man?

Mr. GRODEN. Basically, I would say there are two issues raised here. No. 1 is what he was doing during the assassination, and another one being what he did immediately following the assassination. The lower left hand area is a frame from the Zapruder film, and that area which is highlighted in red but has the arrow pointing to it is the open umbrella of the umbrella man, which is why he has been called that. He was an unidentified witness.

At the time of the assassination that man and the man that we see on the right hand side of the same photograph with his arm raised in a wave, the same photograph, on the lower left. There we go. The man raising his hand who appears to have been with the umbrella man, they were standing next to each other and as the President's car went by, the man we call the umbrella man opened his umbrella and raised it as the President went by, pumped it in the air and turned it in a clockwise manner. This is very evident in the Zapruder film.

The photographs on the top indicate that immediately following the assassination, within seconds of the assassination, he closed up the umbrella and while other people were running away or dropping to the ground or paying attention to the motorcade his reac-

tion always seemed to be quite contrary to the others. While others were dropping to the ground or running away he stood there quite at peace with himself, or at least photographically it appears that way, and he stood there.

He stayed there for quite some time and eventually sat down on the curb as we see in the lower right hand portion of the exhibit, and he is sitting down. You can't see it now, there is a photographer in the way, but there is a man sitting next to him with white socks on. This is the same man who is waving in the Zapruder frame. They sat there for some time talking to each other with the umbrella on the sidewalk next to the umbrella man.

Mr. GOLDSMITH. Was the Warren Commission, Mr. Groden, ever able to identify this individual?

Mr. GRODEN. This man and the information around him was not made an issue until several years after the Warren Commission report was issued. They had no reason to look into this particular area.

Mr. GOLDSMITH. You made reference earlier to an individual named Milteer who you said may have been a co-conspirator. Would you explain to the committee who this individual Milteer was and what basis there was for regarding him as a possible conspirator against JFK?

Mr. GRODEN. Joseph Adams Milteer was an ultra right winger, a member of the National States Rights Party, Ku Klux Klan, and various other right wing organizations. Some 2 weeks before the assassination of President Kennedy an undercover agent, undercover informant for the FBI and Miami police named William Somerset, tape recorded a conversation between himself and Milteer. In this conversation, Milteer said the plans were in the works for the assassination of President Kennedy. It would be done using a high-powered rifle from an office building, the rifle would be broken down, taken into the building, used for the assassination, broken down and removed from the building, and that a patsy would be picked up by the police very soon after the fact to throw the police off and satisfy the public.

Now this was 2 weeks before the assassination of President Kennedy. The tapes were made available to law enforcement organizations, including the Miami police and FBI, so the verification that it was a genuine tape before the fact can be proven.

The day of the assassination Milteer made a long distance phone call from Dallas to the same informant, who by the way obviously he didn't know was an informant, but who had been a boyhood friend, Somerset. He called him and said you won't see your friend Kennedy in Miami again, and ended the conversation quite abruptly, and, of course, the President was shot in Dallas that day.

The day following the assassination, in Miami, no, I believe it was Jacksonville, in Florida, Milteer met with Somerset and said, see, it went according to plan. I have the exact testimony. I don't think it is necessary at this point.

Mr. GOLDSMITH. No, it is not necessary for you to summarize the exact testimony.

Mr. GRODEN. He said it happened just as I said it would, I wasn't doing any guessing.

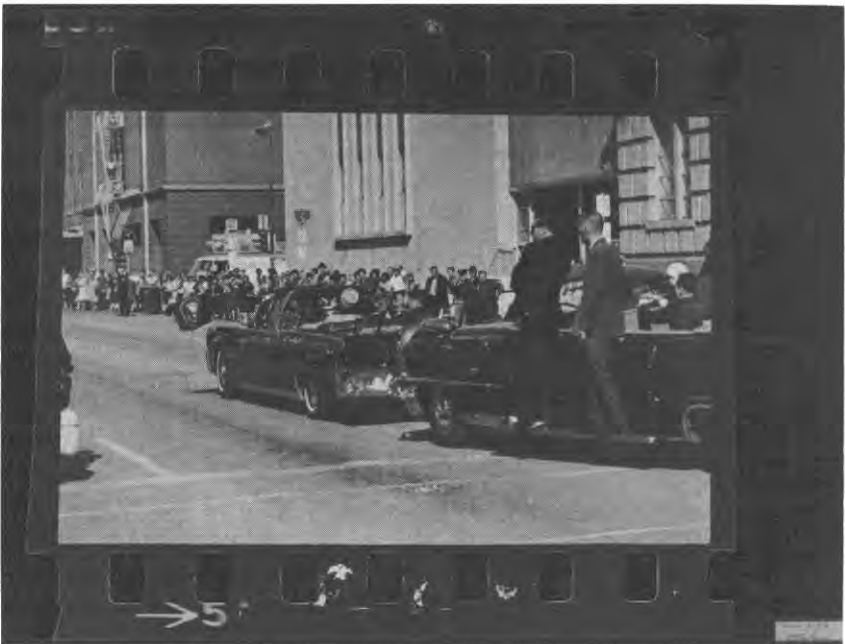
If, indeed, the whole story is true, and much of the evidence might tend to show that it is—if indeed Milteer was in Dallas, it could be assumed that he was in Dealey Plaza that day, viewing the assassination. A photograph taken by James Altgens, the man who took the photographs we saw before showing the first escape, the photograph before that one shows the crowd lining the east side of Houston Street, and in that crowd is a man who bears a very, very close resemblance to Joseph Milteer.

Mr. GOLDSMITH. We are going to take a look at that photograph, Mr. Groden. At this time I would like to refer to JFK exhibits F-124 and F-125.

Mr. Chairman, I ask that these exhibits be entered into the record.

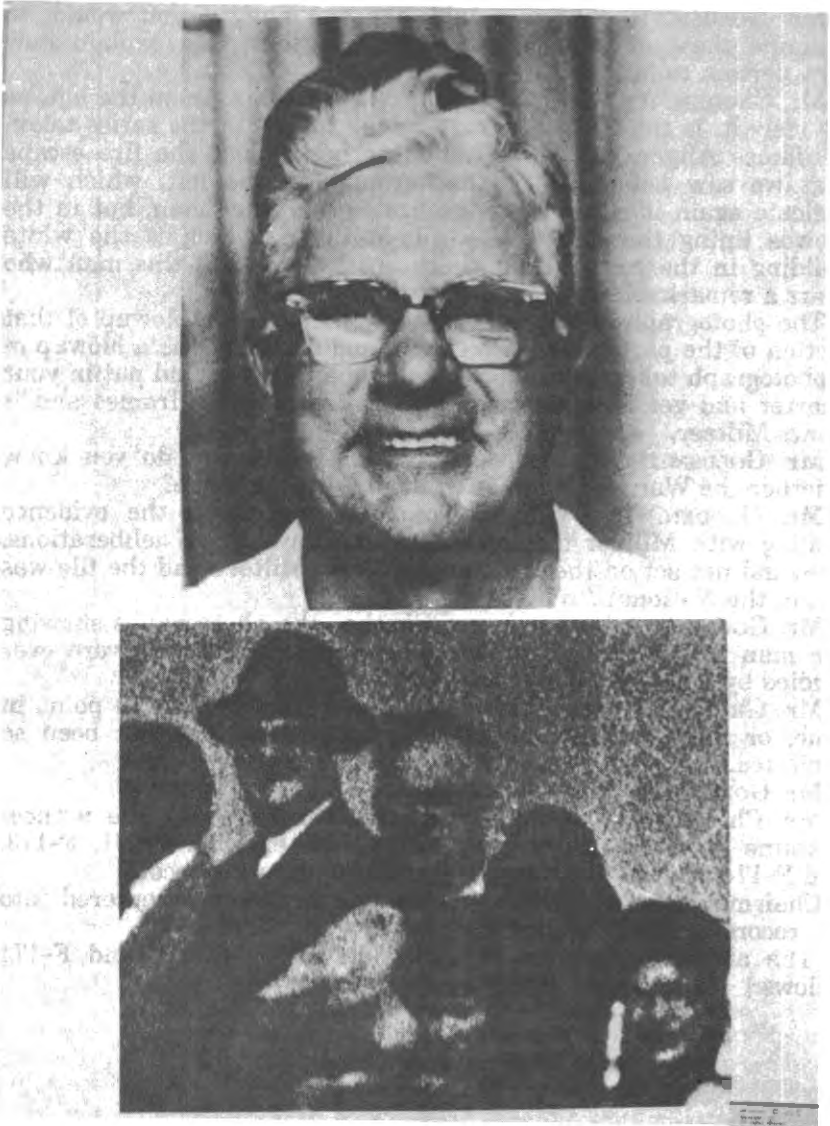
Chairman STOKES. Without objection, they may be entered into the record.

[The above referred to JFK exhibits F-124 and F-125 follow:]



JFK EXHIBIT F-124





JFK EXHIBIT F-125

Mr. GOLDSMITH. Before I ask you to discuss these photographs, Mr. Groden, I would like to clarify something. You made reference to one tape recorded statement made by Milteer and to two other conversations as well. In total, how many of the conversations were tape recorded, to your knowledge?

Mr. GRODEN. To my knowledge, only the initial conversation that included the threat was actually tape recorded, the rest was the testimony or the reports, FBI or Miami police reports, of William Somerset relating to his subsequent meetings with Milteer.

Mr. GOLDSMITH. Fine, I would like you now, if you would, to examine these exhibits, identify them, rather, and explain how they pertain to Milteer.

Mr. GRODEN. As I described before, the photograph on the left, as we view it, is the No. 5 negative or the fourth in the series taken by James Altgens. It shows, among other things, the fire escape that we saw before in the background on the left, which will indicate again it is a cross reference to the other man, but in the crowds lining the County Records Building, which is the white building in the center right there, in the crowd is this man who bears a remarkable resemblance to Joseph Milteer.

The photograph on the right, on the bottom, is a blowup of that section of the particular photograph, and on the top is a blowup of a photograph taken in a photo booth, where you go and put in your quarter and get four pictures. This is one of those frames and it shows Milteer.

Mr. GOLDSMITH. Mr. Groden, to your knowledge, do you know whether the Warren Commission dealt with this issue?

Mr. GRODEN. The Warren Commission received the evidence dealing with Milteer during the closing days of its deliberations. They did not act on the information about Milteer and the file was put in the National Archives.

Mr. GOLDSMITH. Do you know whether the photographs showing the man in the crowd and the photograph of Milteer were ever studied by forensic anthropologists?

Mr. GRODEN. To the best of my knowledge, up to this point in time, or until the life of this committee, they had not been so subjected.

Mr. GOLDSMITH. Thank you.

Mr. Chairman, I would like at this time to have the witness examine what have been marked as JFK exhibits F-131, F-173, and F-174. I move that they be introduced into the record.

Chairman STOKES. Without objection, they may be entered into the record at this point.

[The above referred to JFK exhibits F-131, F-173 and F-174 follows:]





## JFK EXHIBIT F-174

Mr. GOLDSMITH. Mr. Groden, would you please identify these exhibits and explain what issues they raise?

Mr. GRODEN. The four photographs in the exhibit on the left are four of seven photographs depicting the arrest or detainment of three individuals which have become known as in quote "the tramps."

They were arrested very soon after the assassination, behind the depository on a railroad boxcar. They were taken across in front of the depository, diagonally across Elm and Houston, toward Main and the jail. These people have become a tremendous issue in the last couple of years because there is no record of the arrest. They

were picked up in relationship to the assassination but no records were kept of the arrests. There were no official photographs of them, no fingerprints or identification were ever taken or made.

The two exhibits, the one in the center and the one on the right, I believe would represent attempts to identify these people. The allegations were made sometime around 1976 that the taller of the three tramps could very well be Frank Sturgis of Watergate fame and that the shorter of the three, the shortest of the three, might be E. Howard Hunt, again of Watergate fame.

This opinion was certainly not shared by all of the critics but the issue was put forward, thereby creating the need to try to identify these people, which probably should have been done anyway, and it had not been.

The man on the left in the center exhibit is Frank Sturgis. The man on the right is the tall tramp. In the photograph, the exhibit on the right, the short tramp is at the top. E. Howard Hunt is on the left and the man on the bottom is a man named Fred Lee Crissman, who is another ultra right winger, a member of the Minuteman. He has become a prime suspect for critics of the report as a candidate to be the short tramp.

I might also add this brings up a point which I didn't mention before, and I probably should have.

Mr. GOLDSMITH. Please do.

Mr. GRODEN. Mr. Milteer, the man we have just mentioned, died in 1974 at the age of 72, after a freak accident, where a Coleman heating stove exploded. He was hospitalized for a while and then some weeks afterward dies, and the explosion of the stove was given to be the cause of death.

Crissman died prior to this point in time. I am unclear as to when, but he is no longer alive either.

Chairman STOKES. We are still having some difficulty hearing you, if you will pull that mike up a little closer.

Mr. MCKINNEY. I couldn't hear about the explosion.

Mr. GRODEN. I am sorry. The issue that I was speaking about at the time was the death of Milteer. He had a Coleman heating stove and there was an explosion and he suffered burns on his legs, and this was attributed to be the cause of death.

Mr. GOLDSMITH. Mr. Groden, you made reference earlier to photographic evidence that you indicated gave rise to the possibility of an alibi defense for Lee Harvey Oswald. Which photograph were you referring to?

Mr. GRODEN. For that we have to go back to the exhibit we had before, the No. 6 negative of the Altgens series.

Mr. GOLDSMITH. At this time I would request that the witness be given an opportunity to take a look at JFK exhibit F-126 and what has been marked as JFK F-127. JFK F-126 has already been admitted into the record. Mr. Chairman, I request that JFK F-127 now be admitted into the record.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[The above referred to JFK exhibit F-127 follows:]



JFK EXHIBIT F-127

Mr. GOLDSMITH. Mr. Groden, referring to these exhibits, would you identify what they are and discuss how they relate to a possible alibi defense for Lee Harvey Oswald?

Mr. GRODEN. The exhibit on the left is again the full frame photograph taken by James Altgens. It shows in the foreground the Presidential limousine, Secret Service followup car, and the flanking motorcycles that were just to the rear, to the right and the left of the President's limousine.

In the background is the front and top and bottom two stories of the Texas School Book Depository, including the doorway. Within that doorway is the figure of a man, which is the second figure from the left in the exhibit on the right.

A great deal of the issue as to whether Oswald was involved in a conspiracy or whether he was involved at all to kill the President, or if indeed as a lone assassin whether he pulled the trigger, has related to this particular photograph.

The man in the photograph bears a striking resemblance to Lee Harvey Oswald. Again, that would be the second from the left. Lee Harvey Oswald, of course, is the man on the extreme left. The two photographs on the right are Billy Nolan Lovelady, a coworker in the depository, who bore a very, very strong resemblance to Lee Harvey Oswald.

Very soon after the actual assassination of the President, this photograph was discovered and the man in the doorway was seen, and the question that was initially raised, was this Lee Harvey Oswald? If it was him on the first floor, it could not be him firing from the sixth floor.

The FBI went back and investigated and established this was Billy Nolan Lovelady. The question still persisted, however,

through the years because the clothing on the photograph as we view it does not match the clothing that the FBI said Lovelady was wearing that day, which would be a short sleeved broad red and white striped shirt. The man in the doorway appears to be wearing a tweed or plaid type of design which more closely resembles the over shirt worn by Oswald that day.

Mr. GOLDSMITH. Mr. Groden, taking a look at the exhibit on the left, is it possible to correlate that with the Zapruder film?

Mr. GRODEN. This photograph was taken at the approximate midline of the shooting sequence about frame 255 of the Zapruder film, give or take a few frames.

Mr. GOLDSMITH. Excuse me, I am sorry, is the President showing a reaction?

Mr. GRODEN. The President has been struck, his arms are already in the clutching motion, Mrs. Kennedy's left white gloved hand is attempting to aid her husband. By now she must be aware something is wrong and she is trying to assist and see what is happening or grasp the situation. I would assume that is about what we are seeing.

Governor Connally had turned back into his wife's arms and is now looking over his shoulder after he has turned. So the two men by this point have been struck.

Mr. GOLDSMITH. To your knowledge, Mr. Groden, prior to 1978, have these photographs and others showing Oswald and Lovelady, been examined by any forensic anthropologists?

Mr. GRODEN. To the best of my knowledge; they have not.

Mr. GOLDSMITH. Mr. Groden, have you had an opportunity to examine the pictures of Lee Harvey Oswald that were taken from his home in Dallas that show him holding a rifle in one hand and a socialist newspaper in another hand?

Mr. GRODEN. Yes, I have. I have examined them quite closely.

Mr. GOLDSMITH. At this time I would ask that the witness be given an opportunity to examine JFK exhibit F-179.

Mr. Chairman, I move that this exhibit be entered into the record.

Chairman STOKES. Without objection, it may be entered into the record.

[The above referred to JFK exhibit F-179 follows:]



JFK EXHIBIT F-179

Mr. GOLDSMITH. Mr. Groden. Would you please identify this exhibit?

Mr. GRODEN. This exhibit displays two photographs found in Oswald's garage, the garage owned by Mrs. Ruth Paine, where Mrs. Oswald was staying in Irving, Tex. They were found after the assassination, and they depict a man holding a rifle, wearing a pistol on his right hip, and holding two Socialist newspapers, the Militant and the Daily Worker. The face on the photograph would seem to be that of Lee Harvey Oswald.

Mr. GOLDSMITH. What question has been raised about these particular photographs?

Mr. GRODEN. The first question raised about one of these photographs, the photograph on the left, which is indented as 133-A, were shown to Lee Harvey Oswald the afternoon of the assassination. Or let me clarify that. It may be the afternoon of the assassination or it may have been the next day. For the moment I am not clear on that. He was shown the photograph and he said this photograph is a fake. He said I know how this is done, it is my face but not my body, I could show you how it is done. He never got the opportunity to do so.

But the issue was raised at that point were these photographs genuine or not.

Mr. GOLDSMITH. How did the Warren Commission deal with this issue.

Mr. GRODEN. The Warren Commission had their investigative arm, the FBI, examine the photographs and run some tests on them, including testing the camera to which these photographs were supposed to have been taken. The conclusion was that the



photograph was almost definitely taken with Oswald's camera, an Imperial Reflex, and that although they could not prove that the photographs were genuine, it seemed to them in all likelihood that they were indeed genuine.

In other words, they could find no definite signs of fakery in the photographs.

Mr. GOLDSMITH. Fine. At this point, I would ask that the witness be given an opportunity to refer to what has been marked as JFK exhibit F-270.

Mr. GRODEN. I might also add that the Dallas police at the time of the discovery of these two photographs, also found one negative. The one that would belong or coincide with F-133-B.

Mr. GOLDSMITH. This negative was examined by the FBI?

Mr. GRODEN. Yes, it was.

Mr. GOLDSMITH. Mr. Chairman, I request that JFK exhibit F-270 be entered into the record.

Chairman STOKES. Without objection, it may be entered into the record.

[The above referred JFK exhibit F-270 follows:]



JFK EXHIBIT F-270

Mr. GOLDSMITH. And, Mr. Groden, referring to both of these exhibits, I would ask you at this point to explain on what basis the Warren Commission's conclusion regarding the exhibit on the left, specifically the conclusion that the photographs are authentic, has been criticized?

Mr. GRODEN. There have been a lot of issues raised about these photographs through the years by the critics of the Warren report.

For instance, among them, the most credible of the arguments are the size ratio between the length of the rifle, which is now in the Archives and in relationship to the height of the man in the photographs. Indeed, the height of the man in one photograph in relationship to one in the other, there seems to be a 4 or 5 inch disparity in height between the two photographs. A different falling of shadows, for instance. In one photograph the head tilts to a different angle yet the relationship of the shadow under the nose to the mouth does not change with the shadows in the rest of the picture, as it should, but rather stays in relationship to the angle of the face.

More than any other issues, I think, however, relate to what Oswald had said, that is, that his face had been pasted on another person's body, and through the years much study has indicated that there is evidence of a line, a crop or paste line through the center of Oswald's chin, occurring at that point. It starts at one edge of the head, of the neck, and goes on to the other, and there seems to be a slight misalignment of the neckline as it travels downward from the head toward the shoulders on both sides of the head. This occurs only on F-133A, as viewed here.

On F-133B, it is not sufficiently sharp to see this type of a line. There again seem to be problems with that photograph as well, but the main issue that we are dealing with here is what appears to be a paste line through Oswald's chin.

Mr. GOLDSMITH. Have any other questions been raised about the chin itself?

Mr. GRODEN. This is very well demonstrated by the exhibit on the right. Oswald in the arrest photograph that we see on the left had a pointed chin with a cleft in it, and a not particularly muscular neck. The man on the right however, seems to have a squarish chin, without a cleft, and a slightly more muscular neck.

Even taking into consideration the difference in the angle the photograph may have been taken, there does seem to be quite a difference in the two chins.

Mr. GOLDSMITH. Turning to another aspect of this photograph, Mr. Groden, what finding, if any, did the Warren Commission make concerning the rifle that Oswald is shown holding in these picture?

Mr. GRODEN. Although they could not verify completely or be 100 percent sure the rifle in that photograph was the one that was found in the depository, they did use it as part of their conclusion that Oswald did indeed own that rifle. They said in all likelihood it was the same, it bore the same general configuration, but there were no sufficient identifying marks that would be peculiar to that particular rifle over any other of the same product run.

Mr. GOLDSMITH. So are you saying then that the Warren Commission was unable to make a positive identification of the rifle but, nevertheless, concluded generally that this was the rifle that Oswald used for the assassination?

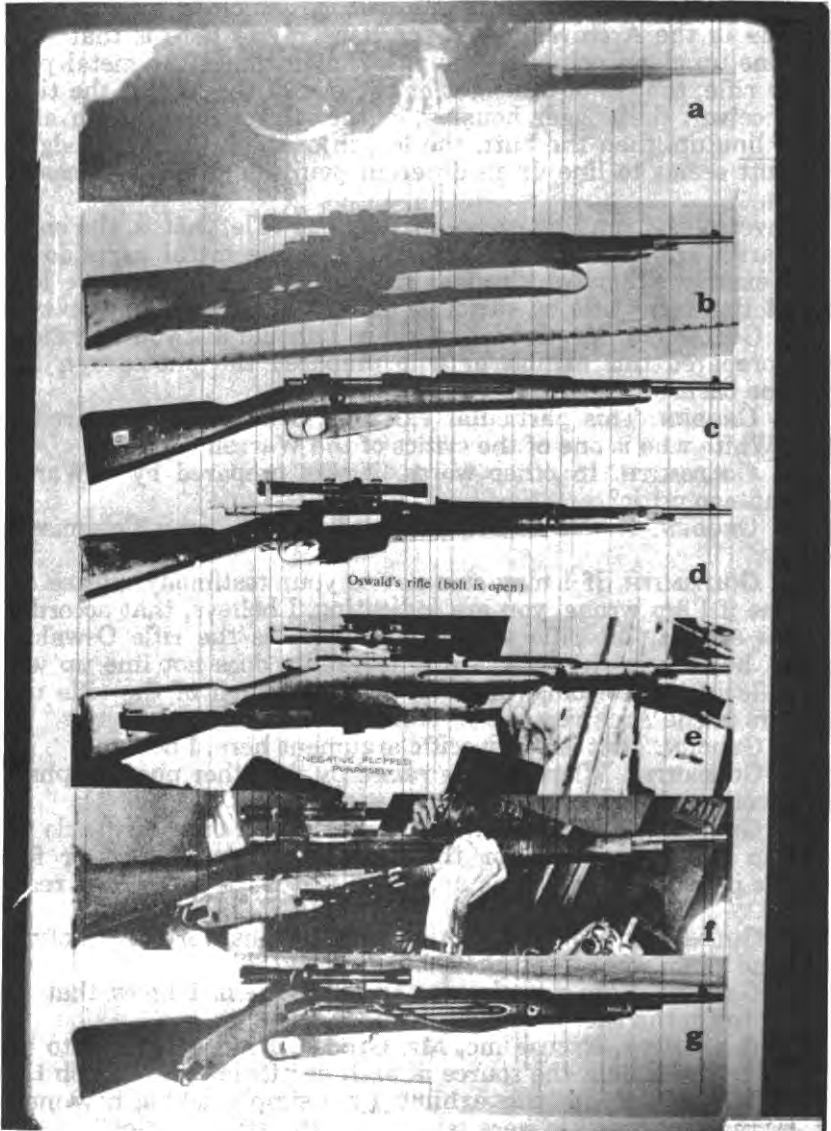
Mr. GRODEN. That is correct.

Mr. GOLDSMITH. At this time I would request that the witness be given an opportunity to examine JFK F-208.

Mr. Chairman, I ask that this exhibit be introduced into the record.

Chairman STOKES. Without objection, it may be entered into the record.

[The above referred to JFK exhibit F-208 follows:]



JFK EXHIBIT F-208

Mr. GOLDSMITH. Mr. Groden, referring to this exhibit, would you explain on what basis the Warren Commission's conclusion concerning the rifle has been questioned?

Mr. GRODEN. The major question relating to this rifle starts with a fact that there were several reports of different rifles being found and the comparison, the photographic comparison of the various

photographs of the rifle which is in question, the Mannlicher-Carcano C-2766, starting with the photograph on top, which is one of the backyard photographs, as we see here, 133-A, going through various other photographs and stages of photography dealing with that particular rifle, down to the bottom, which is the rifle as it appears in the Archives today, the issue raised here is that when you line up given points on the rifle, for instance, the metal parts of the rifle, the tip of the sight or the end of the barrel, the tip of the receiver, the trigger housing, or the trigger itself, when all of those line up, then the butt, the length of the butt or the edge of the butt seems to line up in different points to different measurements.

Conversely, if you line up both tips of the rifle, that is, the end of the barrel and the end of the stock, then the metal parts do not aline exactly either, which gives rise to the question, are we looking at the same rifle or various different rifles of a similar type.

Mr. GOLDSMITH. Mr. Groden, perhaps I should ask you to indicate who prepared this exhibit or who prepared the photograph that was the basis for this exhibit?

Mr. GRODEN. This particular exhibit I believe was prepared by Jack White who is one of the critics of the Warren report.

Mr. GOLDSMITH. In other words, it was prepared by a Warren Commission critic?

Mr. GRODEN. It was indeed prepared by a Warren Commission critic.

Mr. GOLDSMITH. If I may summarize your testimony, please correct me if I am wrong, you are indicating, I believe, that according to this exhibit, the rifle at the top, which is the rifle Oswald is shown holding in the backyard photograph, does not line up with the rifle in the bottom, which is the photograph of the rifle that appears in the Archives, is that correct?

Mr. GRODEN. That is the specific argument here, I believe.

Mr. GOLDSMITH. What issue is raised by the other photographs or by the other rifles that appear in that exhibit?

Mr. GRODEN. Simply that the different points on the rifle do not line up with either one or the other. There are three or four specific points that don't line up, which if it is the same rifle, really should.

Mr. GOLDSMITH. How many other photographs were taken of this rifle and when were they taken, if you know?

Mr. GRODEN. I am not clear as to all of them. I know that the one on top is the backyard photograph.

Mr. GOLDSMITH. Excuse me, Mr. Groden, I am not going to ask you to try to explain the source of each particular photograph that served as the basis for this exhibit. I am simply asking how many photographs of the rifle were taken after the assassination?

Mr. GRODEN. I would say countless, countless photographs. I don't know exactly how many.

Mr. GOLDSMITH. And were some of those photographs used as the basis for this exhibit?

Mr. GRODEN. Yes, they were. I see some as the rifle was removed from the depository, which were some of the first photographs we saw of them, or that we have of them, some of the earliest ones,

some in the police station, probably, but it is during various stages and from different sources.

Mr. GOLDSMITH. Now, examining the exhibit, is your testimony that the rifle as shown there also fails to line up consistently?

Mr. GRODEN. Quite frankly they do seem to have a problem lining up. They don't seem to line up exactly.

Mr. GOLDSMITH. Was there ever any question about how many rifles were discovered in Dealey Plaza?

Mr. GRODEN. Yes, there was. Initially, the first report was that—one of the first reports was that a rifle was found on the roof and the specific rifle we are talking about now was originally described as a Mauser of a different caliber.

That is what gave rise to the question initially and then there is the question of the length of the rifle that Oswald was supposed to have ordered and the length of the one that is in the Archives at this point. So the question has been raised several times for various different reasons, and for that reason, I think that this is a very valid test to check the analysis out.

Mr. GOLDSMITH. Fine, now other than the backyard photographs of Oswald, to your knowledge, what other photographs pertaining to this case itself, to the Kennedy assassination case, have been questioned with regard to their authenticity?

Mr. GRODEN. Some of the photographs dealing with Lee Harvey Oswald earlier on in his life have become recently under fire as to whether or not they are genuine or not. An issue has been raised whether the Lee Harvey Oswald that was alleged to have shot the President and was arrested in Dallas was eventually shot by Jack Ruby was the Lee Harvey Oswald of history, the one who had been Lee Harvey Oswald up until going to the Soviet Union.

Mr. GOLDSMITH. Has any question been raised about the Kennedy autopsy photographs?

Mr. GRODEN. The autopsy photographs also came into a great deal of challenge by the Warren Commission critics in that the reports dealing with the autopsy photographs from different groups going into the Archives to view them gave such markedly different results, at least verbal results, as described in relationship to each other and to the medical personnel at Parkland Hospital who seem to describe totally different wounds than those seen in the photographs described.

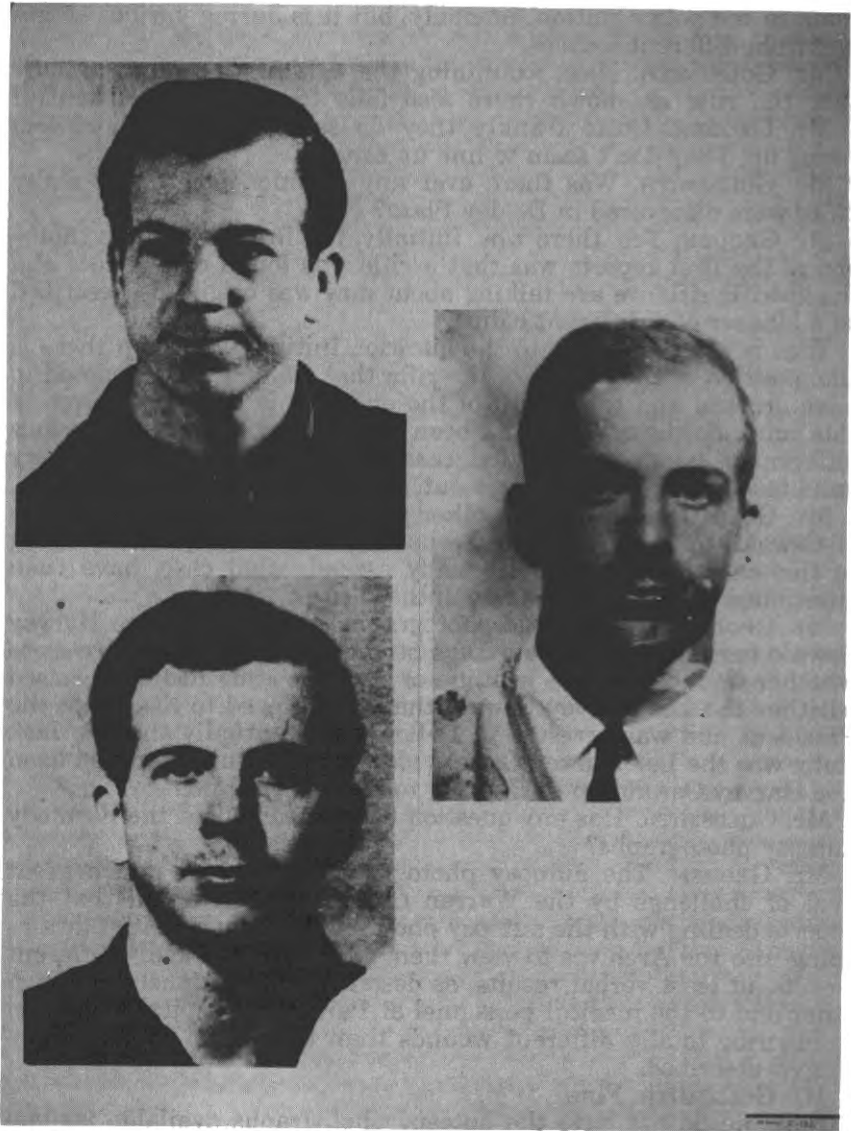
Mr. GOLDSMITH. Fine.

Now, we do not have the autopsy photographs available for you to examine, Mr. Groden, at least not today. You have made reference earlier to photographs of Oswald taken of him while he was in the Soviet Union, and at this time I would like you to refer to what has been marked as JFK exhibits F-132 and F-166.

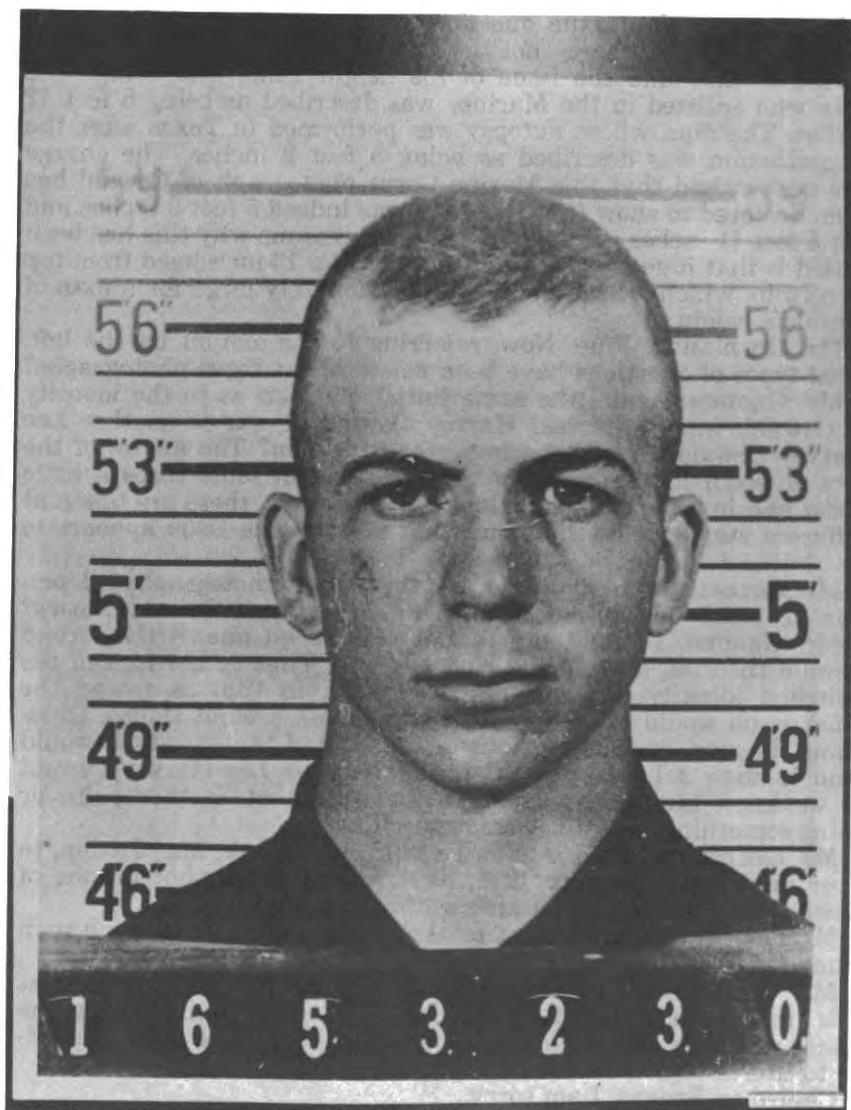
I ask, Mr. Chairman, that these exhibits be entered into the record.

Chairman STOKES. Without objection, they may be entered into the record.

[The above referred to JFK exhibits F-132 and F-166 follow:]



JFK Ехнівіт F-132



JFK EXHIBIT F-166

Mr. GOLDSMITH. Would you identify these exhibits and explain what issue they raise?

Mr. GRODEN. The exhibit on the left shows three separate photographs taken at different times of either a or the Lee Harvey Oswald. The photograph on the right, the exhibit on the right, represents the Marine photograph showing Oswald and allegedly his height.

Mr. GOLDSMITH. What issue is raised by that photograph, Mr. Groden?

Mr. GRODEN. Well, the question as to the identity of the man who was alleged to have shot the President has been raised over a period of time and the issue of his height came into being. The man who enlisted in the Marines was described as being 5 feet 11 inches. The man whose autopsy was performed in Texas after the assassination was described as being 5 feet 9 inches. The charge has been raised that this Marine Corps photograph of Oswald has been doctored to show that this man was indeed 5 feet 9 inches and not 5 feet 11 inches, and one of the main reasons why this has been raised is that it seems to show a man with a 13-inch head from top to bottom, which would seem disproportionately large for a man of Oswald's height.

Mr. GOLDSMITH. Fine. Now, referring to the exhibit on the left, what types of questions have been raised about these photographs?

Mr. GRODEN. Again, the same initial question as to the identity of Oswald, was it the real Harvey Oswald or was it another Lee Harvey Oswald or someone impersonating him? The angles of the face do seem to change from time to time, in some cases a little wider and in some cases a little taller. Of course, these are taken at different stages in his life. But, that is what the issue appears to be.

Mr. GOLDSMITH. Is it fair to say that these photographs all pertain to what has become known as the second Oswald theory?

Mr. GRODEN. I would say that it reflects on one of the second Oswald theories, there being basically two. That is, the idea of the switched identity or an imposter Oswald, in that case, and the other issue would relate to various incidents around Dallas, Oklahoma, Mexico, various portions of the United States, which would tend to show a Lee Harvey Oswald when the Lee Harvey Oswald as we know him would appear to have been at another point or doing something else at the same specific time.

Mr. GOLDSMITH. Fine. Again, I would like to ask, Mr. Groden, to your knowledge, prior to 1978, have any of these photographs of Oswald been studied by forensic anthropologists?

Mr. GRODEN. To the best of my knowledge, no; I know of no such study.

Mr. GOLDSMITH. Mr. Chairman, I have no further questions at this time. I would like to thank Mr. Groden for summarizing the issues raised by the photographic evidence that have been presented to this committee's scientific panels.

Chairman STOKES. I am sorry.

Mr. GOLDSMITH. I simply indicated, Mr. Chairman, I have no further questions at this time.

Chairman STOKES. The Chair recognizes the gentleman from North Carolina, Mr. Preyer.

Mr. PREYER. Thank you, Mr. Chairman.

I gather, Mr. Groden, that what you have been doing for us is outlining issues which have been raised in the critical community by various photographs?

Mr. GRODEN. Yes, sir, indeed those which could be addressed by the medical or photographic panels.

Mr. PREYER. And you are not attempting to answer those for us this afternoon?

Mr. GRODEN. Not this afternoon; no, sir.



Mr. PREYER. So this is a stay tuned next week part of the program today.

I won't go into the answers to those tantilizing questions but will await further news on that.

I did just want to ask you one question. From the Zapruder film and your analysis of that, is it your opinion that the first shot that hit President Kennedy also hit Governor Connally? I wasn't quite clear on your description of that.

Mr. GRODEN. It would appear photographically that analysis of the film would show that the two men were struck by at least two if not more separate nonfatal shots prior to the head shot.

Mr. PREYER. Would you say that again, each man was hit by at least two shots?

Mr. GRODEN. No, more than the single bullet was involved in the actual nonfatal wounding of both men. It would, at least my analysis of the film through the years would tend to show that.

Mr. PREYER. But you are not giving your opinion as to whether the shot which hit President Kennedy in the throat, the first shot, whether that was the shot that hit Governor Connally or not?

Mr. GRODEN. I do not believe that they are the same bullet. I severely question that particular conclusion.

Mr. PREYER. Thank you, Mr. Chairman.

Chairman STOKES. Time of the gentleman has expired.

The Chair recognizes the gentleman from Ohio, Mr. Devine.

Mr. DEVINE. Mr. Groden, in your photographic analysis of the Zapruder film—let me backtrack a moment—were you here in the room this morning when Governor Connally testified?

Mr. GRODEN. Yes, sir, I was.

Mr. DEVINE. My recollection of the Governor's testimony was that when he heard the first of what he described as two shots fired, that he turned slightly to his right to glance but did not observe the President, he turned back at which time when he attempted to turn to the left, at which time he didn't hear the shot but was hit by a bullet.

Now, if I correctly witnessed the Zapruder film a moment ago, I believe it showed Governor Connally turned to his right and was virtually facing the President after the first shot.

Would you say that is a correct analysis or incorrect?

Mr. GRODEN. I would say, sir, that it is very definitely accurate analysis and you have seen something that is extremely important; yes, it is true.

Mr. DEVINE. My next question would be this. As Governor Connally turned back toward the front, do you recall from your photographic analysis at what position his head was at the time he was struck by a bullet when, I think you said, his cheeks and his hair indicated he was being hit? Was he faced forward or more to the left or do you recall?

Mr. GRODEN. Well sir, to answer that question I would like to go back very quickly to Governor Connally's testimony before the Warren Commission, which was that he had turned to the right, could not see far enough to see the President, started to turn back toward the left, to turn to the left, which is I believe what he repeated this morning, and as he, according to the Warren Commission testimony, he turned a little bit left, as he got a little bit

left of center, that was the point where he was struck by the bullet, which would line up with about 236 to 238, which is what we saw just now with the exhibits.

Mr. DEVINE. Was that confirmed by your analysis of the Zapruder film?

Mr. GRODEN. Yes, it was, sir.

Mr. DEVINE. When Governor Connally's recollection is that he heard one shot fired, turned back, did not hear the shot that hit him, but heard a third shot, is that consistent with your analysis of the Zapruder film? Of course, there is not a sound track.

Mr. GRODEN. No, there isn't. As to whether that is consistent or not would be a matter of interpretation and a little bit of guesswork. The only thing I could say is that, where the guesswork is concerned is if Governor Connally, upon being hit, went into an immediate state of shock, where for the moment he did not hear the sound of the bullet that hit him, this could account for him not hearing the second shot. Again, this is purely interpretive. I certainly don't want to present that as fact, but it could possibly be a reason why he didn't hear the second shot.

Mr. DEVINE. I am totally confident that Governor Connally's testimony was based on his best recollection of the situation as it occurred nearly 15 years ago.

Thank you, sir.

Mr. GRODEN. Thank you, sir.

Chairman STOKES. The Chair recognizes the gentleman from the District of Columbia, Mr. Fauntroy.

Mr. FAUNTROY. Thank you, Mr. Chairman.

Mr. Groden, I would just like to ask a couple of questions based on your knowledge as a photo-optical technician. The first relates to the photographs of the book depository, alleged to have been taken around the time the shots were fired. Would a camera pick up a smoke puff from a rifle?

Mr. GRODEN. It could, sir, if the light hit it a specific way, where the light was reflecting off of the smoke; yes. If it were coming so that the light were passing through it it might not. It is conceivable that it would show. I can cause as a definite type of perhaps future exhibit to answer that question.

During the 1967 CBS reconstruction of the crime, which there are an awful lot of problems with, as far as the critics are concerned, but when they showed the rifle, a Carcano rifle being fired from the depository window, there was a great deal of smoke in evidence on the film. If you would want to see the degree to which smoke could be photographed in this specific sense, that might be a very good place to go to to view such an exhibit.

Mr. FAUNTROY. I guess then my question is, why, on the photographs which we saw, was there no smoke, if in fact the pictures were taken at about the time the firing began?

Mr. GRODEN. Well, sir, I can only answer that by saying in two of the photographs there appear to be smoke and in one there almost definitely is. The Moorman photograph that we viewed, the enlargement from the Polaroid there is, what definitely appears to be a large puff of smoke within, well within 1 second after the President's been struck in the head. There does appear to be such evidence.

Mr. FAUNTROY. Are you familiar with the picture that suggests a puff of smoke from the grassy knoll?

Mr. GRODEN. This is what I was referring to.

Mr. FAUNTROY. Yes. Give us an explanation of how that could be photographed and how, at least, I could not see any puffs around the window?

Mr. GRODEN. OK. If I may, just to digress for a moment. The first question of the puff of smoke came from the witnesses on the overpass that looked in that direction, the area of the grassy knoll as the shots were being fired and saw what appeared to them to be a puff of smoke.

The reason why you could not see it here is this was a somewhat wide angle situation. I am preparing, if I may get back to what Mr. Preyer said a moment ago about possibly a future appearance—I am preparing an exhibit dealing with a very clear enlargement of the specific area where this man who appears in the Zapruder film, the Willis film and the Moorman photographic film, where he was standing, where there does appear to be a very clear puff of smoke.

Now, it may not be a puff of smoke. It may be an illusion. But, it does appear to be such a puff of smoke.

Mr. FAUNTROY. Given the angle from which the Zapruder film was taken and the suggestion that perhaps it was a figure of a man as the camera panned past what seemed to be some shrubbery?

Mr. GRODEN. Yes, sir.

Mr. FAUNTROY. Where would that man have been standing?

Mr. GRODEN. That man would have been standing in the same position where the man was in the Willis photograph and Moorman photograph, within the crux of the concrete retaining wall, that low retaining wall.

Is it appropriate to recall an exhibit?

Chairman STOKES. Sure.

Mr. GRODEN. The Willis photograph.

Mr. GOLDSMITH. That is numbers F-155 and F-129, Willis and Moorman, and number F-274.

Mr. GRODEN. In fairness to the Warren Commission report dealing with this specific figure that we are talking about here, the issue was never raised to them. This is a figure which did appear, we knew it appeared in Willis and Moorman and the rest, and the question was did he appear in any of the motion pictures, and the question became, does he appear in the Zapruder film and another researcher of the assassination and myself both spent a great deal of time searching and scanning the film to try to find if there was anybody there, and it became very, very time consuming because we didn't know exactly what we were looking for.

The direction is not particularly clear in the Zapruder film, initially because there are no specific reference points except for in the background that pole behind the running man that we viewed on the right. The man at the end of the retaining wall on the Willis photograph, right there, and right there at the end, a little bit smaller than that, than was just indicated in that area there, the same man in the same position, you can see Zapruder on the Willis photograph standing at that point.

Directly in front of him and slightly lower in the tree in question, it is a pyracantha and 54 feet away and through we pick up

the image at the end of the wall of the man who does appear in the Zapruder film. At least this is my analysis of it.

Mr. FAUNTROY. Thank you.

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from Connecticut, Mr. Dodd.

Mr. DODD. Thank you, Mr. Chairman.

Mr. Groden, I really don't have any specific questions for you other than to thank you for your help and to, as I understand it, reiterate what I understood your testimony is this afternoon.

You are identifying through photographic evidence those areas of controversy that have been raised by critics of the Warren Commission report.

Is that a fair assessment of what you are doing here?

Mr. GRODEN. I would say that is a very fair assessment of it, those which I felt could be addressed. There are other questions about this, but they could not be rectified or enlightened upon, in my opinion. I was able—I must say I was not restrained by the committee and I was able to express all of my opinions from the very beginning on through.

Mr. DODD. I only ask this because I am curious, I am not sure myself, not being that familiar with your background. You are a photooptical technician. I presume you have studied that or do you have a degree, or is there some formal course work or is that something you acquired through normal work?

Mr. GRODEN. Basically it starts as on the job type of training. It is something that someone who goes to school to learn to try to do, say, through RIT or the Kodak Institute or any specific—

Mr. DODD. What I was getting at here is, as part of that training, you don't have any specific expertise in ballistics, fire arms, or forensic pathology?

Mr. GRODEN. No, sir, not at all.

Mr. DODD. Thank you very much.

Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired. I would just like to say for the benefit of both the members of the committee and the audience or the viewers, that the gentleman who appears here today, Mr. Groden, appears here in his capacity as a genuine critic, and the sole purpose of receiving his testimony is to raise the various issues that have been raised relative to photographs by the various critics of the critical community.

In subsequent days in these hearings, this committee will produce the technical experts who will answer the types of questions that have been raised here today through one of the members of the critical community. So, I caution that his testimony is to be received for that purpose only.

The Chair recognizes the gentleman from Connecticut, Mr. McKinney.

Mr. MCKINNEY. I have no questions, Mr. Chairman. I would just like to thank the witness for putting forth, as clearly as he has, the critical questions that have been raised over the years.

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from Tennessee, Mr. Ford.

Mr. FORD. Thank you, Mr. Chairman.

In light of what you said, I have only one question. When Mrs. Kennedy crawled out of the limousine on the back of the trunk, do we have a photo of what she picked up at that time? Have you seen a photo of what she picked up from the trunk of the car?

Mr. GRODEN. This is a very, very touchy issue, sir. You are one of the few people who, viewing this—I assume this is not the first time you have seen this film, but, very few people catch the fact she does indeed appear to be picking something up. I specifically did not mention what I thought that to be, but from her testimony, which includes the fact she has no recollection of ever climbing out on the trunk in the first place, it would appear that she picked up a piece of skull that had been blown to the rear or a piece of brain matter, or something that had been blown backward from the impact of the shot.

She does appear to reach out, brace herself with her left hand, reach out with her right hand, pick something up and take it back into the car. One of the initial interpretations of the film was that the Secret Service agent, Clint Hill, reached her and pushed her back into the car. He doesn't do that. She climbs back by herself. He barely touches her forearm. So, it would seem as though she had some specific purpose to climb out, pick something up and bring it back, which may be relevant to dealing with the direction from which the shot may have come.

Mr. FORD. Do you recall a photograph of her picking anything up off the trunk?

Mr. GRODEN. There is one. The No. 7 Altgens photograph, No. 7, which is the sixth one of the series. I state it that way because the numbers on the individual negatives, there is no No. 1, so I state it that way for clarity, shows her picking something up cupped in her hand, but what it is, we cannot see from the photograph.

Mr. FORD. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired. The Chair recognizes the gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. I only have one question, Mr. Groden. This morning Mrs. Connally was very clear in her testimony about what she perceived each of the three shots as having done; the first one going through the President's neck, the second one hitting Governor Connally, and the third one exploding the President's head.

In your hours of analyzing photographs, do you have photographic evidence to either corroborate or refute that?

Mr. GRODEN. In my opinion, I would state that I find that to be a more accurate description of what the photographic evidence would tend to show happened than what has become known as the single-bullet theory.

Again, I want to express this is my opinion on it and it is subject to change.

I do believe that the President was, in all probability, was struck by an earlier bullet. From Governor Connally's very definite testimony as having heard the first shot, and had the reaction time to turn around and then turn back, that whether the President was hit by an earlier bullet or not, that there was one bullet fired before Governor Connally was hit.

I think there is very little question about that.

Mr. FITHIAN. Thank you.

Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Yes, I only have one question. There has been a lot of testimony that we have heard, not just from you, but earlier in other sessions, about puffs of smoke, and I don't have any expertise in knowing what the photographic sensitivity of film is, but I do a lot of hunting myself, and I have seen a lot of guns fired with smokeless powder loads, and there is no discernible smoke to the human eye when you are watching one fired.

I wonder, have you ever done anything along that line to try to get pictures of smoke coming out of a modern rifle?

Mr. GRODEN. The only way I can answer that, and I think it is an excellent question, the only way I can answer that question is to say that I initially thought the idea of smoke on the knoll could not have happened for that very same argument, a modern rifle simply does not smoke.

However, the CBS report, although they didn't catch it themselves, shows the rifle being fired, as I recall, several dozen times, and every single time, there is a rather large puff of white smoke.

Mr. SAWYER. Yes, I don't know how they did that, but when you are firing a muzzle-loader or black powder rifle, which they haven't put out for a long, long time, way before the period of time we are talking about, the modern mode and smokeless loads, at least when you watch them fired, you can't see any smoke come out of them.

Mr. GRODEN. Again, that was my argument originally, too. I thought that there was no chance of it. Yet, this specific visual testing showed in every single case, not just an occasional case, that there was a tremendous amount of smoke. As a possible explanation, I certainly do not want to represent myself as anything close to an expert on it, is that it is my recollection that the ammunition made for that specific weapon ceased sometime around the late 1940's. I could be wrong about that. So, it would not be "modern ammunition" per se, unless they were handloaded. I would have no knowledge of this.

Mr. SAWYER. I am sure way before that, they stopped using black powder even in Carcanos.

Mr. GRODEN. I am sure, too. The only answer I can give to you, the only time I have seen a Carcano fired physically was in a CBS testing and it did, indeed, show a great deal of smoke.

Mr. SAWYER. I have nothing further.

Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from Pennsylvania, Mr. Edgar.

Mr. EDGAR. Thank you, Mr. Chairman.

Mr. Chairman, I don't have any specific questions of the witness today. As I listened this afternoon and looked at the pictures and photographic evidence, there were number of issues that were raised in my mind. It occurred to me some people listening and watching and perhaps some here today, will get a little bit confused about what we have seen and witnessed this afternoon. I think that it would be accurately described as a shopping list of issues and that in the next few days and weeks, I hope that we can

examine the issues relating to the autopsy and the acoustics and the trajectory and the other issues which I know are going to be laid out and give us an opportunity to accurately come back to each of these photographs and each of the exhibits that have been introduced today, and come up with some resolution to some of the theories and issues which have been raised.

I appreciate our witness coming and sharing the shopping list. I don't think that we have resolved many of the issues or should we take the time at this time, in my opinion, to go into all of the analysis of each of these pictures.

Chairman STOKES. Will the gentleman yield?

Mr. EDGAR. I yield to the chairman.

Chairman STOKES. I think that the gentleman precisely states the case. As I attempted to say earlier, so that those who are following the evidence being produced to our committee might better understand it, we are merely, at this time, trying to lay the groundwork so that when the other technical experts testify, they will be in a much better position to be able to understand their testimony having had the critical issues pointed up at this time.

Mr. EDGAR. I withhold my questions until that time.

Chairman STOKES. I thank the gentleman.

Mr. Goldsmith, do you have anything further?

Mr. GOLDSMITH. No, Mr. Chairman. Thank you.

Chairman STOKES. Mr. Groden, under the rules of our committee, every witness testifying before this committee at the conclusion of his testimony is to be given 5 minutes in which he may make any statement, either explaining or amplifying or in any way, expanding upon the testimony he has given before this committee.

On behalf of the committee, I extend to you, at this time, that period of time in the event that you so desire.

Mr. GRODEN. Thank you, sir.

May I have one moment, please?

Chairman STOKES. Certainly.

Mr. GRODEN. Mr. Stokes, everybody present, the first thing I want to do is to thank you for the opportunity for my being here to present some of the issues as I see them, those specific issues which we felt could be best addressed by the scientific panels.

Mr. Preyer before suggested that perhaps I might be coming back in the future to raise other issues or present further viewpoints. I would hope so and request so.

Back in January 1975 when my wife Chris and I decided that we would release the films and visuals dealing with the assassination to the public, they came to the attention of Congressman Thomas Downing of Virginia, now retired, who felt there were enough questions here to warrant such a committee and the legislation was initially introduced, and I commend him for his foresight.

What I have done here is present some of the issues as they were and as I felt about them when this all began. Some of these issues, in my mind, have changed. Some of the case which I presented here, I never felt were issues in the first place, but other credible critics did believe so.

Some of them, which I believed at the time, I no longer believe, and I would request at the committee's convenience, if the time is going to be available, to come back and discuss the new findings

and the feelings as they are today and the additional issues which were not raised before the panels to be dealt with scientifically.

Other than that, again, I thank you and wish you well with the investigation.

Chairman STOKES. Mr. Groden, we certainly want to thank you for your appearance here today and for the very articulate way in which you have pointed up some of the issues that have been raised in the critical community. You certainly have been of value to this committee over a period of time.

We want to thank you for your appearance here today. Thank you very much.

Mr. GRODEN. Thank you.

Chairman STOKES. There being nothing further, the committee is adjourned until 9 a.m. tomorrow morning.

[Whereupon, at 4:20 p.m., the committee recessed, to reconvene at 9 a.m., Thursday, September 7, 1978.]



# INVESTIGATION OF THE ASSASSINATION OF PRESIDENT JOHN F. KENNEDY

THURSDAY, SEPTEMBER 7, 1978

HOUSE OF REPRESENTATIVES,  
SELECT COMMITTEE ON ASSASSINATIONS,  
*Washington, D.C.*

The committee met at 9:09 a.m., pursuant to recess, in room 2172, Rayburn House Office Building, Hon. Louis Stokes (chairman of the committee) presiding.

Present: Representatives Stokes, Preyer, Fauntroy, Dodd, Fithian, Edgar, Ford, Devine, McKinney, and Sawyer.

Staff present: Clifford A. Fenton, Jr., chief investigator; Kenneth D. Klein, assistant deputy chief counsel; G. Robert Blakey, chief counsel; Donald A. Purdy, Jr., staff counsel; and Elizabeth Berning, chief clerk.

Chairman STOKES. A quorum being present, the committee will now come to order.

The Chair recognizes the chief counsel, Professor Blakey.

## NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND STAFF DIRECTOR

Mr. BLAKEY. Thank you, Mr. Chairman.

John F. Kennedy was the fourth American President to be assassinated, the first in 60 years. It is somewhat remarkable, therefore, that despite major advances in medical technology, his autopsy created the most controversy, though in two earlier murders there was a dispute over the fine points of the post mortem examination.

In Lincoln's case in 1865, the autopsy surgeons disagreed over the path of the bullet through the President's head. X-ray techniques that could have settled the question had not yet been invented.

Ironically, when William McKinley was shot in 1901, his wife ordered the autopsy terminated before the fatal bullet could be located, and although X-ray equipment was available—Thomas Edison had sent his newly invented machine to the pathologists—it wasn't used.

The one assassination not to raise an autopsy controversy was that of James Garfield in 1881.

The handling of President Kennedy's treatment and autopsy—first in Texas and then in Washington—by the doctors, the Warren Commission, and by the President's family, has given rise to more questions touching on his assassination than any other single aspect of the investigation. The facts of what happened and the

questions that have arisen out of those facts merit the closest attention.

The first doctors to attend the President at Parkland Hospital were Malcolm Perry and Charles J. Carrico. According to each, they observed a massive head wound and a small, circular wound in the neck just below the Adam's apple. Later, they referred to it as an "entry wound." Dr. Perry performed a tracheotomy to help the President breathe. The incision was made at the throat wound, making it subsequently difficult to determine the nature of the wound or even to notice its existence.

Other Parkland doctors have differed dramatically in their descriptions of the head wound. Dr. Robert McClelland, in a written report dated November 22, 1963, described it as "a massive head and brain injury from a gunshot wound of the left temple." Dr. William Kemp Clark said he observed a large gaping hole in the rear of the President's head.

The Parkland doctors worked on the President for about 20 minutes. They did not examine his back, so they could not have been aware of a wound there. The only head wound they say they saw was the massive one they described. Their job, of course, was to administer emergency treatment, not to measure the location of wounds or to determine that all wounds had been accounted for. The Parkland doctors' duties extended only up until the time of the death of the President.

Efforts to save the President were futile; Dr. Clark pronounced him dead at 1 p.m., central standard time. It was a formality. The President was beyond help before he arrived at the hospital.

The doctors who examined Governor Connally were Robert Shaw, Charles Gregory, and George Shires. They described the wounds to his back, chest, wrist, and thigh. The Governor, at first listed as critical, fully recovered.

After the President was declared dead, his body was taken to Air Force One for the flight back to Washington. On the return flight, Mrs. Kennedy decided to have the autopsy performed at Bethesda Naval Hospital, since the President had served in the Navy. Comdr. James J. Humes was appointed chief autopsy surgeon. He, in turn, chose Drs. J. Thornton Boswell and Pierre A. Finck to assist him. The autopsy began at 8 p.m. eastern standard time. Other doctors, laboratory technicians, Secret Service and FBI agents and military personnel were in attendance. Members of the Kennedy family and friends remained in the tower suite of the hospital.

Preliminary X-rays failed to detect the presence of a missile in the President's body. Commander Humes was then given authority to conduct a full autopsy by Adm. Calvin B. Galloway and Dr. George Burkley, the White House physician.

Dr. Humes first determined that a missile had entered the rear of the head and exited at the top right side of the skull, resulting in a large exit wound and leaving tiny metallic particles throughout the brain.

Next, he found a wound he determined had entered the upper back. Pathologists tried to probe this wound, but they could only detect a pathway that extended a few inches. They could not find a

point of exit. Despite the uncertainty over the missile track, Dr. Humes decided not to dissect the track through the neck.

At about this time, Dr. Humes was informed by FBI agents that a bullet had been discovered on a stretcher in the emergency room at Parkland. He and the other pathologists tentatively decided the bullet had penetrated a few inches into the President's back and had been dislodged during emergency treatment at the hospital.

During the autopsy, pieces of bone discovered in the Presidential limousine were brought to Bethesda, where they were determined to have been part of the President's skull.

Dr. Humes made note of the tracheotomy incision. The pathologists examined most major organs of the President's body. X-rays and photographs were taken. The brain was retained for future examination; slides were extracted from tissue organs and sections. The autopsy ended at about 11 p.m. eastern standard time.

On the morning of Saturday, November 23, Dr. Humes spoke by telephone with Dr. Perry in Dallas, who explained that he had made the tracheotomy incision through a small, circular throat wound. Dr. Humes then theorized it was an exit corresponding to the entry wound in the upper back, and he reflected this belief in his autopsy report filed November 24.

All participants in the autopsy were under naval orders—not lifted until the select committee began its investigation—to be silent as to its results, but rumors began to fly anyway, and confusing news accounts soon began to appear. The effect of these erroneous news accounts on public perceptions is important to emphasize. Here is a sampling from the *New York Times*:

November 23: The President suffered an entrance wound in the Adam's apple and a massive head wound in the head.

December 17: The FBI had concluded one bullet had struck the President in the right temple and another had hit where the right shoulder joins the neck.

December 19: The pathologists had determined a bullet had lodged in the back, a second had struck the right rear of the head.

J. Edgar Hoover, the Director of the FBI, submitted the Bureau's report of the assassination to the Warren Commission on December 9, and a supplement to it was filed on January 13, 1964. They reflected the preliminary observations of the FBI agents, who had attended the autopsy.

By early February, the theory that one bullet had traversed President Kennedy's back and throat wounds and caused Governor Connally's wounds—the so-called single bullet theory—began to emerge. At this time, and for several months to come, members of the Warren Commission and its staff were taking testimony from the doctors who had attended the President and who had participated in the autopsy. The Warren Commission and its staff had also viewed the Zapruder film. As far as is known, however, no member of the Commission, or its staff, ever carefully examined the autopsy X-rays or photos, although Chief Justice Warren is reported to have seen them.

In September 1964, the Warren Commission issued its report, in which it concluded the President had been struck by two bullets, one in the back and one in the rear of the skull, as the autopsy report had indicated. Although it used carefully guarded language,

the Commission concluded that the bullet that exited the President's throat also caused all of Governor Connally's wounds.

Finally, the Commission said the bullet that was found on the stretcher at Parkland Hospital was the one that hit both the President and Governor Connally. This bullet, known by its exhibit number, CE-399, has come to be known as the pristine bullet.

Not long after publication of the Warren report, criticisms of its findings began to appear. In 1966, Edward Jay Epstein, in *Inquest*, revealed that the FBI report of December 9, 1963, stated that the missile that entered the President's back did not exit—this, in spite of the fact that the FBI had access to Dr. Humes' written report indicating otherwise.

In addition, in 1966, Mark Lane published his "Rush to Judgment." He quoted the early comments of several doctors at Parkland, in which they described the throat wound "as one of entry." Lane then argued that if the President was hit both from the front and back, there had to be more than one assassin. Lane also criticized the "single bullet" theory, suggesting that it had been devised by the Warren Commission to explain how one assassin could have inflicted all the wounds in the requisite time period. As the "single bullet" theory fell, so, argued Lane, the specter of two gunmen rose.

In 1967, Josiah Thompson, in "Six Seconds in Dallas," proposed that the President had been struck simultaneously by two shots, one from the rear and one from the front.

In October 1966, the autopsy materials, which had been, up until that time, retained by the Kennedy family, were transferred to the custody of the National Archives under a restrictive deed of gift that sharply limited public access to them. In November 1966, the autopsy pathologists were asked by the Department of Justice to review the X-rays and photographs. This was the first time they had ever reviewed the photographs. Nevertheless, they concluded they were consistent with their original autopsy findings.

In 1968, Acting Attorney General Ramsey Clark convened a panel of medical experts for the purpose of making an independent review of the X-rays and photos. The panel confirmed the autopsy findings as to the number of wounds and the general direction from which the shots came, but it differed with the pathologists at Bethesda on one important point: it said that the wound in the rear or the President's head was 10 centimeters above where it had been placed by the autopsy.

In 1975, the Rockefeller Commission asked still another panel of experts to review the photographic evidence. The findings concurred with those of the panel appointed by Clark.

In 1976, the select committee was, of course, charged by the House of Representatives to undertake its investigation into the assassination of President Kennedy. The committee recognized that it, too, was obligated to examine all of the medical issues that had arisen over the years.

They include: (1) The number of bullets that struck President Kennedy and Governor Connally; (2) the number of wounds each man received, their locations and whether they were wounds of entry or exit; (3) the 10-centimeter discrepancy in the location of the wound to the rear of the President's head; (4) the course of the

so-called pristine bullet through both President Kennedy and Governor Connally; (5) the apparent backward motion of the President's head, as shown in the Zapruder film, as he is hit by the fatal bullet; (6) the possibility that the President was struck in both the rear and the front of the head; (7) the statements of the Parkland doctors concerning President Kennedy's wounds; (8) the authenticity of the autopsy X-rays and photographs; (9) the competence and the validity of the autopsy, including an allegation that the pathologists were ordered to perform an incomplete examination.

The committee has convened a panel of forensic pathologists to evaluate and interpret the medical evidence. It consists of two groups of doctors—one that had previously reviewed the autopsy photographs and X-rays and one that had not.

Panel members who had previously reviewed the evidence are: Dr. Werner Spitz, medical examiner of Detroit, Mich.

Dr. Cyril H. Wecht, coroner of Allegheny County, Pa.

Dr. James T. Weston, chief medical investigator, University of New Mexico School of Medicine, Albuquerque, N. Mex.

Panel members who had not previously reviewed the evidence are:

Dr. John I. Coe, chief medical examiner of Hennepin County, Minn.

Dr. Joseph H. Davis, chief medical examiner of Dade County, Fla.

Dr. Joseph S. Loquvam, director of the Institute of Forensic Sciences, Oakland, Calif.

Dr. Charles S. Petty, chief medical examiner, Dallas County, Tex.

Dr. Earl Rose, professor of pathology, University of Iowa, Iowa City, Iowa.

The moderator of the panel is Dr. Michael M. Baden, chief medical examiner of New York City.

The panel was asked by the committee to undertake four fundamental assignments:

One, to determine whether there are basic conclusions in the field of forensic pathology on which most, or all, of the panel members could agree.

Two, to perform a detailed critique of the autopsy of President Kennedy.

Three, to write a report of its findings.

Four, to make recommendations for pursuing matters outside the expertise of forensic pathologists.

The committee has arranged to have the two groups of medical experts express their views in a single report with the stipulation that, should any member hold a dissenting opinion, it would be stated in the body of the report.

The committee has also conducted a comprehensive investigation in an attempt to locate missing materials, that is, materials missing from the National Archives, including a steel container alleged to have contained the President's brain which was removed during the autopsy.

All persons, either directly or indirectly, involved in the chain of custody of the autopsy materials have been either interviewed or deposed. The total number of persons interviewed or deposed exceeds 30. The committee has also contacted the Kennedy family.

Despite these efforts, the committee has not been able to determine what precisely happened to the missing materials. A family spokesman, however, did indicate that Attorney General Robert F. Kennedy expressed concern that these materials could conceivably be placed on public display many years from then and that he wished to prevent it.

The spokesman indicated that in his judgment, the materials were destroyed and cannot be recovered. The committee has determined that the materials were not buried with the body of the President at reinterment. The committee has not obtained any other relevant information on this issue.

To illustrate the location of the wounds in the President, the committee has engaged Ms. Ida Dox, an experienced medical illustrator, to render drawings. Ms. Dox graduated from the Johns Hopkins Medical School, Department of Art as applied to Medicine.

Presently, she is the medical illustrator for the Department of Medical-Dental Communication at the Georgetown University Schools of Medicine and Dentistry.

Mr. Chairman, it will be appropriate now to call Ms. Dox.

Chairman STOKES. The committee calls Ms. Dox as a witness. Would you stand, please, and raise your right hand. Do you solemnly swear the testimony you are about to give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

Ms. Dox. I do.

Chairman STOKES. Thank you. You may be seated.

The Chair recognizes staff counsel, Donald A. Purdy, Jr. for questioning of the witness.

#### TESTIMONY OF IDA DOX, PROFESSIONAL MEDICAL ILLUSTRATOR

Mr. PURDY. Thank you, Mr. Chairman.

Ms. Dox, please state your full name.

Ms. Dox. Ida Dox.

Mr. PURDY. What is your occupation?

Ms. Dox. I am a professional medical illustrator.

Mr. PURDY. How did you come to work for the select committee?

Ms. Dox. The committee contacted the medical school, the Georgetown Medical School, and I was recommended.

Mr. PURDY. How did you determine what to illustrate for the select committee?

Ms. Dox. This was done by consultation, the staff of the committee, the medical panel, and myself, and it was decided that the photographs taken at autopsy should be copied to illustrate the position of the wounds. The photographs that were selected were the ones that best showed the injuries.

Also, a series of illustrations was needed that would illustrate the findings of the medical panel.

Mr. PURDY. What photographs did you attempt to copy?

Ms. Dox. Four photographs. One shows the back of the head, another one shows the upper back, then the side of the head, and the front of the neck.

Mr. PURDY. How did you copy the autopsy photographs?

Ms. DOX. The autopsy photographs were copied by placing a piece of tracing paper directly on the photograph, then all the details were very carefully traced. Later on, while working on the final drawing, I had to have the photograph in front of me at all times. In this way I could be constantly comparing and looking back and forth at the drawing and the photograph so that no detail could be overlooked or omitted or altered in any way. That is the way the copies were made and the tracings were made from the originals.

Mr. PURDY. Where did you get access to the original autopsy photographs?

Ms. DOX. At the National Archives.

Mr. PURDY. How often did you have access to the original photographs?

Ms. DOX. A great number of times. I don't remember exactly how many times because I had to use them a great number of times and then the staff of the National Archives was very cooperative and they let me use them as many times as I needed. So I really don't remember how many times.

Mr. PURDY. Was a member of the staff of the Archives present when you reviewed the autopsy materials?

Ms. DOX. Yes.

Mr. PURDY. Did you also review the autopsy X-rays?

Ms. DOX. Yes, I did.

Mr. PURDY. Did you have access to a set of duplicates of the original autopsy material?

Ms. DOX. Yes, I did. I used these at the offices of the committee.

Mr. PURDY. Why was it necessary to use duplicates?

Ms. DOX. Well, this was because, as I said, a member of the Archives staff had to be present at all times when I was using the original material, and so that I would not use their time unnecessarily, while there I concentrated on working in all the minute details and finishing them up and then for other items in the photograph like, well, the gloved hands of the physician, or the ruler that was placed on the surface of the body. These things reproduced very faithfully on the duplicate photographs. So to finish these up I could easily use the duplicates at the committee offices.

Mr. PURDY. You stated that you copied four autopsy photographs. How did you make the other drawings to illustrate the conclusions of the forensic pathology panel?

Ms. DOX. This was a series of composite reconstructions which means several sources were used to arrive at the final product. This was also done, of course, in very close consultation with the medical panel, especially Dr. Michael Baden, and the sources that were used were, for instance, the photographs and X-rays of the President taken at autopsy and others that were taken when he was alive. These were superimposed and compared so that the right proportions would be arrived at.

The findings were several—so then different drawings had to be used to illustrate these. In another instance, one of the frames of the film taken during the motorcade was photographed and the outline of the President's head was used so that the drawing would

have the head of the President in the position that the medical panel decided was necessary.

At other times a skull was used that had the dimensions of the President's and the photographs of the retrieved bone fragments were traced to get the outline. This paper was cut out along the outline and taped on the skull in the position that the X-rays indicated there was bone missing, and from this paper and skull reconstruction I made my drawing.

Another example of reconstruction would be the way the fractures on the skull were placed, by studying very carefully the X-rays, and as I said before, in close consultation with the medical panel, particularly Dr. Baden.

Mr. PURDY. Ms. Dox, prior to today, did you have the opportunity to review the enlargements of your drawings to insure that they are accurate?

Ms. DOX. Yes, I did. I looked at them very, very carefully and they are my drawings except that they are photographically enlarged. They haven't been altered in any way.

Mr. PURDY. Thank you, Ms. Dox.

Mr. Chairman, I have no further questions.

Chairman STOKES. The Chair recognizes Professor Blakey.

I am sorry, Ms. Dox, you are excused. Thank you very much.

#### NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND STAFF DIRECTOR

Mr. BLAKEY. Thank you, Mr. Chairman.

The committee also asked Dr. Lowell Levine to determine whether the autopsy X-rays were, in fact, those of President Kennedy.

Dr. Levine received his DDS degree from the New York University College of Dentistry in 1963.

Dr. Levine has been in charge of identification of a large number of mass disasters, both in the United States and abroad. He has published innumerable professional papers. In addition to Dr. Levine, the committee asked Mr. Calvin S. McCamy to determine whether the autopsy photographs are, in fact, the original, unmodified autopsy photographs of President Kennedy.

Mr. McCamy received a BS degree in chemical engineering and an MS degree in physics from the University of Minnesota. Mr. McCamy is a fellow of the Optical Society of America, the Society of Motion Picture and Television Engineers and the Society of Photographic Scientists and Engineers. It would now be appropriate, Mr. Chairman, to call both Dr. Levine and Mr. McCamy to testify as a panel on the authenticity of the X-ray and the photographs.

Chairman STOKES. At this time, then, the committee calls Dr. Levine and Mr. McCamy as witnesses.

Gentlemen, would you stand and raise your right hands and be sworn. Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

Mr. McCAMY. I do.

Dr. LEVINE. Yes sir; I do.

Chairman STOKES. Thank you. You may be seated.

The Chair recognizes staff counsel, Mr. Donald A Purdy, Jr.



Mr. PURDY. Thank you, Mr. Chairman.  
Gentlemen, I will begin the questioning with Dr. Levine.

**TESTIMONY OF DR. LOWELL LEVINE, CONSULTANT TO THE CHIEF MEDICAL EXAMINER, NEW YORK CITY, AND CALVIN S. McCAMY, CHAIRMAN OF THE AMERICAN NATIONAL STANDARDS WORKING GROUP ON PRINT QUALITY FOR OPTICAL CHARACTER RECOGNITION**

Mr. PURDY. Mr. McCamy, if you have any comments during the questions directed to Dr. Levine, please feel free to add them.

Dr. LEVINE, what is your occupation?

Dr. LEVINE. I am a dentist.

Mr. PURDY. How does the process of dental identification work?

Dr. LEVINE. The forensic odontologist or forensic dentist will examine a particular piece of dental evidence and attempt to find all the particular unique and individual characteristics in that piece of evidence. He will then attempt to secure a prior record which contains those same characteristics.

Mr. PURDY. In the case of the X-rays of President Kennedy, what was your task?

Dr. LEVINE. My task basically was to examine the films taken during the course of the autopsy of President Kennedy and to determine if in fact the person who was X-ray was the late President.

Mr. PURDY. To what extent are X-rays considered adequate for identification purposes?

Dr. LEVINE. X-rays are excellent dental evidence for identification purposes. They contain the positions of the teeth in relation to each other. They contain the shapes and sizes of the fillings and the lining or basing materials that the teeth contain. We can find anomalous or bizarre situations, pathology such as cysts, roots, and consequently there are a myriad of areas for comparison in X-ray film.

Mr. PURDY. Do X-rays exist showing the teeth and jaws of President Kennedy taken prior to the autopsy X-ray?

Dr. LEVINE. Yes sir, they do.

Mr. PURDY. Where are they?

Dr. LEVINE. There were 22 such films in the custody of the National Archives.

Mr. PURDY. Generally, what do these films show?

Dr. LEVINE. Thirteen of the films are dental X-ray type films. The other nine are marked JFK sinus. The X-ray films show teeth, jaws, dental restorations, bony patterns, and the like. The sinus films are both anterior, posterior, front to back, and lateral skull films taken side to side.

Mr. PURDY. What is the basis for your opinion as to whether or not the autopsy X-rays were actually made on President Kennedy?

Dr. LEVINE. Well, the first thing that I did was to compare each of the photographs in the National Archives with each other and I was very readily able to determine that all the films were taken on the same person, President Kennedy. There are four sources of the films, including a Captain Petter of the U.S. Navy Dental Corps, and a Dr. Robert Morris of New York City.

The sinus films were taken by Dr. Stephen White of New York City, and by Drs. Groover, Christie, and Merit in Washington, D.C., through the years 1960 to 1962. These names appear either on the films themselves or on the film mounts, which is normal procedure.

Mr. PURDY. Dr. Levine, will you please examine these items marked JFK exhibits F-295 and F-296 and tell us what they represent?

Dr. LEVINE. May I walk over there, Mr. Counsel?

Mr. PURDY. Yes.

Dr. LEVINE. F-295 is a composite of certain of the films in the National Archives, and autopsy films 1 and 2. I have in fact examined autopsy films 1, 2, and 3 and was able to authenticate all of those, but at the time I had my permission to do the photography work it was my understanding that I was not to photograph injury pattern and in order to authenticate film No. 1 that would have showed injury pattern in that the frontal sinuses were used to authenticate autopsy film 1.

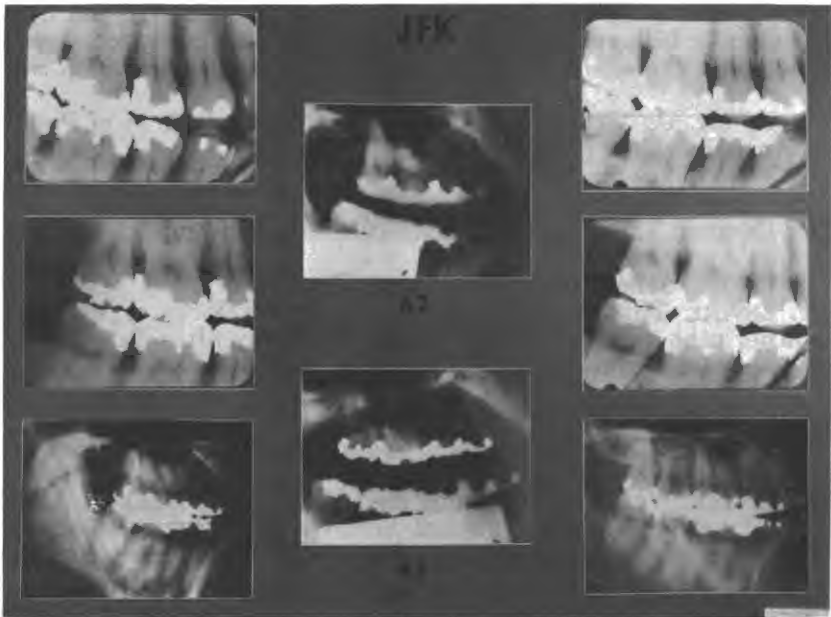
Mr. PURDY. Dr. Levine, what do the autopsy Nos. 1, 2, and 3 represent, what views of the President?

Dr. LEVINE. They are all skull films. Autopsy 1 is a front to back and back to front—an AP-type film. Nos. 2 and 3 represent lateral films taken from side to side, so to speak.

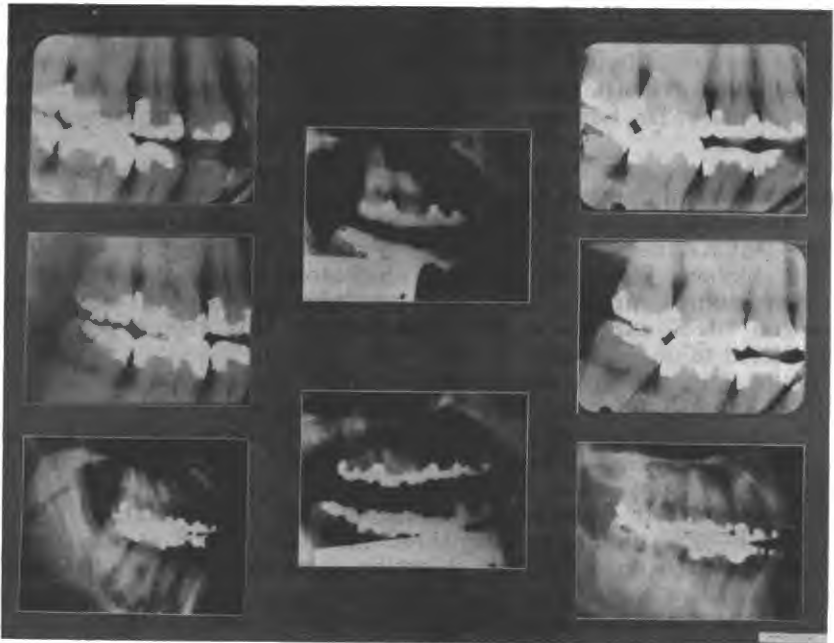
Mr. PURDY. Mr. Chairman, I would like to have these exhibits, marked JFK F-295 and F-296, introduced into the record at this time.

Chairman STOKES. Without objection, they may be entered into the record at this time.

[The above-referred-to JFK exhibits F-295 and F-296 follow:]



JFK EXHIBIT F-295



JFK EXHIBIT F-296

Mr. PURDY. Could you please demonstrate the areas of comparison in the exhibits?

Dr. LEVINE. Yes, sir. The four films on top in F-295—and these in F-296—are actually duplicates of each other with certain of the areas of comparison color coded in red. The four films on top were taken by Dr. Robert Morris in New York City I believe on January 18, 1962, right side and left side. The film in the lower corner on both the exhibits on the "J" side is the Stephen White film taken on August 14 of 1960, and the film on the left side is the Drs. Groover, Christy, and Meritt film taken in Washington, D.C., and this is of a lateral skull film on August 17, 1960.

This is the dentition and supporting structures on both autopsy 2 and autopsy 3. We can see some very distinctive areas that makes comparison not too difficult. But one thing we must understand, the dental films are taken by placing the piece of film in the mouth, and so you get the one tooth.

The lateral skull films are taken by passing the X-rays, so to speak, through the skull to the film on the other side, so that we get a composite very often, or the teeth of both sides superimposed upon each other, which has happened in the four films here. We have elements then of both the right and left sides in autopsy 2 and autopsy 3.

Autopsy 3 is very evident from the very distinctive shapes of the fillings. For example, in the upper second molar we see a "W" shape filling and we can follow them as we go forward. So that there is absolutely no difficulty in authenticating that.

One of the elements that has stayed throughout is a kidney-shaped area of cement base in the lower left second molar, and this shows very readily in this area here, in the 60 film, in both autopsy films. There are others, too, just to point out—

Mr. PURDY. Dr. Levine, I appreciate your pointing out a couple of those areas.

Based on the comparison X-rays that you have used, are you able to state a firm opinion as to whether or not the three skull X-rays you viewed from the autopsy materials are in fact X-rays taken of President Kennedy?

Dr. LEVINE. Yes, sir, there is absolutely no question of that.

Mr. PURDY. Mr. Levine, will you please examine this item marked "JFK exhibit F-323" and identify this report you have submitted to us.

If the clerk will give the report.

[Document handed to the witness by the clerk.]

Mr. PURDY. Dr. Levine, is this the report you submitted to the staff of this committee?

Dr. LEVINE. Yes, it is.

Mr. PURDY. Mr. Chairman, I would like this report marked "JFK exhibit F-323" and have it entered into the record at this time.

Chairman STOKES. Without objection, it may be entered into the record at this time.

[The above-referred-to JFK exhibit F-323 follows:]

JFK EXHIBIT F-323

REPORT TO THE  
SELECT COMMITTEE ON ASSASSINATIONS  
U. S. HOUSE OF REPRESENTATIVES

Identification of the Skull X-Ray  
Films Taken During the Autopsy of  
President John F. Kennedy

Lowell J. Levine, D.D.S.  
Consultant for the  
Select Committee on Assassinations  
U. S. House of Representatives  
September 7, 1978

AUTHENTICATION OF AUTOPSY FILMS 1, 2, 3 ( BY DR. LOWELL LEVINE)

BASIS FOR DENTAL IDENTIFICATION

The science of dental identification is based upon the fact that characteristics associated with the dentition and the hard and soft tissue structures of the oral cavity occur in astronomical numbers of combinations.

Typically, the adult dentition contains sixteen teeth in each jaw; four incisors, two canines, four premolars, and six molars. Each tooth has characteristics such as morphology, root configuration, root canal shapes, anomalies, pathology, and the like which are unique and individual to that particular tooth. Similarly, the supporting structures of the oral cavity have unique and individual characteristics.

Teeth are often attacked by carious lesions (decay) and other processes which cause unique and individual characteristics.

There are five surfaces on each tooth which may be attacked by dental caries and restored by the dentist. On posterior teeth ( premolars and molars ), mesial and distal ( towards and away from the midline ), occlusal ( the grinding surface ), buccal ( towards the cheek ), and lingual ( towards the tongue ). On anterior teeth ( incisors and canines ) mesial and distal, facial or labial ( towards the face or lips ), lingual, and incisal ( cutting surface ). These surfaces may be attacked by dental caries singly or in combination and restored by the

dentist in single or multiple surface restorations. Different surfaces on the same tooth may be restored with various filling, insulating, and lining materials. Different sized and shaped dental burs ( drills ) are used to remove the dental caries, and prepare the tooth to receive the filling material.

The dentist uses various materials to repair the effects of dental caries. Metals such as gold in various forms and silver amalgam are commonly used. Porcelains and acrylics are used and various cements are used as temporary restorations, insulating materials, and sealers.

It should be abundantly clear that the possible combinations which may occur because of such factors as presence or absence of particular teeth, surfaces of each tooth free of caries or decayed, surfaces of each tooth present restored with various types of dental materials, sizes and shapes of cavity preparations is limitless.

Almost all dental evidence is useful for identification purposes. Dental evidence could include the written records of examinations and treatments, Models of the mouth, teeth, and jaws used for diagnosis and treatment planning or the actual fabrication of prosthetic appliances. The prosthetic appliances themselves. Photographs and x-ray films taken incident to diagnosis and/or treatment.

X-ray films are excellent evidence for identification purposes. The films will graphically exhibit characteristics such as presence or absence of teeth, rotations of teeth, level of eruption of teeth, tipping of teeth, and the relation of these teeth to each other.

The films will show the morphology of teeth, roots, and root canals as well as the presence of caries, root canal therapy, pathology such as retained roots and cysts, unerupted teeth, anomalies, wear, and breakage among other things.

We may examine the shapes of fillings, extent of caries involvement and removal, cement materials present, and density of filling materials. Hard tissue patterns, pathology, and landmarks are also graphically represented.

Even when extensive dental treatment, performed subsequent to the date of the x-ray films, has considerably altered the visual appearance of the teeth, the underlying hard tissue characteristics remain quite distinctive.

#### DENTAL IDENTIFICATION PROCESS

The dental identification process will include a comparison by the forensic odontologist of the unique and individual characteristics exhibited by the evidence at hand with previously existing records containing evidence of those same characteristics. The forensic odontologist will use his training, experience, skill, and expertise to form an



an opinion as to whether his comparison is positive. He will render that opinion in a report which will also contain the basis for that opinion.

The early use of dental identification in the United States can be documented in two historically significant cases which both occurred in President Kennedy's home state of Massachusetts.

Paul Revere, noted for his famous ride and as a silversmith, also practiced dentistry. General Joseph Warren, a Revolutionary War hero killed at the Battle of Bunker Hill, had been a patient of Revere. Originally buried by the British, his remains were subsequently identified by Revere some ten months later when Revere recognized a prosthetic appliance he had made for General Warren.

In 1850 the Webster-Parkman case shocked Boston. Dr. John White Webster, Professor of Chemistry and Mineralogy at Harvard Medical School was convicted of murdering Dr. George Parkman, Professor of Anatomy at Harvard Medical School. In this first recorded instance of dental identification in the courtroom, Dr. Nathan Cooley Keep, subsequently first Dean of Harvard Dental School, identified a few fragments of lower jaw and an intact porcelain bridge which fitted the cast Dr. Keep had preserved from recent dental care of the missing Dr. Parkman. An expert witness for the defense was William Morton, the young Boston dentist of ether anesthesia fame.

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Historical References:

Sognaes, Reider F., "Talking Teeth", American Scientist, Vol.64,p.369  
 Luntz & Luntz, Handbook for Dental Identification, J.B. Lippincott,  
 Phila., 1973, pp. 1-15

EVIDENCE USED IN THE DENTAL IDENTIFICATION PROCESS

The evidence to be used for the comparisons was in the custody of the National Archives of the United States at the time I examined it. There was a "Descriptive List" of the materials which was apparently made when the National Archives received them from the Kennedy Library.

"Descriptive List" ( Items I personally used for comparisons )

1. Manila Envelope - Business Letter Size  
Addressed to Captain J.W. Pepper, D.C., USN  
containing two dental films, loose  
JFK 7/12/62
2. Manila Envelope - Business Letter Size  
marked JFK 4/9/62  
containing two dental films, loose
3. Manila Envelope- About 5" x 6"
  - a. one mounted dental film dated 3/11/61
  - b. two mounted dental films dated 3/11/61
  - c. five mounted dental films dated 1/18/61
  - d. one mounted dental film dated 3/8/62
6. Manila Sleeve, about 10 x 12  
JFK Sinus Films, 8-17-60  
containing five films
7. Manila envelope (sic), about 10 x 12  
JFK Sinus Films, 8-14-60  
containing four films

Description of 1, 2, 3, 6, 7: \*

1. Two dental films loose : Both are left mandibular periapical \*\* type films. The root apices (ends of the roots) do not appear on the films. One film is taken slightly anterior to the other. The anterior film includes a portion of the lower left canine, both lower left premolars, the lower left first molar, and a portion of the lower left second molar. ( Universal numbers 22, 21, 20, 19, 18 )

The posterior film includes a portion of the lower left first premolar, the lower left second premolar, the lower left first molar, and a portion of the lower left second molar. ( Universal numbers 21, 20, 19, 18 )

The following surfaces are interpreted to be restored:

First Premolar (#21) - Distal Occlusal  
 Second Premolar (#20) - Mesial Occlusal Distal  
 First Molar (#19) - Mesial Occlusal Distal  
 Second Molar (#18) - Mesial Occlusal

The restorations are interpreted as cast metal restorations. A less radio opaque material pulpal ( towards the "nerve" ) to the restorations is interpreted as dental cement. The lower left first molar (#19) appears to have a portion of a previous metallic restoration on the pulpal floor.

\* The teeth will be described by name and by the Universal Numbering system. In this system the Maxillary (upper) Right Third Molar is #1, The Maxillary Left Third Molar #16, the Mandibular (lower) Left Third Molar #17, the Mandibular Right Third Molar #32

\*\* This type film usually is of the crown and root portions of a tooth or teeth in a segment of one jaw.

2. Two dental films loose: Both are left mandibular periapical type films. One film includes the root apicies, the other does not. Both films include a portion of the lower left canine, the two lower left premolars, the lower left first molar, and a portion of the lower left second molar. ( Universal Numbers 22, 21, 20, 19, 18 )

The following surfaces are interpreted to be restored:

First Premolar-(#21) - Distal Occlusal

Second Premolar (#20) - Mesial Occlusal Distal

First Molar (#19) - Mesial Occlusal Distal

Second Molar (#18) - Mesial Occlusal

The restorations are interpreted as cast metal restorations. A less radio opaque material pulpal to the restorations is interpreted as dental cement. The lower left first molar (#19) appears to have a portion of a previous metallic restoration on the pulpal floor.

3 a. One mounted dental film dated 3/11/61 : A film mount marked, "Kennedy JF 3/11/61", contains a left Bite wing\* type film. It includes a portion of the upper left first premolar, lower left first premolar, Upper and lower second premolars , first and second molars. ( Universal Numbers 12, 13, 14, 15, 21, 20, 19, 18 )

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\* This type film is usually of the crown portions of opposing teeth of a segment or an entire side.

The following surfaces are interpreted to be restored:

Upper: First Premolar (#12) - Mesial Occlusal Distal  
 Second Premolar (#13) - Mesial Occlusal Distal  
 First Molar (#14) - Mesial Occlusal Distal  
 Second Molar (#15) - Mesial Occlusal Distal  
 Lower: First Premolar (#21) - Distal Occlusal  
 Second Premolar (#20) - Mesial Occlusal Distal  
 First Molar (#19) - Mesial Occlusal Distal  
 Second Molar (#18) - Mesial Occlusal

The restorations are interpreted as cast metal on all surfaces except for those of the two upper premolars. The restored surfaces on these two teeth are metallic and may be either cast metal or silver amalgam. There is dental cement pulpally on all teeth except the upper and lower first premolars. There appears to be a portion of a previous metallic restoration on the pulpal floor of the lower left first molar.

3 b. Two mounted dental films dated 3/11/61 : A film mount marked, "Kennedy John F 11 March 61" contains two maxillary left periapical type films. These include a portion of the upper first premolar, upper second premolar, upper first molar, and upper second molar. ( Universal Numbers 12, 13, 14, 15 )

The following surfaces are interpreted to be restored:

First Premolar (12) - Distal Occlusal ( mesial portion of tooth is )  
 not shown on the film  
 Second Premolar (13) - Mesial Occlusal Distal  
 First Molar (14) - Mesial Occlusal Distal ( probably lingual )  
 Second Molar (15) - Mesial Occlusal Distal

All restorations are interpreted as being of metal with the molars probably cast metal. There is cement visible under all restorations with the exception of the first premolar.

3 c. Five mounted dental films date 1/18/61: A film mount marked, "Kennedy, Pres John F 1-18-61". The mount bears a stamp, "Robert D. Morris, D.D.S., 140 East 54th St., New York, 22, N.Y." \* The mount contains five x-ray films. There are two right bite wing type films, two left bite wing type films, and one maxillary left periapical type film.

One right bite wing film is taken anterior to the other. The more anterior film contains a portion of the upper and a portion of the lower canine, the upper and lower first and second premolars, the upper and lower first molars, a portion of the upper and lower second molars. The more posterior film contains a portion of the upper and a portion of the lower second premolars,

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\* Dr. Morris confirmed the fact that he treated President Kennedy on 1/18/61 in a telephone conversation which occurred on June 7, 1978. This appointment was two days prior to his inauguration. He had a routine "check up" which included x-rays and "cleaning".

the upper and lower first and second molars.

The following surfaces are interpreted to be restored:

Upper Right: Canine (6) - Distal

    First Premolar (5) - Occlusal

    Second Premolar (4) - Mesial Occlusal Distal

    First Molar (3) - Mesial Occlusal Distal

    Second Molar (2) - Mesial Occlusal

Lower Right: First Premolar (28) - Occlusal, Occlusal

    Second Premolar (29) - Distal Occlusal

    First Molar (30) - Mesial Occlusal Distal

    Second Molar (31) - Mesial Occlusal

The upper right canine is interpreted as having a cement restoration.

All other restorations are metal. The first premolars appear to have silver amalgam restorations, all others appear to be cast metal.

There appears to be cement pulpal to all restorations except those of the first premolars.

One left bite wing film is taken anterior to the other. Both films include the upper and lower first premolars, second premolars, first molars and second molars. The more anterior film includes a portion of the upper and lower second molars, the more posterior film, a small portion of the upper and lower first premolars.

The following surfaces are interpreted to be restored:

Upper Left: First Premolar (12) - Distal Occlusal

    Second Premolar (13) - Mesial Occlusal Distal

Upper Left: First Molar (14) - Mesial Occlusal Distal  
 Second Molar (15) - Mesial Occlusal Distal  
 Lower Left: First Premolar (21) - Distal Occlusal  
 Second Premolar (20) - Mesial Occlusal Distal  
 First Molar (19) - Mesial Occlusal Distal  
 Second Molar (18) - Mesial Occlusal

The restorations are interpreted as cast metal on all surfaces with the exception of the two upper premolars. The restored surfaces on these two teeth are metallic and may be either cast metal or silver amalgam. There is dental cement pulpally on all teeth except the upper and lower first premolars. There appears to be a portion of a previous metallic restoration on the pulpal floor of the lower first molar.

The maxillary left periapical film includes a portion of the upper first premolar, second premolar, first and second molars.

The following surfaces are interpreted to be restored:

Upper Left: First Premolar (12) - Distal Occlusal  
 Second Premolar (13) - Mesial Occlusal Distal  
 First Molar (14) - Mesial Occlusal Distal (probably lingual)  
 Second Molar (15) - Mesial Occlusal

The restored surfaces of the molars are interpreted as cast metal. The premolars may be either cast metal or silver amalgam. There appears to be cement under all restorations with the exception



of the first premolar.

3 d. One mounted dental film dated 3/8/62 : A film mount marked, " JF Kennedy 3/8/62 " contains an upper left periapical type film. The film includes a portion of the upper left canine, first and second premolars, first molar, and a portion of the second molar.

The following surfaces are interpreted to be restored:

Upper Left: First Premolar (12) - Distal Occlusal  
 Second Premolar (13) - Mesial Occlusal Distal  
 First Molar (14) - Mesial Occlusal Distal  
 Second Molar (15) - Mesial Occlusal (the distal portion of)  
 #15 is not in the film

All surfaces are restored in metal. The molars appear to be restored with cast metal the premolars with either cast metal or silver amalgam. Cement is apparent pulpally on all teeth but the first premolar.

6. JFK Sinus Films, 8-17-60, ... five films: There is a container marked, " 5 sinus films " J.F.K.

It is labelled, " Name Kennedy, Mr. John F.  
 No. 336042  
 Remarks 8/17/60

Drs. Groover, Christie & Merritt  
 1835 Eye Street N.W.  
 Washington, 6, D.C.

The manila sleeve contains five x-ray films. One is a lateral skull film. Four are AP films taken at various angulations.

The configuration of the frontal sinuses can be clearly determined from the AP films.

The following dental restorations can be interpreted from the lateral skull film:

Upper Left: First Premolar (12) - Distal Occlusal  
 Second Premolar (13) - Mesial Occlusal Distal  
 First Molar (14) - Mesial Occlusal Distal  
 Second Molar (15) - Mesial Occlusal Distal  
 Lower Left: First Molar (19) - Mesial Occlusal Distal  
 Second Molar (18) - Mesial Occlusal

Superimposition in the premolar area makes clear interpretation difficult. Overlapping makes clear interpretation difficult towards the anterior region.

These restorations all appear to be metallic. Cement can be clearly seen pulpal to the restorations in the molar area. The appears to be a portion of a previous metallic restoration pulpal to the restoration and cement liner on the lower left first molar (19).

7. JFK Sinus Films, 8-14-60....4 films : There is a container marked, " #202617

8-14-60

JFK

Dr. Stephen White

'Sinus X-Rays'

The envelope contains one lateral skull film  
and three AP type films taken at various angulations.

The configuration of the frontal sinus can be clearly determined from the AP films.

The following dental restorations can be interpreted from the lateral skull film:

Upper Right second molar (2) - Occlusal portion of restoration  
Upper Left Second Molar (15) - Distal portion of restoration  
Lower Right First Molar (30) - Mesial Occlusal Distal  
Lower Right Second Molar (31) - Mesial Occlusal

There is considerable superimposition and overlap.

Authenticity of 1., 2., 3 a., 3 b., 3 c., 3 d., 6., 7.

The first task of the forensic odontologist is to form an opinion as to whether the films he will use for comparison with the films in question are authentic. The twenty-two films described were received by the National Archives from the Kennedy Library. According to a source at the Kennedy Library, the films were found in the White House after the death of the President. They came to the Kennedy Library through a family member.\*

Dates of Films and Source:

8/14/60 - Lateral Skull Film - Dr. Stephen White, #7  
Three AP skull films  
8/17/60 - Lateral Skull Film - Drs. Groover, Christie & Merritt  
Four AP Skull Films #6

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\* William Moss, Chief Archivist, Kennedy Library

- 1/18/61 - five dental films - Dr. Robert D. Morris - #3 c.  
 two right bite wings  
 two left bite wings  
 one left maxillary periapical
- 3/11/61 - three dental films - Captain J.W. Pepper, D.C., USN - #3 a., 3  
 one left bite wing  
 two left maxillary periapical s
- 3/8/62 - one dental film - Captain J.W. Pepper, D.C., USN - #3 d.  
 one left maxillary periapical
- 4/9/62 - two dental films - Captain J.W. Pepper, D.C., USN - #2  
 two left mandibular periapicals
- 7/12/62 - two dental films - Captain J.W. Pepper, D.C., USN - #1  
 two left mandibular periapicals

Films of the Left Side:

- #1 - 2 films 7/12/62 - two mandibular periapicals  
 #2 - 2 films 4/9/62 - two mandibular periapicals  
 #3a- 1 film 3/11/61 - bite wing  
 #3b- 2 films 3/11/61 - two maxillary periapical  
 #3c- 3 films 1/18/61 - two bite wings, one maxillary periapical  
 #3d- 1 film 3/8/62 - maxillary periapical  
 #6 - 1 film 8/17/60 - lateral skull

There are twelve films taken over a twenty-three month period by at least three different sources, Drs. Pepper, Morris, and White.

Films of the Right Side:

#3c - 2 films 1/18/61 - two bite wings

#7 - 1 film 8/14/60 - lateral skull (also shows portion of left)

There are three films taken in a five month period by two different sources, Dr. Morris and Drs. Groover, Christie & Merritt.

There are seven films useful for comparing frontal sinus configurations, # 6 and #7 from two different sources, Dr. White and Drs. Groover, Christie & Merritt. \*

Opinion as to the authenticity of the films to be used for comparisons

Dr. Robert D. Morris confirms the fact that he did expose x-ray films on President John F. Kennedy on January 18, 1961. There are numerous unique and individual characteristics reproduced in the fifteen films illustrating the dentition. The films were acquired from at least four different sources. Films taken in like areas may be easily compared with each other. It is my opinion that all films were taken on the same person, John F. Kennedy.

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\* It is interesting to note that President Kennedy had numerous x-ray films of the left side taken in the period between 3/11/61 and 7/12/62. One could speculate that he was suffering from some non-specific dental pain of the left posterior area during that period.

Autopsy Films 1, 2, 3

## Description of Films:

1. AP Skull Film
2. Lateral Skull Film
3. Lateral Skull Film

Each film is marked, " 21296"

U.S. Naval Hospital  
NNMC, Bethesda, Md.

Description of areas of comparison of Autopsy 1, 2, 3

Autopsy 1. The configuration of the frontal sinuses are quite distinctive. The right side is "heart" shaped, the left almost "rhomboid".

Autopsy 2. There is considerable superimposition and overlap of the jaws, teeth, and restorations, however the right side appears slightly superior. There is a <sup>radio opaque</sup> rectangular shaped object with ~~three~~ small and one large radiolucent circular areas in it extending from the second lower premolar considerably beyond the third molar area. It obliterates the roots of ~~the~~ molars and extends at an angle beyond the inferior border of the mandible. Because of the angulation at which this film was taken, this object is parallelogram shaped, the circular areas oval shaped.

The configuration and juxtapositions of a number of the dental restorations are useful for comparison purposes. The two occlusal restorations can be clearly interpreted on the lower right first premolar (28) as can the occlusal portion of the distal occlusal restoration on the lower right second premolar (29). In the second molar area the two second molars are superimposed upon each other. The very distinctively shaped cement liner in the lower left second molar (18) is quite apparent. It is kidney shaped with the concavity towards the pulpal floor. The deeper portion extends towards the distal. Immediately above the cement liner is the occlusal portion of the mesial occlusal restoration. The concave distal occlusal wall is apparent. The shallow portion of the distal occlusal wall of the mesial occlusal restoration in the lower right second molar (31) can be interpreted immediately above the convexity of the distal occlusal wall of the lower left second molar (18) restoration. The deeply rounded floor of the mesial portion of the mesial occlusal restoration on the lower left second molar (18) can be seen.

The distal portions of restorations on the upper second molars can be interpreted although considerably superimposed upon each other.

There are unquestionably ample unique and individual characteristics which can be interpreted for comparison purposes contained in this film.

Autopsy 3. There is no superimposition of the maxillary left segment. Although there is slight overlap, the configuration and juxtapositions of the dental restorations in this segment can be readily interpreted. There is superimposition of the right maxillary molar area on the superior portion of the occlusal of the lower right second premolar(29) and lower right first molar(30). There is a radio opaque rectangular object, apparently the same object as in Autopsy 2., which obliterates almost entirely both lower left premolars, the roots of the lower left first molar, and a portion of the roots of the lower left second molar. The lower left second molar appears free of distortions.

The characteristics of the restorations and existing lining materials can be readily interpreted on the following

teeth: Upper Left: First premolar (12)

Second premolar (13)

First molar (14)

Second molar (15)

Upper Right: First premolar(5)

Second premolar(4)

Lower Left: First molar(19)

Second molar(180)

There are numerous unique and individual characteristics which can be interpreted for comparison purposes contained in this film.



Comparisons

Autopsy 1. The configurations and relationships of the frontal sinuses depicted in this film and in films contained in Sinus 6. and Sinus 7. are similar.

Autopsy 2. The unique and individual characteristics described in this film can also be interpreted in films contained in:

1., 2., 3a., 3c., 6., 7

Autopsy 3. The unique and individual characteristics described in this film can also be interpreted in films contained in:

1., 2., 3a., 3b., 3c., 3d., 6., 7.

Conclusions

It is my opinion that Autopsy Films 1., 2., 3. are unquestionably of the skull of President John F. Kennedy. It is further my opinion that the unique and individual dental and hard tissue characteristics which may be interpreted from Autopsy Films 1., 2., 3. could not be simulated.

*Lowell J. Levine DDS*

Lowell J. Levine, D.D.S.

Exhibits

Comparison of dental x-rays are visually quite persuasive when presented to juries of lay persons as photographic "blow-ups". The forensic odontologist can easily demonstrate the characteristics and relationships he has interpreted to form his opinion.

Almost at the outset of my examination in consultations between Dr. Michael M. Baden, the committee staff, and myself, it was decided it would be very desirable to attempt to get permission to reproduce portions of x-ray films which were significant in forming my opinion.

The strongest reason for publishing facsimiles of the x-ray evidence is that they are so much more convincing than a narrative description of characteristics compared.

The committee staff obtained permission for me to photograph and reproduce portions of the films I felt were necessary to document the identification and authentication. Autopsy 1. was not photographed at that time because it was my understanding that my permission precluded reproducing areas which depicted injury pattern. The fact that documentation of Autopsy 1. is not included in these exhibits should in no way be construed to imply that my opinion as to the authenticity of that film is anything less than a positive identification.

On November 15, 1977 I personally photographed the films at the National Archives. The exhibits were produced under my direction by Walter Poppe, Forensic Photographer, Office of the Medical

Examiner, Nassau County, N.Y. while employed as a private consultant.

Exhibits

FIG. 1 - Dental Film (Descriptive List 1.) taken 7/12/62. The more posterior of the two films described.

FIG. 2 - Dental Film (Descriptive List 2.) taken 4/9/62. One of the two films described.

FIG. 3 - Dental Film (Descriptive List 3a.) taken 3/11/61.

FIG. 4 - Dental Films (Descriptive List 3b.) taken 3/11/61.

FIG. 5 - Dental Films (Descriptive List 3c.) taken 1/18/61. Four of the five films described.

FIG. 6 - Dental Film (Descriptive List 3d.) taken 3/8/62.

FIG. 7 - Sinus Film (Descriptive List 6.) taken 8/17/60. Dentition and supporting structures depicted in Lateral Skull Film.

FIG. 8 - Sinus Film ( Descriptive List 6 ) taken 8/17/60. "Waters Position" type film.

FIG. 9 - Sinus Film ( Descriptive List 7 ) taken 8/14/60.  
Dentition and supporting structures depicted in Lateral Skull Film.

FIG. 10 - Autopsy 2. Dentition and supporting structures.

FIG. 11 - Autopsy 3. Dentition and supporting structures.

Mr. PURDY. I have no further questions for Dr. Levine. I will move on to Mr. McCamy.

What is your occupation?

Mr. McCAMY. I am a scientist specializing in photography and the measurement of color.

Mr. PURDY. Have you examined the photographs said to be taken of President Kennedy at the time of the autopsy?

Mr. McCAMY. Yes, I have.

Mr. PURDY. Did anyone else on the photographic panel examine these materials?

Mr. McCAMY. Yes; they were examined in great detail by Frank Scott, by David Eisendrath, by Bennett Sherman, and by one of the professors from RIT.

Mr. PURDY. Did you observe anything of interest in the photographs which is relevant to the issue of the authenticity of the autopsy photographs?

Mr. McCAMY. Yes; there were numbers embossed on the edges of the color films. These numbers indicate the batch numbers of emulsions. Sometimes but not always, a manufacturer of the film can date the film knowing these numbers. David Eisendrath copied down two of these numbers from the color film and he prepared a letter to the manufacturer, Eastman Kodak, asking about the date of the films. As it happened, he had some old boxes of film on which the dates were known. He took the numbers of some of those films and submitted them at the same time just as a control procedure.

Mr. PURDY. Did you notice anything else on the autopsy photographs relevant to the issue of authenticity?

Mr. McCAMY. Might I remark that the Eastman Kodak Co. did respond. They were able to date David Eisendrath's films and they were able to date the films that were taken at the time of the autopsy and they said the films were manufactured in 1963, which is an appropriate finding.

Mr. PURDY. Thank you.

As I was saying, Mr. McCamy, is there anything else you observed on the autopsy photographs relevant to the issue of authenticity?

Mr. McCAMY. Yes. Of course we examined the films in great detail to see whether or not there were any indications, any evidence whatsoever, of falsification of the photographs. We found no

disturbing of the surface of the film. We found nothing taken away from the film or added to the film, no evidence of any cutting or pasting or construction of a montage, in short, found no evidence whatsoever of any such faking.

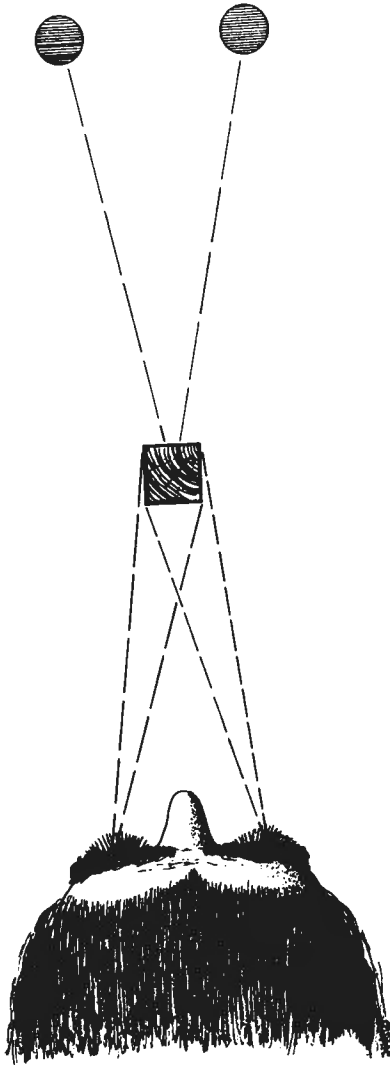
Mr. PURDY. You mentioned earlier to members of the staff that you were able to view some of the photographs stereoscopically. Could you briefly state what it means to view photographs stereoscopically and why you believe this is evidence of authenticity?

Mr. McCAMY. Yes. We have an exhibit. The human eyes are located a short distance apart.

Mr. PURDY. Mr. Chairman, could we examine this item and mark it as JFK exhibit F-294 and enter it into the record at this time.

Chairman STOKES. Without objection, it may be entered into the record at this time.

[The above referred to JFK exhibit F-294 was marked erroneously and should have been marked JFK exhibit F-203.]



JFK EXHIBIT F-203

Mr. McCAMY. As you can see on the diagram, if a person looks at a small square peg in front of him, the right eye may see the front and part of the side of the peg. The left eye can see the front and part of the left side of the peg. This is a disparity, a difference in the two views that the two eyes see.

Another fact is observed. For the right eye, the peg lines up with the left hand spot in that diagram in the background where, for the left eye, the peg lines up with the right hand spot, so we have what is called parallax, that is, a difference of alinement in the photograph.

Mr. PURDY. Mr. McCamy, were there autopsy photographs in which you were able to observe parallax?

Mr. McCAMY. Yes, sir.

Mr. PURDY. Which autopsy photographs were those?

Mr. McCAMY. They were photographs of the back of the head, of the top of the head, the front of the body showing the neck wound, the back showing the back wound.

Mr. PURDY. Mr. McCamy, based on your viewing of these photographs and your determination that parallax was evident in them, to what extent are you able to say that these photographs were unaltered?

Mr. McCAMY. I would say on the basis of the examination of these photographs, stereoscopically, it is highly unlikely that they were altered in any way.

Mr. PURDY. Why do you have this opinion based on viewing them stereoscopically?

Mr. McCAMY. Let me take four cases because—

Mr. PURDY. Mr. McCamy, if we could deal with the general principle of stereoscopic vision, could you tell us why your ability to view them stereoscopically permits you to say they are authentic.

Mr. McCAMY. Yes. Suppose, first, we take the possibility that someone substituted a body and that it was not the body of the President. Viewing these photographs stereoscopically provides the best kind of view because you can observe not only lateral dimensions but dimensions in depth, so it provides the best kind of view for identification.

In this case, we must remember we are looking at professional photographs taken at short range, not distant photographs, so there is very little difficulty in identifying the person and the things seen.

The fact that it is in stereo gives the observer full advantage of the information available to him.

Mr. PURDY. Mr. McCamy, then it is your opinion that based on your examination of these stereo pairs that you are able to conclude that it is very unlikely these photographs are altered?

Mr. McCAMY. Yes, extremely unlikely. We have considered the possibilities of various photographic techniques that could have been used in a train of events to produce these photographs. Some of them are virtually impossible because of the stereoviewing. Others would be exceedingly difficult, if not impossible.

Mr. PURDY. Thank you, Mr. McCamy.

Mr. Chairman, I have no further questions.

Chairman STOKES. Thank you, Counsel.

Dr. Levine, Mr. McCamy, thank you both for your testimony here this morning and you are now excused.

[Witnesses excused.]

The Chair recognizes Professor Blakey.

Mr. BLAKEY. Mr. Chairman, of those doctors involved in either the original autopsy or subsequent reviews of it, the committee has available to it today or tomorrow Dr. Baden, Captain Humes, Dr. Wecht, and Dr. Petty. Dr. Baden received an M.D. degree from New York University School of Medicine in 1959 and completed his residency in pathology at Bellevue Hospital in 1964. He is, of

course, the chairman of the committee's panel reviewing the autopsy. It would be appropriate now, Mr. Chairman, to call Dr. Baden.

Chairman STOKES. The committee calls Dr. Baden.

Dr. Baden, would you raise your right hand, please?

Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Dr. BADEN. I do.

Chairman STOKES. Thank you. You may be seated.

Before I recognize counsel. Dr. Baden, I understand you will be giving testimony relative to illustrated photographs.

**TESTIMONY OF DR. MICHAEL BADEN, PATHOLOGIST AND  
CHIEF MEDICAL EXAMINER FOR THE CITY OF NEW YORK**

Dr. BADEN. Taken at the autopsy, yes, sir.

Chairman STOKES. I guess it is important at this point that the record reflect the fact that the photographs which are sealed in the National Archives have been made available to the appropriate members of this committee staff and to the members of this committee.

The committee has viewed those photographs as late as this past evening. The committee feels it would be in extremely poor taste for this committee to submit those photographs to public view. It also, in our opinion, would be an invasion of the privacy of the President's family. It is for that reason that these photographs will remain sealed and will not be displayed during the course of these hearings.

The committee, at this time, will recognize counsel Kenneth Klein.

Mr. KLEIN. Thank you, Mr. Chairman.

Doctor, what is your current position?

Dr. BADEN. I am Chief Medical Examiner of the City of New York.

Mr. KLEIN. What are your duties as chief medical examiner of the city of New York?

Dr. BADEN. My duties include supervision and responsibility for the functioning of the Office of Chief Medical Examiner of New York City, which has responsibility to investigate all sudden, suspicious, and unnatural deaths that occur in the five boroughs of New York City.

Mr. KLEIN. During the course of your duties as Chief Medical Examiner, do you perform autopsies?

Dr. BADEN. Yes, sir.

Mr. KLEIN. What is an autopsy?

Dr. BADEN. An autopsy is a systematic external and internal examination of the dead body to determine any abnormalities that might be present to assist in determining cause of death.

Mr. KLEIN. What is your specialty as a medical doctor?

Dr. BADEN. My specialty is pathology and within that area, forensic pathology.

Mr. KLEIN. What is forensic pathology?

Dr. BADEN. Pathology is that area of medicine concerned with the investigation and evaluation of natural disease and other abnormalities in the human body; and forensic pathology specifically



refers and relates to investigation of unnatural death and to areas of pathology and medicine that are concerned with legal aspects of death and injury, and ability to present these materials in courts and other jurisdictions.

Mr. KLEIN. Prior to serving on the panel, did you have any contact with the Kennedy case?

Dr. BADEN. No, I had not.

Mr. KLEIN. Mr. Chairman, I would ask that this document marked JFK F-19 be received as a committee exhibit and shown to the witness.

Chairman STOKES. Without objection, it may be received as a committee exhibit and entered into the record at this point.

[The above-referred-to exhibit, JFK F-19, follows:]

## JFK EXHIBIT F-19

LISTING OF MATERIALS PROVIDED TO THE PATHOLOGY PANEL BY  
THE SELECT COMMITTEE - JOHN F. KENNEDY1. AUTOPSY AND RELATED MATERIALS

Autopsy Protocol 11-22-63  
 Supplementary Autopsy Report 12-6-63  
 Notes of Dr. James J. Humes 11-23-63  
 Autopsy Descriptive Sheet 11-22-63  
 Death Certificate 11-22-63  
 Authorization for Post-Mortem Examination 11-22-63  
 Report of Inquest 12-6-63  
 Original autopsy photographs  
 Original autopsy X-rays  
 Comparison X-rays 1960-63  
 Clothing worn at time of assassination  
 LogeTronic X-ray enhancements of original X-rays  
 Aerospace Corporation computer enhancements of original  
 X-rays and photographs  
 1966 Index by Drs. Humes, Boswell, Ebersole and Stringer  
 1967 Report by Drs. Humes, Boswell and Finck  
 Dr. Finck's notes  
 Dr. Finck's 1965 report  
 Dr. Finck's 1967 Review  
 Dr. Finck's Testimony - State of Louisiana v. Clay L. Shaw

2. WARREN COMMISSION TESTIMONY

Dr. James J. Humes  
 Dr. Pierre A. Finck  
 Dr. Thornton Boswell  
 Dr. Malcolm O. Perry  
 Dr. Martin G. White  
 Dr. Paul C. Peters  
 Dr. Adolph A. Giesecke, Jr.  
 Dr. William K. Clark  
 Dr. Don T. Curtis  
 Dr. Fuoad A. Bashour  
 Dr. Gene C. Atkin  
 Dr. Charles J. Carrico  
 Dr. Charles R. Baxter  
 Rufus W. Youngblood  
 Clinton Hill  
 Roy H. Kellerman  
 William Greer

Listing of Materials Provided to the Pathology Panel by  
The Select Committee - John F. Kennedy

3. STAFF INTERVIEWS

Dr. Norman Chase  
Dr. William Seaman  
Dr. Malcolm O. Perry  
Dr. C. James Carrico  
Dr. Marion T. Jenkins  
Admiral George Burkley, M.D.  
Dr. John Lattimer

4. BALLISTICS MATERIALS

Bullets and bullet fragments  
Rifle  
Cartridges

5. SECRET SERVICE REPORT

Bullet trajectories

6. FBI REPORTS

Harper skull fragment  
Examination of clothing  
Autopsy

7. REPORTS

Dr. David O. Davis  
Dr. Gerald M. McDonnel  
Dr. John Nichols  
Soft X-ray and Energy Dispersive X-ray Analysis of Clothing  
Prepared by Southwestern Institute of Forensic  
Sciences at Dallas  
J. Lawrence Angel - October 24, 1977  
Clark Panel - 1968  
Rockefeller Panel - 1975  
  
Parkland medical reports

8. ARTICLES BY:

Dr. Cyril H. Wecht  
Dr. John K. Lattimer

9. MOTION PICTURE FILMS AND SLIDES

Zapruder film  
Nix film  
Single frame pictures of Zapruder film  
Film and slide presentation given by Robert Groden  
Harper fragment

Mr. KLEIN. Doctor, do you recognize that document?

Dr. BADEN. Yes, I do.

Mr. KLEIN. What is that?

Dr. BADEN. It is a listing, three pages, of various medical and other materials provided to members of the medical panel in evaluating the cause of death of President Kennedy.

Mr. KLEIN. Using that document, would you tell the committee how the panel went about its examination of the evidence in this case?

Dr. BADEN. The panel initially consisted of a group of forensic pathologists who had previously seen the archival materials and a group that had not. Prior to the meeting of each panel separately, the doctors were provided with various printed materials including copies of the autopsy report, and medical findings and evidence relating to the death of President Kennedy from Parkland Hospital, Warren Commission testimony, and from the Clark and Rockefeller panels. Each member of the panel reviewed these materials, then met individually and collectively at the National Archives where each member reviewed all of the photographic illustrations taken prior to and during the autopsy of the President, all X-rays taken prior to and during the autopsy of the President, the clothing that the President wore at the time of the shooting, various related ballistics material, including a rifle, cartridge shell casings and bullets, and bullet fragments preserved at the Archives.

These are some of the material, listed in these three pages that each member reviewed.

Mr. KLEIN. After meeting at the Archives, did other material become available to the panel?

Dr. BADEN. Yes, in the course of their discussions various panel members suggested additional materials and studies to assist and aid in clarifications of issues and questions that arose after examining the materials provided.

And in this regard, various types of expertise were made available to the panel members, much relating to interpretation of the X-rays taken of the President at the time of the autopsy.

The X-rays were subjected to various techniques that clarified images. The panel members had opportunity to consult with and read reports from various radiologists who are physicians who specialize in taking and interpreting X-rays. The panel did have opportunity to view closely the Zapruder film and sections from the Zapruder film. Studies were requested of soft X-rays and authentication and other studies were performed to assist the panel members in gathering whatever data could be gathered to arrive at conclusions as to the medical aspects of the death.

Mr. KLEIN. Are the members of the panel experienced in evaluating such materials to determine such things as cause of death, number and location of wounds and bullet tracts?

Dr. BADEN. Yes, sir. The full-time occupation of each panel member has been or is investigation of deaths, particularly unnatural deaths, to determine cause of death, every day in the various jurisdictions that the panel members represent.

This is something that is the normal working procedure of each of the doctors assembled.

Mr. KLEIN. Can you give us an approximation of how many autopsies the various members of the panel collectively have performed or been responsible for?

Dr. BADEN. In reviewing the jurisdictions and the length of service of the doctors on the panel, I would estimate that well more than 100,000 medicolegal autopsies have been performed or supervised by the panel members collectively in the course of their official capacities.

Mr. KLEIN. What, if any, relevant materials could not be made available to the panel?

Dr. BADEN. The specific relevant materials not available to the panel have already been mentioned by Professor Blakey pertaining to further examination of brain tissue and microscopic slides.

However, the doctors who performed the autopsy were made available for interview to the panel members and responded on short notice at the very initial meeting of the first panel so that Dr. Humes, Dr. Boswell, subsequently Dr. Ebersole and Dr. Finck were interviewed by the panel members; transcripts were made of the interviews and made available to all the members, especially the interview with Drs. Humes and Boswell at which the second panel members were not present.

Mr. KLEIN. Despite the absence of the brain and the fact that the panel doctors were not present at the autopsy, were the panel members able to reach conclusions with respect to the cause of death, the number of wounds, the location of the wounds, and the path of the bullets through the body?

Dr. BADEN. Yes, sir.

Mr. KLEIN. Are you testifying today as a representative of the entire panel of forensic pathologists?

Dr. BADEN. Yes, I am.

Mr. KLEIN. Did any members of the panel disagree with the conclusions reached by the panel?

Dr. BADEN. The essential conclusions were unanimously agreed to by eight of the panel members. One panel member, Dr. Wecht, did dissent in some important aspects of the conclusions.

Mr. KLEIN. Doctor, since Dr. Wecht will be testifying before the committee today, I will ask you from this point on to confine your testimony to the conclusions reached by the other members of the panel.

Dr. BADEN. Yes.

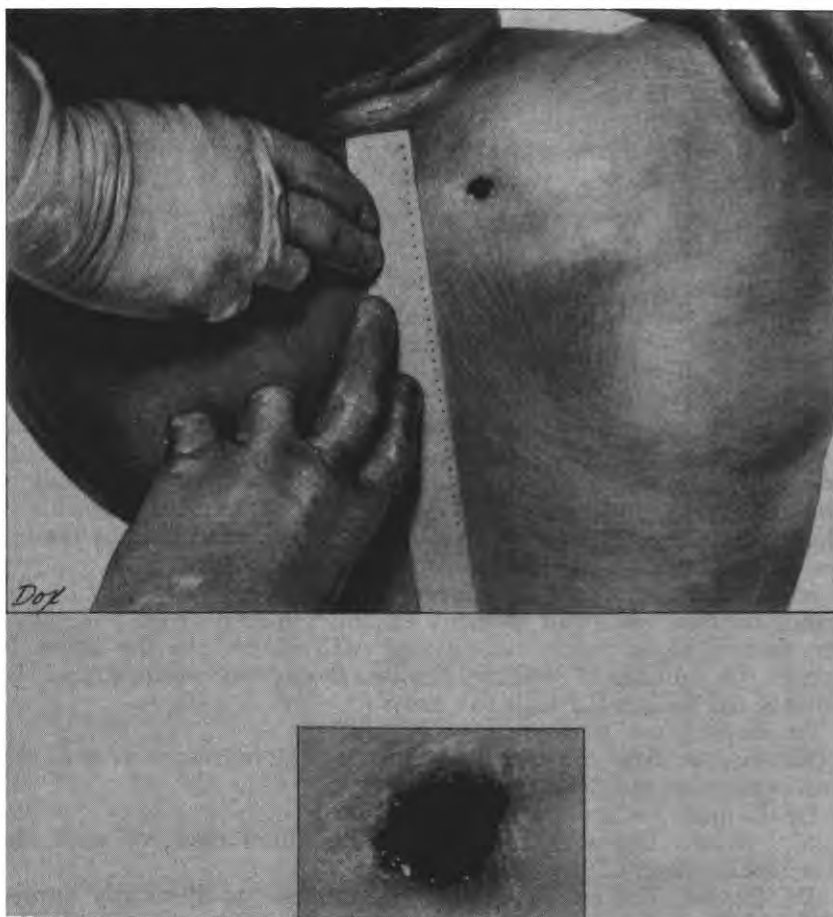
Mr. KLEIN. What was the cause of death of President John F. Kennedy?

Dr. BADEN. President Kennedy died as a result of two gunshot wounds of the head, brain, back and neck areas of the body.

Mr. KLEIN. At this point, Mr. Chairman, I would ask that the drawing marked JFK F-20 be received as a committee exhibit and shown to the witness.

Mr. DODD [presiding]. Without objection, so ordered.

[The above-referred-to document, JFK exhibit F-20, follows:]



JFK EXHIBIT F-20

Mr. KLEIN. I would also ask at this point that Dr. Baden be allowed to move over to the area where the exhibits are shown because a good number of the exhibits will be drawings and diagrams.

Mr. DODD. Dr. Baden, there is a microphone over there for you as well: if you could put that on your tie.

Mr. KLEIN. Doctor, do you recognize that drawing?

Dr. BADEN. Yes, I do.

Mr. KLEIN. What is that drawing of?

Dr. BADEN. This a drawing done by Miss Dox of one of the autopsy photographs taken just prior to the autopsy of President Kennedy.

Mr. KLEIN. What does that particular drawing portray?

Dr. BADEN. This particular drawing shows the back of the President and the head where I am pointing to, and a perforation of the skin of the right upper back with a centimeter ruler alongside.

Mr. KLEIN. Doctor, does this diagram fairly and accurately represent the location of the wound in the President's upper right back?

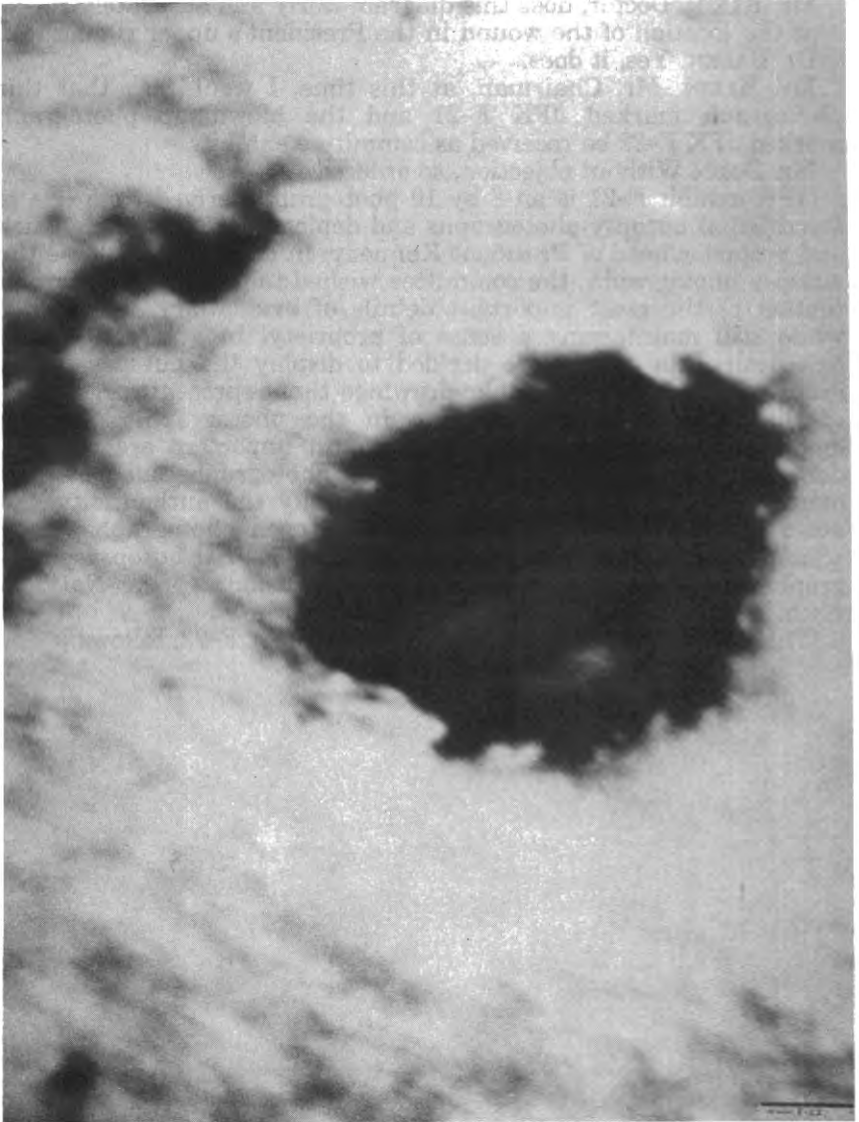
Dr. BADEN. Yes, it does.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that this photograph marked JFK F-21 and the blown up photograph marked JFK F-22 be received as committee exhibits.

Mr. DODD. Without objection, so ordered.

[JFK exhibit F-21 is an 8 by 10 photograph derived from one of the original autopsy photographs and depicts a portion of the back and posterior head of President Kennedy. In deciding to release the autopsy photographs, the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy photographs to the public in either drawings that represent large areas of the President's body as seen in the photograph or closely cropped photographs that depict the most important areas of evidentiary concern. The committee used photographs such as JFK exhibit F-21 in the hearings only to verify the authenticity and accuracy of the drawings and closely cropped photographs; these photographs are not being published. The original autopsy photographs and committee copies are in the custody of the National Archives.]

[The above-referred-to document, exhibit JFK F-22, follows:]



JFK EXHIBIT F-22

Mr. KLEIN. Doctor, do you recognize that photograph and that blowup?

Dr. BADEN. The photograph, an 8 by 10 black and white photograph, that I have in my hand is an enlarged detail from one of the autopsy photographs showing the perforation in the right upper back region seen on the diagram; the exhibit alongside is a blowup of the perforation in the right upper back as seen in this photograph.

Mr. KLEIN. So, the blowup is of the wound in the back of the President on the right; is that correct?



Dr. BADEN. That's correct, and this diagram is a diagrammatic representation of this photograph.

Mr. KLEIN. Did the panel have an opportunity to examine the original photograph from which that blowup was made?

Dr. BADEN. The panel had the opportunity and exercised the opportunity to examine, with magnifying lenses, photographs, negatives, transparencies of all of the material available at the Archives.

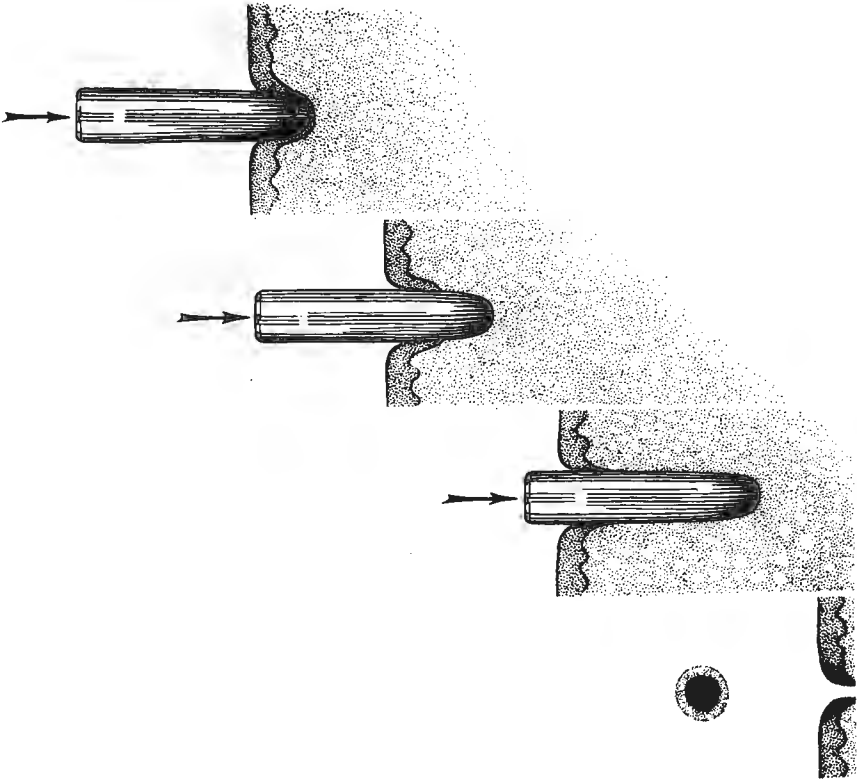
Mr. KLEIN. And using that blowup, would you please explain to the committee what the panel learned from the photograph of the wound on the President's back?

Dr. BADEN. The panel was able to conclude after examining the photographs and the details of the perforation in the right upper back, that this perforation was a gunshot wound of entrance and is characterized uniquely by an abrasion collar, a roughening of the edges around the entrance perforation, which is more apparent in the photographs than the blowup, but which clearly depicts and identifies the perforation as an entrance gunshot wound.

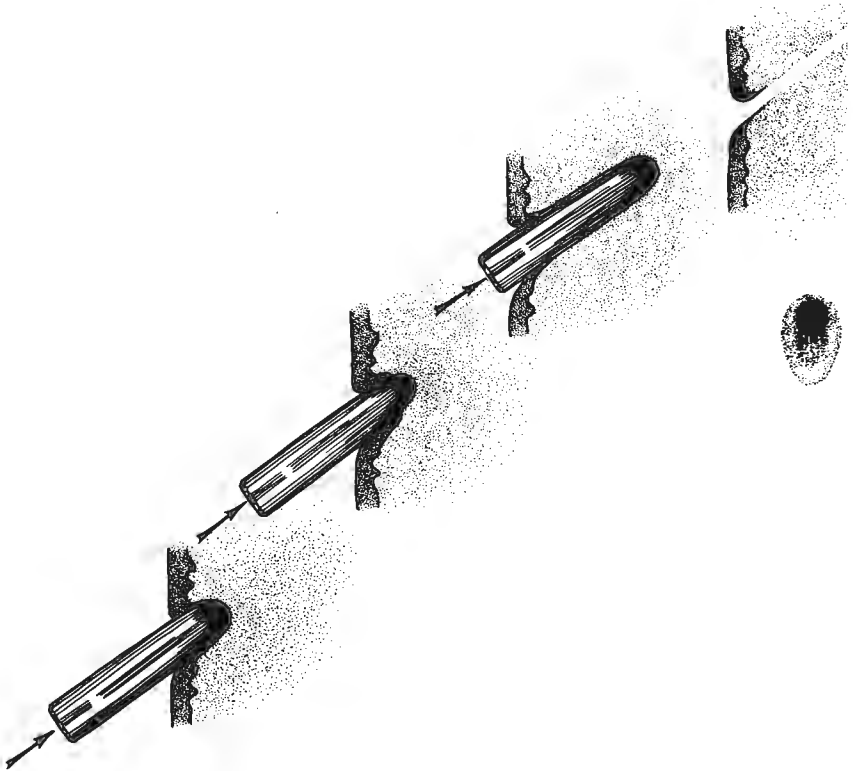
Mr. KLEIN. At this time, Mr. Chairman, I would ask that two diagrams marked JFK F-23 and F-24 be received as committee exhibits.

Mr. DODD. Without objection.

[The above-referred-to documents, JFK F-23 and JFK F-24, follow:]



JFK EXHIBIT F-23



JFK EXHIBIT F-24

Mr. DODD. I would point out while this is occurring, we are missing some members. There is a quorum call going on and they will be coming in and coming out as votes and quorum calls occur during the day.

You may proceed, counsel.

Mr. KLEIN. Doctor, using JFK F-23 and F-24, the two diagrams, would you please explain what an abrasion collar is?

Dr. BADEN. Yes. An abrasion collar is characteristic of an entrance wound produced when a bullet, as seen in these diagrams made by Miss Dox, penetrates the skin from outside the body. The outer surface of the skin here, the epidermis, is depicted darker than the inner tissues underneath; the diagram shows the bullet entering at a 90° angle to the skin, with initial stretching of the outer layer of skin, and rubbing of the bullet against the skin surface as it perforates the overstretched skin causing, after the bullet has passed through and the skin has returned to its normal unstretched condition, a rough, abraded margin of the outer layer of the skin which has a typical darker appearance as in the photographs of President Kennedy. This is referred to as an abrasion collar because it immediately surrounds the perforation of the skin. It tells the forensic pathologists that it was caused by a bullet entering the body and rubbing against the outside of the skin.

When a bullet exits the body through the skin, proceeding from inside the body to the outside, it does not cause, usually, except under special circumstances, this same type of rubbing effect on the edges of the skin.

In this other diagram that Miss Dox has prepared is an example of a bullet entering the skin at an angle. When the bullet enters at an angle, the skin is stretched prior to perforation unequally so that one part of the abrasion collar is wider than another part and this produces a perforation that is assymetric and indicates directionality; thus the abrasion collar establishes not only that it is an entrance wound but also the direction that the bullet is traveling.

When a bullet enters head-on at a 90° angle, the abrasion collar surrounding is equal, uniformly equal. When it enters at an angle, part of the abrasion collar is wider than the other part and this assists in establishing direction of the bullet track.

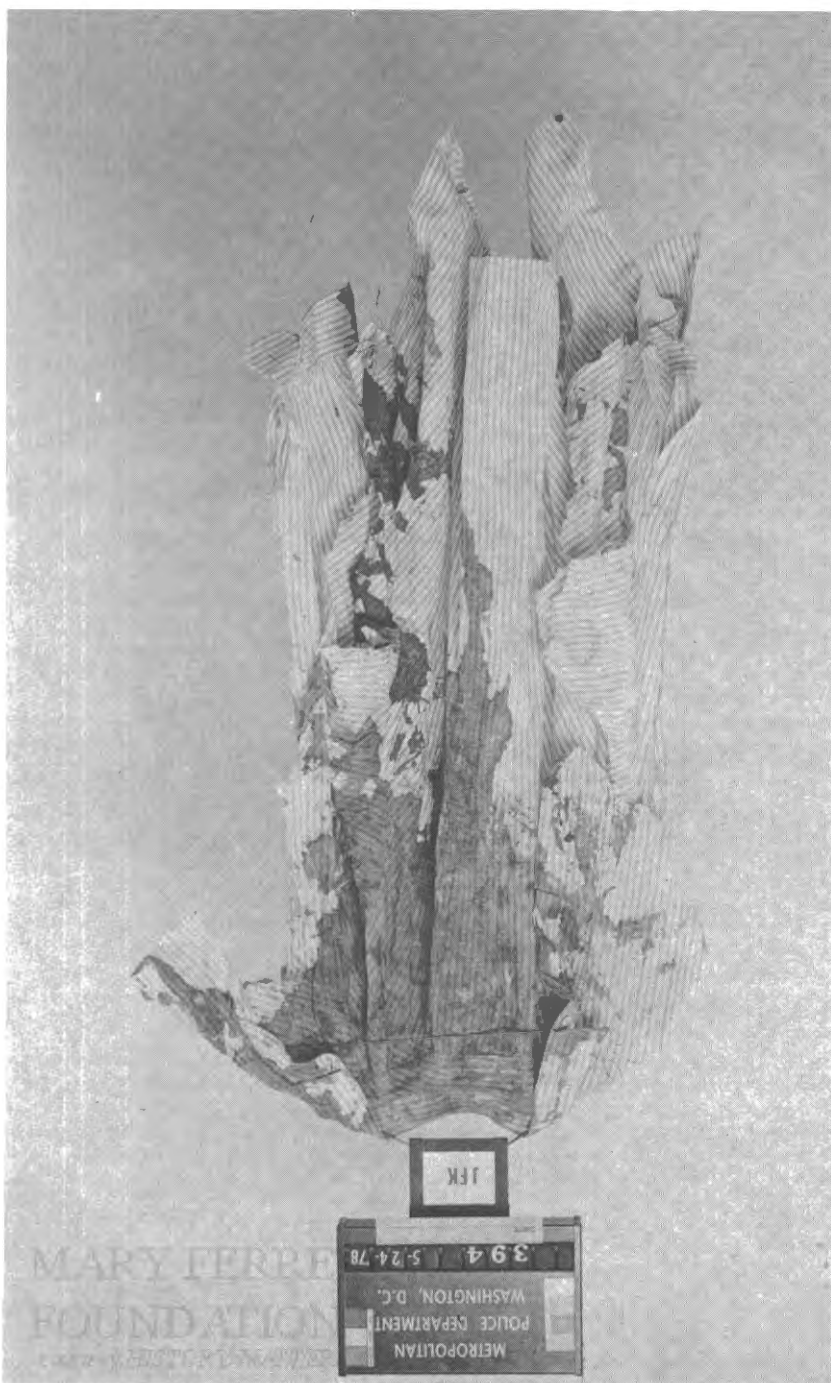
Mr. KLEIN. And the panel found an abrasion collar on the wound of the President's back of the kind you have shown us in these drawings?

Dr. BADEN. Yes, sir. This represents a diagram, a blowup of the actual entrance perforation of the skin showing an abrasion collar. The abrasion collar is wider toward 3 o'clock than toward 9 o'clock, which would indicate a directionality from right to left and toward the middle part of the body, which was the impression of the doctors on reviewing the photographs initially at the Archives.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the shirt, jacket, and tie, marked JFK F-25, F-26, and F-27, be received as committee exhibits.

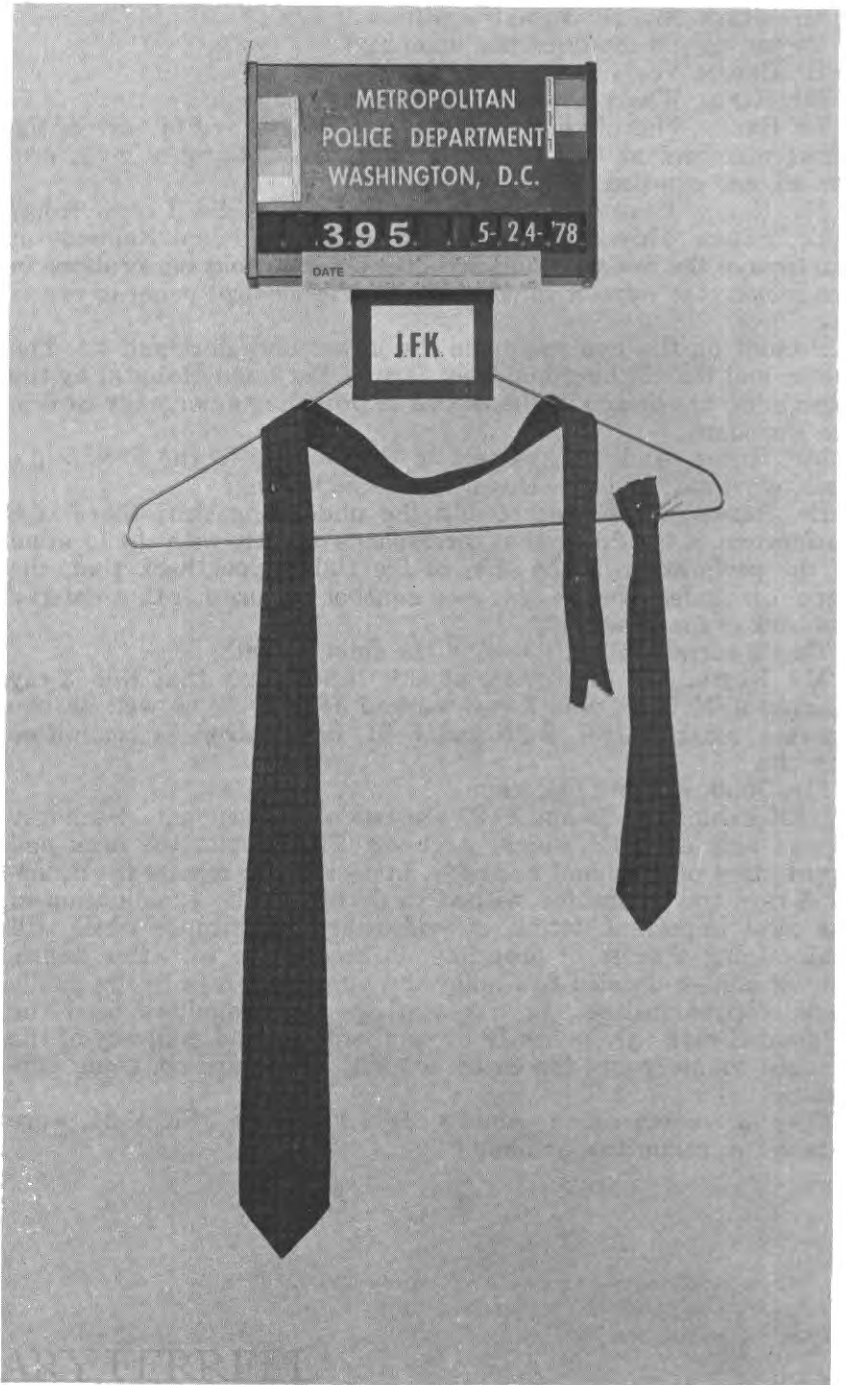
Mr. DODD. Without objection.

[The above-referred-to exhibits, JFK F-25, F-26, and F-27, were received as committee exhibits and photographs made for the record.]





JFK EXHIBIT F-26



JFK Exhibit F-27

Mr. KLEIN. And shown to the witness.

Doctor, do you recognize that clothing?

Dr. BADEN. Yes, I do, Mr. Klein.

Mr. KLEIN. Where have you seen that?

Dr. BADEN. This clothing was examined by me and by each of the panel members at the Archives where the clothing is kept, preserved, and guarded.

Mr. KLEIN. Whose clothing is that and where did it come from?

Dr. BADEN. This is the clothing worn by President Kennedy at the time of the assassination and does show various perforations in the fabric that were of importance for the medical panel to evaluate.

Present on the mannequin is the jacket and shirt and tie. The jacket and the clothing had been torn at Parkland Hospital by the examining physicians in the course of providing emergency care to the President.

Mr. KLEIN. And with respect to the wounds to the President's back, what did the panel learn from that clothing?

Dr. BADEN. In the jacket and the underlying shirt there is a perforation of the fabric that corresponds directly with the location of the perforation of the skin of the right upper back that, the panel concluded, was an entrance gunshot perforation that entered the back of the President.

This is correspondingly seen in the shirt beneath.

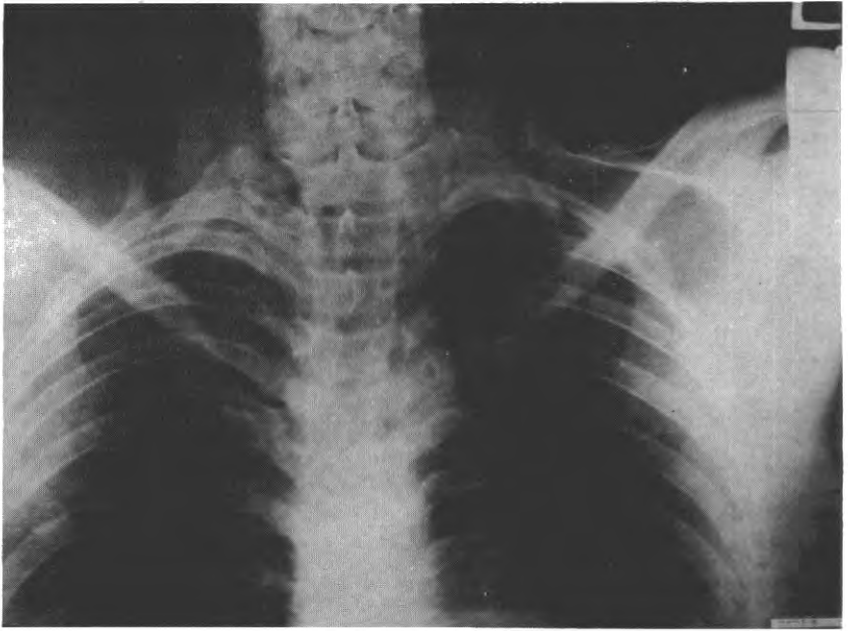
Mr. KLEIN. Mr. Chairman, at this time, I ask that this X-ray marked JFK F-28, this X-ray marked JFK F-29, as well as two blowups marked JFK F-30 and F-31, be received as committee exhibits.

Mr. DODD. Without objection.

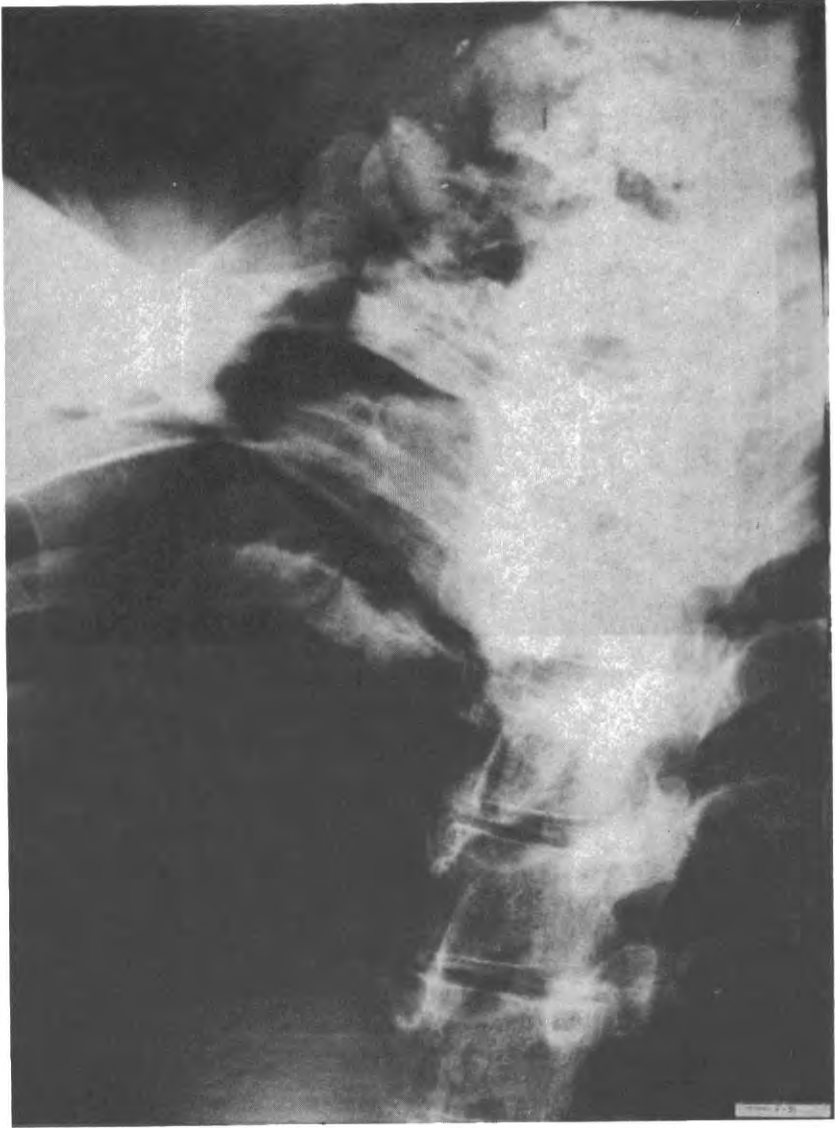
[JFK exhibits F-28 and F-29 are two of the original 14 autopsy X-rays kept at the National Archives. They depict the neck and upper chest of President Kennedy. In deciding to release the autopsy X-rays the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy X-rays to the public in a cropped fashion. In the hearings the committee used the original X-rays only to verify the authenticity and accuracy of the cropped counterparts; the entire original X-rays are not being published.]

[The above-referred-to exhibits, JFK F-30 and JFK F-31, were received as committee exhibits.]





ЖК ЕХНІВІТ F-30



JFK EXHIBIT F-31

Mr. KLEIN. Doctor, do you recognize those blowups and those X-rays?

Dr. BADEN. Yes; these X-rays that I hold are 2 of the 14 X-rays kept at the National Archives and identified to the members of the panel by the radiologist who took the X-rays, Dr. Ebersole. In personal interview Dr. Ebersole told the panel members that the 14 X-rays are the same ones he personally took and received at the time of the autopsy and that he took no other X-rays. These two have been previously labeled 8 and 9 with red tags by Dr. Ebersole

who did not indicate the sequence in which the X-rays were taken when he numbered them.

The blowups are enlargements of portions of the X-rays. The one I am pointing to labeled 9 shows the chest and neck of the President. This area is the lower neck, this is the upper chest, the right lung, the left lung, a portion of the heart shadow; the other X-ray blowup is of archival X-ray No. 8, which was taken after the autopsy had begun and shows the lower neck, the right side of the neck and the upper ribs and spine of President Kennedy.

Mr. KLEIN. What did the panel learn from those X-rays?

Dr. BADEN. The X-rays show, first, that there is no missile present in the body at the time the X-rays were taken. This X-ray, No. 9, was taken before the autopsy, this one, No. 8, during the autopsy. Further, there is evidence of injury to the right side of the neck with air and gas shadows in the right side of the neck and an irregularity of one of the spines, a portion of one spine of the President; that is, the first thoracic vertebra which is also apparent on the blowup and which the panel, and in consultation with the radiology experts, concluded represents a fracture-type injury to that vertebra.

Mr. KLEIN. Are those X-rays consistent with the bullet having passed through the President's body?

Dr. BADEN. Yes, sir. They are consistent with the bullet passing through and no longer being present.

Mr. KLEIN. Mr. Chairman, at this time I ask that these reports marked JFK F-32-F-35 be received as exhibits and shown to the witness.

Mr. DODD. Without objection, so ordered.

[The above-referred-to exhibits, JFK F-32-JFK F-35 were received as committee exhibits.]

## JFK EXHIBIT F-32

THE  
GEORGE  
WASHINGTON  
UNIVERSITY  
MEDICAL CENTER

Department of Radiology  
Diagnostic Division  
202] 676-4600

The University Hospital / 901 Twenty-Third Street, N.W. / Washington, D.C. 20037

910958

MEMORANDUM TO: Mr Mark Flanagan, US House of  
Representatives Select Committee on  
Assassinations  
Staff Member

FROM: David O Davis, MD  
Professor and Chairman  
Department of Radiology  
The George Washington University Hospital  
Washington DC

PLACE: The George Washington University Hospital  
Department of Radiology  
Washington DC

DATE: August 23, 1978

SUBJECT: Examination of JFK Autopsy X-Rays

PERSONS PRESENT: Doctor Davis, Mr Mark Flanagan (HSCA), Mr Michael  
Leahy (National Archives)

I reviewed the Kennedy skull films labeled #1 and #2, taken at the US Naval Hospital on September 22, 1963, and two aerospace enhanced images of those films.

The findings are as follows:

There is massive calvarial damage, which will be described below. There is a metallic fragment about 9 or 10cm above the external occipital protuberance, which metallic fragment is apparently imbedded in the outer table of the skull. On the frontal view, this metallic fragment is located 2.5cm to the right of midline, and on the lateral view, it is approximately 3-4cm above the lambda. There are a large number of fractures in the calvarium, and the linear fractures seem to more or less emanate from the imbedded metallic fragment, and radiate in a stellate fashion in various directions. There is a large fracture extending directly anteriorly along the sagittal suture, which is, at least at the point visualized, widely separated. This fracture seems to extend into the frontal bone, more or less at the midline, down to

the frontal sinus which is also fractured. There is a sharply defined linear fracture extending laterally from the metallic fragment into the left side of the calvarium, around the parietal bone to the lateral aspect of the skull. Two linear fractures extend inferolaterally from the metallic fragment, one into the occipital bone, about 3cm from the midline, and this fracture crosses the lambdoid suture. The other one is more lateral, and extends down toward the lateral sinus, probably above the lambdoid suture.

Additionally, there is a fracture line extending more or less laterally from the metallic fragment toward the temporal bone on the right side, which is identified only by the anterior edge of the posterior fragment, since there is apparently absence of bone anterior to this line, with the absence present to a point approximately equivalent to where the coronal suture on the right side should be.

There is a fracture fragment inferior to the absent bone, with the corner of the fragment extending down to the parietal squamosal suture, and this fragment is displaced from its normal position as indicated by overlap of the infero and posterior aspects of the fracture fragment. There is a faint line extending inferiorly from the superior aspect or vertex of the skull towards this fragment, which I feel is probably a shadow caused by avulsed scalp and is not explained by absent bone although it projects essentially over the central portion of the absent parietal calvarium that is evident.

The absent bone in the parietal region apparently includes some fragment from the left parietal region, since the fracture seems to cross the midline where there is some lucency, and presumably part of the sagittal suture and sagittal sinus is absent.

The right orbital rim is also fractured laterally, and the roof of the orbit is fractured on the right side, as is the inferior orbital rim, indicating that there is an unstable orbit.

There are a number of metallic fragments extending anteriorly from the inner table of the skull at a point approximately 6cm antero-superiorly from the previously described imbedded metallic fragment. These fragments extend inferoanteriorly across the entire skull and actually project (on other images that I have seen) in a fashion that suggests that the the large fragment is outside the intracranial space. Presumably this represents a metallic fragment in the scalp, although this cannot be accurately determined from this particular examination.

There is some air in the subarachnoid space of the spinal canal, and also apparently in the temporal lobe sulci in the middle fossa, presumably on the right side, but since the fracture is open to the subarachnoid space, this is not at all surprising.

CONCLUSION: There is an extensive comminuted, open, explosive calvarial fracture which seems to radiate in various directions as described above from a central point which is located in the right parietal bone, 3cm from the midline and about 9 or 10cm from the external occipital protuberance. There is absence of a part of the calvarium, beginning near the impact point and extending anteriorly to the coronal suture, with absence of a significant amount of bone in the right parietal and presumably a small amount of left parietal region. There is a displaced fragment or fragments in the right frontal and parietotemporal region, with some overlap of the bone. There is a significant fracture in the frontal region extended into the right orbit and frontal sinus. The fractures also extend, from the posterior impact point, into the occipital bone on both sides.

I neglected to describe in the text of this report an extensive fracture which extends inferolaterally from the impact point toward the left side which probably reaches the temporal bone or at least the mastoid region after crossing a goodly portion of the occipital bone there. It seems apparent that explosive impact occurred in this calvarium. It also seems reasonable to assume that the exit point is near the coronal suture on the right side, about 5 or 6, or perhaps slightly more, cm above the pterion. It is not possible to totally explain the metallic fragment pattern that is present from some of the metallic fragments located superiorly in the region of the parietal bone, or at least projecting on the parietal bone, are actually in the scalp. The frontal view does not give much help in this regard and it is impossible to work this out completely.

I have also reviewed the films numbered 8, 9 and 10, which are of the thoracic region. In addition, I reviewed a film taken at Doctor White's office on Park Avenue in New York, in 1960.

Evaluation of the pre-autopsy film shows that there is some subcutaneous or interstitial air overlying the right C7 and T1 transverse processes. There is disruption of the integrity of the transverse process of T1, which, in comparison with its mate on the opposite side and also with the previously taken film, mentioned above, indicates that there has been a fracture in that area. There

is some soft tissue density overlying the apex of the right lung which may be hematoma in that region or other soft tissue swelling.

Evaluation of the post-autopsy film shows that there is subcutaneous or interstitial air overlying C7 and T1. The same disruption of T1 right transverse process is still present.

On the film of the right side, taken post-autopsy, there are two small metallic densities in the region of the C7 right transverse process. These densities are felt to be artifact, partly because of their marked density, because there is a similar artifact overlying the body of C7, and because these metallic-like densities were not present on the previous, pre-autopsy film. Therefore, I assume that these are screen artifacts from debris present in the cassette at the time that this film was exposed.

OPINION: There is evidence of interstitial air on the pre-autopsy film, and evidence of a right T1 transverse process fracture, both on the pre-autopsy and post-autopsy film. The fracture fragments are not significantly displaced. I do not feel that there is any evidence of foreign body on these films, and that the small metallic density mentioned above, overlying the C7 transverse process region, is actually an artifact.

DOD/mhw

## JFK EXHIBIT F-33

DEPARTMENT OF RADIOLOGY  
THE HOSPITAL OF THE GOOD SAMARITAN616 SOUTH WITMER STREET  
LOS ANGELES, CALIFORNIA 90017*Diagnostic Radiology*ROBERT E. LEVIS, M.D.  
GARALD M. McDONNELL, M.D.  
JOSEPH L. WESTOVER, M.D.  
PHILIP C. SHU, M.D.  
GERALD B. IRA, M.D.  
NATHAN N. LEVENICK, M.D.  
WILLIAM C. SCHEIFER, M.D.  
TELEPHONE 488-8251*Radiation Therapy*R. WILBUR MELBYE, Ph.D., M.D.  
DONALD P. ANDERSON, M.D.  
TELEPHONE 488-8983*Radiation Physicists*RICHARD M. CARVER, M.S.  
MELISSA C. MARTIN, M.S.*Nuclear Medicine*LEONARD A. SWANSON, M.D.  
TELEPHONE 488-8245TO: Michael Goldsmith  
Senior Staff Counsel  
Select Committee on Assassinations  
U.S. House of Representatives  
3342 House Office Building, Annex 2  
Washington, D.C. 20515

DATE: August 4, 1978

SUBJECT: Report of G.M. McDonnell, M.D. concerning observation, analysis, and  
conclusions in connection with radiographic images and enhanced images  
attributed to President John F. Kennedy.This report replaces my report of March 8, 1978 and supplements my presentation of  
July 21, 1978 in the Rayburn Building, Washington, D.C.I was exposed to radiographic images identified by the number 21296 at Aerospace  
Corporation, El Segundo, California on March 7, 1978. At my suggestion portions  
of these radiographs were digitized and enhanced by Aerospace Corporation for  
further observation and analysis.I participated in discussions during the photographic evidence panel on 6 and 7  
April 1978 during which time I dialogued with Dr. James Weston concerning my inter-  
pretation of these radiographs and the enhanced images.On 2 June 1978 I again viewed and analyzed the radiographic images at the National  
Archives Building in Washington, D.C. As requested I also interpreted and analyzed  
skull and sinus radiographs obtained during the lifetime of the subject for the  
specific purpose of authenticating the radiographs obtained before and after the  
autopsy.

The original radiographs seen on 7 March were:

- a. An attempted anteroposterior projection of a skull identified as:  
21296 (numbers upside down)  
US Naval Hospital  
NNMC Bethesda Maryland  
11 22 65
- b. Right lateral projection of a skull with the same identification symbols.
- c. Left lateral projection of a skull with the same identification symbols.



- d. Three radiographs of three fragments of bone unidentified by symbols.
- e. An anteroposterior projection of a chest with the same identification symbols as a, b, c above. This radiograph was obtained with the thoracic cage intact, i.e., before autopsy.
- f. An anteroposterior projection of a chest with the same identification as e above. This radiograph was obtained after the thorax had been opened and the lungs and mediastinal contents had been removed.

The findings and interpretation of the skull films are:

- 1. Nearly complete loss of right parietal bone, the upper portion of the right temporal bone, and a portion of the posterior aspect of the right frontal bone.
- 2. Subdural air over the left parietal hemisphere.
- 3. Multiple skull fractures and disruption of continuity of the bony tables.
- 4. A metallic fragment on the outer table of the right occipital bone 9.6 cm. above the mid portion of the external occipital protuberance (EOP). 1 cm. above the metallic fragment is a depressed fracture from which stellate type fractures "radiate" into both occipital bones, the right parietal bone and the right temporal bone. These are vividly and convincingly displayed in the enhanced images, specifically the "anteroposterior" (AP) projection of the skull. The metallic fragment in this projection is nearly spherical in contour.
- 5. There is a fracture line extending through the floor of the sella turcica with bony fragments in the sphenoid sinus. This is vividly depicted in the enhanced images.
- 6. There are fracture lines through the anterior and posterior aspects of the right frontal sinus with air in this sinus. There is a metallic fragment above the sinus appearing to be between the bony tables of the frontal bone.
- 7. There is elevation of the galea medial and lateral, as well as anteriorly, to the depressed fracture in the right occipital bone. A small metallic fragment lies medial to the fracture site between the galea and the outer table of the skull.

The mechanism of damage to the skull is concluded to be:

- 1. A low mass, high velocity, metallic projectile penetrated the right occipital bone at the area of the depressed fracture, leaving behind the spherical shaped contoured metallic fragment in 4 above.
- 2. The reflected shock wave from the outer table propelled a metallic fragment medially as in 7 above.
- 3. The stellate type "radiating" fractures as in 4 above resulted from the entering metallic projectile.
- 4. (also 8 in findings).

A linear alignment of tiny metallic fragments is associated with the entry, path of travel, and exit in the posterior aspect of the right frontal bone.

#### CHEST

The pre-autopsy radiograph of the chest shows air in the soft tissues of the right supraclavicular area soft tissues.

There is an undisplaced fracture of the proximal portion of the right transverse process of T1 (or the region of the costovertebral junction).

There is no evidence of fracture of the cervical spine or its associated appendages.

In the post autopsy film of the thoracic region there is debris in the radiographic image superimposed over the area to the right of the C7 vertebral body.

In the enhanced post autopsy image of the same area, there appears to be fractures of the posterior aspects of the 2nd, 3rd, and 4th ribs. These are artifacts.

#### Authentication of Radiographs.

The following radiographs were provided at the National Archives, Washington, D.C. on June 2, 1978.

- a. A left lateral skull radiograph dated 8/17/60 performed by Groover, Christie and Merritt, with number 336042 and blue ink writing of "Kennedy".
- b. A paranasal sinus series performed by (or for) Stephen White, M.D., 521 Park Ave. NYC, dated 8/14/60, and identified by number 202617.

The following anatomical and bony structures are common and identical to all three sets of radiographs.

1. The thickness and contour of the frontal bones.
2. Deviation of the mid portion of the nasal septum from right to left.
3. The contour of the frontal sinuses.
4. The contour and shape of the sella turcica.
5. The contour of the posterior clinoids.
6. The contour and calcification of the posterior clinoid ligaments.
7. There is thickening of the medial and superior aspects of the mucoperiosteal margin of the left frontal sinus. This is less severe in the radiographs of 8/14/60 and 8/17/60 than in the radiographs of 11/22/63. The general margin of this tissue swelling is similar in all three studies.

In my opinion the three sets of radiographs are positively and without controversy, of the same individual. It is impossible to simulate the referenced anatomical landmarks, the nasal septum deviation, and the documentation of the progressive disease process in the left frontal sinus.

Enhancement of the Radiographic Images.

The digitized and enhanced images produced by Aerospace Corporation permitted definitive observation and analysis of the original radiographs. Further, enhancement permitted analysis or elimination of artifacts on the images. The most vivid result is the clear definition of the multiple fractures radiating from the area of the entrance of the penetrating missile in the right occipital bone.

"Doctored" of the Radiographic Images"

In my opinion the images which I have seen have not been "doctored" or "treated" in any fashion, except for:

- a. Two small areas of thermal damage resulting from a light source held too close to the "anteroposterior" image. These were reported to be present on an observation report dated November 1, 1966 and validated by signature November 10, 1966. This report is in the National Archives. Interestingly, the enhanced images downgrade the prominence of the "burns" while enhancing the true radiographic image.
- b. Minor "staining" or discoloration of the images due to incomplete processing of the film in the developing process. This discoloration has, and will continue to be, more prominent with the passage of time.

The linear opacities associated with the images have been said to be the result of manipulation. These opacities or normal grid lines from the grid used to eliminate "scatter fogging" of the images at the time of exposure of the films and therefore represent normal images without evidence of manipulation.

Final Summary:

1. The observations of the findings are as stated and validated by the enhanced images.
2. The described mechanisms of damage are the writer's professional opinion.
3. The radiographs observed are incontrovertibly of the same individual during life and the early post mortem period.
4. The observed radiographic images have not been altered in an effort to provide a false image.

  
G.M. McDonnell, M.D.

GMM:st

#### Enhancement of Radiographic Images.

The digitized and enhanced images produced by Aerospace Corporation permitted definitive observation and analysis of the original radiographs. Further, enhancement permitted analysis or elimination of artifacts on the images. The most vivid result is the clear definition of the multiple fractures radiating from the area of the entrance of the penetrating missile in the right occipital bone.

#### Alteration or "Doctoring" of the Radiographs.

There have been allegations that the post mortem radiographic images have been modified or altered ("doctored") to produce misinformation and therefore improper conclusions. An altered image should be readily apparent by:

- a. Observation of a difference in density of the images,
- b. discontinuity of anatomical structures,
- c. alteration of continuity of an abnormal pattern, or
- d. production of an image which is not anatomical or an image of an impossible pathologic process.

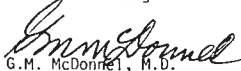
The radiographic images both ante mortem and post mortem, have NOT been altered in any fashion, except for:

- a. Two small areas of thermal damage resulting from a light source held too close to the "anteroposterior" image. These were reported to be present on an observation report dated November 1, 1966 and validated by signature November 10, 1966. This report is in the National Archives. Interestingly, the enhanced images downgrade the prominence of the "burns" while enhancing the true radiographic image.
- b. Minor "staining" or discoloration of the images due to incomplete processing of the film in the developing process. This discoloration has, and will continue to be, more prominent with the passage of time.

The linear opacities with the post mortem have been said to be the result of manipulation. These opacities are normal grid lines from the grid used to eliminate "scatter fogging" of the images at the time of exposure of the films and therefore represent normal images without evidence of manipulation.

#### Final Summary:

1. The observations of the findings are as stated and validated by the enhanced images.
2. The described mechanisms of damage are the writer's professional opinion.
3. The radiographs observed are incontrovertibly of the same individual during life and the early post mortem period.
4. The observed radiographic images have not been altered in an effort to provide a false image.

  
G.M. McDonnell, M.D.

GMM:st

## JFK EXHIBIT F-34

OUTSIDE CONTACT REPORTDATE 2/27/78 TIME \_\_\_\_\_

## I. Identifying Information:

Name Dr. Norman Chase Telephone \_\_\_\_\_Address NYU Medical Center, New YorkType of Contact:  Telephone  
 Person

## II. Summary of Contact:

Dr. Chase examined the JFK and Connally X-rays in the presence of Dr. Michael Baden, Mark Flanagan, and Andy Purdy. He made preliminary observations before we focussed his attention on particular areas of interest to the medical panel.

JFK: Skull X-ray - The lateral skull X-ray indicated that the missile ". . .blew the top of the head off. . .striking with enormous power." The wound was massive, not the kind he would expect from a single, jacketed bullet hitting straight on; it was possibly tumbling or hit on an angle. The entry point was visible on the upper rear head. Regarding the anterior-posterior X-ray, Dr. Chase noted the large metal fragment prominent in the X-ray and said he believes it corresponds to the metal fragment in the rear of the head as evi-

## III. Recommended Follow-up (if any):

Signature: Andy Purdy Mark Flanagan

Form #5

dence on the lateral view. He said the frontal fragment would appear higher (than the aforementioned fragment) in the anterior view (and slightly left of center).

Dr. Chase said the head X-rays show extensive comminuted fractures of the calvarium. He said that while it is unclear exactly what happened to the top of the skull because of the extensive damage, he is sure that the skull was not perforated by a missile at any point below the one he designated as an entrance wound. When referred by Dr. Baden to the lower skull region and asked what his response would be if told that the autopsy surgeons believed there was a wound of entry there, he said he would say they were wrong.

He said the degree of damage to the skull and the fact that there was "little residual material" led him to believe the missile was jacketed. He said there is no evidence in the X-rays of a shot coming from the front or of more than one bullet striking the skull; for there to have been a second bullet, Dr. Chase said there would have to be another exit point in the skull or a bullet which was left behind (which entered the exit hole of the one bullet which entered in the upper rear of the head).

Regarding the circular temporal bone area, Chase said it appeared to represent normal skull thinning at that point but said there could be bone missing, noting the area was ". . . awfully luscant." When viewing a pre-assassination lateral skull X-ray, Dr. Chase said he believed there was

exit of bone from the temporal area, the zygomatic process (lateral view). He also noted fracture of the right orbit.

In the neck X-ray, Chase noted the presence of a metal fragment or artifact in the area of the transverse process--definitely not a bone fragment. The first rib appeared to be separated from the sternum but he had trouble noting specific evidence of a missile passing through the first or second rib. Air was noted in the subcutaneous tissue in this same region, caused by the passage of a missile and/or air entering the region due to the tracheostomy incision. He said the object present was not bone because it was too small and too dense; the little trail of dots near the fragment were believed to be artifacts. The object was about 1 mm x 2½mm--"very small." Chase said that if a break occurred in T-1 it was peculiar and had no displacement. He said that extra work on X-ray #9 might bring out this fragment in another view.

CONNALLY; Regarding the thigh X-ray, Chase said there was a metal fragment in the subcutaneous tissue and there was no fragment in the femur; the object thought to be such a fragment is artifact.

Regarding the chest X-ray, he said there was no evidence of pneumothorax. The fifth rib appears fractured in the post-operative X-ray but is not evident in the pre-op (region of posterior axillary line or mid-axillary line). Soft tissue damage is evidenced by the presence of air and blood.

Dr. Chase had no recommendations for experts in forensic radiology.

## JFK EXHIBIT F-35

KENNEDY

006132

OUTSIDE CONTACT REPORTDATE 2/27/78 TIME 1:30PM

## I. Identifying Information:

Name Dr. William B. Seaman Telephone \_\_\_\_\_Address Columbia Presbyterian Hospital, New York CityType of Contact:  Telephone  
 Person

## II. Summary of Contact:

Dr. Seaman examined the JFK and Connally X-rays  
in the presence of Dr. King, Dr. Michael Baden, Mark Flanagan  
and Andy Purdy. He made his preliminary observation before  
his attention was focused on areas of particular interest to  
the medical panel.

JFK- Regarding the lateral skull X-ray, Dr. Seaman  
said pieces of metal were strewn in a track-like manner.  
Fractures were evident through the upper part of the right eye,  
including the top and bottom of the right orbit. The bottom  
of the frontal sinus was fractured. At the upper rear skull  
point of possible defect in the skull, Dr. Seaman said it could  
be an entrance wound and could not be a missile exit wound.  
He said he could not denote beveling of the skull at that point.

## III. Recommended Follow-up (if any):

\_\_\_\_\_  
Andy Purdy Mark Flanagan



He found inferences difficult to draw from the extensive damage to the top of the skull, which includes overlapping skull pieces. The lower head was fairly intact with no evidence of entrance or exit in the region ("very unlikely"). The upper point (mentioned earlier) "suggests entry but is not conclusive."

Regarding the neck X-ray, Dr. Seaman said there was a fragment-like object present near the transverse process which is too dense to be bone ("fairly confident"). He said the transverse process appears abnormal with air present (possibly by-product of tracheostomy), calling it "...highly suspicious compared with the other side! He thinks he can "... see the fragment separated" (also in #9) and concludes there is a possible fracture in C-7.

Connally - Wrist - comminuted fracture with fragments. He was not sure if the fragments were on the entrance (volar) or exit sides. Dr. Seaman concludes from the spatial orientation that they are fragments of metal.

Thigh - Dr. Seaman denoted a fragment of metal in the subcutaneous tissue, characterized by a tail-like end which makes it recognizable on both thigh X-rays and ensures it is not bone. There is no metal fragment in the femur.

Chest - Dr. Seaman noted an area of consolidation and fluid in the right chest. In the 5th rib he noted a fracture and fragment of bone in the anterior axillary line with evidence of hemorrhage and air in the axilla.

Regarding the possible existence of a higher fracture in the fifth rib Dr. Seaman said he was a "little skeptical" of it as a fracture because he couldn't see it fractured all the way

through ("possibly a lung marking"). He said subsequent healing as evidenced in a subsequent (even now) X-ray might provide more information about exactly what happened. Dr. Seaman found no evidence of metal fragments in the chest and couldn't form an opinion as to the nature of the object visible on the left side.

Dr. Seaman had no one to recommend who is an expert in forensic radiology. He did say Dr. Juan Taveras of Massachusetts General Hospital (Boston) is a skull expert who might have something to contribute.

Mr. KLEIN. Doctor, looking at those reports, do you recognize them?

Dr. BADEN. Yes, sir. These are reports of the X-rays from physician experts consulted by the panel members and submitted to us for review and incorporation into our conclusions as to the medical aspects of the death of the President.

Mr. KLEIN. What were the names of the doctors to whom you submitted the X-rays?

Dr. BADEN. The doctors are Dr. David Davis, who is chairman of the Radiology Department at George Washington University here in Washington and who has been extremely helpful to the panel in interpreting the X-rays and who has worked with us in making diagrams to illustrate the injuries seen on X-ray.

Dr. Norman Chase, who is chairman of the Radiology Department at New York University, Bellevue Medical Center. Dr. William Seaman, chairman of the Department of Radiology at Columbia Presbyterian Hospital in New York City. And Dr. McDonnell of Los Angeles, Calif., Department of Radiology, Hospital of the Good Samaritan, who performed various specialized tests on the X-rays for the benefit of the panel.

Mr. KLEIN. Doctor, were the reports of these experts consistent with the panel's evaluation of the JFK X-rays?

Dr. BADEN. Yes, sir; they were consistent and gave additional evidence to the panel for reaching its conclusions.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the drawing marked JFK F-36 be received as a committee exhibit.

Mr. DODD. Without objection, so ordered.

[The above-referred-to document, JFK F-36, follows:]



JFK EXHIBIT F-36

Mr. KLEIN. Doctor, do you recognize that drawing?

Dr. BADEN. Yes, this is a drawing of a photograph taken prior to the beginning of the autopsy of the President showing the neck region, the upper chest region, and a wound in the front of the neck.

Mr. KLEIN. Does this diagram fairly and accurately represent the location of the wound on the front of the President's neck?

Dr. BADEN. Yes, it does.

Mr. KLEIN. Mr. Chairman, I would ask that this cropped photograph marked JFK F-37 and the blowup marked JFK F-38 be received as committee exhibits and shown to the witness.

Chairman STOKES [presiding]. Without objection, it may be entered into the record at this point.

[JFK exhibit F-37 is an 8 by 10 photograph derived from one of the original autopsy photographs and depicts the injury to the front of the neck of the President. In deciding to release the autopsy photographs, the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy photographs to the public in either drawings that represent large areas of the President's body as seen in the photograph or closely cropped photographs that depict the most important areas of evidentiary concern. The committee used photographs such as JFK F-37 in the hearings only to verify the authenticity and accuracy of the drawings and closely cropped photographs; these photographs are not

being published. The original autopsy photographs and committee copies are in the custody of the National Archives.]

[The above-referred-to document, JFK F-38, follows:]



JFK EXHIBIT F-38

Mr. KLEIN. Doctor, do you recognize that photograph and that blowup?

Dr. BADEN. Yes, sir. The black and white 8 by 10 photograph I have in my hand is from a photograph taken of the President at the time of the autopsy and the blowup is a detail from that

photograph showing the injury to the front of the neck as depicted in the drawing before us.

Mr. KLEIN. Using the blowup, would you tell us what the panel learned from the photograph?

Dr. BADEN. The panel learned from the photograph that a tracheostomy, incision, an incision to aid the dying President in breathing, had been made on the front of the neck at the hospital and is a typical type of tracheostomy incision; and the panel also noted a semicircular defect at the lower margin of that tracheostomy which required further evaluation.

Mr. KLEIN. Doctor, in speaking to and reading the reports of the doctors who attended President Kennedy after he was shot, in Parkland Hospital, did you learn any further information about that wound of the neck?

Dr. BADEN. Yes. In the reports made available to us from prior testimony, prior medical reports, and from current interviews with the doctors, it is apparent that there was a perforation, a perforating wound, of the front of the neck present when the President was received at Parkland Hospital; and that the tracheostomy incision, the incision to put in a breathing tube, was made through that perforation of the skin and did modify and change the hole in the manner seen here from a circular hole to a semicircle, that remains.

Mr. KLEIN. Doctor, directing your attention to the clothing already received as exhibits, would you tell us what the panel learned from that clothing with respect to the wound of the President's neck?

Dr. BADEN. Yes, sir. On examining the clothing of the President, there is present in the left upper portion of the shirt, just beneath the left shirt collar, a slit-like tear. This slit-like tear corresponds directly with the area of perforation in the anterior neck seen on the photographs taken prior to the autopsy and is characteristic of a bullet perforation of exit in which the perforation is not necessarily as round as the entrance perforation.

The entrance perforation on the back is a round perforation typical for an entrance wound. The perforation in the front of the shirt, slit-like, is typical for an exit perforation of a missile.

There is also associated with this tear in the shirt fabric a tear or nick of the tie the President was wearing, which corresponds to that same area of the body when the tie is made into a knot as he was wearing at the time of the shooting.

Mr. KLEIN. Doctor, in addition to examining the foregoing evidence, did the panel have an opportunity to examine the autopsy protocol report, the autopsy descriptive sheet, and the autopsy supplementary report?

Dr. BADEN. Yes, sir.

Mr. KLEIN. Mr. Chairman, I would ask that these three reports marked JFK F-42 through F-44 be received as exhibits and shown to the witness, and F-45, an enlargement of F-44.

Chairman STOKES. Without objection, they may be received and entered into the record at this point.

[The above-referred-to exhibits, JFK F-42 to JFK F-44, follow:]

## JFK EXHIBIT F-42

OPTIONAL FORM NO. 10  
5010-104

UNITED STATES GOVERNMENT

*Memorandum*

4-1

U. S. Secret Service

TO : J. Lee Rankin  
General Counsel

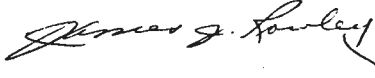
FROM : James J. Rowley  
Chief, U. S. Secret Service

SUBJECT: Autopsy Report

DATE: December 20, 1963

Commission No 77

There is attached standard form 503, a clinical record of the autopsy protocol prepared by the Naval Medical School, Bethesda, Md., relative to the autopsy performed on President John F. Kennedy.



Standard Form 503  
Revised August 1974  
Prescribed  
By Bureau of the Budget  
Circular A-33 (Rev.)

CLINICAL RECORD		AUTOPSY PROTOCOL			A63-272 (JJH:ec)		
DATE AND HOUR DIED		A. M.	DATE AND HOUR AUTOPSY PERFORMED		CHECK ONE		
22 November 1963 1300(CST)		P. M.	22 November 1963 2000(EST)		FULL AUTOPSY	HEAD ONLY	TRUNK ONLY
PROSECTOR (497831)		ASSISTANT (489878)					
CDR J. J. HUNES, MC, USN		CDR "J" THORNTON BOSWELL, MC, USN		X			
CLINICAL DIAGNOSES (Including operations)		LCOL PIERRE A. FINCK, MC, USA (04 043 322)					

Ht. - 72½ inches  
Wt. - 170 pounds  
Eyes - blue  
Hair - Reddish brown

PATHOLOGICAL DIAGNOSES

CAUSE OF DEATH: Gunshot wound, head.

APPROVED: <i>J. J. Hunes</i>						
J. J. HUNES, CDR, MC, USN						
MILITARY ORGANIZATION (If App. required)	AGE	SEX	RACE	IDENTIFICATION NO.	AUTOPSY NO.	
PRESIDENT, UNITED STATES	46	Male	Cauc.		A63-272	
PATIENT'S IDENTIFICATION (For typed or written entries give Name, last, first, middle, grade, date, hospital or medical facility)				REGISTER NO.	WARD NO.	
KENNEDY, JOHN F. NAVAL MEDICAL SCHOOL						
				AUTOPSY PROTOCOL Standard Form 503		

## CLINICAL SUMMARY:

According to available information the deceased, President John F. Kennedy, was riding in an open car in a motorcade during an official visit to Dallas, Texas on 22 November 1963. The President was sitting in the right rear seat with Mrs. Kennedy seated on the same seat to his left. Sitting directly in front of the President was Governor John B. Connolly of Texas and directly in front of Mrs. Kennedy sat Mrs. Connolly. The vehicle was moving at a slow rate of speed down an incline into an underpass that leads to a freeway route to the Dallas Trade Mart where the President was to deliver an address.

Three shots were heard and the President fell forward bleeding from the head. (Governor Connolly was seriously wounded by the same gunfire.) According to newspaper reports ("Washington Post" November 23, 1963) Bob Jackson, a Dallas "Times Herald" Photographer, said he looked around as he heard the shots and saw a rifle barrel disappearing into a window on an upper floor of the nearby Texas School Book Depository Building.

Shortly following the wounding of the two men the car was driven to Parkland Hospital in Dallas. In the emergency room of that hospital the President was attended by Dr. Malcolm Perry. Telephone communication with Dr. Perry on November 23, 1963 develops the following information relative to the observations made by Dr. Perry and procedures performed there prior to death.

Dr. Perry noted the massive wound of the head and a second much smaller wound of the low anterior neck in approximately the midline. A tracheostomy was performed by extending the latter wound. At this point bloody air was noted bubbling from the wound and an injury to the right lateral wall of the trachea was observed. Incisions were made in the upper anterior chest wall bilaterally to combat possible subcutaneous emphysema. Intravenous infusions of blood and saline were begun and oxygen was administered. Despite these measures cardiac arrest occurred and closed chest cardiac massage failed to re-establish cardiac action. The President was pronounced dead approximately thirty to forty minutes after receiving his wounds.

The remains were transported via the Presidential plane to Washington, D.C. and subsequently to the Naval Medical School, National Naval Medical Center, Bethesda, Maryland for postmortem examination.

## GENERAL DESCRIPTION OF BODY:

The body is that of a muscular, well-developed and well nourished adult Caucasian male measuring 72½ inches and weighing approximately 170 pounds. There is beginning rigor mortis, minimal dependent livor mortis of the dorsum, and early algor mortis. The hair is reddish brown and abundant, the eyes are blue, the right pupil measuring 8 mm. in diameter, the left 4 mm. There is edema and ecchymosis of the inner canthus region of the left eyelid measuring approximately 1.5 cm. in greatest diameter. There is edema and ecchymosis diffusely over the right supra-orbital ridge with abnormal mobility of the underlying bone. (The remainder of the scalp will be described with the skull.)



There is clotted blood on the external ears but otherwise the ears, nares, and mouth are essentially unremarkable. The teeth are in excellent repair and there is some pallor of the oral mucous membrane.

Situated on the upper right posterior thorax just above the upper border of the scapula there is a 7 x 4 millimeter oval wound. This wound is measured to be 14 cm. from the tip of the right acromion process and 14 cm. below the tip of the right mastoid process.

Situated in the low anterior neck at approximately the level of the third and fourth tracheal rings is a 6.5 cm. long transverse wound with widely gaping irregular edges. (The depth and character of these wounds will be further described below.)

Situated on the anterior chest wall in the nipple line are bilateral 2 cm. long recent transverse surgical incisions into the subcutaneous tissue. The one on the left is situated 11 cm. cephalad to the nipple and the one on the right 8 cm. cephalad to the nipple. There is no hemorrhage or ecchymosis associated with these wounds. A similar clean wound measuring 2 cm. in length is situated on the antero-lateral aspect of the left mid arm. Situated on the antero-lateral aspect of each ankle is a recent 2 cm. transverse incision into the subcutaneous tissue.

There is an old well healed 8 cm. McBurney abdominal incision. Over the lumbar spine in the midline is an old, well healed 15 cm. scar. Situated on the upper antero-lateral aspect of the right thigh is an old, well healed 8 cm. scar.

#### MISSILE WOUNDS:

1. There is a large irregular defect of the scalp and skull on the right involving chiefly the parietal bone but extending somewhat into the temporal and occipital regions. In this region there is an actual absence of scalp and bone producing a defect which measures approximately 13 cm. in greatest diameter.

From the irregular margins of the above scalp defect tears extend in stellate fashion into the more or less intact scalp as follows:

- a. From the right inferior temporo-parietal margin anterior to the right ear to a point slightly above the tragus.
- b. From the anterior parietal margin anteriorly on the forehead to approximately 4 cm. above the right orbital ridge.
- c. From the left margin of the main defect across the midline antero-laterally for a distance of approximately 8 cm.
- d. From the same starting point as c. 10 cm. postero-laterally.

Situated in the posterior scalp approximately 2.5 cm. laterally to the right and slightly above the external occipital protuberance is a lacerated wound measuring 15 x 6 mm. In the underlying bone is a corresponding wound through the skull which exhibits beveling of the margins of the bone when viewed from the inner aspect of the skull.

Clearly visible in the above described large skull defect and exuding from it is lacerated brain tissue which on close inspection proves to represent the major portion of the right cerebral hemisphere. At this point it is noted that the falx cerebri is extensively lacerated with disruption of the superior sagittal sinus.

Upon reflecting the scalp multiple complete fracture lines are seen to radiate from both the large defect at the vertex and the smaller wound at the occiput. These vary greatly in length and direction, the longest measuring approximately 19 cm. These result in the production of numerous fragments which vary in size from a few millimeters to 10 cm. in greatest diameter.

The complexity of these fractures and the fragments thus produced tax. satisfactory verbal description and are better appreciated in photographs and roentgenograms which are prepared.

The brain is removed and preserved for further study following formalin fixation.

Received as separate specimens from Dallas, Texas are three fragments of skull bone which in aggregate roughly approximate the dimensions of the large defect described above. At one angle of the largest of these fragments is a portion of the perimeter of a roughly circular wound presumably of exit which exhibits beveling of the outer aspect of the bone and is estimated to measure approximately 2.5 to 3.0 cm. in diameter. Roentgenograms of this fragment reveal minute particles of metal in the bone at this margin. Roentgenograms of the skull reveal multiple minute metallic fragments along a line corresponding with a line joining the above described small occipital wound and the right supra-orbital ridge. From the surface of the disrupted right cerebral cortex two small irregularly shaped fragments of metal are recovered. These measure 7 x 2 mm. and 3 x 1 mm. These are placed in the custody of Agents Francis X. O'Neill, Jr. and James W. Sibert, of the Federal Bureau of Investigation, who executed a receipt therefor (attached).

2. The second wound presumably of entry is that described above in the upper right posterior thorax. Beneath the skin there is ecchymosis of subcutaneous tissue and musculature. The missile path through the fascia and musculature cannot be easily probed. The wound presumably of exit was that described by Dr. Malcolm Perry of Dallas in the low anterior cervical region. When observed by Dr. Perry the wound measured "a few millimeters in diameter", however it was extended as a tracheostomy incision and thus its character is distorted at the time of autopsy. However, there is considerable ecchymosis of the strap muscles of the right side of the neck and of the fascia about the trachea adjacent to the line of the tracheostomy wound. The third point of reference in connecting

these two wounds is in the apex (supra-clavicular portion) of the right pleural cavity. In this region there is contusion of the parietal pleura and of the extreme apical portion of the right upper lobe of the lung. In both instances the diameter of contusion and ecchymosis at the point of maximal involvement measures 5 cm. Both the visceral and parietal pleura are intact overlying these areas of trauma.

**INCISIONS:** The scalp wounds are extended in the coronal plane to examine the cranial content and the customary (Y) shaped incision is used to examine the body cavities.

**THORACIC CAVITY:** The bony cage is unremarkable. The thoracic organs are in their normal positions and relationships and there is no increase in free pleural fluid. The above described area of contusion in the apical portion of the right pleural cavity is noted.

**LUNGS:** The lungs are of essentially similar appearance the right weighing 320 Gm., the left 290 Gm. The lungs are well aerated with smooth glistening pleural surfaces and gray-pink color. A 5 cm. diameter area of purplish red discoloration and increased firmness to palpation is situated in the apical portion of the right upper lobe. This corresponds to the similar area described in the overlying parietal pleura. Incision in this region reveals recent hemorrhage into pulmonary parenchyma.

**HEART:** The pericardial cavity is smooth walled and contains approximately 10 cc. of straw-colored fluid. The heart is of essentially normal external contour and weighs 350 Gm. The pulmonary artery is opened in situ and no abnormalities are noted. The cardiac chambers contain moderate amounts of postmortem clotted blood. There are no gross abnormalities of the leaflets of any of the cardiac valves. The following are the circumferences of the cardiac valves: aortic 7.5 cm., pulmonic 7 cm., tricuspid 12 cm., mitral 11 cm. The myocardium is firm and reddish brown. The left ventricular myocardium averages 1.2 cm. in thickness, the right ventricular myocardium 0.4 cm. The coronary arteries are dissected and are of normal distribution and smooth walled and elastic throughout.

**ABDOMINAL CAVITY:** The abdominal organs are in their normal positions and relationships and there is no increase in free peritoneal fluid. The vermiform appendix is surgically absent and there are a few adhesions joining the region of the cecum to the ventral abdominal wall at the above described old abdominal incisional scar.

**SKELETAL SYSTEM:** Aside from the above described skull wounds there are no significant gross skeletal abnormalities.

**PHOTOGRAPHY:** Black and white and color photographs depicting significant findings are exposed but not developed. These photographs were placed in the custody of Agent Roy H. Kellerman of the U. S. Secret Service, who executed a receipt therefore (attached).

## ROENTGENOGRAMS:

Roentgenograms are made of the entire body and of the separately submitted three fragments of skull bone. These are developed and were placed in the custody of Agent Roy H. Kellerman of the U. S. Secret Service, who executed a receipt therefor (attached).

## SUMMARY:

Based on the above observations it is our opinion that the deceased died as a result of two perforating gunshot wounds inflicted by high velocity projectiles fired by a person or persons unknown. The projectiles were fired from a point behind and somewhat above the level of the deceased. The observations and available information do not permit a satisfactory estimate as to the sequence of the two wounds.

The fatal missile entered the skull above and to the right of the external occipital protuberance. A portion of the projectile traversed the cranial cavity in a posterior-anterior direction (see lateral skull roentgenograms) depositing minute particles along its path. A portion of the projectile made its exit through the parietal bone on the right carrying with it portions of cerebrum, skull and scalp. The two wounds of the skull combined with the force of the missile produced extensive fragmentation of the skull, laceration of the superior sagittal sinus, and of the right cerebral hemisphere.

The other missile entered the right superior posterior thorax above the scapula and traversed the soft tissues of the supra-scapular and the supra-clavicular portions of the base of the right side of the neck. This missile produced contusions of the right apical parietal pleura and of the apical portion of the right upper lobe of the lung. The missile contused the strap muscles of the right side of the neck, damaged the trachea and made its exit through the anterior surface of the neck. As far as can be ascertained this missile struck no bony structures in its path through the body.

In addition, it is our opinion that the wound of the skull produced such extensive damage to the brain as to preclude the possibility of the deceased surviving this injury.

A supplementary report will be submitted following more detailed examination of the brain and of microscopic sections. However, it is not anticipated that these examinations will materially alter the findings.

*J. J. Humes*  
J. J. HUMES  
CDR, MC, USN (497831)

*J. Thornton Boswell*  
J. THORNTON BOSWELL  
CDR, MC, USN (489878)

*Pierre A. Finck*  
PIERRE A. FINCK  
LT COL, MC, USA  
(04-043-322)

## JFK EXHIBIT F-43

SUPPLEMENTARY REPORT OF AUTOPSY NUMBER A63-272  
 PRESIDENT JOHN F. KENNEDY

1/16/63

PATHOLOGICAL EXAMINATION REPORT

No. A63-272

GROSS DESCRIPTION OF BRAIN:

Following formalin fixation the brain weighs 1500 gms. The right cerebral hemisphere is found to be markedly disrupted. There is a longitudinal laceration of the right hemisphere which is para-sagittal in position approximately 2.5 cm. to the right of the of the midline which extends from the tip of the occipital lobe posteriorly to the tip of the frontal lobe anteriorly. The base of the laceration is situated approximately 4.5 cm. below the vertex in the white matter. There is considerable loss of cortical substance above the base of the laceration, particularly in the parietal lobe. The margins of this laceration are at all points jagged and irregular, with additional lacerations extending in varying directions and for varying distances from the main laceration. In addition, there is a laceration of the corpus callosum extending from the genu to the tail. Exposed in this latter laceration are the interiors of the right lateral and third ventricles.

When viewed from the vertex the left cerebral hemisphere is intact. There is marked engorgement of meningeal blood vessels of the left temporal and frontal regions with considerable associated sub-arachnoid hemorrhage. The gyri and sulci over the left hemisphere are of essentially normal size and distribution. Those on the right are too fragmented and distorted for satisfactory description.

When viewed from the basilar aspect the disruption of the right cortex is again obvious. There is a longitudinal laceration of the mid-brain through the floor of the third ventricle just behind the optic chiasm and the mammillary bodies. This laceration partially communicates with an oblique 1.5 cm. tear through the left cerebral peduncle. There are irregular superficial lacerations over the basilar aspects of the left temporal and frontal lobes.

In the interest of preserving the specimen coronal sections are not made. The following sections are taken for microscopic examination:

- a. From the margin of the laceration in the right parietal lobe.
- b. From the margin of the laceration in the corpus callosum.
- c. From the anterior portion of the laceration in the right frontal lobe.
- d. From the contused left fronto-parietal cortex.
- e. From the line of transection of the spinal cord.
- f. From the right cerebellar cortex.
- g. From the superficial laceration of the basilar aspect of the left temporal lobe.

During the course of this examination seven (7) black and white and six (6) color 4x5 inch negatives are exposed but not developed (the cassettes containing these negatives have been delivered by hand to Rear Admiral George W. Burkley, MC, USN, White House Physician).

**MICROSCOPIC EXAMINATION:**

BRAIN:

Multiple sections from representative areas as noted above are examined. All sections are essentially similar and show extensive disruption of brain tissue with associated hemorrhage. In none of the sections examined are there significant abnormalities other than those directly related to the recent trauma.

HEART:

Sections show a moderate amount of sub-epicardial fat. The coronary arteries, myocardial fibers, and endocardium are unremarkable.

LUNGS:

Sections through the grossly described area of contusion in the right upper lobe exhibit disruption of alveolar walls and recent hemorrhage into alveoli. Sections are otherwise essentially unremarkable.

LIVER:

Sections show the normal hepatic architecture to be well preserved. The parenchymal cells exhibit markedly granular cytoplasm indicating high glycogen content which is characteristic of the "liver biopsy pattern" of sudden death.

SPLEEN:

Sections show no significant abnormalities.

KIDNEYS:

Sections show no significant abnormalities aside from dilatation and engorgement of blood vessels of all calibers.

SKIN WOUNDS:

Sections through the wounds in the thoracic regions are essentially similar. In each there is loss of continuity of the epidermis with coagulation necrosis of the tissues at the wound margins. The scalp wound exhibits several small fragments of bone at its margins in the subcutaneous tissue.

FINAL SUMMARY:

This supplementary report covers in more detail the extensive degree of cerebral trauma in this case. However neither this portion of the examination nor the microscopic examinations alter the previously submitted report or add significant details to the cause of death.


*J. J. Humes*  
 J. J. HUMES  
 CDR, MC, USN, 497831 *WPH*

6 December 1963

From: Commanding Officer, U. S. Naval Medical School  
To: The White House Physician  
Via: Commanding Officer, National Naval Medical Center

Subj: Supplementary report of Naval Medical School autopsy No. A63-272,  
John F. Kennedy; forwarding of

1. All copies of the above subject final supplementary report are forwarded herewith.

J. H. STOVER, JR. 

-----  
6 December 1963

FIRST ENDORSEMENT

From: Commanding Officer, National Naval Medical Center  
To: The White House Physician

1. Forwarded.

C. B. GALLOWAY

JFK EXHIBIT F-44

ATOPSY DESCRIPTIVE SHEET

AUTOPSY

NMS # A-3-3 #272 DATE 11-22-63 HR. STARTED \_\_\_\_\_ HR. COMPLETED \_\_\_\_\_

NAME: \_\_\_\_\_ RANK/RATE \_\_\_\_\_

DATE/HOUR EXPIRED: \_\_\_\_\_ WARD \_\_\_\_\_ DIAGNOSIS \_\_\_\_\_

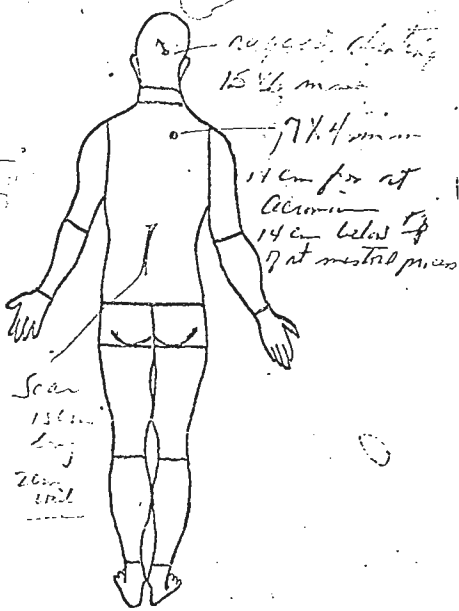
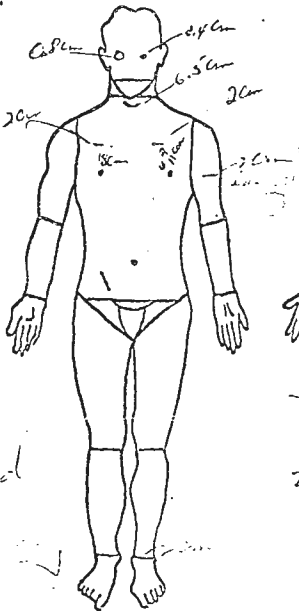
PHYSICAL DESCRIPTION: RACE: \_\_\_\_\_ Obtain following on babies only:

Color \_\_\_\_\_  
 Height \_\_\_\_\_ in. Weight \_\_\_\_\_ lb. Hair \_\_\_\_\_ Color \_\_\_\_\_  
 Color eyes \_\_\_\_\_ Pupil: RT \_\_\_\_\_ mm, Lb. \_\_\_\_\_ mm Crown-rump \_\_\_\_\_ in.  
 Circumference: \_\_\_\_\_ in.  
 Head \_\_\_\_\_ in. Chest \_\_\_\_\_ in.  
 WEIGHTS: (Grams, unless otherwise specified) Abd. \_\_\_\_\_ in.

LUNG, RT. 320 KIDNEY, RT. 1395 ADRENALS, RT. \_\_\_\_\_  
 LUNG, LT. 250 290 KIDNEY, LT. 140 ADRENALS, LT. \_\_\_\_\_  
 BRAIN \_\_\_\_\_ LIVER 150 PANCREAS \_\_\_\_\_  
 SPLEEN 90 HEART 50 THYROID \_\_\_\_\_  
 THYMUS \_\_\_\_\_ TESTIS \_\_\_\_\_ OVARY \_\_\_\_\_

HEART MEASUREMENTS: A 7.5 cm. P 7 cm. T 1.2 cm. M 10 cm.  
 LVM 1.5 cm. RVW .4 cm.

NOTES:

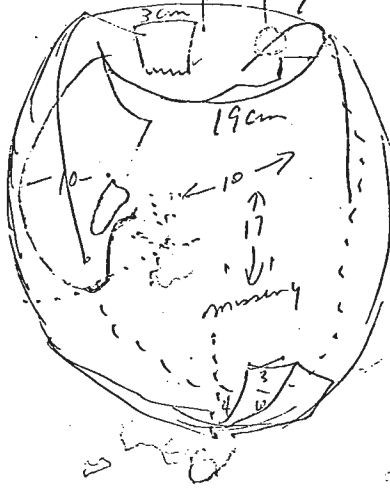


Pathologist \_\_\_\_\_





Ventral  
orbital  
glide at eye  
Fracture through floor



4 x 4 mm from right  
5 mm  
from the  
Cannal sutures.



Mr. KLEIN. Do you recognize these reports, Doctor?

Dr. BADEN. Yes. These are copies of reports that the panel had opportunity to see and examine. The panel members then had the opportunity to question the persons who prepared the reports.

Mr. KLEIN. Who prepared those reports?

Dr. BADEN. The autopsy reports of President Kennedy were prepared by Dr. Humes and Dr. Boswell, who were the autopsy physicians.

Mr. KLEIN. When were they prepared?

Dr. BADEN. They were prepared during the course of, and in the 2 days following, the performance of the autopsy with the written portions prepared the day following the autopsy.

Mr. KLEIN. When was the supplementary report prepared?

Dr. BADEN. The supplementary report was prepared 2 weeks later and describes the brain after fixation in formaldehyde, which is a customary way of preparing the brain prior to further examination, and also describes the findings on microscopic examination of various tissues of the President. These two types of study do take time in the normal course of an autopsy and such reports are prepared some time after the initial autopsy.

Mr. KLEIN. With respect to the wounds of the upper right back and the front of the neck, what did the autopsy report conclude?

Dr. BADEN. The autopsy report concludes that there was a gunshot perforation of entrance in the right upper back and that the exit wound was in the front of the neck.

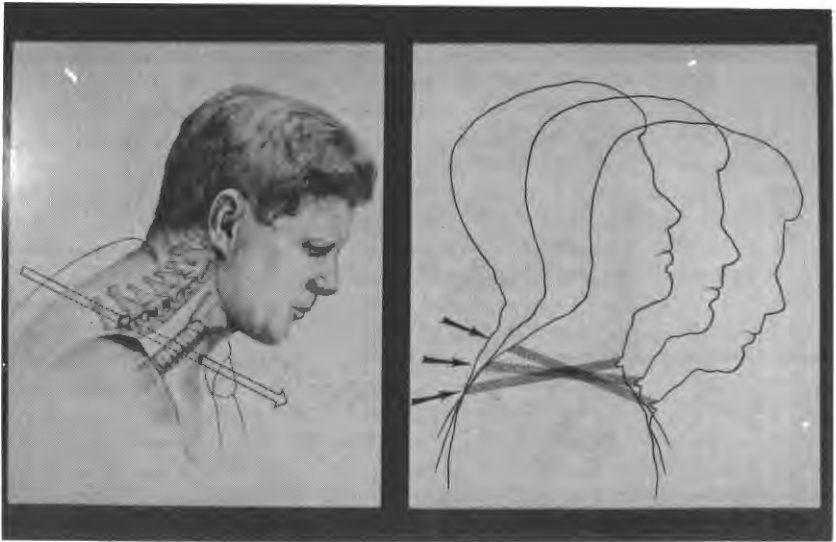
Mr. KLEIN. Doctor, on the basis of the foregoing evidence, photos and X-rays taken at the autopsy, the examination of the President's clothing, the reports of radiologists, interviews of the surgeons who attended the President at Parkland Hospital, and the autopsy report, did the panel unanimously conclude that a bullet entered the upper right back of the President and exited from the front of his neck?

Dr. BADEN. Every member of the panel so concluded.

Mr. KLEIN. Mr. Chairman, at this time I would ask that the drawing marked JFK F-46 be received as a committee exhibit.

Chairman STOKES. Without objection, it may be received and entered into the record at this point.

[The above-mentioned document, JFK exhibit F-46, a drawing, follows:]



JFK EXHIBIT F-46

Mr. KLEIN. Doctor, do you recognize that drawing?

Dr. BADEN. Yes, I do.

Mr. KLEIN. What does that show?

Dr. BADEN. This is a drawing prepared by Miss Dox with the medical panel of the upper portion of the President showing the track that the bullet took through the back, exiting the neck adjacent to the spine, and through the windpipe (or trachea) in the neck; it shows the direction of the bullet path in the body. This path can be produced by various bullet trajectories, depending on the position of the President at the time the missile struck. On your right, there are three positions of the head of the President all showing the same bullet track and direction within the body, going from the back to the exit in the neck, that could be inflicted by a bullet traveling upward, approximately horizontally, or downward.

Each of these trajectories could produce the autopsy findings as depicted on the left and cause a similar track within the body itself.

We cannot, on the basis of the autopsy findings alone, in this instance, determine from whence the bullet came.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the drawing marked JFK F-47 be received as a committee exhibit.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[The above-mentioned document, JFK exhibit F-47 follows:]



JFK Exhibit F-47

Mr. KLEIN. Do you recognize that drawing, Doctor?

Dr. BADEN. Yes, sir; I recognize this as a drawing made for the Warren Commission depicting the same track from back to front neck region that we have been describing.

Mr. KLEIN. Doctor, does that drawing made for the Warren Commission fairly and accurately represent the location of the entry wound and the exit wound and the path of the bullet?

Dr. BADEN. Not precisely. The exit perforation in the neck is approximately at the proper area, but the entrance wound in the back is higher than the medical panel concluded from examining the documents, the photographs as to the point of entrance. We place the entrance perforation a bit lower, almost 2 inches lower than depicted in the Warren Commission exhibit.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the drawing marked JFK F-48 be received as a committee exhibit.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[The above-mentioned document, JFK exhibit F-48, follows:]



JFK EXHIBIT F-48

Mr. KLEIN. Do you recognize that drawing, Doctor?

Dr. BADEN. Yes, sir.

Mr. KLEIN. What does that drawing depict?

Dr. BADEN. This is a drawing made from photographs taken at the time of the autopsy showing the back of the President's head and showing a ruler adjacent to an area of discoloration in the cowlick area of the back of the head of the scalp, which the panel determined was an entrance perforation, an entrance bullet perforation; this also shows portions of fractures of the skull of the

President caused by this gunshot wound and a fragment of dried tissue near the hairline of the President.

Mr. KLEIN. Doctor, does this drawing fairly and accurately represent the location of the wound high in the back of the President's head?

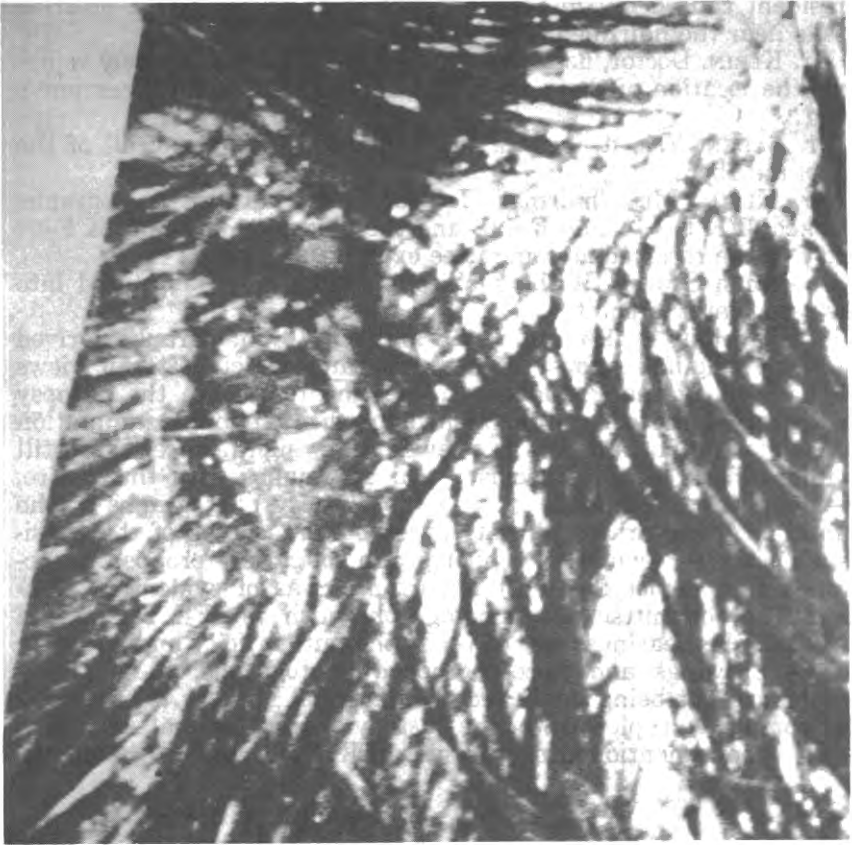
Dr. BADEN. Yes, it does, in the unanimous opinion of all of the panel members.

Mr. KLEIN. Mr. Chairman, I would ask that the photographs marked JFK F-49A and F-49B and the blowups marked JFK F-50 and F-51 be received as committee exhibits.

Chairman STOKES. Without objection, they may be entered into the record at this point.

[JFK exhibits F-49A and F-49B are 8 by 10 photographs derived from the original autopsy photographs and depict posterior views of the head of the President. In deciding to release the autopsy photographs, the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy photographs to the public in either drawings that represent large areas of the President's body as seen in the photograph or closely cropped photographs that depict the most important areas of evidentiary concern. The committee used photographs such as JFK F-49A and F-49B in the hearings only to verify the authenticity and accuracy of the drawings and closely cropped photographs; these photographs are not being published. The original autopsy photographs and committee copies are in the custody of the National Archives.]

[The above-mentioned documents, JFK F-50, and F-51, follow:]



JFK EXHIBIT F-50





JFK EXHIBIT F-51

Dr. BADEN. Yes, sir; I have the 8 by 10 photographs.

Mr. KLEIN. Do you recognize those photographs and those blowups?

Dr. BADEN. Yes, Mr. Klein.

Mr. KLEIN. Would you tell us what they are?

Dr. BADEN. The two photographs I have, 8 by 10 glossy prints, have been prepared from the original photographs in the Archives and show enlargement of the perforation in the cowlick area of the scalp, which is represented on your extreme right in this area; the detail in the photograph is much superior to the blowup detail.

Also depicted in the center is the area in the lower back of the head which I referred to as dry tissue. This is depicted in the middle photograph. These are both enlargements of the actual photographs taken prior to the autopsy of the President.

Mr. KLEIN. Doctor, using those blowups, would you please explain to the committee what the panel learned from those photographs?

Dr. BADEN. The panel did learn and conclude from the photographs and close examination under magnification of the transpar-

encies, and other materials in the Archives, that without question, the superior more area under consideration is a typical gunshot wound of entrance and that it corresponded in many of its features very closely with the gunshot wound of entrance in the right upper back, especially as to the appearance of the abrasion collar and as to its size.

The panel further concluded that the lower more area under question is clearly extraneous dried brain tissue on top of the scalp hair.

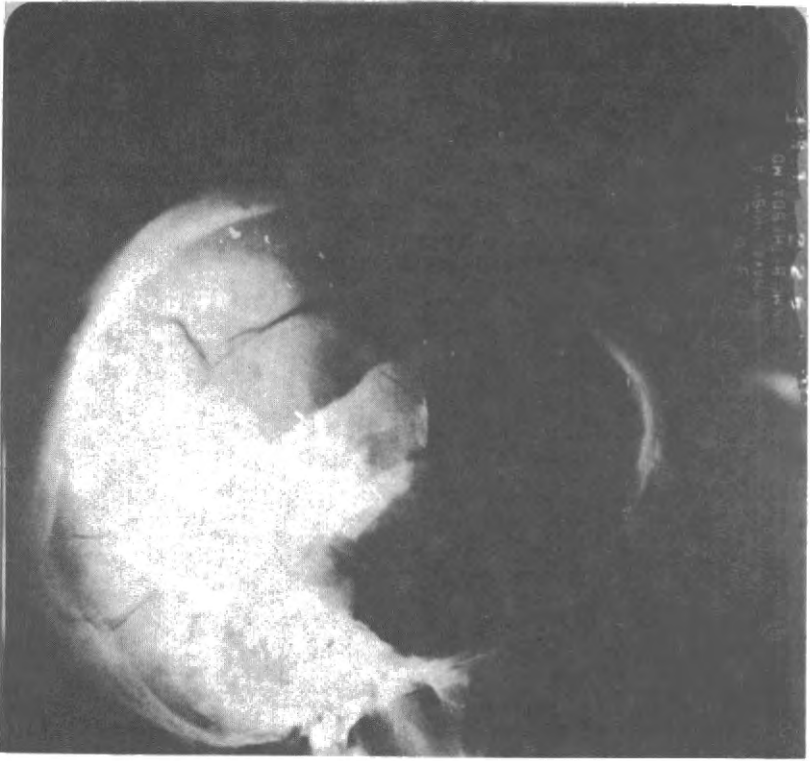
Mr. KLEIN. Mr. Chairman, I would ask that this X-ray deemed marked JFK F-54 as well as the blowups marked "JFK F-52," "JFK F-53," and "JFK F-297" be received as committee exhibits and shown to the witness.

Chairman STOKES. Without objection.

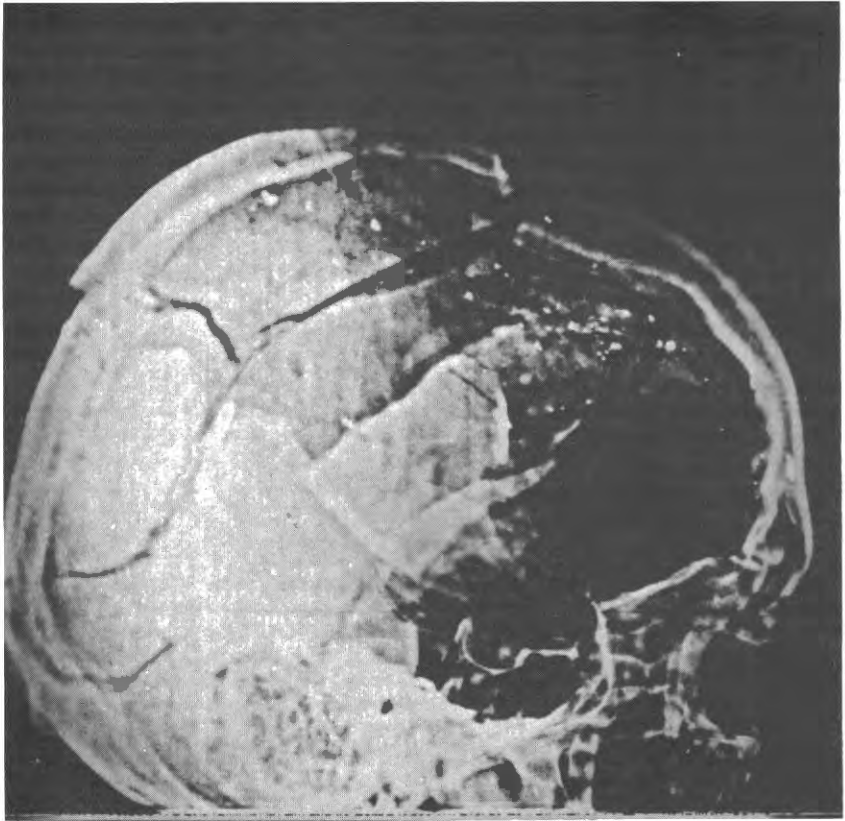
[Documents handed to the witness for his inspection.]

[JFK exhibit F-54 is one of the original 14 autopsy X-rays kept at the National Archives. It depicts a lateral or side view of the President and is labeled "No. 2." In deciding to release the autopsy X-rays the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy X-rays to the public in a cropped fashion. In the hearings the committee used the original X-rays only to verify the authenticity and accuracy of the cropped counterparts; the entire original X-rays are not being published.]

[The above-referred-to JFK exhibits F-52, F-53, and F-297 were marked as committee exhibits and received into the record, and follow:]



JFK EXHIBIT F-52



RIGHT SIDE DOWN HEAD X-RAY - ENHANCED IMAGE - 11 X 11 BLOCK  
MAPPING 255:0.00 0:5.11 WEIGHT = 0.29  
SCALE 424 MICRONS PER PIXEL

JFK EXHIBIT F-53



JFK EXHIBIT F-297

Mr. KLEIN. Do you recognize those X-rays and those blowups?

Dr. BADEN. Yes, I do.

This is X-ray labeled "No. 2" by the tag applied by Dr. Ebersole and identified to the panel members by Dr. Ebersole as an X-ray he took at the time of the autopsy of President Kennedy; it shows a side view of the President's head and is preserved in the Archives. This is an enlarged copy of that specific X-ray showing a side view of the skull of the President with the back of the head to your left, the front of the head to your right. Because of the difficulty interpreting some of the subtle features on the X-ray, the X-rays were further examined using enhancement techniques to increase the image contrast. This is a computerized enhancement on your right of the same X-ray showing the same structures but bringing out some of the details of the X-ray more clearly by the enhancement techniques.

Mr. KLEIN. What did the panel learn from those X-rays?

Dr. BADEN. The panel learned from these X-rays that there was extensive fracturing of the bones of the skull of the President as manifested by these various lines and irregularities, that there was displacement of some bony fragments as a result of this explosive-type injury to the skull as seen on the X-ray, and that there are many small white areas in the X-ray film that are metallic fragments resulting from a bullet having passed through the skull and fragmenting to some small degree.

Mr. KLEIN. Are those X-rays consistent with a bullet having entered the President's head high on top of the head and passed through?

Dr. BADEN. Yes sir. This is clearly demonstrated in these X-rays, and as comparison, the X-ray on the extreme left is an X-ray taken of President Kennedy during life showing the normal appearance of the skull with the various skull bones in their normal appearance and illustrates the extensive damage of the skull present at the time of the autopsy.

The panel concluded, and all of the radiologist consultants with whom the panel spoke with and met with, all concluded that without question there is an entrance bullet hole on the upper portion of the skull at the area I am pointing to, where the bone itself has been displaced, and that this corresponds precisely with the point in the cowlick area on the overlying skin has the appearance of an entrance wound, that the track of the bullet then proceeded from back to front and toward the right causing extensive damage to the head.

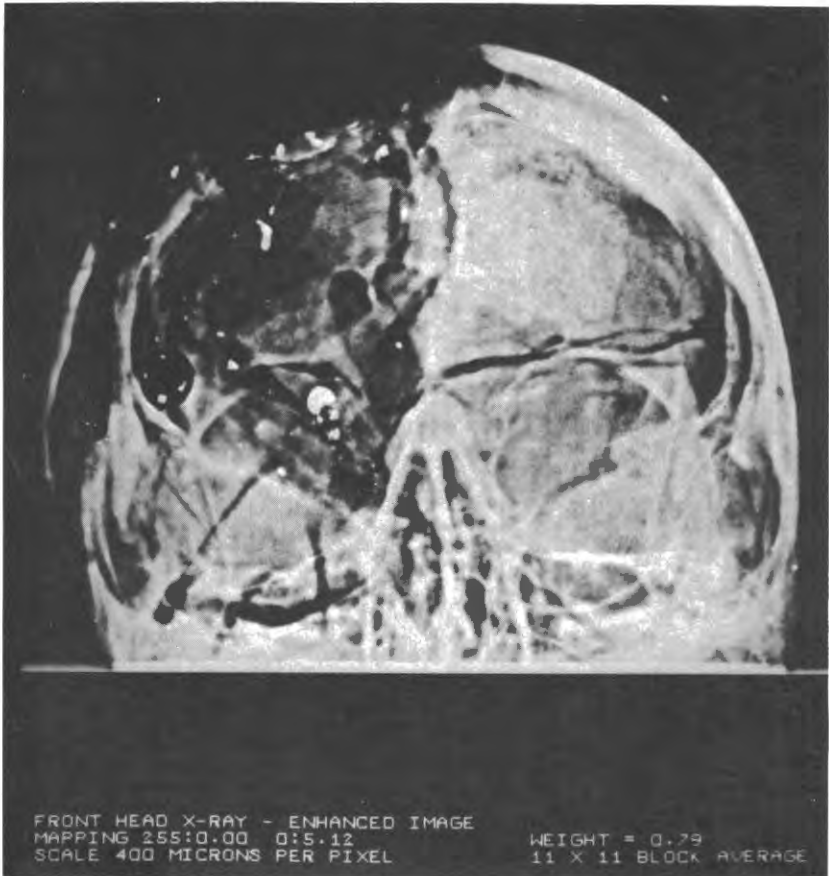
Mr. KLEIN. Mr. Chairman, at this time, I would ask that this original X-ray marked "JFK F-57" as well as two blowups marked "JFK F-55" and "JFK F-56" be received as committee exhibits. Chairman STOKES. Without objection, they may be received.

[JFK exhibit F-57 is one of the original 14 autopsy X-rays kept at the National Archives. It depicts an anterior-posterior view of the skull. In deciding to release the autopsy X-rays the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy X-rays to the public in a cropped fashion. In the hearings the committee used the original X-rays only to verify the authenticity and accuracy of the cropped counterparts; the entire original X-rays are not being published.]

[The above-referred-to exhibits "JFK F-55" and "JFK F-56" were marked committee exhibits and received into the record and follow:]



JFK ЕХНІВІТ F-55



JFK EXHIBIT F-56

Dr. BADEN. For orientation, this is the back of the skull, front of the skull, the eye area, pituitary gland, the ear bones.

Mr. Klein, what I have just been given is an X-ray from the Archives viewed by the panel at the Archives with the label in red "No. 1" affixed.

Mr. KLEIN. Would you briefly tell us, using the blowups, what the panel learned from these X-rays?

Dr. BADEN. Yes, this is an antero-posterior view of the skull—that is, taken with the back of the head directly against the X-ray film. These are true enlargements of portions of those X-rays.

Mr. KLEIN. Are these X-rays consistent with a bullet having passed through the President's head?

Dr. BADEN. Yes; there is extensive damage to the right side of the skull area, shown more clearly in the enhancement of the X-

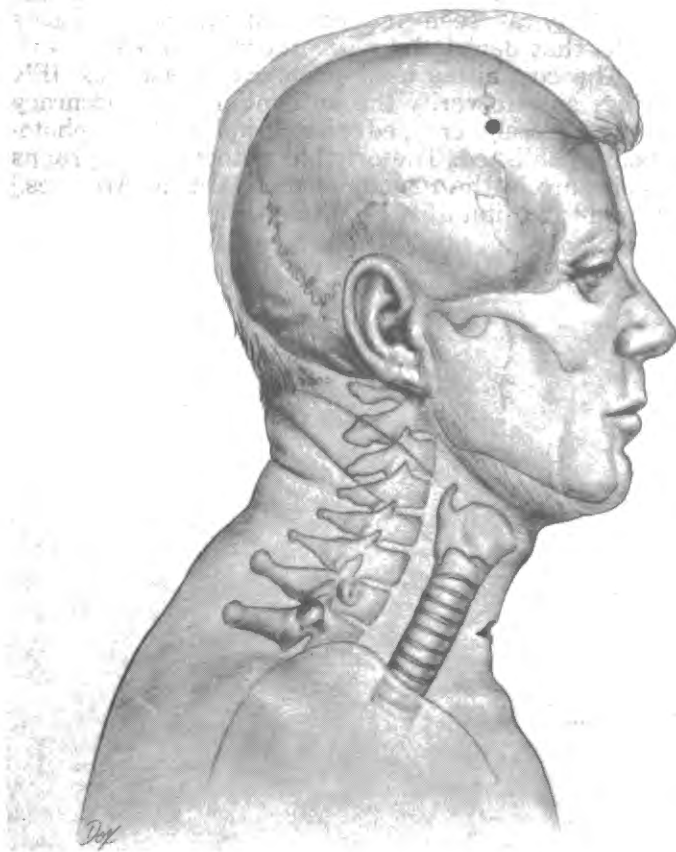


ray, and there are extensive fracture lines radiating from the point of entrance marked by this relatively large metal fragment and the X-ray lines extending from it. This corresponds precisely to the point of entrance beneath the cowlick area and shows the extensive loss of bone at that area.

Mr. KLEIN. Mr. Chairman, at this time I ask that the drawing marked "JFK F-58" be received as an exhibit and shown to the witness.

Chairman STOKES. Without objection, it may be received at this point.

[The above-referred-to exhibit "JFK F-58" follows:]



JFK EXHIBIT F-58

Mr. KLEIN. Doctor, do you recognize that drawing?

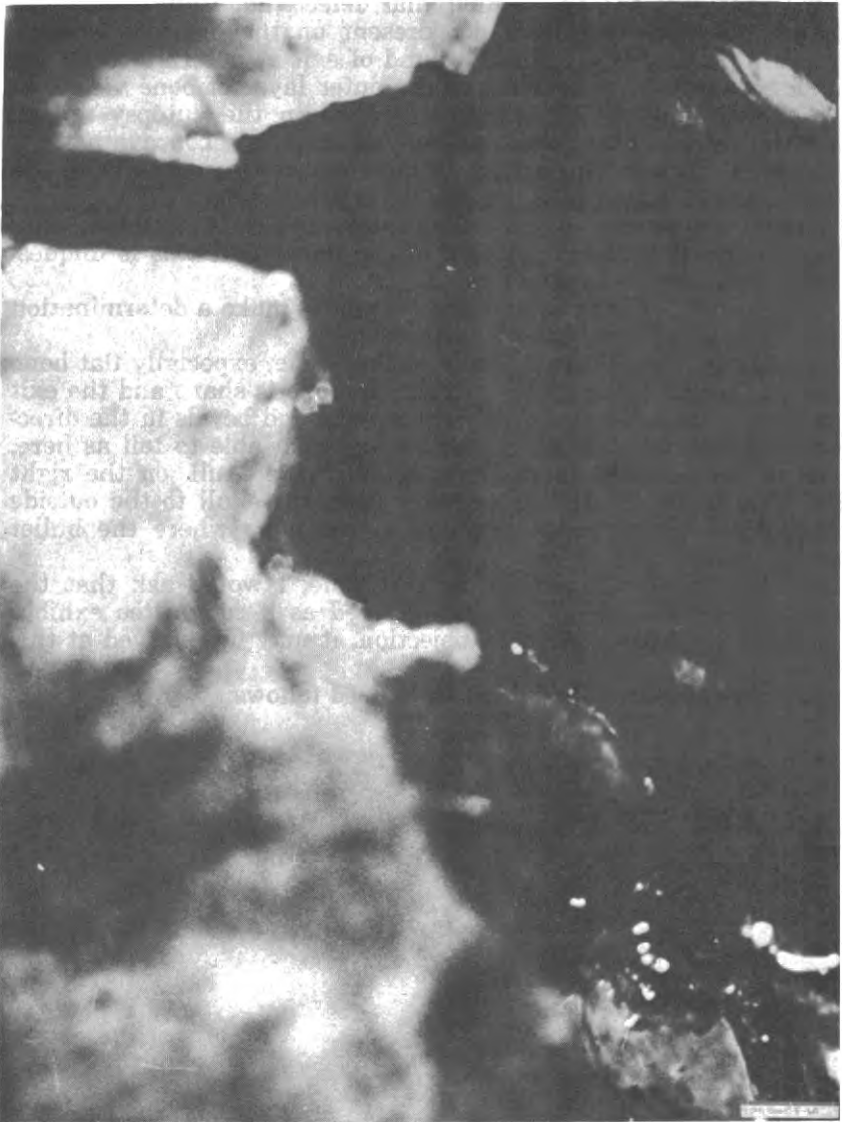
Dr. BADEN. Yes; this is a drawing prepared with the panel and Miss Dox showing a side view of the President's skull and showing the point that the panel agreed was the exit point for the gunshot wound that entered the back of the head; this exit perforation is on the right front side of the head of the President.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that this photograph and the blowup marked "JFK F-59" and "JFK F-60" be received as committee exhibits and shown to the witness.

Chairman STOKES. Without objection, they may be received at this point.

[JFK exhibit F-59 is an 8 by 10 photograph derived from one of the original autopsy photographs and depicts the area of bone injury on the right side of the head. In deciding to release the autopsy photographs, the committee wished to permit public examination of the most important details of evidentiary significance while still maintaining a sense of propriety. In accordance with this desire, the committee decided to display the autopsy photographs to the public in either drawings that represent large areas of the President's body as seen in the photograph or closely cropped photographs that depict the most important areas of evidentiary concern. The committee used photographs such as JFK F-59 in the hearings only to verify the authenticity and accuracy of the drawings and closely cropped photographs; these photographs are not being published. The original autopsy photographs and committee copies are in the custody of the National Archives.]

[The above-referred-to exhibit JFK F-60 follows:]



JFK EXHIBIT F-60

Mr. KLEIN. Doctor, do you recognize that photograph and that blowup?

Dr. BADEN. Yes; this is a detail of one of the autopsy photographs, in fact the only photograph that shows any internal structures of the President at the time of autopsy as opposed to all of the other photographs which are of the outside of the body. This photograph shows the bullet exit area on the right side of the head and is seen in better detail and sharper on the photograph than in the blowup. The photograph shows the front right part of the skull

of the President and the semicircular defect that I am pointing to corresponds with the black dot present on the previous exhibit. This is a portion of a gunshot wound of exit as determined by the panel because of the beveling of the outer layer of bone visible in the photographs, which is also described in the autopsy report. Beveling refers to the breaking away of bone in a concave pattern as when a BB goes through plate glass causing a concavity in the glass in the direction in which the BB is proceeding.

This also happens when a bullet enters and exits skull bone and other bones. It is the conclusion of the panel that this is unquestionably an exit perforation.

Mr. KLEIN. Does the beveling allow you to make a determination whether it is an entry or exit perforation?

Dr. BADEN. Yes. When a bullet strikes bone, especially flat bone such as the skull, the entrance into the bone is sharp and the exit from the bone is beveled. The bone breaks and bevels in the direction that the bullet is going and we are then able to tell as here, because the beveling is on the outside of the skull, on the right side, that the bullet traveled from within the skull to the outside causing this characteristic change in the bone where the bullet exited.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the blowup marked "JFK F-64" be received as a committee exhibit.

Chairman. STOKES. Without objection, it may be received at this point.

[The above-referred-to exhibit JFK F-64 follows:]



JFK EXHIBIT F-64

Mr. KLEIN. Doctor, do you recognize that blowup?

Dr. BADEN. Yes sir, this is a blowup of one of the X-rays, one of the 14 X-rays kept at the Archives, showing 3 fragments of bone received by Dr. Humes and Dr. Boswell in the autopsy room while they were performing the autopsy on the President, that had been retrieved from the limousine in which the President had been riding. The doctors looked at the bone fragments, took X-rays of the bone fragments, inserted this particular bone fragment against this semicircle and concluded that they matched and fitted together. On this larger triangular fragment there is at one edge metal fragments seen on the X-ray that the panel concluded, and the autopsy physicians concluded, were part of the exit perforation

through the bone and that there is beveling on this bony fragment of the outer aspect of the bone. In addition, a portion of a suture line is also present on one edge of this fragment.

A suture line refers to the point at which two bones join. This suture line assisted the panel in precisely identifying from where the fragment derived. The panel concluded that this was part of the gunshot wound of exit of the right side of the head of the President.

Mr. KLEIN. Doctor, directing your attention to the autopsy reports which have already been received as exhibits, in what ways was the autopsy report consistent with the other evidence available with respect to the wound to the President's head?

Dr. BADEN. The autopsy reports did indicate that the gunshot wound of the head of the President came from behind, proceeded in a forward direction, and exited the right side of the skull. This is consistent with the findings of the panel.

Mr. KLEIN. In what ways was the autopsy report not consistent with the other evidence available to the panel?

Dr. BADEN. The location and placement of the gunshot wound of entrance was significantly different on examination by the panel members than the autopsy pathologists had indicated. The panel members unanimously placed the gunshot wound of entrance in the back of the President's head approximately 4 inches above the point indicated in the autopsy report prepared by Drs. Humes and Boswell.

Mr. KLEIN. So the panel concluded that the autopsy report placed the wound in the back of the head 4 inches too low?

Dr. BADEN. That is correct; as recorded in the original autopsy.

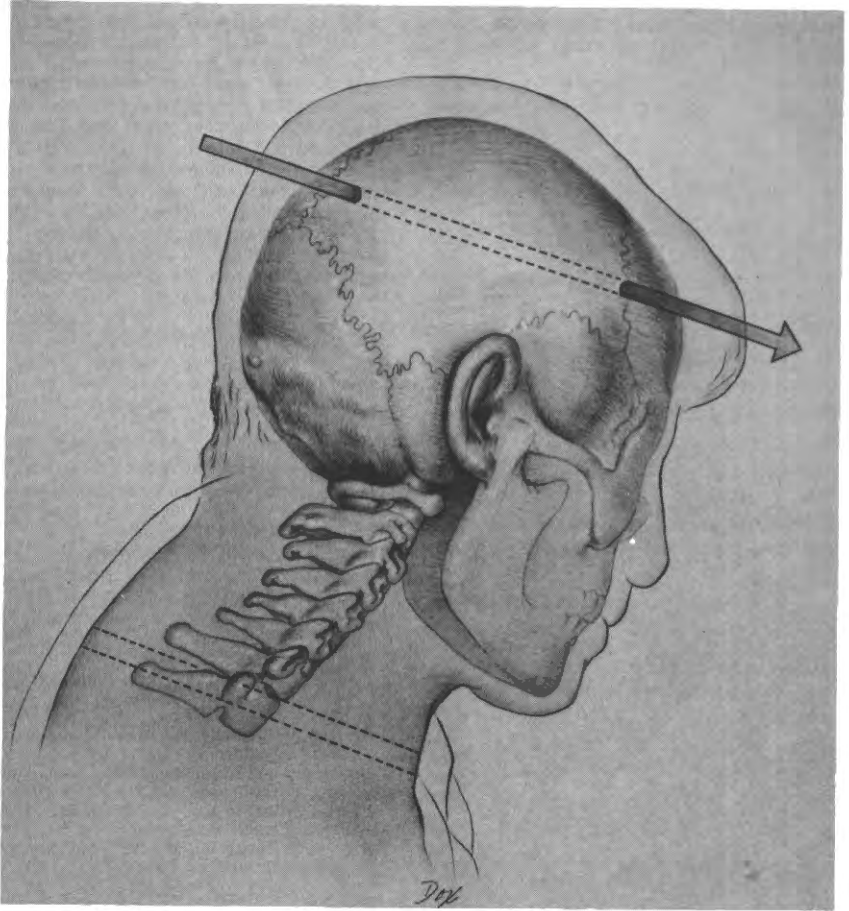
Mr. KLEIN. Doctor, on the basis of the foregoing evidence, the photographs and X-rays taken of the autopsy, the reports of the radiologists and the autopsy report, did the panel unanimously conclude that a bullet entered the President high on the back of his head and exited on the right side toward the front of his head?

Dr. BADEN. All nine members of the panel so unanimously concluded.

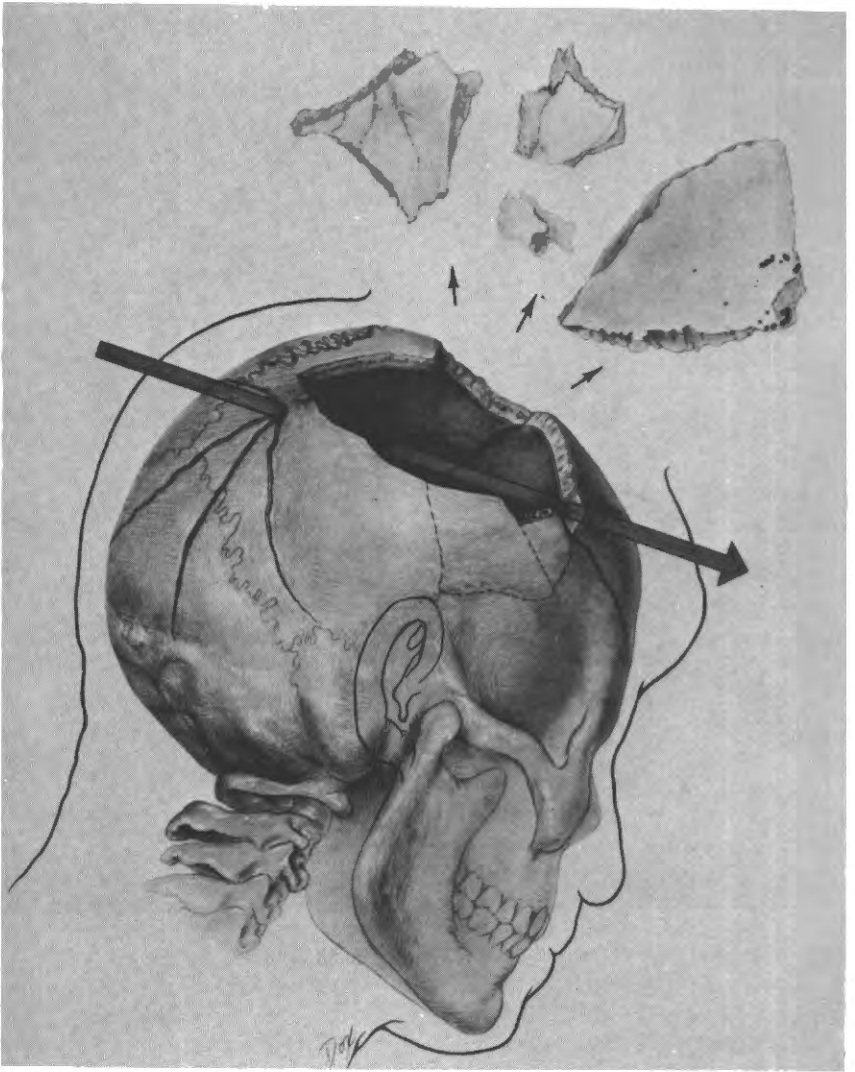
Mr. KLEIN. Mr. Chairman, I would ask that two drawings marked "JFK F-65" and "JFK F-66" and the photograph marked "JFK F-67" be received as committee exhibits at this time.

Chairman STOKES. Without objection, they may be received.

[The above referred to exhibits, "JFK F-65," "JFK F-66," and "JFK F-67" follow:]



JFK EXHIBIT F-65



JFK EXHIBIT F-66





JFK EXHIBIT F-67

Mr. KLEIN. Do you recognize these exhibits, doctor?

Dr. BADEN. Yes, I do.

Mr. KLEIN. What do they depict?

Dr. BADEN. The drawings were prepared with Miss Dox and the members of the panel to illustrate the path of the gunshot wounds that struck the President. The photograph is Zapruder frame 312 and shows the President just before the explosion caused by the head shot.

Mr. KLEIN. Do the diagrams fairly and accurately represent the path of the bullet which entered high on the back of the President's head and exited from the right side of the head toward the front?

Dr. BADEN. Yes, sir. One, the drawing to your right, indicates the path of the bullet entering the right upper head region approximately 1 inch to the right of the midline of the body and approximately 4 inches above a bony prominence in the back of the head, the external occipital protuberance which is depicted here.

This bullet, then, proceeds from back to front exiting in the area of the suture line, that I mentioned earlier, the coronal suture line as depicted on the drawing, causing a semicircular defect in the frontal bone of the skull.

This drawing does indicate that at the time of this injury to the back of the head there already existed in the body a bullet track of the right upper back region going from back to front exiting through the tracheostomy incision in the front of the neck.

The other diagram, the other drawing, is an attempt to illustrate the direction of the gunshot wound and the damage done to the skull, utilizing the X-rays in great measure and the photographs taken at the autopsy procedure. This shows the entrance perforation in the upper posterior right side of the skull, and the bullet path proceeding forward causing extensive fractures of the skull bones on the right and then exiting the right front area.

The four bone fragments illustrated in this diagram are drawn to scale in relation to each other, but not to the skull, utilizing the X-rays and photographs at the Archives. The three to your right are

the fragments removed from the limousine of the President and brought to the autopsy doctors during the course of the autopsy; and the fourth fragment is a separate fragment found a few days later in Dealey Plaza and referred to as the Harper fragment.

These four fragments did emanate from the large defect in the side of the President's head.

The position of the President's head in both of these diagrams was derived from Zapruder frame 312, which, as I already mentioned, shows the position of the President just before the explosion of the head.

Mr. KLEIN. Did the panel conclude that the direction of the bullet was downward?

Dr. BADEN. Yes, in this instance the panel was able to arrive at a conclusion of the directionality from whence the bullet originated because of other evidence made available to the panel, notably, the Zapruder film showing the position of the head of the President at the moment of impact with the bullet.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the drawing marked JFK F-68 be received as a committee exhibit.

Chairman STOKES. Without objection, it may be received at this point.

[The above referred to JFK exhibit F-68 follows:]



JFK Exhibit F-68

Mr. KLEIN. Do you recognize that drawing, Doctor?

Dr. BADEN. Yes, sir, this is a drawing prepared for the Warren Commission attempting to illustrate the gunshot wound that entered the back of the President's head.

Mr. KLEIN. Does that drawing fairly and accurately represent the location of the wounds and the path of the bullet in the President's head?

Dr. BADEN. Not in the area of location of the entrance perforation but it does illustrate the general concept that it is a gunshot wound from the back proceeding to the front. That the panel agrees with.

However, the panel places the entrance perforation 4 inches higher in the back of the head than the illustration for the Commission shows.

The panel also places the entrance perforation on the lower, in the back area, a few inches lower than illustrated on this drawing.

Mr. KLEIN. Doctor, you have testified that the President was hit by two bullets, one of which entered his upper right back, and the other entered high on the back of his head. Did the panel reach any conclusions as to whether each of these wounds would have been fatal in and of itself?

Dr. BADEN. Yes, the panel did conclude, without question, that the gunshot wound that struck the head of the President in and of itself would be fatal. The panel could not unanimously agree as to whether or not the gunshot wound through the back and neck would necessarily be fatal because of the failure to examine the bullet track at the time of the autopsy—dissect the track. As a result we do not know whether there was injury to the spine of the President or to major blood vessels. If the spine or blood vessels were injured, that bullet also could have been fatal, but we are unable to conclusively agree on that question.

Mr. KLEIN. Doctor, at this point, I would ask you to direct your attention to the wounds received by Governor Connally. What was the nature of the injuries received by the Governor?

Dr. BADEN. The Governor suffered injuries also of the right upper back region, more to the side, than the President. The bullet exited. It entered near the top of the armpit on the Governor, exited beneath the right nipple. There was another bullet path through the right wrist, entering on the thumb side about an inch above the wrist, exiting on the palm aspect of the wrist, and there was another bullet perforation in the left inner thigh of the Governor.

Mr. KLEIN. Mr. Chairman, I would ask that these reports marked JFK F-70 and F-71 be received as committee exhibits and shown to the witness.

Chairman STOKES. Without objection, they may be received.  
[The above referred to JFK exhibits F-70 and F-71 follow:]

## JFK EXHIBIT F-70

Tuesday, April 21, 1964

TESTIMONY OF DR. ROBERT ROEDER SHAW, DR. CHARLES FRANCIS GREGORY, GOV. JOHN BOWDEN CONNALLY, JR., AND MRS. JOHN BOWDEN CONNALLY, JR.

The President's Commission met at 1:30 p.m., on April 21, 1964, at 200 Maryland Avenue NE., Washington, D.C.

Present were Chief Justice Earl Warren, Chairman; Senator Richard B. Russell, Senator John Sherman Cooper, Representative Hale Boggs, John J. McCloy, and Allen W. Dulles, members.

Also present were J. Lee Rankin, general counsel; Francis W. H. Adams, assistant counsel; Joseph A. Ball, assistant counsel; David W. Belin, assistant counsel; Norman Redlich, assistant counsel; Arlen Specter, assistant counsel; Charles Murray and Charles Rhyne, observers; and Waggoner Carr, attorney general of Texas.

## TESTIMONY OF DR. ROBERT ROEDER SHAW

Senator COOPER. The Commission will come to order.

Dr. Shaw, you understand that the purpose of this inquiry is taken under the order of the President appointing the Commission on the assassination of President Kennedy to investigate all the facts relating to his assassination.

Dr. SHAW. I do.

Senator COOPER. And report to the public.

Do you solemnly swear the testimony you are about to give before this Commission will be the truth, the whole truth, and nothing but the truth, so help you God?

Dr. SHAW. I do.

Senator COOPER. Do you desire an attorney to be with you?

Dr. SHAW. No.

Mr. SPECTER. Will you state your full name for the record, please?

Dr. SHAW. Robert Roeder Shaw.

Mr. SPECTER. What is your profession, please?

Dr. SHAW. Physician and surgeon.

Mr. SPECTER. Will you outline briefly your educational background?

Dr. SHAW. I received my B.A. degree from the University of Michigan in 1927, and my M.D. degree from the same institution in 1933.

Following that I served 2 years at the Roosevelt Hospital in New York City from July 1934, to July 1936, in training in general surgery. I had then 2 years of training in thoracic surgery at the University Hospital, Ann Arbor, Mich., from July 1936 to July 1938.

On August 1, 1938, I entered private practice limiting my practice to thoracic surgery in Dallas, Tex.

Mr. DULLES. What kind of surgery?

Dr. SHAW. Thoracic surgery or surgery of the chest.

I have practiced there continuously except for a period from June 1942, until December 1945, when I was a member of the Medical Corps of the Army of the United States serving principally in the European theater of operations.

I was away again from December 1961, until June of 1963, when I was head of the MEDICO team and performed surgery at Avicenna Hospital in Kabul, Pakistan.

Mr. DULLES. Will you tell us a little bit about MEDICO. Is that the ship?

Dr. SHAW. No; that is HOPE. MEDICO was formed by the late Dr. Tom Dooley.

Mr. DULLES. Yes; I know him very well. He was the man in Laos.

Dr. SHAW. Yes, sir; this was one of their projects.

Mr. DULLES. I see.

Dr. SHAW. I returned to—

Mr. DULLES. An interesting project.

Dr. SHAW. I returned to Dallas and on September 1, 1963, started working full time with the University of Texas Southwestern Medical School as professor of thoracic surgery and chairman of the division of thoracic surgery.

In this position I also am chief of thoracic surgery at Parkland Memorial Hospital in Dallas which is the chief hospital from the standpoint of the medical facilities of the school.

Mr. SPECTER. Are you licensed to practice medicine in the State of Texas?

Dr. SHAW. I am.

Mr. SPECTER. Are you certified?

Dr. SHAW. By the board of thoracic surgery you mean?

Mr. SPECTER. Yes; by the board of thoracic surgery.

Dr. SHAW. Yes; as of 1948.

Mr. SPECTER. What experience, if any, have you had, Dr. Shaw, with bullet wounds?

Dr. SHAW. I have had civilian experience, both in the work at Parkland Hospital, where we see a great amount of trauma, and much of this involves bullet wounds from homicidal attempts and accidents.

The chief experience I had, however, was during the Second World War when I was serving as chief of the thoracic surgery center in Paris, France. And during this particular experience we admitted over 900 patients with chest wounds of various sort, many of them, of course, being shell fragments rather than bullet wounds.

Mr. SPECTER. What is your best estimate as to the total number of bullet wounds you have had experience with?

Dr. SHAW. It would be approximately 1,000, considering the large number of admissions we had in Paris.

Mr. SPECTER. What were your duties in a general way on November 22, 1963.

Dr. SHAW. On that particular date I had been at a conference at Woodlawn Hospital, which is our hospital for medical chest diseases connected with the medical school system. I had just gone to the Children's Hospital to see a small patient that I had done a bronchoscopy on a few days before and was returning to Parkland Hospital, and the medical school.

Woodlawn and the Children's Hospital are approximately a mile away from Parkland Hospital.

Mr. SPECTER. Were you called upon to render any aid to President Kennedy on November 22?

Dr. SHAW. No.

Mr. SPECTER. Were you called upon to render medical aid to Gov. John B. Connally on that day?

Dr. SHAW. Yes.

Mr. SPECTER. Will you describe briefly the circumstances surrounding your being called into the case.

Dr. SHAW. As I was driving toward the medical school I came to an intersection of Harry Hines Boulevard and Industrial Boulevard.

There is also a railroad crossing at this particular point. I saw an open limousine pass this point at high speed with a police escort. We were held up in traffic because of this escort. Finally, when we were allowed to proceed, I went on to the medical school expecting to eat lunch. I had the radio on because it was the day that I knew the President was in Dallas and would be eating lunch at the Trade Mart which was not far away, and over the radio I heard the report that the President had been shot at while riding in the motorcade. I went on to the medical school and as I entered the medical school a student came in and joined three other students, and said the President has just been brought into the emergency room at Parkland, dead on arrival.

The students said, "You are kidding, aren't you?" and he said, "No, I am not. I saw him, and Governor Connally has been shot through the chest."

Hearing that I turned and walked over to the emergency room, which is approximately 150 yards from the medical school, and entered the emergency room.

Mr. SPECTER. At approximately what time did you arrive at the emergency room where Governor Connally was situated?

Dr. SHAW. As near as I could tell it was about 12:45.

Mr. SPECTER. Who was with Governor Connally, if anyone, at that time, Dr. Shaw?

Dr. SHAW. I immediately recognized two of the men who worked with me in thoracic surgery, Dr. James Duke and Dr. James Boland, Dr. Giesecke, who is an anesthesiologist, was also there along with a Dr. David Mebane who is an instructor in general surgery.

Mr. SPECTER. What was Governor Connally's condition at that time, based on your observations?

Dr. SHAW. The Governor was complaining bitterly of difficulty in breathing, and of pain in his right chest. Prior to my arriving there, the men had very properly placed a tight occlusive dressing over what on later examination proved to be a large sucking wound in the front of his right chest, and they had inserted a rubber tube between the second and third ribs in the front of the right chest, carrying this tube to what we call a water seal bottle.

Mr. SPECTER. What was the purpose?

Dr. SHAW. Yes; this is done to reexpand the right lung which had collapsed due to the opening through the chest wall.

Mr. SPECTER. What wounds, if any, did you observe on the Governor at that time?

Dr. SHAW. I observed no wounds on the Governor at this time. It wasn't until he was taken to the operating room that I properly examined him from the standpoint of the wound.

Mr. SPECTER. How long after your initial viewing of him was he taken to the operating room?

Dr. SHAW. Within about 5 minutes. I stepped outside to talk to Mrs. Connally because I had been given information by Dr. Duke that blood had been drawn from the Governor, sent to the laboratory for cross-matching for blood that we knew would be necessary, that the operating room had already been alerted, and that they were ready and they were merely awaiting my arrival.

Mr. SPECTER. How was Governor Connally transported from the emergency room to the operating room?

Dr. SHAW. On a stretcher.

Mr. SPECTER. And was he transported up an elevator as well?

Dr. SHAW. Yes. It is two floors above the emergency rooms.

Mr. SPECTER. Will you describe what happened next in connection with Governor Connally's—

Mr. DULLES. Could I ask a question, putting in this tube is prior to making an incision?

Dr. SHAW. Yes; a stab wound.

Mr. DULLES. Just a stab wound?

Dr. SHAW. Yes.

Mr. SPECTER. What treatment next followed for Governor Connally, Doctor?

Dr. SHAW. He was taken to the operating room and there Dr. Giesecke started the anesthesia. This entails giving an intravenous injection of sodium pentothal and then after the Governor was asleep a gas was used, that will be on the anesthetic record there.

Mr. SPECTER. Do you know at approximately what time this procedure was started?

Dr. SHAW. I will have to refresh my memory again from the record. We had at the time I testified before, we had the—

Mr. SPECTER. Permit me to make available to you a copy of the Parkland Memorial Hospital operative record and let me ask you, first of all, if you can identify these two pages on an exhibit heretofore marked as Commission Exhibit 392 as to whether or not this constitutes your report?

Dr. SHAW. Yes; this is a transcription of my dictated report of the operation.

Mr. SPECTER. Are the facts set forth therein true and correct?

Dr. SHAW. Yes. On this it states that the operation itself was begun at 1300 hours or 1 o'clock, 1 p.m., and that the actual surgery started at 1335 or 1:35 p.m. The operation was concluded by me at 3—1520 which would be 3:20 p.m.

Mr. SPECTER. You have described, in a general way, the chest wound. What other wounds, if any, was Governor Connally suffering from at the time you saw him?

Dr. SHAW. I will describe then the wound of the wrist which was obvious. He had a wound of the lower right forearm that I did not accurately examine because I had already talked to Dr. Gregory while I was scrubbing for the operation, told him that this wound would need his attention as soon as we were able to get the chest in a satisfactory condition. There was also, I was told, I didn't see the wound, on the thigh, I was told that there was a small wound on the thigh which I saw later.

Mr. SPECTER. When did you first have an opportunity then to examine Governor Connally's wound on the posterior aspect of his chest?

Dr. SHAW. After the Governor had been anesthetized. As soon as he was asleep so we could manipulate him—before that time it was necessary for an endotracheal tube to be in place so his respirations could be controlled before we felt we could roll him over and accurately examine the wound entrance.

We knew this was the wound exit.

Mr. SPECTER. This [indicating an area below the right nipple on the body]?

Dr. SHAW. Yes.

Mr. DULLES. How did you know it was a wound exit.

Dr. SHAW. By the fact of its size, the ragged edges of the wound. This wound was covered by a dressing which could not be removed until the Governor was anesthetized.

Mr. SPECTER. Indicating this wound, the wound on the Governor's chest?

Dr. SHAW. Yes; the front part.

Mr. SPECTER. Will you describe in as much detail as you can the wound on the posterior side of the Governor's chest?

Dr. SHAW. This was a small wound approximately a centimeter and a half in its greatest diameter. It was roughly elliptical. It was just medial to the axillary fold or

the crease of the armpit, but we could tell that this wound, the depth of the wound, had not penetrated the shoulder blade.

Mr. SPECTER. What were the characteristics, if any, which indicated to you that it was a wound of entrance then?

Dr. SHAW. Its small size, and the rather clean cut edges of the wound as compared to the usual more ragged wound of exit.

Mr. SPECTER. Now, I hand you a diagram which is a body diagram on Commission Exhibit No. 679, and ask you if, on the back portion of the figure, that accurately depicts the point of entry into Governor Connally's back?

Dr. SHAW. Yes. The depiction of the point of entry, I feel is quite accurate.

Mr. SPECTER. Now, with respect to the front side of the body, is the point of exit accurately shown on the diagram?

Dr. SHAW. The point is—

Mr. SPECTER. We have heretofore, may the record show the deposition covered much the same ground with Dr. Shaw, but the diagrams used now are new diagrams which will have to be remarked in accordance with your recollection.

Dr. SHAW. Yes. Because I would have to place—they are showing here the angle.

Mr. DULLES. Is this all on the record?

Mr. SPECTER. It should be.

Dr. SHAW. We are showing on this angle, the cartilage angle which it makes at the end of the sternum.

Mr. SPECTER. That is an inverted V which appears in front of the body?

Dr. SHAW. Now the wound was above that. They have shown it below that point so the wound would have to be placed here as far as the point is concerned.

Mr. SPECTER. Would you draw on that diagram a more accurate depiction of where the wound of exit occurred?

Dr. SHAW. Do you want me to initial this?

Mr. SPECTER. Yes; if you please, Dr. Shaw.

I hand you another body diagram marked Commission Exhibit 680 and I will ask you if that accurately depicts the angle of decline as the bullet passed through Governor Connally?

Dr. SHAW. I think the declination of this line is a little too sharply downward. I would place it about 5° off that line.

Mr. SPECTER. Will you redraw the line then, Dr. Shaw, and initial it, indicating the more accurate angle?

Dr. SHAW. The reason I state this is that as they have shown this, it would place the wound of exit a little too far below the nipple. Also it would, since the bullet followed the line of declination of the fifth rib, it would make the ribs placed in a too slanting position.

Mr. SPECTER. What operative procedures did you employ in caring for the wound of the chest, Dr. Shaw.

Dr. SHAW. The first measure was to excise the edges of the wound of exit in an elliptical fashion, and then this incision was carried in a curved incision along the lateral portion of the right chest up toward the right axilla in order to place the skin incision lower than the actual path of the bullet through the chest wall.

After this incision had been carried down to the level of the muscles attached to the rib cage, all of the damaged muscle which was chiefly the serratus anterior muscle which digitates along the fifth rib at this position, was cleaned away, cut away with sharp dissection.

As soon as—of course, this incision had been made, the opening through the parietal pleura, which is the lining of the inside of the chest was very obvious. It was necessary to trim away several small fragments of the rib which were still hanging to tags of periosteum, the lining of the rib, and the ragged ends of the rib were smoothed off with a rongeur.

Mr. SPECTER. What damage had been inflicted upon a rib, if any, Dr. Shaw?

Dr. SHAW. About 10 centimeters of the fifth rib starting at the, about the mid-axillary line and going to the anterior axillary line, as we describe it, or that would be the midline at the armpit going to the anterior lateral portion of the chest, had been stripped away by the missile.

Mr. SPECTER. What is the texture of the rib at the point where the missile struck?

Dr. SHAW. The texture of the rib here is not of great density. The cortex of the rib in the lateral portions of our ribs, is thin with the so-called cancellus portion of the rib being very spongy, offering very little resistance to pressure or to fracturing.

Mr. SPECTER. What effect, if any, would the striking of that rib have had to the trajectory of the bullet?



Dr. SHAW. It could have had a slight, caused a slight deflection of the rib, but probably not a great deflection of the rib, because of the angle at which it struck and also because of the texture of the rib at this time.

Mr. SPECTER. You say deflection of the rib or deflection of the bullet?

Dr. SHAW. Deflection of the bullet, I am sorry.

Mr. SPECTER. Was any metallic substance from the bullet left in the thoracic cage as a result of the passage of the bullet through the Governor's body?

Dr. SHAW. No. We saw no evidence of any metallic material in the X-ray that we had of the chest, and we found none during the operation.

Mr. SPECTER. Have you brought the X-rays with you. Dr. Shaw, from Parkland Hospital?

Dr. SHAW. Yes; we have them here.

Mr. SPECTER. May the record show we have available a viewer for the X-rays.

Dr. Shaw, would you, by use of the viewer, exhibit the X-rays of the Governor's chest to show more graphically that which you have heretofore described?

Dr. SHAW. This is the first X-ray that was taken, which was taken in the operating room with the Governor on the operating table, and at this time anesthetized. The safety pin that you see here is used, was used, to secure the tube which had been put between the second and third rib in expanding the Governor's lung.

We can dimly see also the latex rubber tube up in the chest coming to the apex of the chest.

The variations that we see from normal here are the fact that first, there is a great amount of swelling in the chest wall which we know was due to bleeding and bruising of the tissues of the chest wall, and we also see that there is air in the tissues of the chest wall here and here. It is rather obvious.

Mr. SPECTER. When you say here and here, you are referring to the outer portions, showing on the X-ray moving up toward the shoulder area?

Dr. SHAW. Yes; going from the lower chest up to the region near the angle of the shoulder blade.

The boney framework of the chest, it is obvious that the fifth rib, we count ribs from above downward, this is the first rib, second rib, third rib, fourth rib, fifth rib, that a portion of this rib has been shattered, and we can see a few fragments that have been left behind.

Also the rib has because of being broken and losing some of its substance, has taken a rather inward position in relation to the fourth and the sixth ribs on either side.

Mr. SPECTER. What effect was there, if any, on the upper portion of that rib?

Dr. SHAW. This was not noticed at the time of this examination, Mr. SPECTER. However, in subsequent examinations we can tell that there was a fracture across the rib at this point due to the rib being struck and bent.

Mr. SPECTER. When you say this point, will you describe where that point exists on the X-ray?

Dr. SHAW. This is a point approximately 4 centimeters from its connection with the transverse process of the spine.

Mr. SPECTER. And is the fracture, which is located there, caused by a striking there or by the striking at the end of the rib?

Dr. SHAW. It is caused by the striking at the end of the rib.

Mr. SPECTER. Fine. What else then is discernible from the viewing of the X-ray, Dr. Shaw?

Dr. SHAW. There is a great amount of, we would say, obscuration of the lower part of the right lung field which we know from subsequent examination was due to blood in the pleural cavity and also due to a hematoma in the lower part of the right lower lobe and also a severe laceration of the middle lobe with it having lost its ability to ventilate at that time. So, we have both an airless lung, and blood in the lung to account for these shadows.

Mr. SPECTER. Is there anything else visible from the X-ray which is helpful in our understanding of the Governor's condition?

Dr. SHAW. No; I don't think so.

Mr. SPECTER. Would it be useful—As to that X-ray, Dr. Shaw, will you tell us what identifying data, if any, it has in the records of Parkland Hospital, for the record?

Dr. SHAW. On this X-ray it has in pencil John G. Connally.

Mr. SPECTER. Is that G or C?

Dr. SHAW. They have a "G" November 22, 1963, and it has a number 218-922.

Mr. SPECTER. Were those X-rays taken under your supervision?

Dr. SHAW. Yes, by a technician.

Mr. SPECTER. And that is, in fact, the X-ray then which was taken of Governor Connally at the time these procedures were being performed?

Dr. SHAW. It is.

Mr. SPECTER. Dr. Shaw, would any of the other X-rays be helpful in our understanding of the Governor's condition?

Dr. SHAW. I believe the only—perhaps showing one additional X-ray would show the fracture previously described which was not easily discernible on the first film. This is quite often true but not important to the—here is the fracture that can be easily seen.

Mr. SPECTER. You are now referring to a separate and second X-ray.

Dr. SHAW. Yes.

Mr. SPECTER. Will you start out by telling us on what date this X-ray was performed.

Dr. SHAW. This X-ray was made on the 29th of November 1963, 7 days following the incident.

Mr. SPECTER. What does it show of significance?

Dr. SHAW. It shows that there has been considerable clearing in the lower portion of the lung, and also that there is a fracture of the fifth rib as previously described approximately 4 centimeters from the transverse process posteriorly.

Mr. SPECTER. Is there anything else depicted by that X-ray of material assistance in evaluating the Governor's wound?

Dr. SHAW. No.

Mr. McCLOY. Were there any photographs taken as distinguished from X-rays of the body?

Dr. SHAW. There were no photographs.

Mr. SPECTER. Dr. Shaw, we shall then, subject to the approval of the Commission, for the record, have the X-rays reproduced at Parkland Memorial Hospital, and, if possible, also have a photograph of the X-ray made for the permanent records of the Commission to show the actual X-ray, which Dr. Shaw has described during his testimony here this afternoon.

Senator COOPER. It is directed that it be made a part of the record of these hearings.

Mr. SPECTER. Dr. Shaw, what additional operative procedures did you perform on Governor Connally's chest?

Dr. SHAW. I will continue with my description of the operative procedure. The opening that had been made through the rib after the removal of the fragments was adequate for further exploration of the pleural cavity. A self-retaining retractor was put into place to maintain exposure. Inside the pleural cavity there were approximately 200 cc. of clotted blood.

It was found that the middle lobe had been lacerated with the laceration dividing the lobe into roughly two equal parts. The laceration ran from the lower tip of the middle lobe up into its root or hilum.

However, the lobe was not otherwise damaged, so that it could be repaired using a running suture of triple zero chromic catgut.

The anterior basal segments of the right lower lobe had a large hematoma, and blood was oozing out of one small laceration that was a little less than a centimeter in length, where a rib fragment had undoubtedly been driven into the lobe. To control hemorrhage a single suture of triple zero chromic gut was placed in this laceration. There were several small matchstick size fragments of rib within the pleural cavity. Examination, however, of the pericardium of the diaphragm and the upper lobe revealed no injury to these parts of the chest.

A drain was placed in the eighth space in the posterior axillary line similar to the drain which had been placed in the second interspace in the front of the chest.

The drain in the front of the chest was thought to be a little too long so about 3 centimeters of it were cut away.

Attention was then turned on the laceration of the latissimus dorsi muscle where the missile had passed through it. Several sutures of chromic gut were used to repair this muscle.

The inclusion was then closed with interrupted No. zero chromic gut in the muscles of the chest wall—first, I am sorry, in the intercostal muscle, and muscles of the chest wall, and the same suture material was used to close the serratus anterior muscle in the subcutaneous tissue, and interrupted vertical sutures of black silk were used to close the skin.

Attention was then turned to the wound of entrance which, as previously described, was about a centimeter and a half in its greatest diameter, roughly elliptical in shape. The skin edges of this wound were incised—excised, I beg your pardon—I have to go back just a little bit.

Prior to examination of this wound, a stab wound was made at the angle of the scapula to place a drain in the subscapular space. In the examination of the wound of entrance, the examining finger could determine that this drain was immediately under the wound of entrance, so that it was adequately draining the space.

Two sutures were placed in the fascia of the muscle, and the skin was closed with interrupted vertical matching sutures of black silk.

That concluded the operation. Both tubes were connected to a water seal bottle, and the dressing was applied.

Mr. SPECTER. Who was in charge then of the subsequent care on the Governor's wrist?

Dr. SHAW. Dr. Charles Gregory who had been previously alerted and then came in to take care of the wrist.

Mr. SPECTER. Now, with respect to the wound on the wrist, did you have any opportunity to examine it by way of determining points of entry and exit?

Dr. SHAW. My examination of the wrist was a very cursory one. I could tell that there was a compound comminuted fracture because there was motion present, and there was a ragged wound just over the radius above the wrist joint. But that was the extent of my examination of the wrist.

Mr. SPECTER. Dr. Shaw, did I take your deposition at Parkland Memorial Hospital on March 23 of 1964?

Dr. SHAW. Yes; you did.

Mr. SPECTER. Has that deposition been made available to you?

Dr. SHAW. Yes.

Mr. SPECTER. To you here this afternoon?

Dr. SHAW. Yes.

Mr. SPECTER. Have you subsequent to the giving of that deposition on March 23, 1964, had an opportunity to examine Governor Connally's clothing which we have available in the Commission room here today?

Dr. SHAW. Yes.

Mr. SPECTER. Now, based on all facts now within your knowledge, is there any modification which you would care to make in terms of the views which you expressed about entrance and exit wounds, back on March 23, based on the information which was available to you at that time?

Dr. SHAW. From an examination of the clothing, it is very obvious that the wound of entrance was through the coat sleeve.

Mr. SPECTER. While you are testifying in that manner, perhaps it would be helpful if we would make available to you the actual jacket, if it pleases the Commission.

We shall reserve Exhibits Nos. 681 for the X-ray of November 22; 682 for the X-ray of November 29; and we shall now mark a photograph of the coat for our permanent records as "Commission Exhibit No. 683".

Dr. Shaw, I hand you at this time what purports to be the coat worn by Governor Connally, which we introduce subject to later proof when Governor Connally appears later this afternoon; and, for the record, I ask you first of all if this photograph, designated as Commission Exhibit No. 683, is a picture of this suit coat?

Dr. SHAW. It is.

Mr. SPECTER. I had interrupted you when you started to refer to the hole in the sleeve of the coat. Will you proceed with what you were testifying about there?

Dr. SHAW. The hole in the sleeve of the coat is within half a centimeter of the very edge of the sleeve, and lies—

Mr. DULLES. This is the right sleeve, is it not?

Dr. SHAW. I am sorry, yes. Thank you. Of the right sleeve, and places it, if the coat sleeve was in the same position, assuming it is in the same position that my coat sleeve is in, places it directly over the lateral portion of the wrist, really not directly on the volar or the dorsum of the surface of the wrist, but on the lateral position or the upper position, as the wrist is held in a neutral position.

Mr. SPECTER. With the additional information provided by the coat, would that enable you to give an opinion as to which was the wound of entrance and which the wound of exit on the Governor's wrist?

Dr. SHAW. There is only tear in the Governor's garment, as far as the appearance of the tear is concerned, I don't think I could render an opinion as to whether this is a wound of entrance or exit.

Mr. SPECTER. Then, do you have sufficient information at your disposal in total, based on your observations and what you know now to give any meaningful opinion as to which was the wound of entrance and which the wound of exit on the Governor's wrist?

Dr. SHAW. I would prefer to have Dr. Gregory testify about that, because he has examined it more carefully than I have.

Mr. SPECTER. Fine.

Mr. DULLES. Could you tell at all how the arm was held from that mark or that hole in the sleeve?

Dr. SHAW. Mr. Dulles, I thought I knew just how the Governor was wounded until I saw the pictures today, and it becomes a little bit harder to explain.

I felt that the wound had been caused by the same bullet than came out through the chest with the Governor's arm held in approximately this position.

Mr. SPECTER. Indicating the right hand held close to the body?

Dr. SHAW. Yes, and this is still a possibility. But I don't feel that it is the only possibility.

Senator COOPER. Why do you say you don't think it is the only possibility? What causes you now to say that it is the location—

Dr. SHAW. This is again the testimony that I believe Dr. Gregory will be giving, too. It is a matter of whether the wrist wound could be caused by the same bullet, and we felt that it could but we had not seen the bullets until today, and we still do not know which bullet actually inflicted the wound on Governor Connally.

Mr. DULLES. Or whether it was one or two wounds?

Dr. SHAW. Yes.

Mr. DULLES. Or two bullets?

Dr. SHAW. Yes; or three.

Mr. DULLES. Why do you say three?

Dr. SHAW. He has three separate wounds. He has a wound in the chest, a wound of the wrist, a wound of the thigh.

Mr. DULLES. Oh, yes; we haven't come to the wound of the thigh, yet, have we?

Mr. McCLOY. You have no firm opinion that all these three wounds were caused by one bullet?

Dr. SHAW. I have no firm opinion.

Mr. McCLOY. That is right.

Dr. SHAW. Asking me this now if it was true. If you had asked me a month ago I would have.

Mr. DULLES. Could they have been caused by one bullet, in your opinion?

Dr. SHAW. They could.

Mr. McCLOY. I gather that what the witness is saying is that it is possible that they might have been caused by one bullet. But that he has no firm opinion now that they were.

Mr. DULLES. As I understand it too. Is our understanding correct?

Dr. SHAW. That is correct.

Senator COOPER. When you say all three are your referring to the wounds you have just described to the chest, the wound in the wrist, and also the wound in the thigh?

Dr. SHAW. Yes.

Senator COOPER. It was possible?

Dr. SHAW. Our original assumption, Senator Cooper, was that the Governor was approximately in this attitude at the time he was—

Senator COOPER. What attitude is that now?

Dr. SHAW. This is an attitude sitting in a jump seat as we know he was, upright, with his right forearm held across the lower portion of the chest. In this position, the trajectory of the bullet could have caused the wound of entrance, the wound of exit, struck his wrist and proceeded on into the left thigh. But although this is a possibility, I can't give a firm opinion that this is the actual way in which it occurred.

Mr. SPECTER. If it pleases the Commission, we propose to go through that in this testimony; and we have already started to mark other exhibits in sequence on the clothing. So that it will be more systematic, we plan to proceed with the identification of clothing and then go on to the composite diagram which explains the first hypothesis of Dr. Shaw and the other doctors of Parkland. And then proceed from that, as I intend to do with an examination of the bullet, which will explore the thinking of the doctor on that subject.

Dr. Shaw, for our record, I will hand you Commission Exhibit No. 684 and ask you if that is a picture of the reverse side of the coat, which we will later prove to have been worn by Governor Connally, the coat which is before you?

Dr. SHAW. It is.

Mr. SPECTER. What, if anything, appears on the back of that coat and also on the picture in line with the wound which you have described on the Governor's posterior chest?

Dr. SHAW. The picture—the coat and the picture of the coat, show a rent in the back of the coat approximately 2 centimeters medial to the point where the sleeve has been joined to the main portion of the garment.

The lighter-colored material of the lining of the coat can be seen through this rent of the coat.

Mr. SPECTER. Dr. Shaw, I show you a shirt, subject to later proof that it was the shirt worn by Governor Connally, together with a photograph marked "Commission Exhibit No. 685," and ask you if that is a picture of that shirt, the back side of the shirt?

Dr. SHAW. Yes; it is a picture of the back side of the shirt. However, in this particular picture I am not able to make out the hole in the shirt very well.

Now I see it, I believe; yes.

Mr. SPECTER. Will you describe the hole as you see it to exist in the shirt? Aside from what you see on the picture, what hole do you observe on the back of the shirt itself?

Dr. SHAW. On the back of the shirt itself there is a hole, a punched out area of the shirt which is a little more than a centimeter in its greater diameter. The whole shirt is soiled by brown stains which could have been due to blood.

Mr. SPECTER. How does the hole in the back of the shirt correspond with the wound on the Governor's back?

Dr. SHAW. It does correspond exactly.

Mr. SPECTER. Now turning the same shirt over to the front side, I ask you if the photograph, marked "Commission Exhibit No. 386," is a picture of the front side of this shirt?

Dr. SHAW. It is.

Mr. SPECTER. What does the picture of the shirt show with respect to a hole, if any, on the right side of the front of the shirt?

Dr. SHAW. The picture and the shirt show on the right side a much larger rent in the garment with the rent being approximately 4 centimeters in its largest diameter.

Mr. SPECTER. What wound, if any, did the Governor sustain on his thigh, Dr. Shaw?

Mr. DULLES. Just one moment, are you leaving this?

Mr. SPECTER. Yes.

Mr. DULLES. I wonder whether or not it would not be desirable for the doctor to put this photograph where these holes are, because they are not at all clear for the future if we want to study those photographs.

Dr. SHAW. This one is not so hard.

Mr. DULLES. That one appears but the other one doesn't appear and I think it would be very helpful.

Dr. SHAW. How would you like to have me outline this?

Mr. SPECTER. Draw a red circle of what you conceive to be the hole there, Doctor.

Mr. DULLES. The actual hole is not nearly as big as your circle, it is the darkened area inside that circle, is it not?

Dr. SHAW. Yes; the darkened area is enclosed by the circle.

Mr. SPECTER. Are you able to note on the photograph of the back of the shirt, 685?

Will you draw a red circle around the area of the hole on the photograph then, Dr. Shaw?

Mr. DULLES. Would you just initial those two circles, if you can.

Mr. SPECTER. Dr. Shaw, what wounds, if any, did the Governor sustain on his left thigh?

Dr. SHAW. He sustained a small puncture-type wound on the medial aspect of the left thigh.

Mr. SPECTER. Did you have an opportunity to examine that closely?

Dr. SHAW. No.

Mr. SPECTER. Did you have an opportunity to examine it sufficiently to ascertain its location on the left thigh?

Dr. SHAW. No; I didn't examine it that closely, except for its general location.

Mr. SPECTER. Where was it with respect to a general location then on the Governor's thigh?

Dr. SHAW. It is on the medial anterior aspect of thigh.

Mr. DULLES. Nontechnically, what does it mean?

Dr. SHAW. Well, above, slightly above, between, in other words, the medial aspect would be the aspect toward the middle of the body, but as far as being how many centimeters or inches it is from the knee and the groin, I am not absolutely sure.

Mr. SPECTER. I now show you a pair of trousers which we shall later identify as being those worn by the Governor. I will, first of all, ask you if a photograph bearing Commission Exhibit No. 687 is a picture of those trousers?

Dr. SHAW. It is.

Mr. SPECTER. And what hole, if any did you observe on the trousers and on the picture of the trousers?

Dr. SHAW. There is a hole in the garment that has been made by some instrument which has carried away a part of the Governor's garment. In other words, it is not a tear but is a punched out hole, and this is approximately 4 centimeters on the inner aspect from the crease of the trousers.

Mr. DULLES. Can you tell where the knee is there and how far above the knee approximately?

Dr. SHAW. I can't tell exactly.

Mr. DULLES. I guess you can't tell.

Dr. SHAW. From the crotch I would say it would be slightly, it is a little hard to tell, slightly more toward the knee than the groin.

Mr. SPECTER. Does that hole in the left leg of the trousers match up to the wound on the left thigh of the Governor?

Dr. SHAW. To the best of my recollection it does.

Mr. DULLES. Are there any other perforations in these trousers at all, any other holes?

Dr. SHAW. No.

Mr. DULLES. So that means that whatever made the hole on the front side did not come through and make a hole anywhere else in the trousers?

Dr. SHAW. That is correct. It had to be a penetrating wound and not a perforating wound, it didn't go on through.

Mr. SPECTER. Will you turn those trousers over, Dr. Shaw?

Dr. SHAW. I believe we had already looked at it.

Mr. SPECTER. On the reverse side, and state whether or not this picture bearing Commission Exhibit No. 688 accurately depicts the reverse side of the trousers?

Dr. SHAW. Yes; it does.

Mr. SPECTER. Is there any hole shown either on the picture or on the trousers themselves?

Dr. SHAW. No.

Mr. SPECTER. Dr. Shaw, I now show you a body diagram which is marked "Commission Exhibit No. 689."

Senator COOPER. May I ask a question before you ask that question?

When you first saw Governor Connally in the emergency room was he dressed or undressed?

Dr. SHAW. His trousers were still on. He had his shorts on, I should say, Senator Cooper, but his coat, shirt, and trousers had been removed.

Mr. SPECTER. Were his clothes anywhere in the vicinity where you could have seen them?

Dr. SHAW. No; I never saw them. This is the first time that I saw them.

Mr. SPECTER. That is earlier today when you examined them in this room?

Dr. SHAW. That is correct.

Mr. SPECTER. Looking at Commission Exhibit No. 689, is that a drawing which was prepared, after consultation with you, representing the earlier theory of all of the Governor's wounds having been inflicted by a single missile?

Dr. SHAW. That is correct.

Mr. SPECTER. With reference to that diagram, would you explain the position that you had earlier thought the Governor to have been in when he was wounded here?

Dr. SHAW. We felt that the Governor was in an upright sitting position, and at the time of wounding was turning slightly to the right. This would bring the three wounds, as we know them, the wound in the chest, the wound in the wrist, and the wound in the thigh into a line assuming that the right forearm was held against the lower right chest in front.

The line of inclination of this particular diagram is a little more sharply downward than is probably correct in view of the inclination of the ribs of the chest.

Mr. SPECTER. Will you redraw that line, Dr. Shaw, to conform with what you believe to be—

Dr. SHAW. The fact that the muscle bundles on either side of the fifth rib were not damaged meant that the missile to strip away 10 centimeters of the rib had to follow this rib pretty much along its line of inclination.

Mr. DULLES. I wonder if you could use that red pencil to make it a little clearer for us?

Dr. SHAW. I think these would probably work well on this paper. Perhaps this isn't a tremendous point but it slopes just a little too much.

Mr. SPECTER. You have initiated that to show your incline?

Dr. SHAW. Yes.

Mr. SPECTER. With respect to the wound you described on the thigh, Dr. Shaw, was there any point of exit as to that wound?

Dr. SHAW. No.

Mr. SPECTER. I now show you—

Mr. DULLES. Could I ask one more question there, how deep was the wound of entry, could you tell at all?

Dr. SHAW. Mr. Dulles, I didn't examine the wound of the thigh so I can't testify as to that. Dr. Gregory, I think, was there at the time that the debris was carried out and he may have more knowledge than I have.

Mr. DULLES. We will hear Dr. Gregory later?

Mr. SPECTER. Yes; he is scheduled to testify as soon as Dr. Shaw concludes.

Dr. Shaw, I now show you Commission Exhibit 399 which has heretofore been identified as being a virtually whole bullet weighing 158 grains.

May I say for the record, that in the depositions which have been taken in Parkland Hospital, that we have ascertained, and those depositions are part of the overall record, that is the bullet which came from the stretcher of Governor Connally.

First, Dr. Shaw, have you had a chance to examine that bullet earlier today?

Dr. SHAW. Yes; I examined it this morning.

Mr. SPECTER. Is it possible that the bullet which went through the Governor's chest could have emerged being as fully intact as that bullet is?

Dr. SHAW. Yes; I believe it is possible because of the fact that the bullet struck the fifth rib at a very acute angle and struck a portion of the rib which would not offer a great amount of resistance.

Mr. SPECTER. Does that bullet appear to you to have any of its metal flaked off?

Dr. SHAW. I have been told that the one point on the nose of this bullet that is deformed was cut off for purposes of examination. With that information, I would have to say that this bullet has lost literally none of its substance.

Mr. SPECTER. Now, as to the wound on the thigh, could that bullet have gone into the Governor's thigh without causing any more damage than appears on the face of that bullet?

Dr. SHAW. If it was a spent bullet; yes. As far as the bullet is concerned it could have caused the Governor's thigh wound as a spent missile.

Mr. SPECTER. Why do you say it is a spent missile, would you elaborate on what your thinking is on that issue?

Dr. SHAW. Only from what I have been told by Dr. Shires and Dr. Gregory, that the depth of the wound was only into the subcutaneous tissue, not actually into the muscle of the leg, so it meant that missile had penetrated for a very short period. Am I quoting you correctly, Dr. Gregory?

Mr. SPECTER. May the record show Dr. Gregory is present during this testimony and—

Dr. GREGORY. I will say yes.

Mr. SPECTER. And indicates in the affirmative. Do you have sufficient knowledge of the wound of the wrist to render an opinion as to whether that bullet could have gone through Governor Connally's wrist and emerged being as much intact as it is?

Dr. SHAW. I do not.

Mr. SPECTER. Dr. Shaw, assume if you will certain facts to be true in hypothetical form, that is, that the President was struck in the upper portion of the back or lower portion of the neck with a 6.5-mm. missile passing between the strap muscles of the President's neck, proceeding through a facia channel striking no bones, not violating the pleural cavity, and emerging through the anterior third of the neck, with the missile having been fired from a weapon having a muzzle velocity of approximately 2,000 feet per second, with the muzzle being approximately 160 to 250 feet from the President's body; that the missile was a copper jacketed bullet. Would it be possible for that bullet to have then proceeded approximately 4 or 5 feet and then would it be possible for it to have struck Governor Connally in the back and have inflicted the wound which you have described on the posterior aspect of his chest, and also on the anterior aspect of his chest?

Dr. SHAW. Yes.

Mr. SPECTER. And what would your reason be for giving an affirmative answer to that question, Dr. Shaw?

Dr. SHAW. Because I would feel that a missile with this velocity and weight striking no more than the soft tissues of the neck would have adequate velocity and mass to inflict the wound that we found on the Governor's chest.

Mr. SPECTER. Now, without respect to whether or not the bullet identified as Commission Exhibit 399 is or is not the one which inflicted the wound on the Governor, is it possible that a missile similar to the one which I have just described in the hypothetical question could have inflicted all of the Governor's wounds in accordance with the theory which you have outlined on Commission Exhibit No. 689?

Dr. SHAW. Assuming that it also had passed through the President's neck you mean?

Mr. SPECTER. No; I had not added that factor in. I will in the next question.

Dr. SHAW. All right. As far as the wounds of the chest are concerned, I feel that this bullet could have inflicted those wounds. But the examination of the wrist both by X-ray and at the time of surgery showed some fragments of metal that make it difficult to believe that the same missile could have caused these two wounds. There seems to be more than three grains of metal missing as far as the—I mean in the wrist.

Mr. SPECTER. Your answer there, though, depends upon the assumption that the bullet which we have identified as Exhibit 399 is the bullet which did the damage to the Governor. Aside from whether or not that is the bullet which inflicted the Governor's wounds.

Dr. SHAW. I see.

Mr. SPECTER. Could a bullet traveling in the path which I have described in the prior hypothetical question, have inflicted all of the wounds on the Governor?

Dr. SHAW. Yes.

Mr. SPECTER. And so far as the velocity and the dimension of the bullet are concerned, is it possible that the same bullet could have gone through the President in the way that I have described and proceed through the Governor causing all of his wounds without regard to whether or not it was bullet 399?

Dr. SHAW. Yes.

Mr. SPECTER. When you started to comment about it not being possible, was that in reference to the existing mass and shape of bullet 399?

Dr. SHAW. I thought you were referring directly to the bullet shown as Exhibit 399.

Mr. SPECTER. What is your opinion as to whether bullet 399 could have inflicted all of the wounds on the Governor, then, without respect at this point to the wound of the President's neck?

Dr. SHAW. I feel that there would be some difficulty in explaining all of the wounds as being inflicted by bullet Exhibit 399 without causing more in the way of loss of substance to the bullet or deformation of the bullet.

(Discussion off the record.)

Mr. SPECTER. Dr. Shaw, have you had an opportunity today here in the Commission building to view the movies which we referred to as the Zapruder movies and the slides taken from these movies?

Dr. SHAW. Yes.

Mr. SPECTER. And what, if any, light did those movies shed on your evaluation and opinions on this matter with respect to the wounds of the Governor?

Dr. SHAW. Well, my main interest was to try to place the time that the Governor was struck by the bullet which inflicted the wound on his chest in reference to the sequence of the three shots, as has been described to us.

(At this point the Chief Justice entered the hearing room.)

This meant trying to carefully examine the position of the Governor's body in the car so that it would fall in line with what we knew the trajectory must be for this bullet coming from the point where it has been indicated it did come from. And in trying to place this actual frame that these frames are numbered when the Governor was hit, my opinion was that it was frame number, let's see, I think it was No. 36.

Mr. SPECTER. 236?

Dr. SHAW. 236, give or take 1 or 2 frames. It was right in 35, 36, 37, perhaps.

Mr. SPECTER. I have heretofore asked you questions about what possibly could have happened in terms of the various combinations of possibilities on missiles striking the Governor in relationship to striking the President as well. Do you have any opinion as to what, in fact, did happen?

Dr. SHAW. Yes. From the pictures, from the conversation with Governor Connally and Mrs. Connally, it seems that the first bullet hit the President in the shoulder and perforated the neck, but this was not the bullet that Governor Connally feels



hit him; and in the sequence of films I think it is hard to say that the first bullet hit both of these men almost simultaneously.

Mr. SPECTER. Is that view based on the information which Governor Connally provided to you?

Dr. SHAW. Largely.

Mr. SPECTER. As opposed to any objectively determinable facts from the bullets, the situs of the wounds of your viewing of the pictures?

Dr. SHAW. I was influenced a great deal by what Governor Connally knew about his movements in the car at this particular time.

Mr. DULLES. You have indicated a certain angle of declination on this chart here which the Chief Justice has.

Dr. SHAW. Yes.

Mr. SPECTER. Do you know enough about the angle of declination of the bullet that hit the President to judge at all whether these two angles of declination are consistent?

Dr. SHAW. We know that the angle of declination was a downward one from back to front so that I think this is consistent with the angle of declination of the wound that the Governor sustained.

Senator COOPER. Are you speaking of the angle of declination in the President's body?

Dr. SHAW. Of the first wound?

Mr. SPECTER. Yes.

Dr. SHAW. First wound

Mr. SPECTER. What you have actually seen from pictures to show the angle of declination?

Dr. SHAW. That is right.

Mr. SPECTER. In the wounds in the President's body?

Dr. SHAW. Yes; that is right. I did not examine the President.

Mr. DULLES. And that angle taking into account say the 4 feet difference between where the President was sitting and where the Governor was sitting, would be consistent with the point of entry of the Governor's body as you have shown it?

Dr. SHAW. The jump seat in the car, as we could see, placed the Governor sitting at a lower level than the President, and I think conceivably these two wounds could have been caused by the same bullet.

Mr. SPECTER. Do you have anything else to add, Dr. Shaw, which you think would be helpful to the Commission in any way?

Dr. SHAW. I don't believe so, Mr. Specter.

Mr. SPECTER. May it please the Commission then I would like to move into evidence Commission Exhibits Nos. 679 and 690, and then reserve Nos. 681 and 682 until we get the photographs of the X-rays and I now move for admission into evidence Commission Exhibits No. 683 through 689.

Senator COOPER. They have all been identified, have they?

Mr. SPECTER. Yes, sir; during the course of Dr. Shaw's testimony.

Senator COOPER. It is ordered then that these exhibits be received in the record. (The documents referred to, previously identified as Commission Exhibits Nos. 679, 680, and 683-689 for identification were received in evidence.)

Mr. McCLOY. Just one or two questions. It is perfectly clear, Doctor, that the wound, the lethal wound on the President did not—the bullet that caused the lethal wound on the President, did not cause any wounds on Governor Connally, in your opinion?

Dr. SHAW. Mr. McCloy, I couldn't say that from my knowledge.

Mr. McCLOY. We are talking about the, following up what Mr. Dulles said about the angle of declination, the wound that came through the President's collar, you said was consistent between the same bullet. I just wondered whether under all the circumstances that you know about the President's head wound on the top that would also be consistent with a wound in Governor Connally's body?

Dr. SHAW. On the chest, yes; I am not so sure about the wrist. I can't quite place where his wrist was at the time his chest was struck.

Mr. McCLOY. Now perhaps this is Dr. Gregory's testimony, that is the full description of the wrist wound, that would be his rather than your testimony?

Dr. SHAW. I think he could throw just as much light on it as I could. And more in certain aspects.

Mr. McCLOY. It did hit bone?

Dr. SHAW. Obviously.

Mr. McCLOY. And there must have been considerable diminution in the velocity of the bullet after penetrating through the wrist?

Dr. SHAW. Yes.

Mr. DULLES. The wound inflicted on it, the chest wound on Governor Connally, if you move that an inch or two, 1 inch or the other, could that have been lethal, go through an area that could easily have been lethal?

Dr. SHAW. Yes; of course, if it had been moved more medially it could have struck the heart and the great vessels.

Mr. McCLOY. Let me ask you this, Doctor, in your experience with gunshot wounds, is it possible for a man to be hit sometime before he realizes it?

Dr. SHAW. Yes. There can be a delay in the sensory reaction.

Mr. McCLOY. Yes; so that a man can think as of a given instant he was not hit, and when actually he could have been hit.

Dr. SHAW. There can be an extending sensation and then just a gradual building up of a feeling of severe injury.

Mr. McCLOY. But there could be a delay in any appreciable reaction between the time of the impact of the bullet and the occurrence?

Dr. SHAW. Yes; but in the case of a wound which strikes a bony substance such as a rib, usually the reaction is quite prompt.

Mr. McCLOY. Yes.

Dr. SHAW. Yes.

Mr. McCLOY. Now, you have indicated, I think, that this bullet traveled along, hit and traveled along the path of the rib, is that right?

Dr. SHAW. Yes.

Mr. McCLOY. Is it possible that it could have not, the actual bullet could not have hit the rib at all but it might have been the expanding flesh that would cause the wound or the proper confusion, I guess you would call it on the rib itself?

Dr. SHAW. I think we would have to postulate that the bullet hit the rib itself by the neat way in which it stripped the rib out without doing much damage to the muscles that lay on either side of it.

Mr. McCLOY. Was—up until you gave him the anesthetic—the Governor was fully conscious, was he?

Dr. SHAW. I would not say fully, but he was responsive. He would answer questions.

Mr. McCLOY. I think that is all I have.

The CHAIRMAN. I have no questions of the doctor.

Mr. DULLES. There were no questions put to him that were significant as far as our testimony is concerned?

Dr. SHAW. No; we really don't have to question him much. Our problem was pretty clearcut, and he told us it hurt and that was about his only response as far as—

Senator COOPER. Could I ask you a question, doctor?

I think you said from the time you came into the emergency room and the time you went to the operating room was about 5 minutes?

Dr. SHAW. Yes; it was just the time that it took to ask a few simple questions, what has been done so far, and has the operating room been alerted, and then I went out and talked to Mrs. Connally, just very briefly, I told her what the problem was in respect to the Governor and what we were going to have to do about it and she said to go ahead with anything that was necessary. So this couldn't have taken much more than 5 minutes or so.

Mr. DULLES. Did you say anything or did anyone say anything there about the circumstances of the shooting?

Dr. SHAW. Not at that time.

Mr. DULLES. Either of Governor Connally or the President?

Dr. SHAW. Not at that time. All of our conversation was later.

Mr. DULLES. Was the President in the same room?

Dr. SHAW. No.

Mr. DULLES. Did you see him?

Dr. SHAW. I only saw his shoes and his feet. He was in the room immediately opposite. As I came into the hallway, I would recognize that the President was on it, in the room to my right. I knew that my problem was concerned with Governor Connally, and I turned and went into the room where I saw that he was.

Mr. DULLES. Did you hear at that time or have any knowledge, of a bullet which had been found on the stretcher?

Dr. SHAW. No; this was later knowledge.

Mr. DULLES. When did you first hear that?

(At this point Senator Russell entered the hearing room.)

Dr. SHAW. This information was first given to me by a man from the Secret Service who interviewed me in the office several weeks later. It is the first time I knew about any bullet being recovered.

Senator COOPER. I think, of course, it is evident from your testimony you have had wide experience in chest wounds and bullet wounds in the chest.

What experience have you had in, say, the field of ballistics? Would this experience—you have been dealing in chest wounds caused by bullets—have provided you knowledge also about the characteristics of missiles, particularly bullets of this type?

Dr. SHAW. No; Senator. I believe that my information about ballistics is just that of an average layman, no more. Perhaps a little more since I have seen deformed bullets from wounds, but I haven't gone into that aspect of wounds.

Senator COOPER. In the answers to the hypothetical questions that were addressed to you, based upon the only actual knowledge which you could base that answer, was the fact that you had performed the operation on the wound caused in the chest, on the wound in the chest?

Dr. SHAW. That is true. I have seen many bullets that have passed through bodies or have penetrated bodies and have struck bone and I know manners from which they are deformed but I know very little about the caliber of bullets, the velocity of bullets, many things that other people have much more knowledge of than I have.

Senator COOPER. That is all.

The CHAIRMAN. Thank you very much, Dr. Shaw.

## JFK EXHIBIT F-71

## N ASSASSINATIONS

NAME Dr. Robert Shaw Date 11.9.77 Time 1:00  
 Address 7403 Villanova Dallas County Institute of  
 Place Forensic Sciences, Dallas,

Dallas, Texas 75225 214 691 6136 -- 214 752 3752  
 Date of Birth: 11/15/05  
 Interview:

Dr. Shaw arrived at the trauma room in which Governor Connally was being treated five minutes past his arrival. The residents (Drs. Boland, Duke, Giesecke) had done an excellent job.

The Governor's front chest had 5 cm. (obvious) wound of exit - paradoxical motions of chest were evident. There was a smaller tunneling wound in the back/chest. The bullet struck the 5th rib in a tangential way pushing it out, causing a fracture at a point farther up the rib (like a tree limb breaking from pressure exerted near its end). Bullet and rib fragments exited out the front of the Governor causing the larger exit hole.

Shaw said the lower 2/3ds of the Governor's lower lung lobe was like liver, full of blood and holes caused by secondary (bone) missile fragments. There was a rent in the latis-sinus dorci.

The rear entrance wound was not 3 cm as indicated in one of the operative notes. It was a puncture-type wound, as if

(continued)

Interviewer \_\_\_\_\_  
 (Signature)  
Andy Purdy  
 (Typed)

Date Transcribed 11/17/77 by IJ  
 (If

a bullet had struck the body at a slight declination (i.e. not at a right angle). The wound was actually approximately 1½ cm. The ragged edges of the wound were surgically cut away, effectively enlarging it to approximately 3 cm.

Wrist: The wrist wound had been described as a "comminuted" fracture, meaning (according to Dr. Shaw) it was "compounded" (I.E. in more than two pieces). The work on the wrist was primarily done by Dr. Gregory (deceased).

Dr. Shires did the work on the thigh wound.

In response to Dr. Petty's questions, Dr. Shaw provided the following:

- 1) The bullet entering the back did not strike dead on, hitting instead on a decline.
- 2) The entrance wound was olvode (see Dr. Shaw's drawing attached).
- 3) The shape of the entrance wound was consistent with a missile striking in a slightly downward trajectory. It is Dr. Shaw's opinion that the wound was not caused by a tumbling bullet (an inference drawn, explicitly, from his belief that a tumbling bullet would not have had sufficient force to cause the remainder of the Governor's wounds).
- 4) Dr. Shaw believes that the bullet which hit the Governor had not struck any other objects because of his conclusion that the bullet was not tumbling.

He does note that the entrance wound was longer along the vertical axis.

- 5) The bullet did not traverse the thorax; it was essentially "...a chest wall wound ...," with much of the damage to the Governor being caused by a "blast-like" effect which resulted from the bullet tangentially striking the fifth rib, turning pieces of it into secondary missiles.
- 6) He described the chest wound as a "slap wound" exerting an inward force on the body from the secondary fragments.
- 7) The blood found in the lung's lower lobe was from a tear in the middle lobe and contusion from the slapping effect of the bullet, as well as from the penetration of multiple rib fragments ("...it was very much like a blast injury ...").
- 8) The bullet did not traverse the lung; there was essentially a chest wall injury which involved the lung because of a blast injury effect ("...there was a bronchial tear in the middle lobe in addition to the rent...").

Dr. Shaw examined the original Connally X-rays and the enhanced copies. He could not detect any metal fragments in the chest or in the femur (thigh bone). The only metal fragment he denoted was a small one in the subcutaneous tissue in

in the thigh. He did notice the rib fracture in the chest X-ray, as well as rib pieces.

Dr. Shaw indicated that the enhanced X-ray of the fragment in the thigh convinced him that the object was metal because it has greater density than bone and the existence of a hook-like end of the object is more consistent with metallic than with bone characteristics.

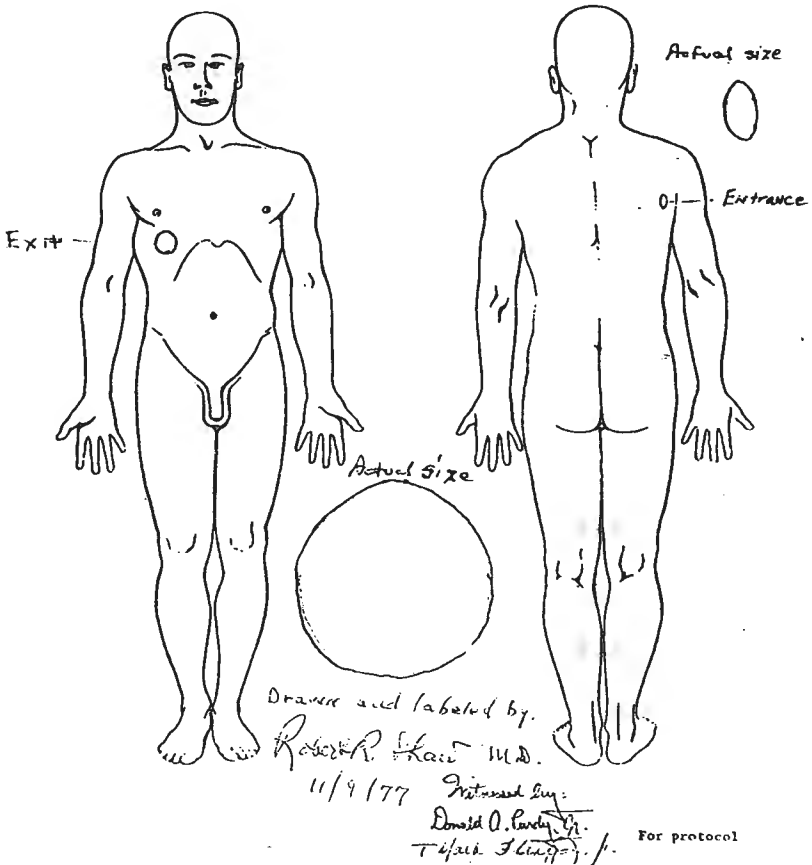
Regarding press accounts that he felt the metal fragment was too heavy to have come from C.E.399, Dr. Shaw said he is not qualified to speculate as to the actual size or weight of the fragment in the thigh or those in the wrist (even though he admittedly did so before the Warren Commission 4 H 113). He did say he has never been satisfied that the bullet found on Governor Connally's stretcher had caused all of the Governor's wounds.

Shaw believes the "...bullet found on the limousine floor was more likely the one which went through Connally." He believes the bullet that went through the President's neck may have gotten caught in the Governor's clothing and another bullet struck the Governor causing his wounds.

Regarding the wrist wound. Shaw said he first thought the bullet entered through the volar aspect and exited the dorsum: he was later convinced by Dr. Gregory (and currently believes) that the exact opposite was the case.

THE SOUTHWESTERN INSTITUTE OF FORENSIC SCIENCES  
AT DALLAS

Name \_\_\_\_\_ Autopsy No. \_\_\_\_\_  
Color \_\_\_\_\_ Age \_\_\_\_\_ Date \_\_\_\_\_



Mr. KLEIN. Doctor, do you recognize those reports?

Dr. BADEN. Yes, these are reports from the testimony of Dr. Shaw, a thoracic surgeon, a chest doctor, who operated on Governor Connally at Parkland Hospital, made before the Warren Commission, and subsequent reports of interviews by the staff members and Dr. Petty of the medical panel who interviewed Dr. Shaw recently.

Mr. KLEIN. Doctor, what did the panel learn from those reports with respect to the entrance and exit wounds of the back of the Governor?

Dr. BADEN. There was an entrance perforation, according to the interpretation of the doctors who operated on Governor Connally, in the upper right back region just next to the top of the armpit area, and the bullet pathway proceeded from back to front, downward, causing extensive fractures of the fifth rib of the Governor



and exited in a large irregular jagged typical exit perforation 1 inch below the right nipple.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the clothing, shirt, and jacket, marked JFK F-74 and F-75 be received as committee exhibits and shown to the witness.

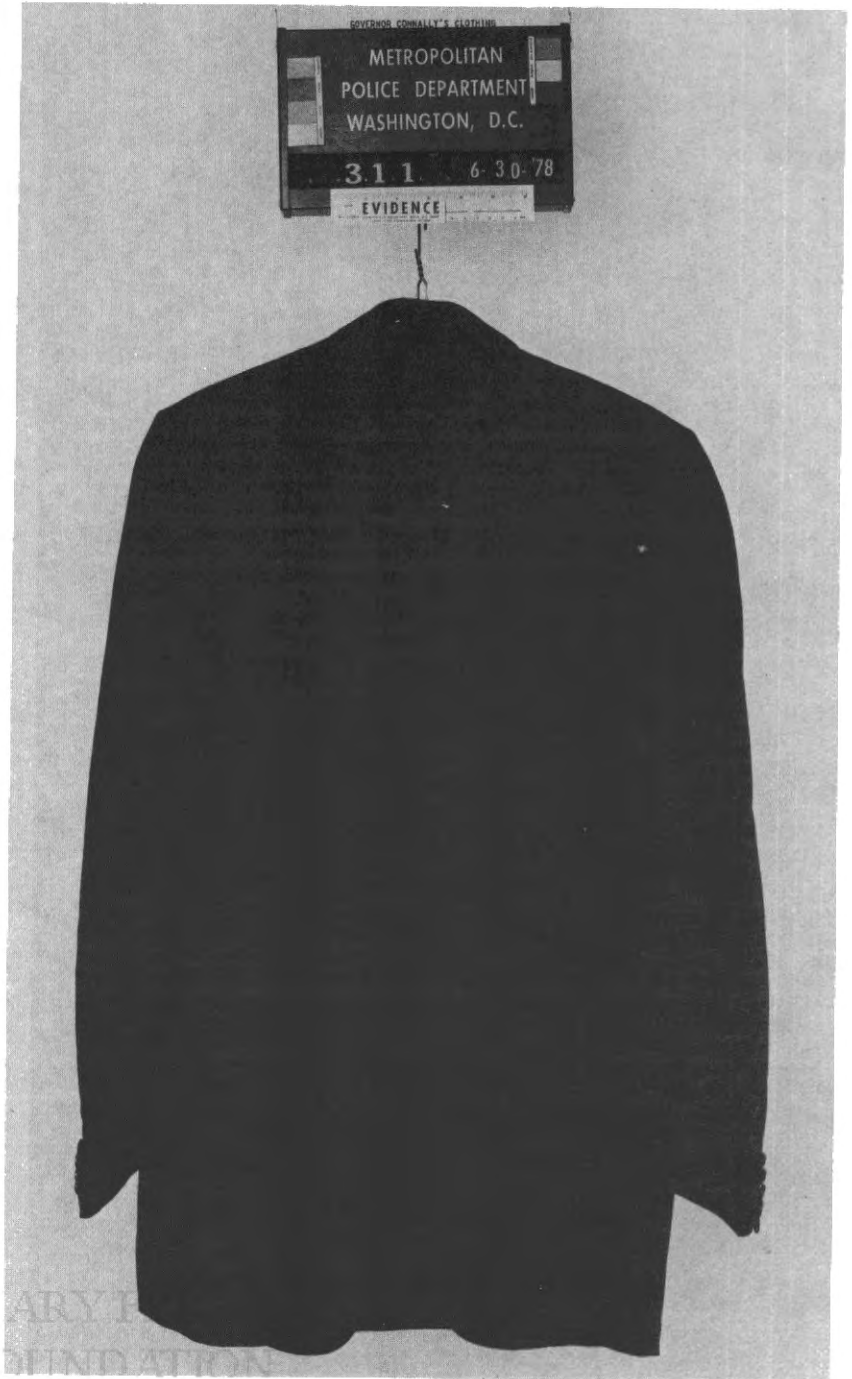
Chairman STOKES. Without objection, it may be received and shown to the witness.

[The above referred to JFK exhibits F-74 and F-75 were received as committee exhibits and photographs made for the record.]

JFK EXHIBIT F-74









Dr. BADEN. This is the clothing of Governor Connally that the medical panel members have had opportunity to examine, that the Governor wore at the time of the shooting.

Mr. KLEIN. With respect to the wound of the Governor's back, would you tell the committee what the panel learned from that clothing?

Dr. BADEN. Yes. There is a tear in the fabric of the cloth in the right upper back region which corresponds precisely to the area where the bullet struck the skin of the Governor and which is larger than would be caused by a bullet perforation that strikes cloth or skin head-on at a right angle.

So the clothing does give us an ability to interpret the position of the bullet wound of entrance and also gives us some information as to the manner in which the bullet struck.

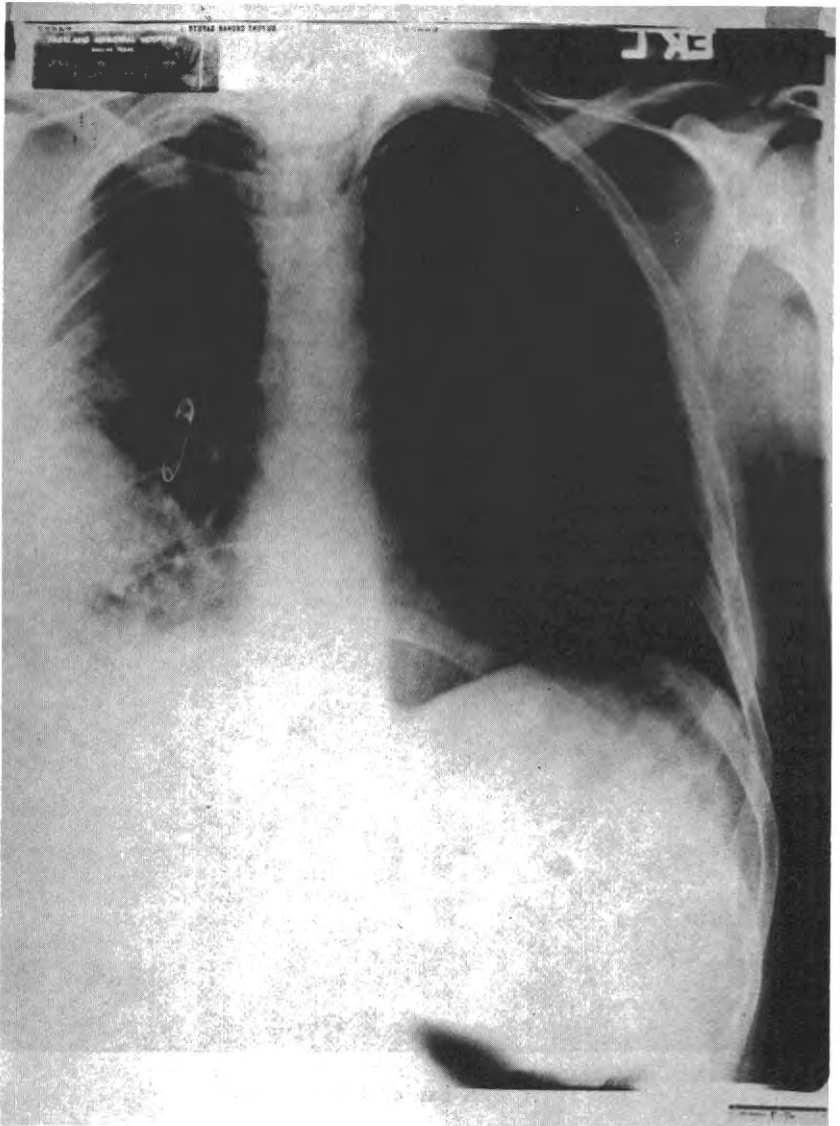
Mr. KLEIN. And what did the panel learn from that clothing with respect to the exit wound?

Dr. BADEN. The exit wound on the clothing—and again the corresponding tears in the fabric of the clothing. The shirt, which is present also, does show a perforation of the fabric corresponding to the exit wound beneath the right nipple of the skin of Governor Connally, and this corresponds to the tear in the right mid-portion of the jacket.

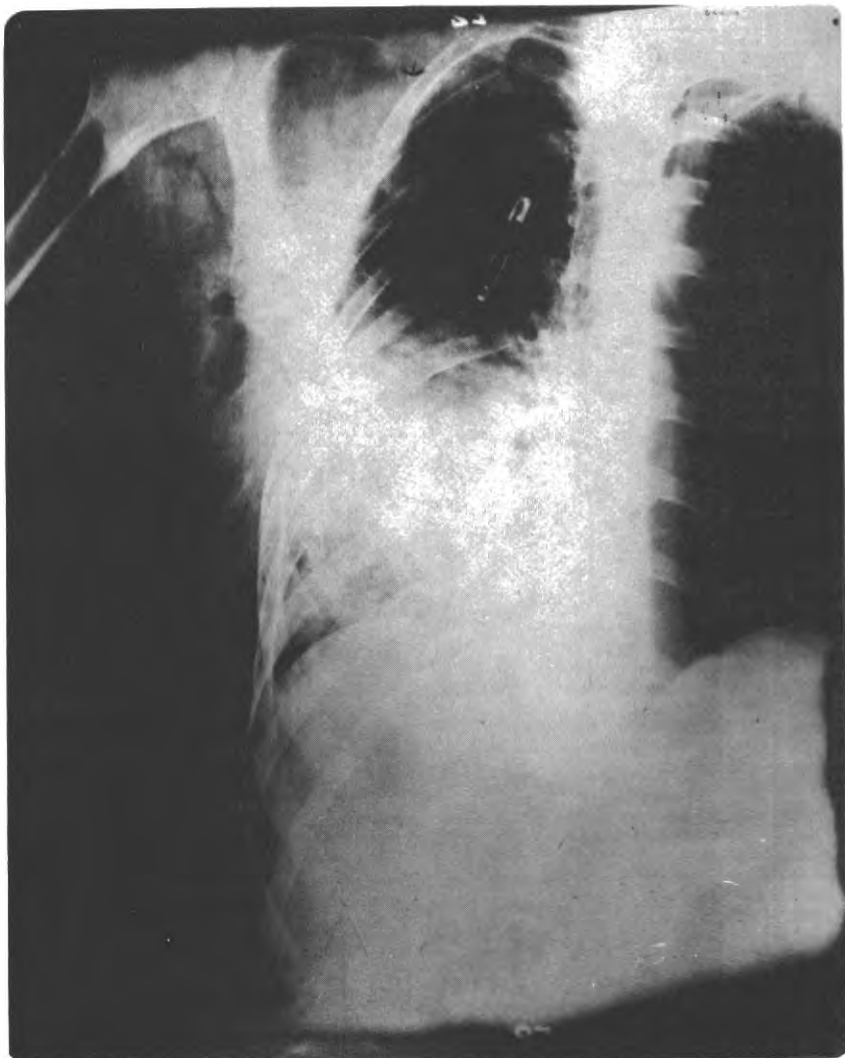
Mr. KLEIN. Mr. Chairman, at this time, I would ask that blowups marked JFK F-76 and F-77 be received as committee exhibits and shown to the witness.

Chairman STOKES. Without objection, they may be received and shown to the witness.

[The above referred to JFK exhibits F-76 and F-77 follow:]



JFK Exhibit F-76



JFK EXHIBIT F-77

Mr. KLEIN. Doctor, do you recognize these blowups?

Dr. BADEN. Yes; I do. They are photographic enlargements of two of the X-rays taken of the chest of Governor Connally at Parkland Memorial Hospital.

Mr. KLEIN. Doctor, did the panel have an opportunity to examine these X-rays?

Dr. BADEN. Yes.

Mr. KLEIN. And from these X-rays did the panel determine whether there were injuries consistent with a bullet passing through the Governor?

Dr. BADEN. Yes. There were X-rays that the panel was able to review that show fractures of the fifth rib, as described by the



surgeons, and no missile, no bullet projectile, nor any evidence of metal present on the X-ray.

Mr. KLEIN. And was there any indication that the bullet was still in the Governor, or did the X-ray show the bullet had passed through?

Dr. BADEN. There was no evidence of any missile or bullet present on the X-rays taken of the Governor at the time of admission to Parkland Hospital.

Mr. KLEIN. Did the panel have an opportunity to examine the reports of Dr. Reynolds?

Dr. BADEN. Yes, sir.

Mr. KLEIN. And who is Dr. Reynolds?

Dr. BADEN. Dr. Reynolds was a radiologist, X-ray physician at Parkland Hospital, who made reports on various X-rays taken of Governor Connally during his stay and treatment at the hospital.

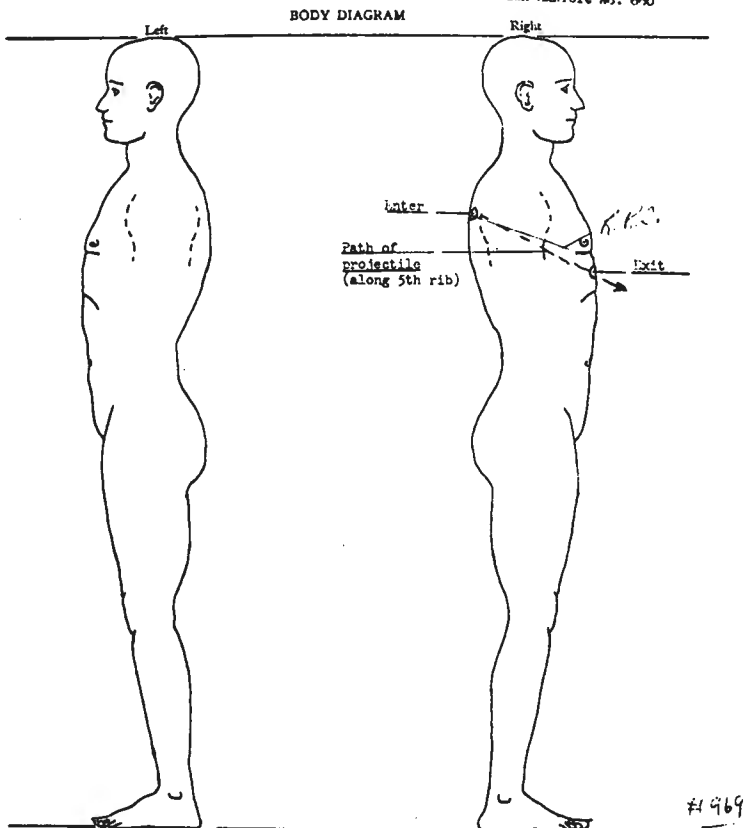
Mr. KLEIN. And were his reports consistent with what you have told us with regard to the bullet which entered the Governor's back?

Dr. BADEN. Yes. He does describe on the X-rays extensive injury to the rib of the Governor, and to the lung.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the diagram marked JFK F-81 be received as a committee exhibit and shown to the witness.

Chairman STOKES. Without objection, it may be received and shown to the witness.

[The above referred to JFK exhibit F-81 follows:]



JFK EXHIBIT F-81

Mr. KLEIN. Doctor, do you recognize that diagram?

Dr. BADEN. Yes, I do. This is an enlargement of a diagram prepared by the surgeons at Parkland Hospital for the Warren Commission, at which time this material was discussed.

Mr. KLEIN. What does that diagram show?

Dr. BADEN. The diagram is an outline of an individual in an erect posture, so-called anatomic position, showing a gunshot wound of entrance indicated in the right upper back, and an exit wound noted below the right nipple, with a straight pathway drawn between.

There are also notations by Dr. Shires, who I believe the initials are of Dr. Shires, who placed the track slightly higher to correspond to the exit being 1 inch beneath the nipple. This track is meant to correspond to the fifth rib, which is the only rib that was injured by the bullet path.

Mr. KLEIN. Did the panel agree with the locations of the entry and exit wounds as well as the path of the bullet as depicted by that diagram?

Dr. BADEN. Yes, sir; in general the panel did agree that there was an entrance wound of the upper back exiting below the nipple and a downward track between.

Mr. KLEIN. Doctor, with respect to the wound of the Governor's wrist, did the panel have an opportunity to read the reports of Dr. Gregory and to read his Warren Commission testimony?

Dr. BADEN. Yes, sir.

Mr. KLEIN. And why wasn't the panel able to speak with Dr. Gregory?

Dr. BADEN. Dr. Gregory is deceased. Panel members did talk, and the staff members did talk, with Dr. Shaw who operated on the chest, and with other doctors from Parkland Hospital, but did not have an opportunity to speak with Dr. Gregory.

Mr. KLEIN. In reading the reports and medical records of Dr. Gregory, what did the panel learn with respect to the wound of the Governor's wrist?

Dr. BADEN. The panel learned that there was a gunshot perforation of the thumb side of the forearm about 1 inch above the wrist, which on examination was finally determined to be the point of entrance, and that the bullet did exit through the front of the wrist at the crease of the wrist.

Mr. KLEIN. Directing your attention to the clothing already received as an exhibit, what did the panel learn from the clothing with respect to the wound of the Governor's wrist?

Dr. BADEN. On the clothing, including the suit coat and the shirt, which has French cuffs and is longer than the coat sleeve, there is a perforation of the fabric of the cloth that corresponds with the thumb side of the lower portion of the forearm of the Governor. The tear in the fabric is wide and irregular and the panel concluded that this was made by a bullet reentering into the wrist.

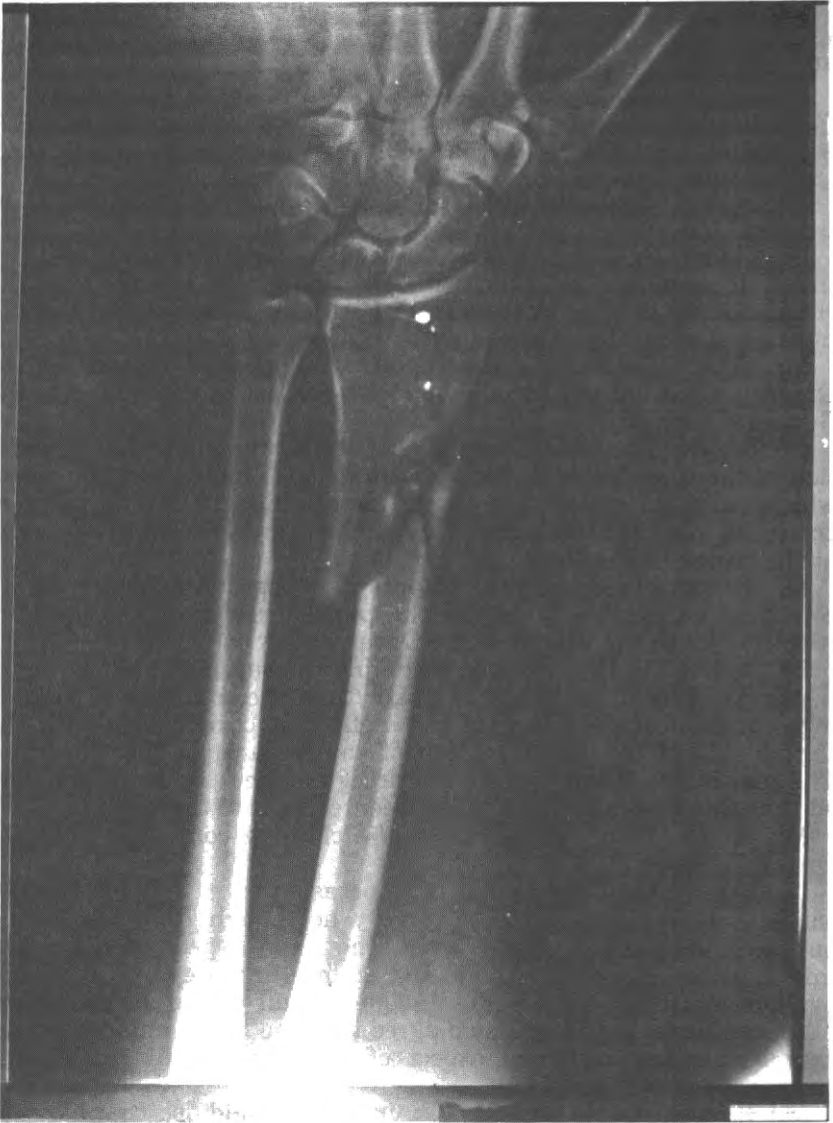
Mr. KLEIN. Were the marks on the clothing consistent with Dr. Gregory's reports?

Dr. BADEN. Dr. Gregory did have occasion to modify his reports. Initially during the course of surgery he thought that the wound on the undersurface of the wrist, the hand aspect of the wrist, might be an entrance wound, but in his final reports after full evaluation Dr. Gregory and subsequently all of the surgeons and all of the panel pathologists do agree that the bullet entered on the thumb side top or dorsal aspect of the forearm and exited the undersurface of the wrist.

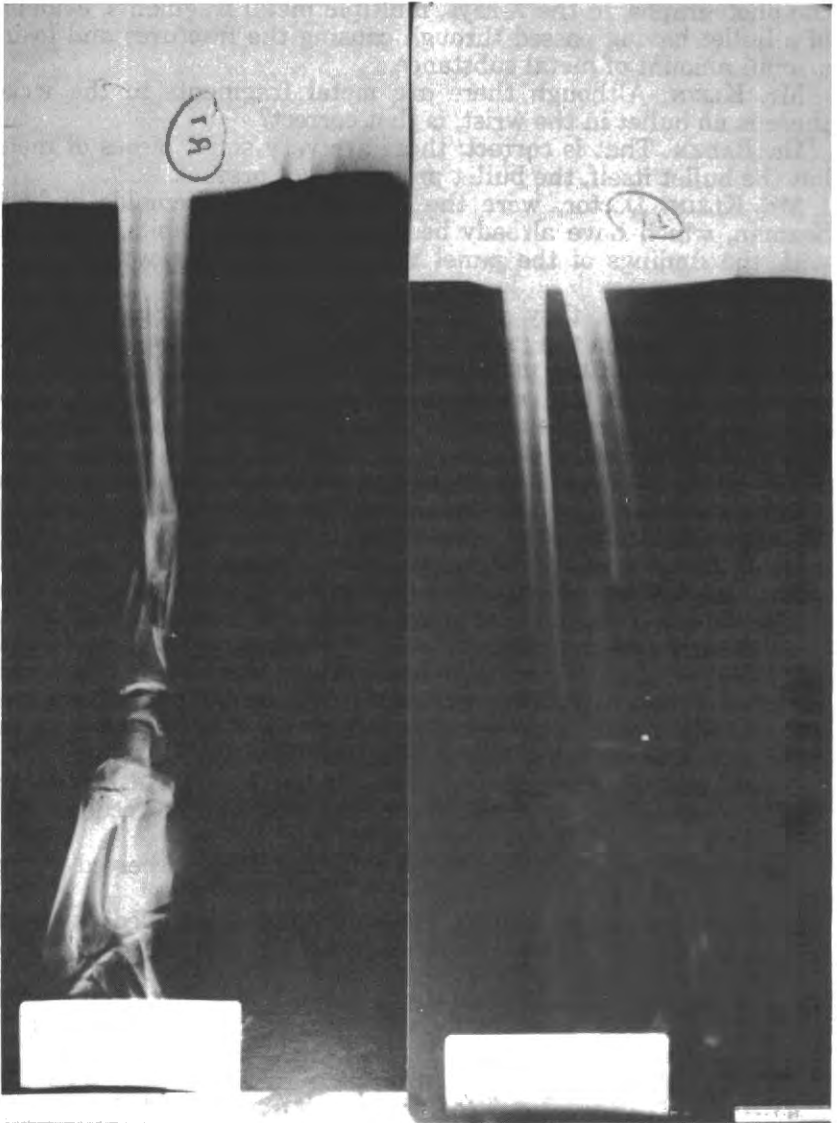
Mr. KLEIN. At this time Mr. Chairman, I would ask that blowups marked JFK F-84 and F-85 be received as committee exhibits and shown to the witness.

Chairman STOKES. Without objection, they may be received at this point.

[The above referred to JFK exhibits F-84 and F-85 follow:]



JFK Exhibit F-84



JFK EXHIBIT F-85

Mr. KLEIN. Doctor, do you recognize these blowups?

Dr. BADEN. Yes, these are enlargements of X-rays provided the panel of Governor Connally's right wrist taken at Parkland Hospital before any surgery was performed. These show extensive fractures of one of the long bones of the forearm, the radius bone, approximately 1 inch above the wrist. The wrist itself is composed of many small bones as can be seen here and is normal. There are fractures of one bone, the radius bone, just before it enlarges to articulate or meet with the wrist bones, and there are present in

the photographs, in the X-rays, multiple metal fragments, evidence of a bullet having passed through causing the fractures and losing a small amount of metal substance.

Mr. KLEIN. Although there are metal fragments in the wrist, there is no bullet in the wrist, is that correct?

Dr. BADEN. That is correct; these are very small pieces of metal but the bullet itself, the bullet proper, is not present.

Mr. KLEIN. Doctor, were the reports of Dr. Reynolds and Dr. Seaman, which have already been received as exhibits, consistent with the findings of the panel with respect to the wound of the wrist?

Dr. BADEN. Yes; they support the panel's view. Subsequent X-rays of the wrist in the process of healing after surgery does reveal that the largest of the metal fragments although still a very small fragment seen in the preoperative blowup of the X-ray, was removed at the time of surgery. This was subsequently given to the Archives for preservation.

Mr. KLEIN. Doctor, I direct your attention to the wound of the Governor's thigh. Did the panel have an opportunity to read the reports of Dr. Shires?

Dr. BADEN. Yes, sir.

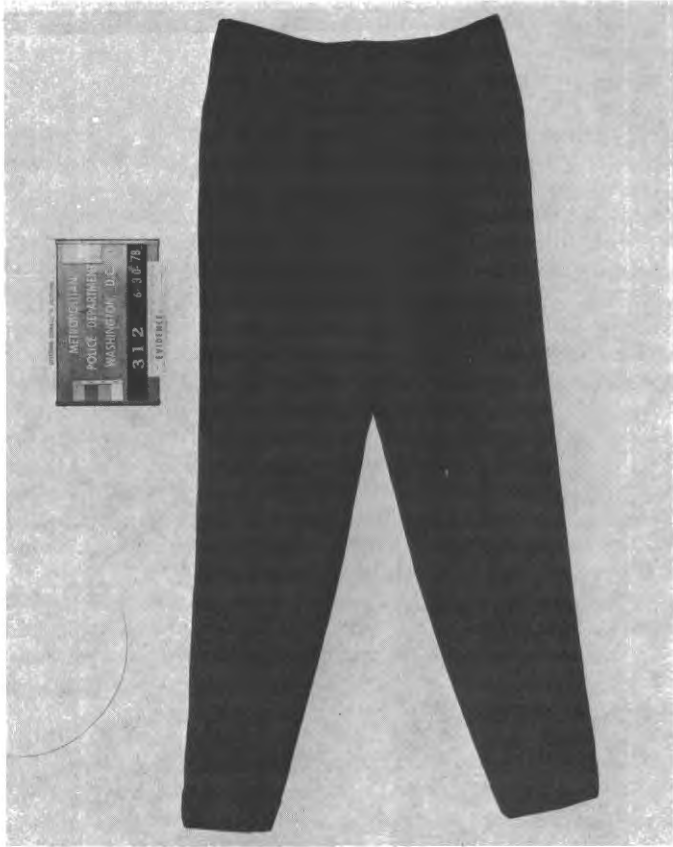
Mr. KLEIN. And could you tell us what the panel learned from the reports of Dr. Shires with respect to the wound of the thigh?

Dr. BADEN. We reviewed Dr. Shires' reports and staff and medical panel members did have an opportunity to speak and interview Dr. Shires recently. We concluded from available evidence that there was a single perforating gunshot wound of entrance in the inner aspect of the left thigh of Governor Connally.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the clothing deemed marked JFK F-88, the trousers, be received as a committee exhibit?

Chairman STOKES. Without objection, it may be received at this point.

[The above referred to JFK exhibit F-88 was received as a committee exhibit and a photograph made for the record.]



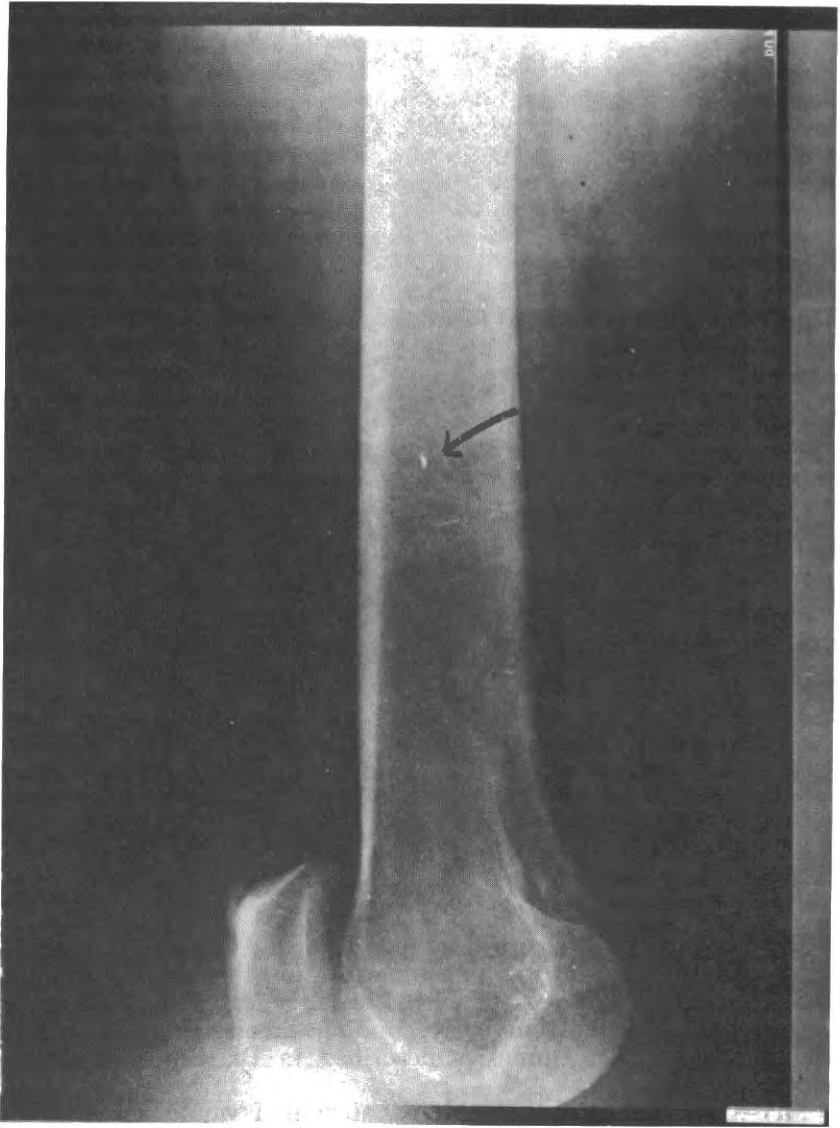
JFK EXHIBIT F-88

Dr. BADEN. The trousers worn by Governor Connally have been preserved and show the entrance perforation through the fabric of the left inner thigh region, with typical features of a round entrance bullet perforation corresponding precisely in location to where the gunshot wound is described in Dr. Shires' operative report.

Mr. KLEIN. At this time, Mr. Chairman, I would ask that the blowups, JFK F-89 and F-90, be received as committee exhibits.

Chairman STOKES. Without objection they may be received.

[The above referred to JFK exhibits F-89 and F-90 follow:]



ЖК Ехнівіт F-89





JFK EXHIBIT F-90

Mr. KLEIN. Do you recognize those blowups, Doctor?

Dr. BADEN. Yes, Mr. Klein, these are enlargements of the X-rays of Governor Connally's thigh that were taken at the time of admission to Parkland Hospital.

Mr. KLEIN. What did the panel learn from those X-rays?

Dr. BADEN. The panel learned that there was no bullet nor significant portion of bullet present in the thigh; this was also confirmed by the fact that the surgeons did explore the wound in the thigh surgically and found no bullet.

This is the lower thigh bone in the blowup. This is the knee area and the left thigh of Governor Connally. The blowup on your left is a side view showing a small piece of white irregularity with an arrow which is on the original X-rays, put there by treating physicians in Parkland Hospital and interpreted by some physicians initially and in testimony to the Warren Commission as being metal from a bullet within the thigh bone itself.

The direct frontal view shows the thigh from the front rather than from the side. This shows the same metal fragment which in the interpretation of the medical panel members, the panel's consultant radiologists and Dr. Reynolds, who reported on the X-rays at Parkland Hospital, is not in the bone but is immediately beneath the skin on the inside of the thigh. What was interpreted by some doctors as being within the bone is really an artifact, that is, a marking produced by dirt or a scratch, et cetera, and does not represent injury to the bone. This is an enhanced LogEtronic X-ray that assisted us, and is clearer than the original X-ray.

We concluded that the bullet did enter the skin of the thigh but that it was a spent bullet and it did not penetrate more than a half inch or so into the skin, and that in fact the bullet was not present in the thigh when treatment was provided to Governor Connally in the operating room.

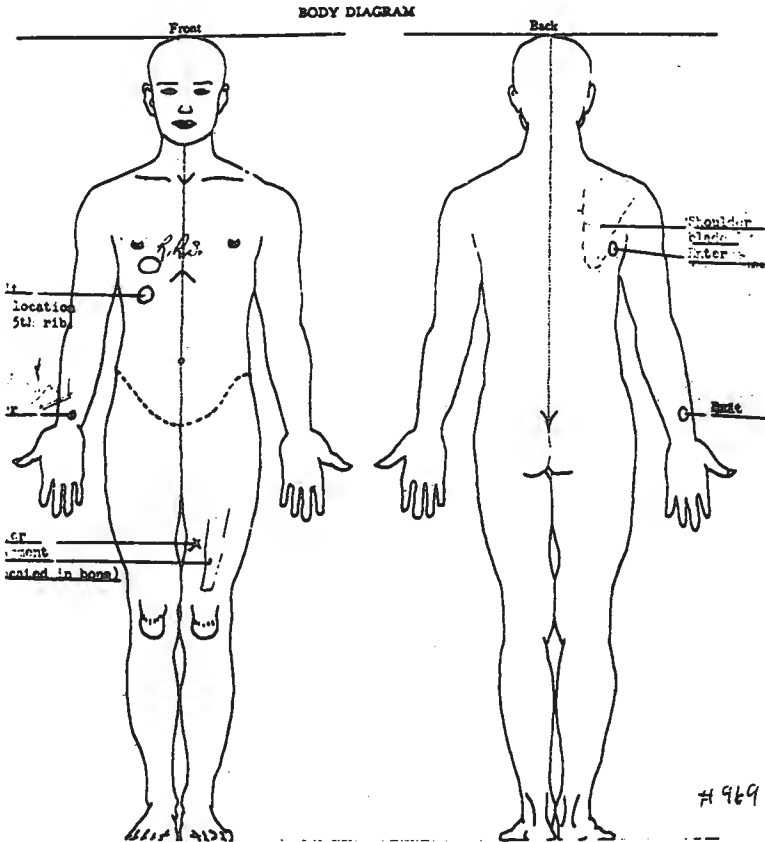
Mr. KLEIN. Doctor, did the panel reach any conclusion as to what happened to the bullet which had entered the thigh?

Dr. BADEN. Yes, the panel concluded after reviewing all of the medical evidence and other evidence and circumstances as to how the Governor was treated, that the bullet had partially entered, the thigh and then had dropped out.

Mr. KLEIN. Mr. Chairman, at this time, I would ask that the diagram marked JFK F-73 be received as a committee exhibit and shown to the witness.

Chairman STOKES. Without objection, it may be received and shown to the witness.

[The above-referred-to JFK exhibit F-73 follows.]



Commission Exhibit No. 679

## JFK EXHIBIT F-73

Mr. KLEIN. Doctor, do you recognize that diagram?

Dr. BADEN. Yes; I do. This is an enlargement of a diagram prepared by the surgeons at Parkland Hospital for the Warren Commission, at which time this material was discussed.

Mr. KLEIN. What does the diagram show?

Dr. BADEN. The diagram is an anterior-posterior outline of an individual in an erect position, so-called anatomic position, showing gunshot wounds to the chest, wrist, and thigh.

Mr. KLEIN. Did the panel agree with the locations of the entry and exit wounds?

Dr. BADEN. Yes; the panel generally agreed.

Mr. KLEIN. Doctor, I have a few more questions but I think you can sit down now, you might be more comfortable.

Doctor, to sum up for a moment. On the basis of foregoing evidence, the X-rays taken by the surgeons in Parkland Hospital, the medical records and interviews with the surgeons from Parkland Hospital, the condition of the Governor's clothing, and the reports of the doctors who examined the X-rays at the request of the panel, did the panel unanimously conclude, first, that the Governor received an entry wound of his right lateral back and the bullet exited from his right chest?

Dr. BADEN. Yes, all the panel members so concluded.

Mr. KLEIN. Second, did the panel unanimously conclude the Governor received an entry wound of his wrist and the bullet exited on the front surface of his right wrist?

Dr. BADEN. Yes, sir; on the hand surface of the wrist.

Mr. KLEIN. And, third, did the panel unanimously conclude that the Governor received an entry wound in his left thigh with subsequent dislodgement of the bullet?

Dr. BADEN. Yes.

Mr. KLEIN. Has the panel reached a conclusion as to whether these wounds were all caused by one bullet?

Dr. BADEN. Yes, sir. The panel did conclude that these wounds were caused by one bullet.

Mr. KLEIN. Would you please explain to the committee why the panel concluded that one bullet caused the wounds received by the Governor?

Dr. BADEN. Yes. The panel concluded that, taking into evaluation the nature of the injuries to the wrist and thigh and to the chest region, and the direction of these injuries, that a single bullet proceeding through the chest exiting below the nipple, entering the wrist in a partially spent manner, not at full force which would have caused much greater damage to the wrist—exiting the wrist and then reentering the left thigh, is all consistent with a single gunshot track, and the panel has seen no other reasonable evidence to support anything but a single track through the Governor.

Mr. KLEIN. Did the examination of the wound to the wrist and thigh lead the panel to conclude that the bullet which entered the wrist and then entered the thigh had been slowed up by something prior to hitting the wrist and prior to hitting the thigh?

Dr. BADEN. Yes, that is, the bullet striking the thigh was an obviously spent bullet that must have gone through other structures or struck something before striking the thigh or else it would have caused a massive defect in the thigh and exited the thigh.

The bullet striking the wrist also was produced by a bullet that had lost full power and it was the conclusion of the panel that it had struck something before striking the wrist and it was the conclusion of the panel the most reasonable area to have struck before striking the wrist and considering the position of the Governor seated at the time of the shooting, that it did indeed strike the back and exit the chest. And the path lines up for all three tracks.

Mr. KLEIN. Doctor, you have also testified that the panel unanimously concluded that a bullet entered the President's upper right back and exited from the front of his neck. Did the panel reach a conclusion as to whether the same bullet which entered the President's upper right back could have then exited from the front of

his neck and struck Governor Connally and caused the wounds that he received?

Dr. BADEN. Yes; the panel concluded, based on the enlarged nature of the entrance perforation in the Governor's back, that the bullet was wobbling when it struck him and had to have struck something before striking the Governor; that this entrance perforation of the Governor's back could have resulted from a missile that had come through the neck of the President on the basis of the autopsy findings alone; that in taking other evidence into consideration, such as the position of the President and the position of the Governor in the car, the findings are entirely consistent with a single bullet exit exiting the front of the President's neck and re-entering in the back of the Governor.

Mr. KLEIN. Mr. Chairman, I would ask that this little container and its contents be deemed marked "JFK Exhibit F-95", received as an exhibit, and shown to the witness.

Chairman STOKES. Without objection, it may be received.

[The above referred to JFK exhibit F-95 was received as a committee exhibit and a photograph made for the record.]



JFK EXHIBIT F-95

Mr. KLEIN. Doctor, do you recognize the contents of that container?

Dr. BADEN. Yes, from the label on the container and from examining the bullet, I recognize this as the Warren Commission Exhibit 399, which is a 6.5 millimeter Mannlicher Carcano bullet.

Mr. KLEIN. Did the entire panel have an opportunity to examine this bullet?

Dr. BADEN. Yes.

Mr. KLEIN. What expertise, if any, did the members of the panel have with respect to determining whether a particular bullet is consistent with having caused one or more wounds?

Dr. BADEN. The panel members in the normal course of their official duties have many occasions frequently to perform autopsies on victims of gunshot wounds and to examine missiles that cause these injuries, so that there is a great deal of experience among the panel members in examining effects of gunshot injuries and the missiles that produce them.

Mr. KLEIN. Doctor, did the panel reach a conclusion as to whether this bullet is consistent with having entered President Kennedy's upper right back, exited through the front of his neck, and entered Governor Connally and caused the wounds that the Governor received?

Dr. BADEN. Yes, the panel did conclude, all but one, Dr. Wecht, who will testify later, that this bullet is in fact consistent with having caused all of the wounds described and that in fact, this bullet is significantly flattened at one end and is not in a virgin state.

Mr. KLEIN. Doctor, you have testified that the panel collectively performed or were responsible for over 100,000 autopsies. You have also testified that the panel members read the autopsy report and spoke with the doctors who performed the autopsy on President Kennedy. Did the panel members reach any conclusions with respect to the procedures used during the course of the autopsy on President Kennedy?

Dr. BADEN. Yes, Mr. Klein, they did, but just as an additional evidence for the panel, on why we felt that the bullet went through the President and the Governor, was the information that we were able to accumulate that indicates clearly there is no other bullet other than this bullet and the bullet fragments that passed through the head of the President, that was found, there is no evidence of other bullet injury to any other occupants of the car or in the car itself, which was part of the information we considered when we concluded in constructing the bullet trajectory.

Mr. KLEIN. Doctor, directing your attention my subsequent question, did the panel reach any conclusions with respect to the procedures used during the course of the autopsy of the President?

Dr. BADEN. Yes. The panel did conclude that there were a number of deficiencies in the manner in which the autopsy of the President was done.

Mr. KLEIN. And will the panel in its final report fully document its conclusions with respect to these deficiencies?

Mr. BADEN. Yes; the panel will document its full critical analysis from the improper assumption of jurisdiction of the dead body and deficiencies in the qualifications of the pathologists who did the autopsy, to the failure of the prosecutors to contact the doctors who treated the President at Parkland Hospital and failure to inspect the clothing, to the inadequate documentation of injuries, lack of proper preservation of evidence, and incompleteness of the autopsy.

Mr. KLEIN. And in its final report will the doctors also be making recommendations as to what procedures should be utilized in the future?

Dr. BADEN. Yes, sir.

Mr. KLEIN. Thank you, Mr. Chairman, I have no further questions.

Chairman STOKES. Thank you, counsel.

Prior to recognizing the next member of the committee, the Chair would like to note the presence in the hearing room today of four gentlemen, Mr. Clarence Lyons, Mr. Marion Johnson, Mr. Michael Leahy, and Mr. William Grover. These gentlemen are employed by the National Archives and over a period of time have been extremely cooperative with this committee in furnishing and making available materials which are held in the National Archives, and they also came over last night and spent time with this committee, to a rather late hour, and are back in the hearing room this morning providing our committee with these materials. The committee wishes to thank you for the kind of cooperation that we have received from you.

The Chair at this time recognizes the gentleman from North Carolina, Judge Preyer.

Mr. PREYER. Thank you very much, Dr. Baden, for your testimony. There has been considerable controversy over the autopsies, and there has been confusion since there have been several autopsies and several panels which have worked on this and we appreciate your meticulous and painstaking testimony which, I think, goes a long way to clearing up much of the uncertainty.

Your testimony reflects the conclusions, I take it, of eight members of your panel. There is one member who dissents, in part, and who will testify later today; is that correct?

Dr. BADEN. That's correct, Mr. Preyer. All nine members do agree on the bulk of the material I presented, but Dr. Wecht does have some important dissents.

Mr. PREYER. Thank you.

The first doctors, the first scientific experts who saw the President after he was shot, were the doctors at Parkland Hospital who operated on him.

Those doctors actually saw the bullet wound in the President's throat and they described it as an entry wound, while you have described it as an exit wound. Can you explain why that's the case?

Dr. BADEN. Yes, sir. It is not uncommon for medical examiners in the course of their investigations of persons who have been injured and treated at hospitals to arrive at different opinions than the treating physician's as to the identification of entrance and exit gunshot wounds.

The reasons for this is that surgeons who treat live patients are most concerned and have greatest expertise in treating the injury suffered by the patient and are little concerned and little trained in distinguishing some of the fine points of differences between entrance and exit gunshot wounds, because this does not have much pertinence to treatment and therapy.

I think, in this particular incident, the exit perforation in the throat was small and did have some characteristics of an exit wound because of its smallness and roundness which may have been, in part, due to the fact that it came out right beneath the collar and tie of the President where the skin was held fairly firm.

An exit perforation through firm skin is smaller than through lax skin.

And in addition, the physicians who treated the President at Parkland Hospital did not turn the President over so they did not know there was another bullet hole in the back. There is a natural tendency, when a doctor sees one bullet hole and not a second bullet hole, to just assume that the one he sees is an entrance wound.

The treatment of the President, the outcome, would not have been any different had different perceptions been made by the doctors. Clearly, despite early confusion as to whether the bullet wound in the neck was an entrance or an exit perforation, the panel members all unanimously agree that it is indeed an exit perforation.

Mr. PREYER. You mentioned another fact about the Parkland Hospital examination, which has been puzzling to many of us and that is why the doctors did not report the wound in the President's back. I gather you were saying they were primarily concerned with the medical treatment of the President and simply did not turn him over?

Dr. BADEN. Yes, sir, they responded, and properly so, by trying to establish breathing by inserting an air tube and by trying to get the heart to start functioning. All these procedures are done, performed, with the patient on his back and they never had the time or opportunity to turn the President over. They just did not know that there was an entrance wound in the upper back.

Of course, this error was compounded by the autopsy physicians who, when they started the autopsy, did not appreciate that the tracheostomy wound, the incision made to insert an airway, was made through the exit perforation.

So, there were two sets of confusions that compounded the problem.

Mr. PREYER. After the President's body was brought back to Washington, the official autopsy was performed out at Bethesda. The pathologists who did the autopsy actually saw the President's body, of course. Your panel has placed the head wound some 4 inches higher than those physicians placed it. How do you account for that when those physicians actually saw the President's body and your panel did not?

Dr. BADEN. Yes. I think, in general, the doctors who perform the autopsy have a better opportunity to make valid observations than those who come later, but in this instance, the photographs taken during the course of the autopsy and the X-rays taken during the course of the autopsy and the autopsy report itself provide sufficient evidence for the panel members to arrive at valid, we feel, valid, independent conclusions.

Further, we had opportunity to interview and we did extensively interview the physicians who did the autopsy, Dr. Humes, Dr. Boswell, and Colonel Finck.

In all candor, these three pathologists, to the present time, do feel that the entrance perforation is 4 inches lower than we have concluded. They place the entrance perforation approximately in the area of that dried brain tissue in the lower portion of the scalp above the hairline.



We disagree with these doctors and we do agree with the observations of the doctors in the Clark panel and the Rockefeller Commission who also independently agreed it was 4 inches higher than the autopsy doctors stated. Our conclusion, in part, is that the observations that these three pathologists made were valid in describing the wound and the characteristics of the wound, but in making the report up the next day, not in the presence of the body, the location of the entrance perforation in the back of the head was mistakenly placed 4 inches lower than it actually was.

Mr. PREYER. So that the original autopsy panel maintained, and I gather still maintains, that what you have described as brain tissue was actually the entry wound in the head? What did they say about the entry wound that you described as being 4 inches higher?

Dr. BADEN. In discussions with the three doctors and looking together at the same photographs, the doctors who did the autopsy feel that what we identify as an entry wound is an artifact, perhaps dried blood, and not a perforation. I think that the committee will have opportunity to hear testimony from Dr. Humes, who did perform the autopsy, later today, and he can give you his reasoning. We, as the panel members, do feel after close examination of the negatives and photographs under magnification of that higher perforation, that it is unquestionably a perforation of entrance; and we feel very strongly, and this is unanimous, all nine members, that X-rays clearly show the entrance perforation in the skull to be immediately beneath this perforation in the upper scalp skin; and further, although the original examination of the brain was not complete, photographs of the brain were examined by the panel members, and do show the injury to the brain itself is on the top portion of the brain. The bottom portion or undersurface of the brain, which would have had to have been injured if the bullet perforated in the lower area as indicated in the autopsy report, was intact. If a bullet entered in this lower area, the cerebellum portion of the brain would have had to be injured and it was not injured.

So that is the basis for what remains a disagreement between our panel and the original autopsy doctors.

Mr. PREYER. Is it at all possible, Doctor, that there could have been two entry wounds, the one described by your panel in the higher part of the head, and the one described by the original autopsy panel, 4 inches lower?

Dr. BADEN. I think we physicians learn that when a question is asked, "is it possible," that many things are possible. It is the firm conclusion of the panel members, however, that, beyond all reasonable medical certainty, there is no bullet perforation of entrance any place on the skull other than the single one in the cowlick area.

It is the firm conclusion of the panel that there is no bullet perforation of entrance beneath that brain tissue nor any place else on the skull and we find no evidence to support any but a single gunshot wound of entrance in the back of the President's head.

Mr. PREYER. Turning to another question that has come up concerning the single bullet theory, you mentioned Dr. Shaw, who operated on Governor Connally. Isn't it true that Dr. Shaw testified

before the Warren Commission that he did not believe the single bullet theory, and if so, how do you account for it?

Dr. BADEN. Yes, Mr. Preyer, he did so testify before the Warren Commission. In fact, I had occasion to speak with Dr. Shaw recently and to determine the basis for his disagreement.

And he advised me that he still feels that the single bullet theory is untenable. But the basis for this belief essentially is what was told to him by Governor Connally and Mrs. Connally at the time he treated the Governor in Parkland Hospital; his basis is what they heard, what they observed, what they perceived.

He feels that Governor and Mrs. Connally are good witnesses, have good memory of what happened and in relying on the information that they gave to him, he concludes that one bullet did not pass through the President and through the Governor.

He does not make that determination on the basis of the medical, surgical, or pathological findings. In discussing the matter with him, he indicates that what he saw at surgery is consistent with a single bullet; but in taking other material into account, especially the Governor's recollection of what happened, and Mrs. Connally's recollection, he feels that for these other reasons, not the medical ones, the single bullet theory is not tenable.

Mr. PREYER. So, his opinion is based partly, at least, on eyewitness testimony rather than purely scientific?

Dr. BADEN. On persuasive eyewitness testimony, yes, sir.

Chairman STOKES. Will the gentleman suspend? Those are the second bells, There is an extremely important vote on the floor of the House, and I think this would perhaps be an appropriate time for us to suspend.

The Chair will recess the hearings until 1:30 this afternoon, at which time Mr. Preyer will resume questioning of the witness.

We are now recessed.

[Whereupon, at 11:45 a.m., the committee recessed, to reconvene at 1:30 p.m. the same day.]

#### AFTERNOON SESSION

Chairman STOKES. At this time, the committee will come back to order.

The Chair recognizes the gentleman from North Carolina, Mr. Preyer.

Mr. PREYER. Thank you, Mr. Chairman.

Dr. Baden, I would like to go back to an earlier question and see if we can't clear it up a little more. That is the difference between the autopsy panels, the original autopsy panel's finding of the entrance of the head wound and your panel's findings.

Your panel's findings put it some 4 inches above the entry found by the original autopsy panel. I believe you have testified that there was no possibility in your judgment, at least you were strongly convinced there were not two wounds.

I would like to ask the clerk if she could put on the easel JFK exhibit F-53. This is the enhanced computerized photograph of the President's skull, a technique which I assume was not available to the original autopsy panel.

## TESTIMONY OF DR. MICHAEL BADEN—Resumed

Dr. BADEN. That's correct.

Mr. PREYER. If you would like to step over to that. As I understand your testimony, you were able to—let me put it this way: Are you able to see a penetration of the skull bone in the higher area where you say the entry wound occurred?

Dr. BADEN. Yes, sir, on this and on the other lateral X-ray, next in number, all the members of the panel, and I think Dr. Petty, Dr. Wecht are here in the room with us now who are members of the panel, we all agreed that the entrance perforation was at this point where there is a separation and an obvious fracture depression on the upper back aspect of the skull.

This perforation has been made more prominent for the members of our panel than the doctors in 1963 because of the X-ray enhancement technique. We are unanimously agreed that this is an entrance perforation.

An additional reason for this conclusion, aside from the fact that it is a depressed fracture, is that there is a metal fragment here which shows up clearer on the original nonenhanced X-ray. This original X-ray shows a piece of metal that rubbed off from the bullet on entering the skull and was deposited at the entrance site which also is typical of an entrance perforation. This piece of metal is clearer on the original X-rays at the site of entrance and from it radiates many fracture lines, also typical of an entrance wound.

May I have the other X-ray blowup showing the anterior-posterior front view?

So, we were in agreement, as were all of the radiologists that we consulted with—Dr. Davis, Dr. Seaman, Dr. Chase—that that is the point of entrance in the right upper back skull with radiating fractures.

Mr. PREYER. And can you say, from looking at those exhibits, that there is no evidence of penetration of the skull 4 inches lower than the original—

Dr. BADEN. Yes, sir. The original X-ray shows it best. About 4 inches below our placement of the entry perforation is the external occipital protuberance, which is the little boney bump in the back of the head that we can feel right in the midline; this is approximately the place where the autopsy surgeons placed the wound of entrance.

On these X-rays and on the enhancements of these X-rays, there is no evidence of any perforation in this area. The autopsy physicians—Dr. Humes, Dr. Boswell, Dr. Finck, and Dr. Ebersole, who was the radiologist present—all agree that there was one and only one entrance wound in the back of the head. They describe the wound's appearance in accord with other available evidence, but they place it 4 inches lower than the panel places it.

So, the disagreement is a matter of the proper placement of a single entrance perforation rather than any reasonable possibility of two perforations.

Mr. PREYER. And I believe on the enhanced photograph, you identified metallic particles left in the top of the skull?

Dr. BADEN. Yes, sir.

Mr. PREYER. Is there any evidence from any photograph or any X-ray you have seen of a bullet entrance lower down than the one

you have described and other metallic fragments or penetration of the skull or any other sort of evidence?

Dr. BADEN. No, sir. May I use an exhibit that wasn't shown, a diagram of the brain, Mr. Chairman? A drawing, it is a diagram, not a picture.

Chairman STOKES. Yes, you may.

Dr. BADEN. Thank you, sir.

Mr. PREYER. It is 302, I believe.

Dr. BADEN. Thank you, sir. There is present evidence of a bullet track only in the upper portion of the skull; these metal fragments have moved a bit because some of the fragments are in the loose scalp tissues and soft tissues that are movable. There is no evidence of any metal fragments in the lower portion of the skull in the X-rays, nor in the photographs.

Now, the brain, as was mentioned, is not available for our examination and was not thoroughly examined, nor examined even in the normal fashion, in 1963. However, it was described externally and many photographs were taken of the brain. Miss Dox has prepared a diagram of the brain as seen here, which shows how the brain looked when it was examined and before it was misplaced or lost. This fairly and accurately represents the extensive damage, and injury to the right top of the brain, that I am pointing to, that is apparent in the photographs.

This, on the left side, is what the normal brain looks like and what the appearance would be on the right side if it were not injured by the bullet track. We do see some of the lower portion of the brain here, the cerebellum area. This area would have to be injured, in the unanimous opinion of the medical panel, if a bullet entered in the lower scalp area near the external occipital protuberance which is the area of discussion relative to a second lower bullet in the back of the head. We did not see any photographic or X-ray evidence of, and there is no description indicating any injury of, the brain other than the extensive damage to the right upper part of the brain consistent with the upper track which the panel agrees to.

Mr. PREYER. Thank you very much, Dr. Baden.

I think that has clarified that. If you will take your seat.

Dr. BADEN. Thank you, sir.

Mr. PREYER. Incidentally, what happened to the metal fragments that you have stated were found in President Kennedy's skull? Were they removed?

Dr. BADEN. There were some fragments removed in the course of the autopsy and preserved and kept at the Archives. They are very small fragments. They have been much enlarged on the blowups; some fine fragments were removed and preserved and kept in the custody of the Archives.

Mr. PREYER. Thank you.

There were several other discrepancies between your report and the Ramsey Clark panel's report and the Rockefeller Commission report which I would like you to comment on briefly. You testified that the bullet which passed through President Kennedy's back and out of his throat did not leave any fragments, and, as I understand it, at least one of the doctors on the Rockefeller Commission panel did state that there were metal fragments left by that bullet.

Do you have any comments on that?

Dr. BADEN. Yes, sir. That, in fact, was a conclusion by one of the members of the Rockefeller Commission and was an area of concern that the panel did spend time examining. If we are able to have X-rays of the chest of President Kennedy placed on the easel, I think I can explain to you how we approached that issue, what we did and what our conclusions were. There is present in the right neck region, as seen on the chest X-ray taken prior to the autopsy, a small white area that has the appearance possibly of metal or bone. That was one of the reasons that the panel requested, and the staff did go to great troubles to have made, enhancement and enlargement photographs of that area of the X-rays. We did resolve that issue to our satisfaction, as I will show you, if I can use those exhibits, please.

On your right is an X-ray taken of the President just prior to autopsy showing the neck, the area where the bullet passed through, and the lungs.

This is an enlargement of a portion of the X-ray taken while the autopsy was in progress to see if there was a bullet in the body; none was present.

This fragment did raise some concern with the Rockefeller panel and with our physicians because it has some appearances suggesting that it is a piece of metal which would indicate that the bullet struck bone in the area as it passed through the neck.

We have concluded that there is a fracture of the transverse process of the first thoracic vertebra which could have been caused by the bullet striking it directly or by the force of the cavity created by the bullet passing near to it.

However, after obtaining the enhancements of the X-rays and after consulting with various X-ray specialists, Dr. Davis here in Washington, Dr. McDonald in California, and others, we have concluded that what appears to be a radioopaque, white metal fragment is, in fact, an artifact: it is not a piece of metal, it is not a piece of bone, and one reason for this conclusion is that it is not present in the first X-ray that was taken. Careful examination of that X-ray shows no evidence of any metal or bone or fragments in the neck area. We are satisfied that the most reasonable explanation for this artifact is that it is due to a piece of dirt present on the X-ray cassette or that it was produced during the X-ray developing process which occurs not uncommonly as can be seen on other of the President's X-rays.

We are satisfied that it does not represent bullet or bone.

Mr. PREYER. Incidentally, you mentioned the bullet nicking the vertebra. Could the bullet, CE-399, the pristine bullet, have nicked President Kennedy's vertebra and still have left the neat, clean exit wound in the throat?

Dr. BADEN. Yes, sir. Usually, when a bullet strikes something of substance, it will begin to wobble, but as a bullet wobbles, there are times when it will be alined in a straight-on directional course. As I am demonstrating by using this wooden pointer there are times when, even if it is wobbling as it is moving, it will be in a straight-on position.

If the bullet did strike bone, and we cannot be certain of that, it may nevertheless have stayed on course; it may have begun to

wobble after it came out from the neck. If it were exiting in a direct head-on fashion and the skin were made more firm because the collar and the shirt were reasonably snug around the President's neck, these factors would tend to make the exit skin hole small. There is no disagreement among the panel members that the perforation in the front of the neck is an exit wound, despite early Parkland Hospital confusion, and this was also the conclusion of the Rockefeller panel and the Clark panel.

Mr. PREYER. Thank you, Dr. Baden. I believe we can try again from your seat here.

One discrepancy, I think, with the Clark panel, the Ramsey Clark panel, was put together in 1968, I believe—

Dr. BADEN. Yes, sir.

Mr. PREYER. That was that they located the wound on the President's neck in a different area from where your panel has located it.

Dr. BADEN. Yes.

Mr. PREYER. Could you comment on that?

Dr. BADEN. Yes, sir. Miss Hess, could we see the neck diagram and the neck photograph?

The Clark panel, which had two fine forensic pathologists as members, Dr. Russel Fisher and Dr. Moritz, who are senior forensic pathologists and well experienced, did conclude that there was a wound of entrance in the back and exit in the neck. In describing the wound that we see here, that semicircle at the lower margin of the tracheostomy incision, the Clark report locates it in the upper margin of the incision.

It is a trivial mistake and in no way does it change the significance of the injury and the interpretation of the injury; but it does reflect, I think, the problems that forensic pathologists have when they make reports while not directly looking at the object being described as would have happened if the description was made sometime after seeing the archival photographs. This same type of error, preparing the autopsy report 24 hours after the autopsy was completed and after the body had been removed, may have contributed to the more significant mistake of placing the gunshot wound of entrance 4 inches lower than it actually was. The description of the size and shape of the entry wound is correct, but the location of it is incorrect perhaps due to reliance on memory.

Mr. PREYER. You have described your findings at some length from photographs and from X-rays. I am sure the question will occur to a lot of people, did you perform any experiments to see if the damage caused by the pristine bullet could have occurred and the bullet still be so slightly damaged? If not, why not?

Dr. BADEN. The panel did review the experiments that have been done, and the panel members, in evaluating the desirability of doing further experiments—and we had long discussions about this—were in agreement, save for Dr. Wecht, that it is impossible to perform experiments to duplicate the injury patterns in President Kennedy or Governor Connally, or in any other individual who dies.

We can do experiments to see how much powder is produced by a gun at a certain distance; but even in wartime—and civilian life occasionally in New York City—when people are killed by

machinegun fire, with the machinegunner firing multiple rounds within seconds at a relatively stationary person, the bullet paths and injuries produced are never duplicated. The slightest difference in weight of the ammunition, in manufacture of the ammunition has significance; the gun that is fired 12 times is different than the gun that is fired 13 times; the slightest contraction of muscle, any injury causes the next bullet fired to take a different course and a different path and produce different injuries.

And it is the opinion of many of the panel members that even the doing of experiments in this regard, to reproduce the President's, the Governor's, and the bullet's injuries does more to obscure the issue than to clarify it; gives a credibility to experiments on people in reproducing injuries that is not warranted and may be very misleading.

Humans are not guinea pigs that can be put in cages and can be standardized. The dead bone, the dead wrist bone, the dead thigh bone is different than the live thigh bone. A bone with blood going through it reacts differently to a gunshot wound than a dried bone without blood going through it. These differences not only affect the path of the bullet going through the body and the injuries produced, but also affect the damage done to the bullet; a hair's breath difference in distance between two bullets similarly fired will cause one bullet to shear in half and split and the other bullet to go straight through the body without the missile being greatly damaged.

I don't want to belabor the point, but the panel majority after much consideration does feel that the injuries sustained by Governor Connally and President Kennedy, and the trajectory and the ballistics could not be precisely duplicated; that there were myriads and myriads of ways the experiment could be done wrong and only one way it could be done right—and if by chance it were done right once we wouldn't know it or be able to prove it. There would still be room for argument.

Mr. PREYER. So, the problem in duplicating the wounds are so complex that you would create more problems than you would solve by conducting experiments of this nature?

Dr. BADEN. Yes, sir, it is a futile search that produces a false confidence in uninterpretable data. In our everyday practices, when we have to make judgments about gunshot wounds and injuries, we do not do so by performing experiments. We make that judgment by looking at the evidence, by taking everything available into consideration and then by drawing a conclusion; not by attempting to duplicate the impossible.

Mr. PREYER. Finally, let me just ask you a couple of questions about something that I think troubles people more than anything else about the autopsy.

That is, the fact that a bullet could appear to do so much damage and still remain in almost pristine condition. It seems to fly in the face of commonsense. Let me ask you, have you ever seen a bullet that has done this much damage as the bullet CE-399 did and still emerge in as good condition as this bullet is in?

Dr. BADEN. Yes, sir. Absolutely, but with qualification. We on the medical panel have certain problems, as have other doctors in the past, in evaluating the injuries produced by the so-called "pristine

bullet", which is a media term that is inaccurate: it is like being a little bit pregnant—it is either pristine or it is not pristine. This is a damaged bullet and this is not a pristine bullet. This is a bullet that is deformed; it would be very difficult to take a hammer and flatten it to the degree that this is flattened. This is a partially deformed bullet with a heavy jacket.

The problem is that although in New York City we see more than 1,000 gunshot wound deaths a year, in a civilian population it is most unusual to encounter military ammunition; and in military practice where people are killed by rifle bullets, autopsies, and follow-up correlations are not performed as in the civilian death situation. Very few people, if any, have had autopsy experience with the Mannlicher-Carcano 6.5 millimeter ammunition in a civilian population.

However, we do see copper-jacketed handgun bullets not infrequently, and typically, a copper-jacketed handgun bullet will cause extensive damage and deform very little. In fact, according to the Geneva Convention, military bullets must be jacketed so that they do not split up and deform. They are meant to cause minimal injury and suffering while killing somebody; the bullets are designed so as not to break up into many different parts and to be minimally deformed.

Mr. PREYER. It only caused death and no side effects; is that it?

Dr. BADEN. That is correct. It stays intact. Further, sir, in fact, this bullet struck little that would deform it. The track through President Kennedy is essentially through soft tissue which does not deform a bullet. The only injury to the chest of Governor Connally that could have damaged the bullet would have occurred if it struck the fifth rib. But the rib is a very thin bone and striking a rib does not significantly deform a copper-jacketed bullet. So, the only impact that caused any appreciable damage to that bullet occurred when it struck the lower forearm.

Do you have that X-ray of Governor Connally available? This X-ray of Governor Connally's forearm shows the radius bone of the forearm, the only object that that bullet, C.E. 399, struck that could have caused only significant damage to the bullet. It is the opinion of the panel that the impact with the radius bone did cause some flattening of the bullet, but it would not necessarily be a very marked deformity. Impact that causes great damage to a bullet typically occurs when the bullet strikes skull bone or spine bone, which are hard and tough bones. The wrist, the radius at that point where you see the fracture lines, is not a very hard bone. It can damage some bullets, and not others.

It is hard to predict. We have seen many bullets that go through radius bones that are very little deformed. The bullet struck only superficial soft tissues of the left thigh where its course terminated; this impact would have caused no damage to the bullet.

Mr. PREYER. I was going to ask you how you explained the massive fragmenting of the bullet from the head wound compared to the relatively undamaged bullet from the throat wound?

Dr. BADEN. The skull bones are much denser and harder and provide much more resistance especially if the bullet should strike at a sheering angle. The skull bone is a round bone and often a bullet like this may enter the skin head on but, when it hits the



bone beneath, because of the curvature, the lines of force are different than when it goes through a flat bone like the radius. It is typical for bullets striking the head to be much more damaged than bullets going through a rib or a wrist; in fact 399 did not strike much that would cause it to be damaged.

But to get back to your original question, if you asked me can I produce a bullet that similarly went through two individuals, I could not because of the uniqueness in the way people are shot and the way people die.

Mr. PREYER. The final question I have, Dr. Baden, you mentioned that part of the information on which you based your conclusions that the single-bullet theory was valid was that no other bullet was found. If another bullet would have turned up, or should turn up, say in the upholstery of the car, would that affect the validity of the single-bullet theory, that is, that one bullet passed through both President Kennedy and Governor Connally?

Dr. BADEN. I think that if another bullet were found in the car, the pathology panel members would have to give that a great deal of consideration before reading its final conclusions. The problem with bullets going through people, through multiple people, which happens from time to time in ordinary civilian practice, or going in and out of one part of the body and into another part of the body, is that it is never possible to say that the only possibility is a single bullet from the autopsy findings alone. The circumstances are very important in interpreting the autopsy findings.

All we as pathologists can do is say they line up together; one bullet could have caused both injuries, but if the two people, if the arm and the chest were held apart and two bullets were fired at appropriate angles, it is possible to simulate tracks with two bullets that could be caused by one bullet. Presence or absence of the reentry characteristic would be important in interpreting the findings.

We are taking into account in our evaluation the Zapruder film, the fact that the President and the Governor are in certain positions, seated down, one in front of the other; from the autopsy point of view they line up. The bullet going through the President would have enough steam behind it to reenter the Governor.

Further, the appearance of the Governor's wound indicates that the bullet entering the Governor struck something before it hit the Governor. There is no evidence of striking anything else in the vicinity of the car, although it is possible; but being reasonable and trying to examine all of the possibilities in the context of the medical evidence available, we find that the bullet that struck the President in the upper back had no other place to go, went no place else, except into the person in front of him, the Governor. And that there is no other place that the bullet going through the chest could go but the wrist. It would be possible for another bullet to have been fired from another point and caused the same injuries to the Governor. This is highly unlikely. In civilian practice with experience with thousands of bullet wounds the majority of panel members find it very significant that the wounds line up: If the shoe fits, it fits.

If the bullet in the hand and the chest line up as consistent with coming from the same bullet track, invariably, when all the evi-

dence is in, this proves to be the correct explanation; but it is not necessarily the only explanation. It is just there are so many ways people can be shot; myriads of ways people can be shot that don't line up. If the bullet paths line up in a way so that they are possibly caused by one bullet, that in itself eliminates countless other possibilities.

Mr. PREYER. Thank you, Dr. Baden. I have no further questions, Mr. Chairman.

Chairman STOKES. Time of the gentleman has expired. Committee will now operate under the 5-minute rule.

The Chair recognizes the gentleman from Ohio, Mr. Devine.

Mr. DEVINE. Thank you, Mr. Chairman.

Dr. Baden, you are obviously eminently qualified with your vast experience in the field of forensic pathology. I know of the general reluctance of members of the medical profession—as well as indeed, lawyers—to be critical of their colleagues or their work, and keeping that in mind I am wondering could you elaborate more fully on the conclusions the panel reached regarding the autopsy procedure? Do you have anything you would like to enlarge upon in that regard?

Dr. BADEN. Yes, sir. As was mentioned previously, we are going to include in the report a full documentation of critical analysis of the autopsy report. I would say that, as you will find today and perhaps other times, that although many physicians are hesitant to criticize one another, that is not the rule among forensic pathologists, and I think this is a good rule because the forensic pathologist is often in the court room and has to call it the way he or she sees it.

I think in this regard, perhaps as a caveat, we did agree as a group with the basic bottom-line conclusions of the original autopsy doctors: Two bullets from behind struck the President and only two bullets. However, we had a great deal of concern on many levels as to how the autopsy was performed, beginning immediately with the assumption of jurisdiction by what appears to be the Federal Government and the family of the President, intruding into what was at that time a State crime, homicide. The effect of that was to remove the body from Dallas, the jurisdiction which had a very competent forensic pathologist in charge, Dr. Earl Rose, who happens to be a member of our panel presently, to Bethesda at, apparently, the request of the family.

The experience of each and every panel member is that in a homicide situation the last person to have control and tell the medical examiner how to proceed or what to do is the family of the next of kin. This is a rule that we live with while still keeping the sensitivities of the family fully in mind.

The very concept of the family having control of the body, of the family having control of the archival material although done with the best and noblest of intentions, does cause great concern for forensic pathologists because of its implications in other homicides where the family does not and is not permitted and should not be permitted to have control over what happens to the bullet that killed Uncle Louie. The district attorney handles that and not the family.

As a result of that move of the body many things happened. In all fairness, Dr. Humes is here and will speak later. Some people assume authority and upon others authority is thrust as happened to Dr. Humes. He was later to become president of the American Society of Clinical Pathologists. A well experienced hospital pathologist in the scheme of things, he had not been exposed to many gunshot wounds and had not performed autopsies in deaths due to shooting previously: neither had the other autopsy pathologists present. So they were required to do an autopsy that by experience and by the way our society is structured in the United States, is reserved for forensic pathologists and coroner's pathologists.

As a result of that, certain things didn't happen. The kinds of documentation, pictures, measurements, that the forensic pathologist does automatically and that a hospital pathologist had no need to do. Further, the forensic pathologist knows that he must speak to any physician who treated or touched the body of the decedent prior to the pronouncing of death before the autopsy is done, just to determine what the doctors did to the body—in this instance to learn that a tracheostomy had been made through a bullet hole.

From our vantage point it appears to be a rule among clinicians, those people who deal with live patients, that if there is a perforation in the body, a tube will be stuck into it, the doctors will enlarge it, or they may incorporate it into a surgical incision. This goes for bullet wounds and stab wounds. This is what we deal with every day as medical examiners in our different jurisdictions. This is not what Dr. Humes and his colleagues deal with or are exposed to at Bethesda Hospital. That created a problem. We forensic pathologists insist on seeing clothing as part of the homicide examination, we must see the clothing because we know from experience that the clothing tells us a great deal about bullet holes, about injuries, that may be obscured in the body. It tells if a bullet struck the clothing but missed the body, for example, which may be important. It gives information as to distance, as to whether the bullet is wobbling, et cetera. The clothing was not examined.

The autopsy itself is conducted differently by a hospital pathologist than by a forensic pathologist. The former is not trained to reconstruct the skull, to put the bones together, preserve evidence appropriate for subsequent medical or legal proceedings, et cetera.

I think the preservation of evidence, the finding of all those little bits of pieces of metal fragments Mr. Preyer referred to, are more important to us as forensic pathologists than to the regular pathologist or surgeon because preservation of evidence is not necessarily relevant to treatment.

The question of how extensive an autopsy should be done becomes an issue. Should a complete autopsy be done? In a homicide, yes, because of medical and legal questions that may be anticipated to arise. The state of the various organs may prove important. Heart diseases, brain tumors, and other natural diseases may not have caused death but may relate to other questions that come up as to how a person acted prior to death. Chemical analysis may also be an important part of the post mortem examination.

Mr. DEVINE. Dr. Baden, I presume that you, as the spokesman for your panel, are convinced that your findings are accurate and that any deviation from the original autopsy that was conducted under

very highly charged emotional stress, the fact that the first group of physicians were involved with trying to attempt to save the President's life, rather than determine entrance and exits of wounds, and so forth, and you are persuaded today as you testify here that your findings, the findings of your panel, are accurate and the previous findings that were different are in error?

Mr. BADEN. Yes, sir. However, as to certain of these differences, in particular, the placement of the entrance wound in the back of the head and of the exit perforation in the neck, after further recent discussions with the original surgeons, Dr. Perry, Dr. Carrico, Dr. Shires, we find that we are not now in disagreement. There are some persistent disagreements between the panel and the autopsy doctors in Bethesda particular as to the location of the entry head wound.

I wish to point out and emphasize that the doctors performed the autopsy in Bethesda in a military situation, with a lot of superior officers who were not forensic pathologists present; this creates a pressure, I think, that we are more able to control in the civilian setting where the medical examiner can ask the chief of police or the mayor's representatives or the chief Rabbi to please leave the autopsy room if we deem this appropriate so that the autopsy can be done under our terms. We can do that in civilian life. It is difficult to do that in a military setting, and that situation itself generates procedures and a tentativeness that may produce disagreements later.

Mr. DEVINE. I think this atmosphere should be pointed out for the record and I appreciate your comments. Thank you, sir.

Chairman STOKES. Time of the gentleman has expired.

The Chair recognizes the gentleman from the District of Columbia, Mr. Fauntroy.

Mr. FAUNTROY. Thank you, Mr. Chairman.

Dr. BADEN. I would like to return to the skull injury.

You viewed with us yesterday the Zapruder film which we and the American people saw several times. You are aware that because of the direction in which the President's body moved, namely, backwards and to the left, it appeared that the bullet had come from the front. Of course, your finding substantiates that of the Commission that two shots came from the rear.

Today you mentioned the presence of beveling in the President's skull. I wonder if you would explain, using a diagram, what causes beveling and how it can be interpreted to learn whether a wound is an entry wound or an exit wound?

Dr. BADEN. Yes; I think Miss Hess is putting up a diagram that we have not used. May I address that please? Thank you.

Because of pressure of time this morning we didn't include all of the materials that might have clarified some issues you are raising, sir. This diagram is to illustrate the beveling concept that I referred to this morning, which was of great importance to us in working out the direction of the bullet wounds in the head and in interpreting the bullet wounds. A bullet entering a bone, like a BB or bullet entering a thick plate glass window, will create lines of force and fractures in the bone or the glass, radiating outward from the point of entrance; a bevel or a concavity will occur in the

bone or glass consequent to these fracture lines in the direction in which the missile is going.

Thus, a bullet entering the skull will cause beveling on the inside of the bone. The skull bone consists of an outer plate and inner plate. Coming in from the outside, the bullet will cause a small round sharp edged hole of the outer table and a concavity or beveling of the inner table, a circumferential defect. Going out, the bullet will cause beveling on the outside of the bone. This is of great assistance to the forensic pathologist in determining which way the bullet is going. Clearly the perforation in the right front side of the head near the suture line, where the two bones joined, as I referred to earlier, had this type of outer bone beveling, which did match up with the separately received triangular bone fragment, indicating that it was the site of an exit perforation.

Do you have that blowup of the X-ray showing the three bone fragments? Thank you. That same beveling was present on one of the fragments of bone found in the car. This fragment of bone found in the car, in the limousine, and brought up to Dr. Humes and his colleagues while they were doing the autopsy, proved to be of value in that one showed a margin of beveling on the outer surface, which permitted the doctors at that time to state there was a bullet wound of exit in the right front head region. It shows some pieces of metal deposited in the area of the beveling. The autopsy doctors also describe in their protocol the entrance wound in the back of the head with beveling of the inner table and an exit wound in the front with beveling of the outer table.

This is consistent with what we could see on the negatives and on the photographs of both wounds, and permits us to give the direction of the track.

Mr. FAUNTROY. Thank you.

Mr. Chairman, I know my 5 minutes are up and I may have other questions later, but for the record, may we have these two illustrations entered at this point?

Dr. BADEN. This one was entered earlier. This one was not.

Mr. FAUNTROY. Let's have this.

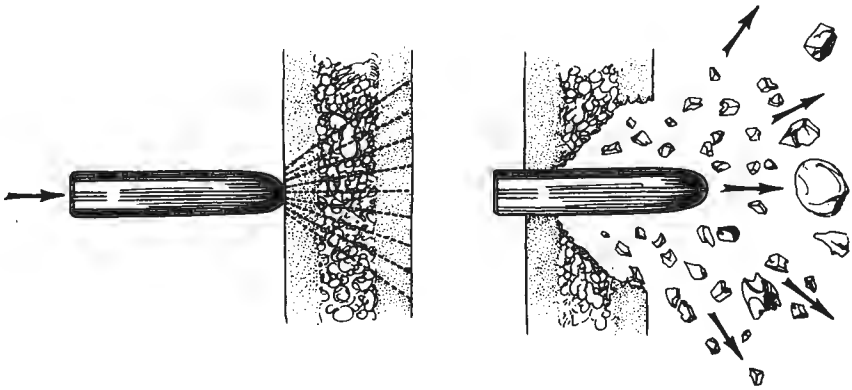
Chairman STOKES. Without objection, the other exhibit may be entered in the record at this point.

Mr. FAUNTROY. What is the number?

Dr. BADEN. It is F-61.

Mr. FAUNTROY. Thank you, Mr. Chairman.

[The above referred to JFK exhibit F-61 follows:]



JFK EXHIBIT F-61

Chairman STOKES. Time of the gentleman has expired.

The Chair recognizes the gentleman from Connecticut, Mr. Dodd.

Mr. DODD. Thank you, Mr. Chairman.

Dr. Baden, I just have two questions I would like to address to you, if I could.

In your response to questions from Mr. Klein early on in your testimony, in talking about the wound in the President's back, you said that an entry wound and an exit wound do not cause the same kind of perforation, except under certain special circumstances, or in special cases. I wonder if you might describe what you mean by special cases, was this a special case, if so, why, if not, why not?

Dr. BADEN. The description of the perforation in the front of the neck, from the original autopsy doctors, and from the persons who had best visualization of it, the surgeons who did the tracheostomy, Dr. Perry, Dr. Carrico in Parkland, essentially only describes it as a small perforation, I think 6 or 7 millimeters at most in diameter. An exit bullet hole can have an abrasion collar, if it is shored. A shored exit wound can have an abrasion collar, if it were firmly in place, or if the skin is against the wall or a hard surface at the time the bullet exits the body, because as the bullet goes out it rubs the skin against the object on the outside such as heavy clothing or a hard surface.

We don't know if this exit perforation had an abrasion collar because it was not that clearly looked at. The doctors were expending all of their efforts to try to save his life. We do not know the perforation was small. The exit perforation is made smaller by clothing tight around the skin.

By chance the bullet exited through the windpipe right at the point where the collar is buttoned against the neck, as seen on the clothing exhibit; this amount of pressure against the skin can prevent an exit hole from being bigger than it might otherwise be. So, although an exit perforation may be small without any clothing or constraint about it, the tighter the constraint the smaller it will be, even to the possibility of arriving at an abrasion collar that looks like an entrance wound. But with all of the other evidence at

hand, and after interviewing all of the surgeons, and all of the doctors who saw the President, I think there is unanimous agreement presently among the physicians and scientists who have been involved, that the perforation of the neck indeed was an exit perforation. There was some misunderstanding of this initially, but that has been worked out and our panel is unanimously in agreement that the neck wound is an exit wound.

Mr. DODD. Are you satisfied that the clothing, the tie and the collar, the tears or rips in them, were caused in fact by the bullet exiting or were these like the other, the jacket and so forth, possibly cut away or ripped away by the surgeons operating in Dallas? Do you have any information which could specifically clear up that controversy?

Dr. BADEN. Yes, sir. We could find no evidence that the tie or shirt collar was torn or cut during removal. The perforation itself, although it might look like a cut to the casual observer, is typical of the slit-like irregularity produced by an exiting bullet. A bullet will destroy some of the clothing on entrance and produce a roundish type hole the edges of which cannot be approximated because there is a little bit of fabric missing. In an exit perforation of this nature, not only is there a jagged slit-like, but not sharp, tear of the fabric, but in addition there is no loss of clothing fabric, so the edges can be approximated as in this instance.

The tear in the tie and shirt collar directly over the neck perforation the doctors saw at the Parkland Hospital. There is no other hole in the fabric. We can conclude beyond a reasonable degree of medical certainty that the slit-like hole in the shirt and the nick in the tie were caused by whatever came out of the neck and not by a knife. A knife would cause a sharper tear than present here.

Mr. DODD. As I understand your testimony, you acknowledge that you had viewed this Zapruder film, on at least one occasion, if not more?

Dr. BADEN. Yes, the panel had many occasions to view the Zapruder film in slow motion and by individual frames. We were very concerned about seeing the film to better interpret the autopsy findings.

Mr. DODD. When I ask you this, I recognize you are not a ballistics expert and you are not testifying as to the ballistic evidence, but as a matter of medical evidence, in light of the fact that you have viewed the Zapruder film, can you state it as a medical certainty, that there were no shots fired from the grassy knoll which could have struck either Governor Connally or President Kennedy?

Dr. BADEN. Yes, sir. If I can take into account the autopsy findings, as well as the Zapruder film.

Mr. DODD. That is what I am asking.

Dr. BADEN. I can state for the majority of the panel, and Dr. Wecht will have his own opinions that he will explain to you, that there is no evidence beyond a reasonable degree of medical certainty, for any bullet to have struck the President from the front or the side. That the only bullets that struck the President are two from behind.

We studied the Zapruder film relative to the motion of the head. Suffice it to say, in all our experiences, among the more than 100,000 autopsies that the nine of us have had responsibility for, none of us have ever seen somebody shot in person or on camera to permit study of head motion. That is unique. The uniqueness is certainly undercut by the fact that it then happened on television 2 days later with Mr. Ruby. Apart from those two instances, and an occasional wartime film clip, it is unique to see a person's reaction to a gunshot wound. We cannot say with all of our experiences with gunshot wounds, what movement a head should have when struck, a live head, a live breathing head with blood going through, with the skin alive and the bones alive. How such a real head would react to a gunshot wound is beyond the limits of scientific study and recorded in the annals of medical literature, nor in the experience of the panel members. We cannot say with any degree of medical certainty precisely how we would expect the President's head to move when shot.

Chairman STOKES. Time of the gentleman has expired.

Mr. DODD. Thank you, Mr. Chairman.

Chairman STOKES. The gentleman from Connecticut, Mr. McKinney.

Mr. MCKINNEY. Doctor, it seems to me that we have an underlying problem. One of the reasons used as a conclusion of one bullet theory and these two men being shot was that no other bullet was found. But, we also have not found the bullet that struck the President's head. But it seems to me that there has always been this one basic problem, could the bullet have done the damage? You have explained that pretty well. But I think one area where we have question is, is there no way that the panel could have found out more to indicate whether or not the President's spinal column was hit by the bullet going through the throat?

In essence if it had been hit, then it would be pretty difficult for that bullet to have proceeded ahead, wouldn't it?

Dr. BADEN. It would have had a significant effect certainly if the spine were hit. I would say, to begin with, that the panel members were satisfied that the two fragments of the bullet found in the limousine were consistent with having caused the injury to the President's head. So the head bullet wounds I think are accounted for.

Mr. MCKINNEY. How much of that bullet was found?

Dr. BADEN. A great proportion of it, a large proportion of it. That is beyond the pathology panel's work.

Mr. MCKINNEY. It is fairly safe to say that bullet was fairly well destroyed by—

Dr. BADEN. Well, it was very much damaged but two major fragments were recovered.

Mr. MCKINNEY. And yet here we have another bullet that went through the neck, went through the chest, rubbed up against a rib, shattered a wrist, and went into the thigh, and stayed relatively—

Dr. BADEN. Intact.

Mr. MCKINNEY. In one piece.

Dr. BADEN. Going through soft tissues, skin and muscle, does not deform a bullet. It may slow it down but doesn't deform it. It is



bone that causes the deformation and skull bone is a very hard bone. The spine bone is also hard.

Forensic pathologists who deal with gunshot wounds frequently are very careful to dissect out the tracks of bullets to identify all of the injuries caused by the bullet; even if this would not change the final cause of death, we can anticipate that it will answer questions that might arise later. It is important for us to know, and we don't know, whether the bullet that went from the President's back through the neck, tore any major vessels in the neck. It may have. If so, this wound in and of itself could have been fatal.

The question you raise has multiple implications because, if the bullet struck the spine, this would cause some damage to the bullet and it would also probably cause damage to the spinal cord. Such injury has certain implication as to how the President would move his extremities, and as to the possibility of survival. The track wasn't dissected out. We have to speculate from other sources of information.

One of the reasons we spent so much attention to the possibility of a metal fragment in the side of the neck earlier, was because if it were a piece of bullet in the side of the neck, it would indicate the bullet struck bone. This would have an effect on the bullet as well as on the body. The majority of the panel members are satisfied that it did not strike bone at that point. The missile did create a cavity. The cavity, the bullet missile cavity, created by the bullet at this speed, causes damage much beyond the missile itself. It can cause damage to the spine, even if the spine is a couple of inches away from the bullet. We can speculate as to what it did strike, but there is no evidence from the X-rays, from the trajectory through the body, that it struck any substantial amount of bone. It might have struck the transverse process of the first thoracic vertebra but we cannot prove this.

Mr. MCKINNEY. That can't be proved one way or the other?

Dr. BADEN. That can't be definitely proved. Even if it had struck the transverse process it did not fragment or break up or leave any metal fragments, as a result of it.

Mr. MCKINNEY. I have just one last question to clarify for the American people, who have been watching us, we showed them in the Martin Luther King case a bullet that had struck the spinal column and was totally demolished. The projectile was flattened. I thought perhaps we ought to have, though you aren't a ballistics expert, your opinion as to what the difference was between those bullets?

Dr. BADEN. Yes, sir. I think it is an interesting comparison because both gentlemen were struck by high velocity rifle bullets as opposed to hand gun bullets commonly seen in the civilian population. A .30-06 rifle bullet struck Dr. King. However, the bullet injuring Dr. King struck two very hard bones, the mandible or jawbone, and the main portion or body of the vertebra itself, which is very thick. The question we have relative to the President's death was whether the bullet struck the tip of the lateral transverse projection of the spine, which is a thin area of the spine bone.

In the death of Martin Luther King, the bullet not only went through the very hard jawbone but it then went through the body,

the bulk of the spine, and may have struck more than one of the vertebra; in such an instance the damage to the bullet is very great. There is one other very important factor, the Martin Luther King bullet was a soft-nosed bullet, it was not fully jacketed, and so it would have a much greater tendency to break up.

Contrariwise, the bullet that struck the President, a 6.5 mm Mannlicher-Carcano is completely jacketed and it did, in the judgment of the majority of the panel, what the Geneva Convention wanted it to do: it went through the body without breaking apart, and it will do that if it doesn't strike very dense bone.

Chairman STOKES. Time of the gentleman has expired.

The gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman.

Dr. Baden, I want to make sure I understood you correctly, then I have one question about bullet fragments.

There is no evidence that the injury to the President's neck and back wound left any bullet fragment. There was to the head wound.

What about the Connally back and chest wounds?

Dr. BADEN. As best as we can determine from interviews with the doctors at Parkland Hospital and in reviewing the X-rays available, the bullet did cause fractures to the fifth rib. There is division within the panel as to whether the bullet struck the rib directly or whether the fractures were caused by the cavity created by the bullet.

There is no evidence of any metal fragments left in the chest of Governor Connally by X-ray or on examination of the materials that were removed at the time of the operations.

Mr. FITHIAN. And the thigh wound of the Governor?

Dr. BADEN. There is a tiny pin-head sized object in the thigh wound of the Governor which we did interpret as a metal object, a fragment of metal, very pin head size perhaps.

Mr. FITHIAN. Was it recovered?

Dr. BADEN. That was not recovered.

Mr. FITHIAN. And the wrist?

Dr. BADEN. Do you have the wrist X-ray of Governor Connally? The wrist was explored and operated on, and recovered from the wrist was some cloth fabric which matched the jacket of Connally.

Thank you.

And the largest of those metal fragments, I think there are three fragments that are visible from this distance, overlay the distal radius near the wrist—the largest of those three fragments was removed by the surgeons in the course of their operation and preserved, kept at the Archives and made available to the committee many years later.

Mr. FITHIAN. The other fragments were not removed?

Dr. BADEN. The other fragments were not removed and are still present as demonstrated on subsequent X-rays available to the committee when the Governor's arm was healing.

Mr. FITHIAN. And is there no way that you could estimate the weight of that bullet fragment which remained in the Governor's wrist?

Dr. BADEN. The panel members felt that we could not, to any reasonable degree of scientific certainty, estimate precisely how

much of the bullet mass was represented by these fragments. However, it was the opinion of the majority of the panel that the amount of metal fragments in the President and the Governor was quite small, and taking everything into consideration, was entirely consistent with coming from bullet CE-399.

Mr. FITHIAN. One final question, Mr. Chairman. The statement that you made of the drawing that you used of the President's brain clarified a lot as to which side was damaged and that the cerebellum was not damaged. There has been some controversy about foreign material showing up in the photos of the brain. Did you look into that and, if so, what were your conclusions?

Dr. BADEN. Yes; we did. In fact, we were very concerned about the brain because of the lack of full and thorough examination of the brain at the time of autopsy. Some experts who had previously looked at the photographs of the brain, from which this diagram was made, did note a dark object within the bullet track.

This diagram was not made for the purpose of illustrating that object. But on all of the photographs of the top of the brain and in the transparencies and the negatives, approximately in this area where I am pointing, in the front right side of the brain, there is an oblong area of blue discoloration.

It was the opinion of the panel, after giving a great deal of consideration to this area on the photographs, and after discussing the X-rays with radiologists—the X-rays of the head were taken prior to removal of the brain—that without question it is not a metal object. It is the opinion of the panel, further, after studying the photographs of the undersurface of the brain, that that area of discoloration is most probably caused by blood vessels on the undersurface of the brain that have been exposed because of the damage to the top of the brain.

We feel it is not foreign material and that it is most probably blood vessels and thin membrane that have been sheered away by the bullet damage.

There is, incidentally, in the actual photograph what appears to be small toothpick-like objects, used to illustrate certain points and placed there by the doctors taking the pictures; that is not at issue. That is foreign material added for purposes of picture taking.

Chairman STOKES. Time of the gentlemen has expired.

The gentleman from Pennsylvania, Mr. Edgar.

Mr. EDGAR. Thank you, Mr. Chairman.

I have just one question with three exhibits that I would like to have put up JFK exhibit F-66, JFK exhibit F-20, and JFK exhibit F-46. Could those three exhibits be put up?

This question may be one, Dr. Baden, that we have gone over perhaps too many times, but I think it would be helpful for a person like myself who is not familiar with damage of gunshot wounds. I would like to draw your attention to the three exhibits and ask a question.

Is it your testimony that it is not unusual that a similar bullet shot from the same rifle traveling at the same speed, when it hits the objects, could in the one instance of the skull fracture, entering the back right side and blowing out a good portion of the upper part of the brain, not cause the same kind of explosive activity as it enters the back and goes through the throat, regardless of whether

it hits any other objects, or any other people? Is your experience that the same kind of bullet fired from the same kind of weapon could cause those two different results on exit?

Dr. BADEN. Yes, sir. As I have said, even with machinegun bullets rapidly fired, many different injury patterns will result in great measure dependent upon how the bullets strike. This bullet struck in a partially tangential manner against the skull bone. After striking the bone and yawing and tumbling and turning and exiting the missile produced an explosive effect causing skull bone and brain to burst outward, as seen in the Zapruder film. That is the transfer of energy can be different relative to the closed cranial cavity and the brain than when it goes through nonenclosed soft tissue. A bullet striking skin over bone produces different effects on the skin than a bullet striking skin that does not overlay bone. Every difference is reflected in the tissue injury produced.

It is of interest, and it is the firm opinion of the panel, that when the bullet exited Governor Connally's chest beneath the nipple, it produced a 2-inch diameter (5 centimeter diameter) round ragged hole while the same bullet only produced a small, narrow hole in exiting the neck of the President.

The extent of injury produced depends on what the bullet strikes, how fast it is traveling, to what extent the bullet is yawing, whether it strikes bone or not. Taking all these things into consideration, it was the view of the panel that it was entirely consistent for the same type of bullet to cause this explosive injury to the skull and brain and a relatively little in the way of injury to a soft tissue when it struck the back and exited the neck.

Mr. EDGAR. Thank you, I have no further questions, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Doctor, I heard you mention, and I am sure you have, that you watched the Zapruder film a number of times.

Dr. BADEN. Yes, sir.

Mr. SAWYER. I have seen it a couple of times myself. And did you observe the pause, the very definite delay in reaction between when the President was lifting his hands to his throat before there was any observable reaction in the film on the part of Governor Connally?

Dr. BADEN. Yes, sir.

Mr. SAWYER. And you apparently discount that as being anything?

Dr. BADEN. It isn't, sir, that we discounted it. We did incorporate those observations, with all the other many observations, into a final conclusion.

I have the greatest respect for Mr. Groden and the work he has done, and the work the other photographers have done, to permit fuller appreciation of the Zapruder film and other films.

The problem that we, as physicians, have is there is no way to compare how people react to fatal gunshot injury. There often is delay time between an injury and a person manifesting the effects of such injury, very much like touching a hot pot on a stove. Some people react immediately and other people don't realize for a second or so that they have been injured. A second is approximate-

ly 16 frames of the Zapruder film. The type of injury that may damage the spinal cord area perhaps by shock waves if not by direct impact by the bullets might produce a certain automatic rapid reflex action while a bullet striking the chest may not produce an immediate reaction.

Mr. SAWYER. Do you observe, too, in that film though, while the President was visibly reacting and the Governor was at least not, to my ability to observe, showing any reaction as yet, he was still holding in his right hand his hat and that wrist was supposedly shattered by that bullet.

Does that disturb you at all?

Dr. BADEN. I think disturb is probably an accurate phrase. Yes; it causes me concern. However, the problem is clearly—

Mr. SAWYER. Aside from concern, how can a man be still holding the hat when his wrist is shattered?

Dr. BADEN. Although it appears incongruent clearly we of the panel have all had experience in which persons have been seriously injured and have not known they were injured for a few minutes. In evaluating all of the evidence, there is no question that Governor Connally did, in fact, hold his hat after he was shot, and after the bullet passed through his wrist—this would be the case even if one did not accept the “single bullet theory.”

He did hold that hat after the wrist was injured and he didn't know the wrist was injured.

Mr. SAWYER. The wrist should have known it, you would think.

Dr. BADEN. The wrist knew. The bone was broken. The greatest effect would have been on the nerves going to the muscles. If a nerve is injured this would produce a quicker response than if a nerve weren't injured. That is why, if the bullet injured the President's spinal nerves in the neck area, which is rich with nerves, a reflex, rapid reaction might ensue whereas, if the bullet goes through an arm there may be little visible response. We have had experience with many decedents who were unaware that they had been stabbed, shot who may run around and who were shot and then ran around the block before collapsing and dying. And I think whatever way Governor Connally was struck, he did, in fact, hold onto his hat. He did, in fact, not know that his wrist was injured after he was shot and it is not in our experience, investigation, unusual although it doesn't sound right but, in fact, people may be significantly injured and may have broken bones and may continue walking, continue holding a hat and not know it.

Mr. SAWYER. And now, when you combine that with what I thought was a very persuasive and impressive testimony of both Governor Connally and Mrs. Connally, adding that to it, you still feel that does not militate against your single bullet theory?

Dr. BADEN. The experience of all of us in forensic pathology and of many in criminal justice, is that, unfortunately, as much as I am impressed with Governor Connally's testimony and his ability to recall and his ability to survive what happened to him, as a forensic pathologist, I have learned not to rely on eyewitnesses or on persons who were present or who were injured in the course of a homicide, particularly when this comes into conflict with autopsy findings.

The panel did incorporate into our discussions Governor Connally's very persuasive testimony to the Warren Commission and otherwise, and Mrs. Connally's remembrance of what happened. Taking all of this into account, it is still strongly our opinion that one bullet and only one bullet went through Governor Connally. It is our opinion that one bullet and only one bullet went through the back of the neck of President Kennedy, clearly from all the evidence.

Taking all factors into consideration, it is also our opinion that it is the same bullet that went through the President and the Governor because there is no other evidence for another bullet in part. I think that Governor Connally's testimony is certainly important, but it would not be the first time that a person receiving an injury misperceives what happened at that precise instant.

Mr. SAWYER. Is it then a fair statement to say, or is it unfair to say, that you are basing your affirmative conclusion on the absence of evidence to the contrary; is that right?

Dr. BADEN. That is so in part; part of the affirmative conclusion, part of the single bullet concept incorporates all the consistencies; all the evidence is certainly consistent with a single bullet, but this conclusion becomes more persuasive because of absence of any reasonable alternative of any scientific merit apart from speculation. It is possible, it is within the realm of possibility to me but very unlikely, that a second bullet could have done damage lined up just as the first bullet. There is no evidence for it, and we are persuaded beyond a reasonable medical certainty against this speculation.

Mr. SAWYER. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman is expired.

Dr. Baden, at the conclusion of any witness testimony before this committee, under the rules of this committee, that witness is entitled to 5 minutes in which to explain or to expand upon or amplify any portion of his testimony, and I would, at this time, extend to you 5 minutes if you so desire.

Dr. BADEN. Thank you, Mr. Chairman.

Knowing the time constraints of the committee, I will not take the 5 minutes. But I would just like to comment that there are nine members of this panel who have contributed a great deal of time and effort, in addition to their normal duties in the nine jurisdictions from whence they arise, who spent this time because they feel that forensic pathology provides a unique expertise to assist investigation of violent and unnatural death.

I would also like to place on the record that, although I may be spokesperson at this point for the majority of the panel, that much more work was done by many other panel members than myself in many areas; and that each each of the panel members, even though we may not all agree on every point, have put in much personal time and have come, each of us, independently and collectively to the conclusions I have outlined to the best of our individual abilities.

Thank you very much.

Chairman STOKES. Thank you.

I might say on behalf of the committee we are indeed grateful to you, and all the members of the panel, for the outstanding job that you have done on behalf of this committee.

At the appropriate time, we will make the proper acknowledgments of all the members of that panel. Thank you very much. You are excused.

Chairman STOKES. Mr. Blakey.

**NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND STAFF DIRECTOR**

Mr. BLAKEY. Thank you.

Mr. Chairman, our next witness, Capt. James J. Humes, received an M.D. degree from Jefferson Medical College in 1948 and completed his residency in pathology at the Armed Forces Institute of Pathology in 1956.

Captain Humes became the chief of anatomic pathology at the National Naval Medical Center in Bethesda, Md. in 1960. He became the director of the laboratories at the National Medical Center in 1961.

In that capacity, he conducted an autopsy of President Kennedy. In 1965, he attained the rank of Captain and he retired from the Navy with that rank in 1967.

Currently, he is a clinical professor of pathology at Wayne State University School of Medicine and director of laboratories and vice president of medical affairs at St. John Hospital in Detroit.

It would be appropriate now, Mr. Chairman, to call Captain Humes.

Chairman STOKES. Captain Humes, will you please stand and be sworn. Raise your right hand.

Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

Dr. Humes. I do.

**TESTIMONY OF CAPT. JAMES J. HUMES, M.D., CLINICAL PROFESSOR OF PATHOLOGY, WAYNE STATE UNIVERSITY SCHOOL OF MEDICINE, DIRECTOR OF LABORATORIES AND VICE PRESIDENT OF MEDICAL AFFAIRS, ST. JOHN HOSPITAL, DETROIT, MICH.**

Chairman STOKES. Thank you. You may be seated.

Dr. Humes. Thanks.

Chairman STOKES. The Chair recognizes staff counsel Gary Cornwell.

Mr. CORNWELL. Thank You, Mr. Chairman.

Dr. Humes?

Dr. HUMES. Mr. Cornwell.

Mr. CORNWELL. In 1965, you were the director of laboratories of the National Medical School, Naval Medical School, Naval Medical Center at Bethesda; is that correct?

Dr. HUMES. That is correct.

Mr. CORNWELL. Very briefly, what was the nature of your responsibility in connection with that position?

Dr. HUMES. In that role, I had overall responsibility for all of the activities of the clinical laboratories of the Naval Medical Center,

overall supervision of the conduct of laboratory examinations, both in the field of clinical pathology, which embraces hematology, bacteriology, chemistry, and so forth, and supervision of the anatomic pathology section, which deals in post mortum examinations, examination of surgical specimens and so forth, and responsible for the training of young physicians and young technical people in laboratory medicine, et cetera.

Mr. CORNWELL. You, of course, prior to that had been certified by the American Board of Pathology and you had received special education and training in the field of pathology; is that correct?

Dr. HUMES. That is correct, yes, sir.

Mr. CORNWELL. You personally conducted the autopsy of President John Kennedy on November 22; is that accurate?

Dr. HUMES. Yes; with the assistance of Commander Boswell and Colonel Finck.

Mr. CORNWELL. What was your specific responsibility in connection with that autopsy?

Dr. HUMES. Well, I was summoned from my home late in afternoon of that day by the Surgeon General of the Navy and the Commanding officer of the Naval Medical Center, and the Commanding Officer of the the Naval Medical School, and much to my surprise, was told that the body of the late President was being brought to our laboratories and that I was to examine the President and ascertain the cause of death.

Mr. CORNWELL. Approximately what time of the day or night did the autopsy begin?

Dr. HUMES. Well, the President's body, as I recall, arrived about 7:35, 7:40 in the evening and after some preliminary examinations, about 8 or 8:15.

Mr. CORNWELL. Just very briefly, in what order or sequence did you conduct the autopsy?

Dr. HUMES. Well, the first thing we did was make many photographs which we knew would obviously be required for a wide variety of purposes, took basically whole body X-rays and then proceeded with the examination of the two wounds that we very shortly detected were present, starting with the wound in the head and proceeding to the wound in the back of the neck, upper thorax.

Mr. CORNWELL. Would it be accurate to state that the photographs and the X-rays were taken not only to document the condition of the body at the time you examined it, but also to provide a record of that event?

Dr. HUMES. I think that's obvious, yes, sir.

Mr. CORNWELL. About what time of the night was the autopsy finally concluded?

Dr. HUMES. Oh, I would estimate around midnight.

Mr. CORNWELL. You, I believe, have been at the hearing today, at least part of the time and, therefore, are aware of the fact that the committee has chosen and had work for them a panel of forensic pathologists?

Dr. HUMES. Yes, indeed.

Mr. CORNWELL. You may have heard part of the testimony which reflected that the panel reviewed your report of the autopsy and, of course, as you know, the panel also spoke with you on one prior occasion.



With respect to the ultimate findings that this committee will, of course, need to wrestle with, there is apparently, from the testimony today, one possible major area of disagreement, and that is with respect to the location of a bullet wound in the back of the President's head or possibly, depending upon the total body of the evidence, whether there was one or more than one bullet holes in the back of the President's head. That is principally what we wish to discuss with you at this time.

Let me ask you first, your autopsy report reflected that there was one and only one bullet wound to the back of the President's head, that it did enter in the rear, exited the front. Is that report accurate on those three points, to the best of your knowledge?

Dr. HUMES. Absolutely.

Mr. CORNWELL. I would like to show you what has been admitted into evidence as JKF exhibit F-48 during these hearings, a drawing of the back of the President's head.

The committee has received evidence from Miss Ida Dox today that that drawing is an accurate representation of photographs taken during the autopsy and I believe the drawing represents photographs from the autopsy numbered 15, 16, 42, and 43, but apart from the testimony of Miss Dox, have you had an opportunity to compare that drawing with those photographs to determine if its fairly and accurately duplicates the photographs?

Dr. HUMES. Yes, I have, Mr. Cornwell, and I believe that it does.

Mr. CORNWELL. The particular photograph that this drawing represents, I take it, would have been taken as part of the normal procedure of the autopsy and for the same reasons that you previously described all of the photographs were taken, is that correct?

Dr. HUMES. Correct, to document the positioning and appearance of the wounds.

Mr. CORNWELL. In the process of examining that, among the other available documentary evidence in the case, our panel of forensic pathologists, of course, were not present during the autopsy, did not have access to the body and, therefore, you and your colleague who were there are in a unique position to provide testimony as to the nature of the wounds to the President.

In that connection, as you recall, the panel invited you, and you responded voluntarily, in fact, as I recall, on very short notice, you responded to an invitation to come speak to them informally.

They, I guess, we could say, interviewed you as to your knowledge on the subject of the autopsy in the National Archives.

In pertinent part, the transcript which was made from the tape recording of that interview at pages 12 to 13 reflects that you reviewed not only that drawing, but an X-ray of the President's head and identified the small droplet in the lower portion of the photograph as a wound of entry and that that was the only wound of entry.

Later in the transcript, at pages 39 to 40, the following colloquy occurred: Dr. Petty of the panel said, going back to the earlier discussion, "Can I go back to another interpretation which is very important to this committee? I don't really mean to belabor the point, but we need to be certain, as certain as we can be, and I am showing you now photograph 15"—that, of course, was a photograph from which that drawing was made—"and here to put it in

the record is the posterior hairline or margin of the hair of the late President and there near the midline in just a centimeter or two above the hairline is an area that you refer to as the in-shoot wound”.

That, in other words, was a verbalization of the description of the location of the small droplet near the bottom of the head.

You replied, Dr. Humes, “Yes sir.”

Dr. Petty then continued, “Also on this same photograph is a ruler and approximately 2 centimeters or so down the ruler and just to the right of it is a second apparent area of defect, and this has been enlarged and is shown to you in an enlargement, I guess No. 16, which shows you right opposite the 1 centimeter mark on the ruler this defect or what appears to be a defect.”

Thereafter, skipping a small portion and going to the very next page, 40, you replied, “I don’t know what that is. No. 1, I can assure you that as we reflected the scalp to get to this point, there was no defect corresponding to this in the skull at any point. I don’t know what that is. It could be to me clotted blood. I don’t, I just don’t know what it is, but it certainly was not any wound of entrance.”

Would it be accurate to state first, Dr. Humes, that at the point at which you made the statements we have just referred to, you were called rather unexpectedly from your normal occupation, came to Washington and with no preparation or no referral to prior notes immediately prior to that, were shown this and other evidence and made the statements that I have just referred to?

Dr. HUMES. That is correct, and I comment that I was similarly summoned on Tuesday of this week, 48 hours ago, for this appearance likewise with no attempt or no chance for preparation and no idea of what questions were to be directed toward me.

Mr. CORNWELL. And we apologize for the short notice in both cases.

Dr. HUMES. Fine. I hope we can straighten that out.

Mr. CORNWELL. I would like to ask you if you would agree to various portions of what are reflected on this photograph. First, in the original photograph, there was shown, as in the drawing, a ruler; is that correct?

Dr. HUMES. That’s correct.

Mr. CORNWELL. And in addition, there were the hands which are shown which appear to be holding the scalp so as to expose some portion of the back of the head.

Dr. HUMES. That’s correct.

Mr. CORNWELL. Would you also agree that in the original photograph, the hair in the upper portion appears to be wet, that in the lower portion appears to be relatively dry?

Dr. HUMES. I would indeed.

Mr. CORNWELL. Would you also agree that the hair is spread apart in the upper portion of the photograph, exposing portions of the scalp and that in the lower portion, the hair is in a relatively natural position?

Dr. HUMES. I would.

Mr. CORNWELL. And finally, would you agree that the relative center portion of the photograph has what you, upon initially being shown this photograph in the Archives by our panel, could not

identify, that's what you said might be a clot or some other item, and that is relatively off-center in the overall photograph the part you identified as being the wound of entry, the locations are as I described them.

Dr. HUMES. Yes, apparently.

Mr. CORNWELL. Now, I would like to ask you today if you have had at least a greater opportunity to look at the photographs along the lines that I have just indicated to you and if, after doing so, you have a more well-considered or a different opinion or whether your opinion is still the same; as to where the point of entry is?

Dr. HUMES. Yes, I think that I do have a different opinion. No. 1, it was a casual kind of a discussion that we were having with the panel members, as I recall it. No. 2, and I think before we talk about these photographs further, if I might comment, these photographs were made on the evening of November 22, 1963. I first saw any of these photographs on November 1, 1966, almost 3 years after the photographs were made, which was the first opportunity that I had to see those photographs.

At that point, Drs. Boswell, Finck and I were asked to come to the National Archives to categorize these photographs, label them, identify them and we spent many hours going through that.

It was not the easiest thing to accomplish, I might say, after 3 weeks short of 3 years. But we identified them and I think in light of the very extensive opportunity that various panels of very qualified forensic pathologists have had to go over them, we did a reasonably accurate job in cataloging these photographs.

So, I saw them on that occasion. I saw them again on the 27th of January of 1967 when we again went to the Archives and made some summaries of our findings.

I go back further to the original autopsy report which we rendered, in the absence of any photographs, of course. We made certain physical observations and measurements of these wounds. I state now those measurements we recorded then were accurate to the best of our ability to discern what we had before our eyes.

We described the wound of entrance in the posterior scalp as being above and to the right of the external occipital protuberance, a bony knob on the back of the head, you heard Dr. Baden describe to the committee members today. And it is obvious to me as I sit here how with this his markedly enlarged drawing of the photograph that the upper defect to which you pointed or the upper object is clearly in the location of where we said approximately where it was, above the external occipital protuberance; therefore, I believe that is the wound of entry. Its relative position to bony structure underneath it is somewhat altered by the fact that there were fractures of the skull under this and the President's head had to be held in this position thus making some distortion of anatomic structures to produce this picture.

By the same token, the object in the lower portion, which I apparently and I believe now erroneously previously identified before the most recent panel, is far below the external occipital protuberance and would not fit with the original autopsy findings.

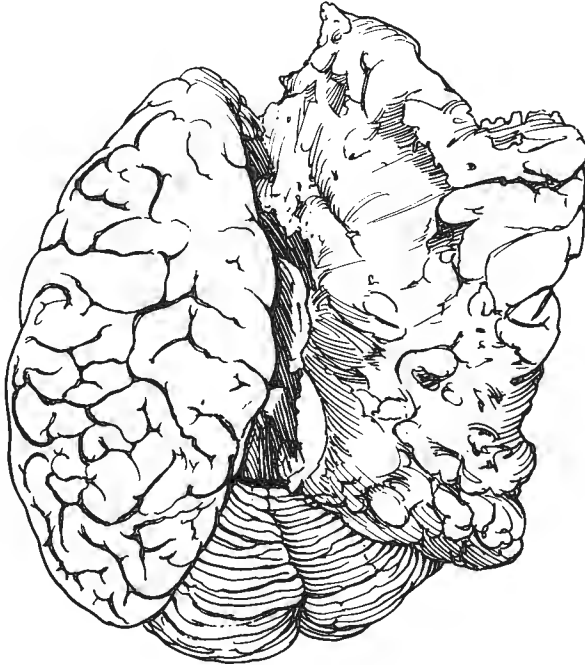
Mr. CORNWELL. I would like to show you, in addition to the photograph or the drawing which is now on the easel, what has

previously been admitted as JFK exhibits F-52 and F-53 and also what has previously been discussed as JFK exhibit F-302.

I don't believe, Mr. Chairman, that JFK exhibit F-302 was previously admitted into evidence and if it was not, I would ask that it be admitted at this time.

Chairman STOKES. Without objection, it may be entered into evidence at this point.

[The above-entitled document, JFK exhibit F-302, follows:]



JFK EXHIBIT F-302

Mr. CORNWELL. First, Dr. Humes, with respect to the X-rays, have you also today had an opportunity to look at those X-rays?

Dr. HUMES. Yes, sir.

Mr. CORNWELL. I would ask you if you would mind stepping to the easel and describing for us what your view, or your opinion, would be as to the location of the entry wound on that X-ray.

Dr. HUMES. OK.

I believe, particularly in this rather enhanced picture, I might say, it is a pleasure to have such because I didn't have anything of this kind formerly, that this would be the point of entrance.

Mr. CORNWELL. For the record simply, would you try to describe the point that you just indicated?

Dr. HUMES. Well, in this approximate area would be about where the external occipital protuberance would be, the knob we can feel in the back of our head. This would be above it. There is a great enlargement here, so it looks considerably further away than it

would be on a standard size film or on the skull and I believe this is above the external occipital protuberance.

I think it also shows on the film that Dr. Baden was showing earlier. I think it shows even better in the in the A.P. view, the anterior-posterior view of the skull.

Mr. CORNWELL. So, you, in effect, would agree with the testimony of Dr. Baden that the entry wound on the X-rays is at the point in which there is, simply from a novice point of view, a dislocation or a jutting out.

Dr. HUMES. It is a fracture line that juts out from that.

Mr. CORNWELL. Thank you.

Dr. HUMES. If I might add, and more importantly, I had the opportunity, which none of the gentlemen had to do, to examine the President's skull from the inside when the brain was removed, with great care. There was one, and only one, wound of entrance.

I think we are in a somewhat of a semantic discussion as to where it was.

Mr. CORNWELL. And would you agree that the fragments shown in the upper portion of the skull would also be relatively consistent with the same entry location on the skull?

Dr. HUMES. Oh yes, however, this bullet was so disrupted, those fragments I think could virtually be any place.

Mr. CORNWELL. And referring to JFK exhibit F-302—

Dr. HUMES. Which is?

Mr. CORNWELL. The one on the very left, the drawing of the brain, would you also agree that the disruption of the brain, as shown in that drawing, is also in the upper portion and therefore would also be roughly consistent with the same entry location?

Dr. HUMES. Yes, sir, I do.

Mr. CORNWELL. Dr. Humes, you have indicated that you, of course, worked under the handicap, which, of course, was caused by conditions beyond your control, during the autopsy and the writing of the report, of not having autopsy photographs to work with; is that correct?

Dr. HUMES. Nor the X-rays by the time we were writing the report.

Mr. CORNWELL. Nor the X-rays.

Your initial autopsy report indicated that, as you have just stated, the wound was, indeed, above, I believe the report is worded in terms of "slightly above," the external occipital protuberance.

The testimony today indicates that the panel places that at approximately 10 centimeters above that external occipital protuberance. Would that discrepancy be explainable?

Dr. HUMES. Well, I have a little trouble with that; 10 centimeters is a significant—4 inches.

Mr. CORNWELL. I would like to simply ask you a few specific questions in order to determine—

Dr. HUMES. I go back to the fact there was only one, period.

Mr. CORNWELL. To determine whether we can understand how such a discrepancy might have occurred. The autopsy was completed late at night; is that correct?

Dr. HUMES. That's correct.

Mr. CORNWELL. After it was over, what did you do next?

Dr. HUMES. We stayed to assist the morticians and their associates to prepare the President's body.

Mr. CORNWELL. How many hours did that take?

Dr. HUMES. Until about 5 o'clock in the morning.

Mr. CORNWELL. Then, what did you do?

Dr. HUMES. After the President's body was removed, half an hour or so later, I went home.

Mr. CORNWELL. Did you get any sleep?

Dr. HUMES. Not too much. I had to take one of my children to a religious function that morning, but then I returned and made some phone calls and got hold of the people in Dallas, which was unavailable to us during the course of the examination, as you heard from Dr. Baden, and I couldn't agree more with the apparent findings of his panel as to problems that we had had and hoped they would never be repeated, and spoke with Dr. Perry and learned of the wound in the front of the neck and things became a lot more obvious to us as to what had occurred.

Mr. CORNWELL. And you finally began to write the autopsy report at what time?

Dr. HUMES. It was decided that three people couldn't write the report simultaneously, so I assumed the responsibility for writing the report, which I began about 11 o'clock in the evening of Saturday, November 23, having wrestled with it for 4 or 5, 6 hours in the afternoon, and worked on it until 3 or 4 o'clock in the morning of Sunday, the 24th.

Mr. CORNWELL. Did you have any notes or records at that point as to the exact location of the—

Dr. HUMES. I had the draft notes which we had prepared in the autopsy room, which I copied.

Mr. CORNWELL. Was the distance between the wound and the external occipital protuberance noted on those notes?

Dr. HUMES. It was not noted in any greater detail than appears in the final report.

Mr. CORNWELL. So, the exact distance, then, above the external occipital protuberance was not noted—

Dr. HUMES. Was not noted, with the feeling, of course, that the photographs and X-rays that we had made would, of themselves suffice to accurately locate this wound.

Mr. CORNWELL. I only have one final question.

First, however, the notes are no longer in existence; is that correct?

Dr. HUMES. The original notes which were stained with the blood of our late President, I felt, were inappropriate to retain to turn in to anyone in that condition. I felt that people with some peculiar ideas about the value of that type of material, they might fall into their hands.

I sat down and word for word copied what I had on fresh paper.

Mr. CORNWELL. And then destroyed them?

Dr. HUMES. Destroyed the ones that were stained with the President's blood.

Mr. CORNWELL. The final question is, you were present throughout the entire embalming operation; is that correct?

Dr. HUMES. I was in the morgue from 7:30 in the evening until 5:30 in the morning. I never left the room.

Mr. CORNWELL. During that period, were there efforts made to reconstruct the President's head?

Dr. HUMES. Yes, indeed.

Mr. CORNWELL. Would it be accurate to state that those efforts entailed handling of the head over a long period of time?

Dr. HUMES. Very accurate.

Mr. CORNWELL. Dr. Baden testified that exhibit 302 and the other photographs which we have of the brain may not be entirely complete, although they show nearly the entire circumference in all directions, but you would have become familiar during that period of time with all of it, I suppose, exterior of the head in order to reconstruct it; is that correct?

Dr. HUMES. That's correct.

Mr. CORNWELL. And based upon that, is there any question about the fact that there were no other bullet holes entering the head?

Dr. HUMES. I was absolutely convinced at that time that there were no such. I have had no reason to change my opinion in the intervening 15 years.

Mr. CORNWELL. I have no further questions. Thank you.

Chairman STOKES. Thank you, counsel.

Are there any members of the committee that would seek recognition?

[No response.]

Chairman STOKES. Dr. Humes, under the rules of our committee, any witness may have 5 minutes in which to explain or in any way expand upon his testimony before our committee. I extend to you at this time such time as you so desire.

Dr. HUMES. Thank you very much, Mr. Chairman.

I certainly don't choose to avail myself of 5 minutes. Having heard most of what Dr. Baden said, and the findings of his committee on forensic pathologists, I think the committee was very well advised to gather such a distinguished group. I wish I had had the availability of that many people and that much time to reach the conclusions that I and my associates were forced to reach in approximately 36 hours.

I hope that the committee, in its wisdom, will make recommendations to appropriate authorities to preclude such a difficulty in the future.

I would say that our testimony—and my associates and I are quite elated, in fact, that the findings, to the best of my knowledge, the substantive findings of all the various panels that have examined these materials in such great detail, are in basic accordance with what we originally ascertained to be the situation. We are pleased by that.

Our testimony before the Warren Commission is quite lengthy, as I am sure some of the committee members are aware. However, I feel it also was hampered by our inability, No. 1, to never have seen, after about midnight of that night, the X-rays, to never have seen at any time until a year or two after the Warren Commission the photographs which we made. I think had we had those opportunities, some of the confusion and difficulties which seem to have arisen might not have arisen.

I will be pleased to answer any other questions from you, sir, or any other members of the committee.

Chairman STOKES. Dr. Humes, we certainly want to say to you, I think all of us can understand the very trying circumstances and conditions under which you were called into action after this very tragic event, and we are indeed appreciative of the testimony that you have given here this afternoon and the other cooperation you have shown with our panel.

For that, we, at this time, wish to thank you very much, and you are now excused.

Dr. HUMES. Thank you, Mr. Chairman, I appreciate the opportunity to be of help.

Chairman STOKES. Thank you.

The Chair recognizes Professor Blakey.

**NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND  
STAFF DIRECTOR**

Mr. BLAKEY. Thank you, Mr. Chairman.

Our next witness, the one dissenting member of the autopsy panel, Dr. Cyril Wecht, received an M.D. degree from the University of Pittsburgh School of Medicine in 1956 and an LL. B. from the University of Maryland School of Law in 1962, and a J.D. from the University of Pittsburgh School of Law in 1962.

Dr. Wecht currently serves as coroner of Allegheny County, Pa. He holds numerous editorial positions on the boards of medical and legal publications, and he has written on a wide variety of medical and legal subjects, and in particular, the assassination of President Kennedy.

It would be appropriate at this time, Mr. Chairman, to call Dr. Wecht.

Chairman STOKES. The committee calls Dr. Wecht.

Will you please stand and raise your right hand to be sworn?

You solemnly swear the testimony you will give before this committee is the truth, the whole truth, and nothing but the truth, so help you God,

Dr. WECHT. I do.

**TESTIMONY OF DR. CYRIL H. WECHT, CORONER, ALLEGHENY  
COUNTY, PA.**

Chairman STOKES. Thank you. You may be seated.

The Chair recognizes staff counsel, Donald A. Purdy, Jr.

Mr. PURDY. Thank you, Mr. Chairman.

Dr. Wecht, did you request to testify today?

Dr. WECHT. Yes, I did.

Mr. PURDY. Dr. Wecht, what are the major conclusions of the forensic pathology panel with which you are in disagreement?

Dr. WECHT. The major disagreement is the single-bullet theory which I deem to be the very essence of the Warren Commission report's conclusions and all the other corroborating panels and groups since that time.

It is the sine qua non of the Warren Commission report's conclusions vis-a-vis a sole assassin. Without the single-bullet theory, there cannot be one assassin, whether it is Oswald or anybody else.

I am in disagreement with various other conclusions of the panel. I am most unhappy and have been extremely dismayed by their failure to insist upon the performance of appropriate experi-



ments, which I believe could have been undertaken with a reasonable degree of expenditure of time, energy, and money to once and for all show whether a bullet 6.5-millimeter, copper-jacketed, lead-core piece of military-type ammunition could indeed strike a rib and a radius in a human being and emerge in the condition which Commission exhibit 399 is today.

I am extremely unhappy about the fact that a greater and more intensive effort was not made to locate the missing pieces of very important medical evidence in this case, which I pointed out back in the summer of 1972. Not that I was the first to learn of this, but amazingly, nobody had made that public disclosure prior to that time. I have raised some questions concerning the head wound and the possibility, albeit remote, of a second shot fired in synchronized fashion from the right side or the lower right rear, synchronized with the head shot that struck the President in the back of the head.

And this is related to a few pieces, a couple of pieces of evidence and, again, emphasizes the necessity of having the brain to examine. These are the major areas.

There are, of course, numerous facets of all of these disagreements that are related to the so-called single-bullet theory.

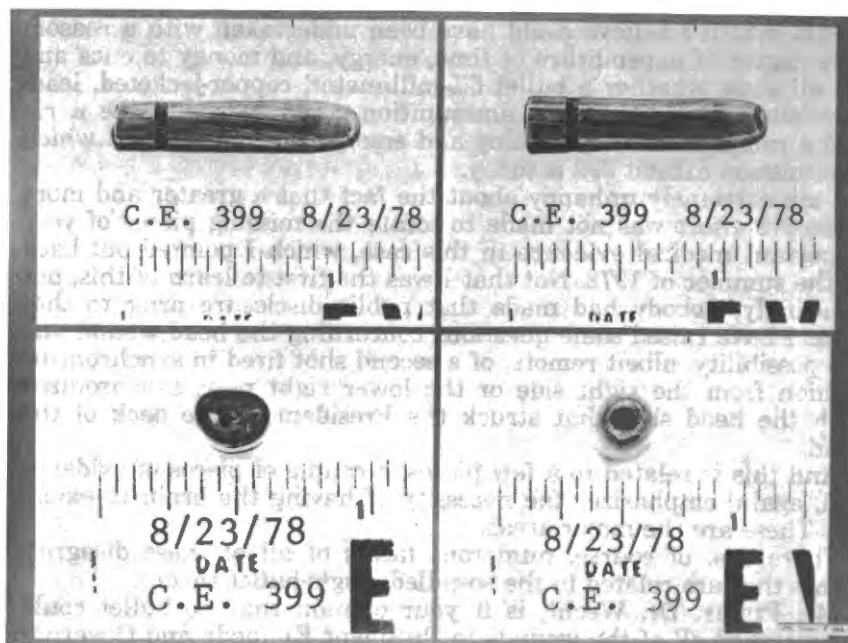
Mr. PURDY. Dr. Wecht, is it your opinion that no bullet could have caused all of the wounds to President Kennedy and Governor Connally or that Commission exhibit 399 could not have caused all of the wounds to both men?

Dr. WECHT. Based upon the findings in this case, it is my opinion that no bullet could have caused all these wounds, not only 399, but no other bullet that we know about or any fragment of any bullet that we know about in this case.

Mr. PURDY. Dr. Wecht, at this time, I would ask you to examine what has been entered into evidence as JFK exhibit No. F-95, which is the bullet Warren Commission 399. I would also like to ask that JFK exhibits F-102 A through D, which are photographic enlargements of this bullet, be entered into evidence at this time.

Chairman STOKES. Without objection, they may be entered into the record at this time.

[The above-referred-to exhibits, JFK F-102 A through D, are shown in JFK exhibit F-102 and follow:]



JFK EXHIBIT F-102

Mr. PURDY. Dr. Wecht, what is the basis for your opinion that Commission exhibit 399 could not have caused all of the wounds to President Kennedy and Governor Connally?

Dr. WECHT. It is a composite based upon several things: The timing of the Zapruder film, which we know runs at 18.3 frames or individual units of the film strip per second; the evaluation of the wounds in the President and Governor Connally; the timing of the test-firing in the hands of the most skilled marksman the Government could find in 1964 of this Mannlicher-Carcano weapon, the bolt action nonautomatic World War II Italian carbine, a grossly inferior weapon; the very vivid testimony of Governor John Connally about which he has been completely consistent for the past 14 years concerning the fact that he was struck by a different bullet; the vertical and horizontal trajectories that must be attributed to Commission exhibit 399 if the single-bullet theory is to be substantiated.

These are the various factors that relate to the single-bullet theory.

Mr. PURDY. Mr. Chairman, I would ask at this time that the item marked "JFK exhibit No. F-294" be entered into the record.

Chairman STOKES. Without objection, it may be entered into the record.

[The above-referred-to exhibit, JFK exhibit F-294, follows:]



JFK EXHIBIT F-294

Mr. PURDY. Dr. Wecht, is it correct that you asked to use this particular exhibit in your presentation today?

Dr. WECHT. Yes, I did. I submitted slides. These are blowups of those slides.

Mr. PURDY. Could you please explain why you feel this exhibit supports your contention that Commission exhibit 399 could not have caused all of the wounds to both men?

Dr. WECHT. Do you wish me to walk over there, Mr. Purdy?

Mr. PURDY. Yes, if you care to, Dr. Wecht.

Dr. WECHT. Commission exhibit 399 in the upper left photo is demonstrated with a side view. It shows the copper jacket to be completely intact, unscathed with no deformity, mutilation or markings. This is another side view. The small defect at the tip is where a piece of metal was properly taken by the FBI for spectrographic analysis.

The photograph on the bottom right shows the nose, the penetrating portion of the missile which is completely unmarked and without any scathing at all.

The photograph on the lower left shows the base of the bullet which is the only area of deformity, what I would refer to as some flattening with indentation of the metallic rim and focal extrusion of the inner lead core. That is the only deformity.

Now, I should like to move over to the next exhibit.

Mr. PURDY. Excuse me, Dr. Wecht. Let the record show that Dr. Wecht is referring to JFK exhibit F-294 now.

Dr. WECHT. Thank you. I do not see—I beg your pardon. Yes, I am sorry, F-294. The one which I was referring to a moment ago was F-102. I forgot to look at the bottom.

This exhibit, F-294, is a composite photo that I believe clearly, dramatically and most succinctly demonstrates the absurdity, the scientific untenability of the single bullet theory. This is Commission exhibit 399. I will not engage in semantical quibbling with my friend and colleague, Dr. Baden, whether you can be near pristine or fully pristine. It is a near pristine bullet, again, with the only deformity being demonstrated at the base, as we saw on F-102.

Commission exhibit 572 represents two bullets of identical ammunition to 399, 6.5 millimeter, copper jacketed, lead core military-type ammunition that were fired under the auspices of the Warren Commission, I believe, at the Edgewood Arsenal, sometime in 1964.

These two bullets in Commission exhibit 572 were fired into cotton wadding, striking nothing, coming to rest in that soft material.

Please note that at the base of those two bullets, one sees, in my opinion, even more extrusion and deformity of the lead core than one sees in 399, from the impact of the firing mechanism.

Commission exhibit 853 represents a bullet that was fired through the carcass of a goat that broke one rib of a goat, a smaller bone than that of a gentleman Governor Connally's size, 6 feet 4 inches.

I want to emphasize this because I realize that this learned body has studied these, but many people miss the fact that it is substantially different. They think maybe it is a visual distortion. The reason that this bullet looks bigger is because it is flattened. Not only is there significant extrusion at the base, but this apparently larger bullet is deformed due to its flattening, a bullet that broke one rib in a goat carcass. And Commission exhibit 856 represents a bullet that went through the wrist of a human cadaver breaking the distal end of the radius.

I would like to emphasize that these are not my selections. They are bullets that were selected by the Warren Commission. I can only assume that for their purposes, since the single bullet theory was their creation, that they chose the bullets that they felt would be best for their vested interest.

I now come back to Commission exhibit 399 and I ask anybody, forensic pathologist, ballistics expert, criminal attorney, investigator, to look at 399 which, under the single bullet theory, is alleged to have broken both a rib and a radius and contrast it with the bullet that was fired through the carcass of a goat breaking only a rib, or the bullet that was fired through the wrist of a human cadaver breaking only a radius.

This is the dramatic evidence that was produced, developed under the auspices of the Warren Commission, and it is this kind of evidence that I wanted to have reproduced by other experiments, I strongly disagree with the statement that has been made by my colleague, Dr. Baden, that perhaps it couldn't be done, it might be too much trouble, and so on I don't know how much he emphasized that today, that was discussed in the past with members of the staff and in our group—and what he did discuss today that this could not be simulated.

I take strong exception to this. We are now in 1978 with technological advancements and greater armamentarium. They could be

simulated in 1964; I have great wonderment as to what the problem is 14 years later.

Mr. PURDY. So, Dr. Wecht, it is your opinion, that were tests to be conducted to simulate these wounds, such tests could sufficiently duplicate the wounds in question to have an accurate illustration?

Dr. WECHT. Let me point out, that these tests that I am referring to have been performed, in fact, by a pathologist, Professor John Nichols, University of Kansas School of Medicine, a full-time academician, who shot them through ribs and wrists.

I know Dr. Nichols. He is not an independently wealthy man. He was able to do this; he was able to get the materials; he was able to set up the experiments and follow through.

Why our panel of distinguished experts with all our expertise and this staff representing a very prominent committee which, in turn, represents the House of Representatives of the United States Congress, why such tests could not be performed is beyond me. I feel constrained to say that they were not performed because people knew full well what the results would be.

I also want to take strong exception with the statement that if one were to shoot through bones that are not innervated and vascularized as they are in living human beings, one cannot be sure that one is getting similar reactions. Here, we are not talking about how the President's body would have reacted to the head wound. We are not talking about that. We are talking only about whether a bullet, as several members of the House Committee have questioned Dr. Baden, we are talking about what the condition of the bullet would be if it went through these bones.

There is no problem in setting up that experiment.

Mr. PURDY. Dr. Wecht, is it your opinion, then, that not only is the conclusion of the forensic pathology panel that Commission exhibit 399 is consistent with the wounds, incorrect, you feel it is demonstrably false, is that correct?

Dr. WECHT. It is absolutely false.

Well, I got involved back in 1965 with the American Academy of Forensic Sciences. For the past 12 or 13 years, I have repeatedly, limited to the context of the forensic pathologist, numerous times implored, beseeched, urged, in writing, orally, privately, collectively, my colleagues; to come up with one bullet, that has done this. I am not talking about 50 percent of the time plus one, 5 percent or 1 percent—just one bullet that have done this.

I also heard reference today by Dr. Baden that, yes, we have seen such bullets, not in the military setting, but we have seen them in civilian life. I can only say to you as a member of the panel, at no time did any of my colleagues ever bring in a bullet from a documented case of the Commonwealth of such and such or the State of such and such versus Jones or Smith and say here is a bullet in a documented case, there is the crime lab's report, it broke two bones in some human being, and look at it, its condition, it is pristine.

I stand here today and I wonder where that bullet is? Maybe it will be presented by the next member of the majority who has conveniently been sandwiched on the other side of me sometime tomorrow.

Mr. PURDY. Dr. Wecht, what is the basis for your opinion that the positions of President Kennedy and Governor Connally in the limousine are inconsistent with the single bullet passing through both men?

Dr. WECHT. The physical—

Mr. PURDY. I think you might want to stay there, we will get to the exhibit in one second.

Dr. WECHT. The physical relationship of the two men clearly demonstrates the physical impossibility of the trajectory attributed to Commission exhibit 399, specifically the horizontal and vertical angles with which it would have had to have struck the President and Governor Connally. Absolutely impossible.

Mr. PURDY. Mr. Chairman, I would ask at this time that exhibits marked JFK exhibit Nos. F-229, F-272, and F-244 be placed up on the board and admitted into evidence.

Chairman STOKES. Without objection, they may be entered at this point.

[The above referred to JFK exhibits were entered previously.]

Mr. PURDY. Dr. Wecht, what point along the film do you feel corresponds with the time when President Kennedy and Governor Connally were supposed to have been hit, according to the single bullet theory?

Dr. WECHT. Commission exhibit of—I am sorry—an exhibit of this panel, of this committee, of 229, which is a blow-up of Zapruder frame 193, demonstrates the President and Governor Connally just before they go in behind the Stemmons Freeway sign. Both gentlemen are turned to the right facing the crowd and their right arms are extended in a wave of greeting or recognition. This exhibit F-272, is a blow-up of Zapruder frame 222 and shows Gov. John Connally after emergence from behind the Stemmons Freeway sign, and F-244, which is a blow-up of Zapruder frame 225, shows the President and Gov. John Connally.

In my opinion, Zapruder frame 193 clearly demonstrates that neither gentlemen had been shot.

Mr. PURDY. Dr. Wecht, based on F-229, what is the basis for your opinion that neither man had been struck by a bullet in that photograph?

Dr. WECHT. There is absolutely no external physical manifestation, no reaction of any kind on their part of a voluntary or involuntary nature which would even suggest they have been struck by a missile.

Mr. PURDY. Dr. Wecht, is it possible that either or both men have been struck by a bullet but are not yet manifesting a reaction?

Dr. WECHT. In my opinion, without any question, no.

Mr. PURDY. Referring to F-272, which corresponds with Zapruder frame 222, is it your opinion that Governor Connally is indicating a reaction to being struck in that photograph?

Dr. WECHT. No; absolutely not.

Mr. PURDY. Referring to F-244, is there any indication on that photograph that either or both men have been struck by a bullet?

Dr. WECHT. Yes. President John F. Kennedy has definitely been struck, as seen on F-244, Zapruder frame 225. Gov. John Connally, in my opinion, has not been struck in that frame, as of that frame.

Mr. PURDY. Referring again to F-244, what is the earliest prior to that point that President Kennedy would have had to have been struck?

Dr. WECHT. I would say probably somewhere like—well I can't—I would put it, based upon the timing of the Zapruder film and counting the frames, I would put it back somewhere about a half a second, maybe even a little bit more, somewhere along there. I cannot be precise.

I do want to point out at this time, if I may, because there is some confusion on this, sometimes there has been deliberate misrepresentation of the period of time during which the two gentlemen are behind the Stemmons Freeway sign. That is a period of 0.9 seconds. I emphasize that because we see in F-229 that indeed Gov. John Connally is sitting directly in front of the President. We see in F-244 that Gov. John Connally is still seated directly in front of the President.

When we bring up the question of the trajectory, that hopefully we will get into later, they say, ah, but we cannot know what happened when they were behind the Stemmons Freeway sign. I just think it is important for the record to reflect upon the fact that what presumably they are asking us to just speculate upon is that in that 0.9 second interval, the President bent down to tie his shoelace or fix his sock, he was then shot and then sat back up. I do not mean to be flip, this is a very serious matter, but I would suggest that is a movement that the most skilled athlete, knowing what he is going to do, could not perform in that period of time.

That is very important to understand, because we see their positions before and immediately afterward. I think it is pure poppycock, it would be an insult to this committee for anybody to suggest that we can't really determine trajectory because we don't know what the physical relationship was between the two men when the President was shot, and when they say under the single bullet theory, John Connally had also been shot.

Mr. PURDY. Dr. Wecht, what was the nature of the wound through President Kennedy that indicates to you that he would have reacted to being struck as quickly as you indicate?

Dr. WECHT. He was struck in the back. There are a variety of nerves that innervate the skin, the musculature, blood vessels, and so on. He, as indeed Gov. John Connally, were both healthy, adult males, in a very vibrant, dynamic sensitive situation, attuned very much to their environment, and there is no question in my mind that the reaction would have occurred immediately in an infinitesimal moment.

Mr. PURDY. Dr. Wecht, based on the photograph, you have already gone into the issue of trajectory and articulated to some extent why you believe the President and the Governor were not lined up in such a way that a bullet could have passed between them.

How certain are you that they could not have been lined up behind the sign when they were out of the view of the camera?

Dr. WECHT. I am absolutely certain for the reasons that I have already given and as are demonstrated on these films. There is simply no way in the world that the kinds of changes of positions of these two men required by the single bullet theory could have

been accomplished. There is no physiological way in which it could have been performed, there is no basis to speculate on why such a movement would have occurred.

Quite literally, John Connally would have had to have moved a foot or more to his left and then moved back, and/or the President would have had to have almost leaned out of the car and then to have come back to his position. And I am not being the least bit facetious. That is what would have had to have occurred in that nine-tenths of a second interval if we are to assume that this bullet went through the two men in the fashion attributed to it in the single bullet theory.

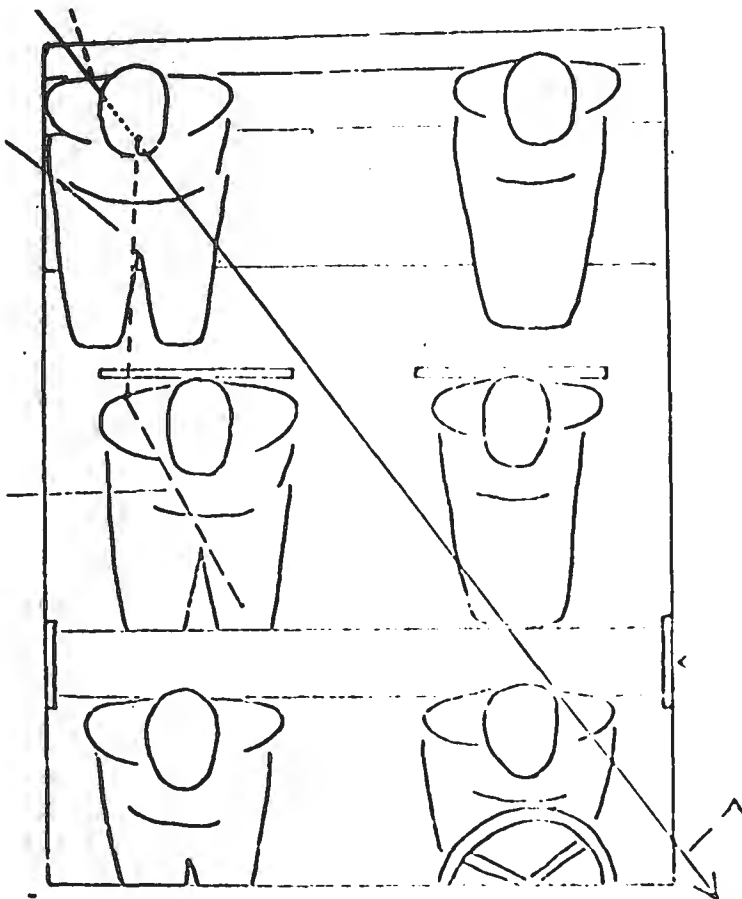
Mr. PURDY. Mr. Chairman, I would like to ask at this time that the two items marked JFK exhibits F-320 and F-273 be entered into the record.

Chairman STOKES. Without objection, they may be entered into the record.

[JFK exhibit F-273 was entered previously.]

[The above referred to JFK exhibit F-320 follows:]





Figure

Scale schematic illustration of passenger compartment of the Presidential limousine showing most likely approximate bullet path. Always angle shown is 35 degrees.

JFK EXHIBIT F-320

Mr. PURDY. Ms. Godfrey, if we could keep those photographs up also.

Dr. Wecht, is it correct that you asked that these two diagrams be used during this questioning?

Dr. WECHT. Yes, I did.

Mr. PURDY. Dr. Wecht, excuse me.

Dr. WECHT. I am sorry.

Mr. PURDY. For the purposes of the formulation of these diagrams, how was it determined where the men were seated in the car and the angle the bullet would have struck President Kennedy?

Dr. WECHT. The positions of the two men were formulated in this schematic representation based upon my review of the Zapruder film, originally at Life magazine headquarters in 1966, at the National Archives in 1972, and repeated under the auspices of this forensic pathology panel last year and this year. It is also based upon my review of the Nix and Muchmore films, my review of the testimony and accounts of numerous people involved, including Governor and Mrs. Connally, Mrs. Kennedy, and other eye witnesses. All of these things together, plus the discussion that we have just been through, would indicate to me that this is a fair and most reasonably accurate representation of the positions of the Kennedys, the Connallys and the two Secret Service agents, Greer and Kellerman, who were sitting in the front seat.

Mr. PURDY. What is it about the normal paths of bullets which leads you to the conclusion that these diagrams illustrating the photographs, permit you to conclude that the bullet did not pass through both men?

Dr. WECHT. The inescapable fact that unless a bullet, especially one fired from a high speed weapon, reasonably high speed, approximately 2,000 feet per second muzzle velocity—unless it strikes something of firm substance, such as bone or something else, that that bullet will travel in a straight line.

Mr. PURDY. Mr. Chairman, I would ask at this time that the item marked JFK exhibit F-245, which is a blowup of frame 230 of the Zapruder film, be entered into the record.

Chairman STOKES. Without objection, it may be entered into the record.

[The above referred to JFK exhibit F-245 was entered previously.]

Mr. PURDY. Dr. Wecht, in your opinion, could Governor Connally have incurred the damage to his wrist which is described in the medical reports and still be holding the hat as shown in this photograph?

Dr. WECHT. No; absolutely not. In F-245, which is a blowup of Zapruder frame 230, we are told under the single bullet theory that Gov. John Connally, for a period of approximately one and a half seconds, has already been shot through the right chest with the right lung pierced and collapsed, through the right wrist, with the distal end of the radius comminuted and the radial nerve partially severed.

I heard some vague reference to a nerve in the prior testimony, but I didn't hear the followthrough discussion that I was waiting for about nerve damage. There was nerve damage, yes, to the radial nerve. And the thumb which holds this large Texas white Stetson that is required for it to be in apposition with the index or index and middle fingers to hold that hat is innervated by the radial nerve. Note in F-245 that the hat is still being held and Governor Connally is not reacting.

This is again a very alert individual, under a very special circumstance, and I do not believe or accept for one moment the story that we must accept under the single bullet theory that this gentlemen, at this point, one and a half seconds previously, has already been shot through his chest, through his wrist, and into his left thigh.

Mr. PURDY. Dr. Wecht, is it your opinion based on this exhibit, JFK exhibit F-245, that Governor Connally is not yet injured in any way?

Dr. WECHT. Yes; that is my opinion.

Mr. PURDY. Dr. Wecht, Is it possible that he had been injured prior to this frame but has not yet manifested a reaction?

Dr. WECHT. No; I do not believe so, not given the nature and extents of his wounds, the multiplicity and the areas damaged, I do not believe that.

Mr. PURDY. Dr. Wecht, given the nature of his wounds, how much prior to the time that he manifests a reaction is the earliest he could have been struck?

Dr. WECHT. Well, a fraction of a second, again, an infinitesimal moment. It is possible that a fraction of a second earlier he could have been shot, although I do not believe that.

Please keep in mind that now we must correlate that with the Governor's own version, and remembering that this bullet was traveling 2,000 feet per second muzzle velocity, much faster than the speed of sound.

Please keep in mind that it does not seem at all likely. I doubt that it is possible that he had already been struck.

Mr. PURDY. Mr. Chairman, I would ask at this time that items marked JFK exhibits F-246 and F-247, which correspond with Zapruder frame numbers 236 and 237, be entered into the record.

Chairman STOKES. Without objection they may be entered into the record.

[The above referred to JFK exhibits F-246 and F-247 were entered previously.]

Mr. PURDY. Dr. Wecht, from your examination of these photographs, do you conclude that Governor Connally has been struck?

Dr. WECHT. Yes; I believe F-246, which is a blowup of Zapruder frame 237, demonstrates that Gov. John Connally has now been struck.

Mr. PURDY. Dr. Wecht, what is it about his movements that leads you to the conclusion that he has been struck?

Dr. WECHT. The body is turning, the cheeks are puffing out, there is a noticeable grimace on his face, in contrast, for instance, to F-245, Z-frame 230, and there seems to be some dishevelment of his hair. These features can be seen very dramatically also one frame later, F-247, or Zapruder frame 238, which I remind you is one-eighteenth of a second interval away, and you can see the hair movement, the twisting of the body. There is no question in my mind that the Governor has now been hit.

Chairman STOKES. Would counsel suspend for a moment. There is a live quorum on with a vote immediately following and at this time, the committee will recess for 15 minutes.

[A short recess was taken.]

Chairman STOKES. The committee will come back to order.

The Chair recognizes staff counsel Purdy.

Mr. PURDY. Thank you, Mr. Chairman.

Dr. Wecht, referring again to the JFK exhibits F-229, F-272 and F-244, which are the frames immediately before and the frames after the sign, you discussed the fact that the men did not line up in a horizontal trajectory?

Dr. WECHT. Yes. The panel, to the best of my recollection, was in unanimous agreement that there was a slight upward trajectory of the bullet through President John F. Kennedy, that is to say, that the bullet wound of entrance on the President's back, lined up with the bullet wound of exit in the front of the President's neck, drawing a straight line, showed that vertically the bullet had moved slightly upward, slightly, but upward.

That is extremely important for two reasons. One, under the single bullet theory—with Oswald as the sole assassin, or anybody else, in the sixth floor window, southeast corner of the Texas School Book Depository Building, you have the bullet coming down at a downward angle of around 20-25 degrees, something like that, maybe a little bit less. It had originally been postulated, I think, by the autopsy team, and the initial investigators, at considerably more. How in the world can a bullet be fired from the sixth floor window, strike the President in the back, and yet have a slightly upward direction?

There was nothing there to cause it to change its course. And then with the slightly upward direction, outside the President's neck, that bullet then embarked upon a rollercoaster ride with a major dip, because it then proceeded; under the single bullet theory, through Gov. John Connally at a 25 degree angle of declination.

To my knowledge, there has never been any disagreement among the proponents and defenders of the Warren Commission report or the critics, about the angle of declination in John Connally—maybe a degree or two. We have that bullet going through the Governor at about 25 degrees downward. How does a bullet that is moving slightly upward in the President proceed then to move downward 25 degrees in John Connally. This is what I cannot understand.

My colleagues on the panel are aware of this. We discussed it, and what we keep coming back to is, "well, don't know how the two men were seated in relationship to each other." I don't care what happened behind the Stemmons freeway sign, there is no way in the world that they can put that together, and likewise on the horizontal plane, the bullet, please keep in mind, entered in the President's right back, I agree, exited in the anterior midline of the President's neck, I agree, and was moving thence by definition, by known facts, on a straight line from entrance to exit, from right to left.

And so with that bullet moving in a leftward fashion, it then somehow made an acute angular turn, came back almost two feet, stopped, made a second turn, and slammed into Gov. John Connally behind the right armpit, referred to medically as the right posterior axillary area.

The vertical and horizontal trajectory of this bullet, 399, under the single bullet theory is absolutely unfathomable, indefensible, and incredible.

Mr. PURDY. Dr. Wecht, I would like you to examine JFK exhibit F-84, which has already been entered into the record, which is an X-ray of Governor Connally's chest—excuse me—of his wrist, and, Dr. Wecht, could you tell us whether you believe that Commission exhibit 399 could have caused the injuries to the wrist of Governor Connally?

Dr. WECHT. No, I do not. I would like to emphasize that this is what is referred to medically as a comminuted fracture. I have been negatively impressed by repeated efforts on the part of my fellow panelists and others to deminimize the nature of the severity of this fracture. They imply it was merely slight linear nondisplaced fracture.

It was a comminuted fracture with substantial displacement—and comminuted means fragmented.

Also, again, despite the testimony of my colleague, my predecessor here today, I must take strong exception. He has indicated that the radius apparently is just not that big a bone. As this distinguished committee and members of the staff saw yesterday, Governor Connally, I think, is about six foot four. I don't know his exact weight, 200 pounds approximately. He is a big man. That is the distal end of the radius where you can see the bone begins to fan out. It indeed is a heavy bone. To suggest that it is no thicker than a phalanx, a finger bone in a 10-year-old child, is not fair. It is not an accurate representation.

I say that a bullet that struck the distal radius, the region above the eight small wrist bones—it is one of the two large bones coming down from the elbow to the wrist—that a bullet that struck and caused that damage and which had previously damaged and destroyed, pulverized 5 inches of the right fifth rib, could not have emerged in the near pristine condition of Commission exhibit 399.

In that relationship I also want to point out that I heard testimony here today, as I heard discussed previously by our panel that we don't really know if the right fifth rib was damaged; if so, and how much; and whether it was struck directly, or perhaps the fracture might have been caused by implosion, or whatever. I don't know where this speculation comes from. I know indeed what the operating surgeon on Friday, November 22, 1963, at Parkland Hospital said about what he found when he explored Gov. John Connally's chest. He found 5 inches of that bone literally pulverized.

Mr. PURDY. Dr. Wecht, is it your opinion that Commission exhibit 399 could not have caused the wounds other than the wrist wound of Governor Connally?

I take it from what you have just stated about the damage to the rib, that you do not believe that Commission exhibit 399 could have caused the damage to Governor Connally's rib, is that correct?

Dr. WECHT. Let me make sure I understand your question. Mr. Purdy, are you asking me could Commission exhibit 399 have caused the damage to the rib alone, if one were to assume that it struck no other bone?

Mr. PURDY. Correct.

Dr. WECHT. That is a possibility that I would accept, that I cannot rule out—

Mr. PURDY. Dr. Wecht—

Dr. WECHT [continuing]. If it struck the rib alone.

Mr. PURDY. Is it possible that Commission exhibit 399 could have caused all of the wounds of Governor Connally, other than the wrist wound?

Dr. WECHT. Only the rib and then a fragment or a portion of a bullet into the left thigh, yes, that is another possibility that I cannot exclude.

Mr. PURDY. Do you want to be seated again?

Dr. WECHT. Yes sir.

Mr. PURDY. Dr. Wecht, earlier today Dr. Baden testified on behalf of the forensic pathology panel that the wound in Governor Connally's back was such that the majority of the panel concluded that the bullet which struck him had struck something else first. Do you agree with that interpretation?

Dr. WECHT. No. I do not feel that there is any such definitive evidence, although it is a possibility that the bullet might have struck a small branch or some leaves coming in. I cannot rule that out, but I think that the fact that the scar on Gov. John Connally's back is in a horizontal plane is more consistent with the shot having been fired from the right side, the right rear, entering with some degree of a tangential nature.

Mr. PURDY. Dr. Wecht, you stated earlier that you have a disagreement with the certainty of the forensic pathology panel's conclusion that the President was struck in the head with only one bullet. If the President was struck by a second bullet in the head, how close in time to the first bullet do you think the other came?

Dr. WECHT. If the President had been struck in the head with a second bullet, then it would have been fired in synchronized fashion simultaneous with the shot that did strike him in the rear of the head, as has been presented here today.

Mr. PURDY. Dr. Wecht, what evidence is there which supports the possibility that there was a shot from the side or from the lower right rear?

Dr. WECHT. Very meager, and the possibility based upon the existing evidence is extremely remote. There is a small piece of some material that is present at the base of the external scalp, just above the hairline, which has never been commented on before except by me following the 1972 investigation of the material at the Archives, and later commented upon by this forensic pathology panel.

There is a total deformation of the right side of the cranial vault with extensive fractures of the calvarium, the top portion of the skull, and extensive scalp lacerations and loss of soft tissue, so that we cannot exactly know where the exit wound was. It is, therefore, possible that that extensive deformity of the scalp, underlying galea, underlying bone calvarium, could also be the locus of the second shot of some kind of frangible ammunition which would not have penetrated deeply or at all through the calvarium.

I want to emphasize that this is remote but I have pointed this out because it is a possibility. The question of the President's movement after he was struck in the head makes us direct our attention toward such a possibility and, of course, the absence of the brain and the failure of the original pathologists to have conducted studies that are routine, perfunctory in any kind of an autopsy where the brain has been fixed in formalin, to serially section the brain 10 to 14 days later, and the absence of the brain and the inability or the failure of the staff to obtain that medical evidence, all of these things, I believe, make it important to just raise that possibility, remote as it may be, that a second shot might have struck the President in the head in synchronized or simultaneous fashion.

Mr. PURDY. Dr. Wecht, to what extent would having access to the brain itself enable a final determination as to whether or not the remote possibility of a shot from the side is supported or refuted by the evidence?

Dr. WECHT. Well, examination of the brain would help a great deal. Of course, if the bullet had not penetrated through the calvarium then there would be no evidence of a second bullet track in the soft brain tissue.

If it had penetrated partly, or even a fragment or two, then certainly at that time, and even today, if the brain had been properly preserved and fixed and the formalin solution changed every so often, one would be able, I believe, to tell whether there is only one bullet track, that is, from the right upper occipital region down to the lower right temporal parietal area. The brain would be extremely important to help us determine whether more than one missile had penetrated or a fragment of a second missile might have penetrated the brain along with the one that we do know definitely penetrated. I am in agreement with the description that was presented today regarding the shot through the head.

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.

Mr. PURDY. Thank you.

Mr. Chairman, I have no further questions.

Chairman STOKES. At this time the committee will operate under the 5-minute rule. I withdraw that. The Chair will recognize Counsel Gary Cornwell.

Mr. CORNWELL. Dr. Wecht, first, so that we might understand the reasons for the disagreement as to principally the single bullet theory between you and the rest of the medical panel, let me ask you whether you have had access to any data or information that the rest of the medical panel members have not had access to?

Dr. WECHT. The only thing that I am personally knowledgeable of was the frame-by-frame study in blown up fashion of what I was informed then was the primary copy of the Zapruder film on huge lighted tables at Life magazine headquarters in 1966. Aside from that, I do not know of anything that I have seen that they have not seen.

Mr. CORNWELL. And would you feel that your expertise in the field of forensic pathology differs in a substantial way from the expertise of the other panel members in that field?

Dr. WECHT. Insofar as professional scientific expertise related to formal training in forensic pathology, and practice in the field of forensic pathology in a medical-legal investigative facility are concerned, I would say that I am not aware of any major or substantial difference.

Mr. CORNWELL. Then would it be fair to state that the difference of opinion between you and the other panel members, as again to principally the single bullet theory, is based strictly or derived

strictly from a difference of opinion based on the same evidence from persons of similar backgrounds and training?

Dr. WECHT. Yes; clearly, Mr. Cornwell, it is a difference of opinion. However, I would like to supplement that answer by saying that I believe this is not in the realm of interpretive or speculative or conjectural opinion but is related to things which I truly believe do not even require the expertise of a forensic pathologist to see and interpret.

Mr. CORNWELL. Just so we understand for sure what your testimony is as to the possibility of a head shot on the right, you have called it a remote possibility—

Dr. WECHT. Remote possibility.

Mr. CORNWELL. In a court of law, what would be the normal role of opinions to only that degree of certainty?

Dr. WECHT. You are more of an expert than I, Mr. Cornwell, however, I won't take the easy way out and evade your question in that fashion. I am sure that every judge I have been involved with would not permit such testimony to go in.

But, of course, there are other differences, too. As you know, they work the other way involving the fact that this is not a court of law.

Mr. CORNWELL. So, just again to understand that part of your testimony, would it be fairly accurate to state that what you have suggested basically is that this is not a normal case and that, therefore, it is sort of because it was the President who was killed that we would like to know as much as absolutely possible, and if we had had more data, such as the brain, we might even have been able to do away with all speculation on the subject; is that correct?

Dr. WECHT. I am not sure if I completely follow you. Let me say, and please stop me if I am not being responsive, that had I been involved in the original investigation, then I certainly would have done those things that I have talked about—the examination of the brain in its formal in fixed state, approximately 2 weeks afterward, which incidentally they started to do on December 6, 1963, but which they then aborted. The last sentence of that supplemental report is something like, "No sagittal sections of the brain are made in order to preserve the specimen." Quote, unquote. Were this case brought to me in consultation as a medical-legal expert, not involving the President but just somebody who was able to retain an independent forensic pathologist, I indeed would raise the same points to the attorney, whichever side, the district attorney or the defense attorney, and ask them to look into it.

You see, what I would be permitted to testify to subsequently at a trial would be one thing, but I would raise these things investigatively in advance of the trial. It would make no difference, were it the President, you, me, Mr. Jones, or Mr. Smith.

Mr. CORNWELL. Directing your attention, next, to the single-bullet theory, as I understand your testimony, it is not that one bullet of the Mannlicher-Carcano type would not have been powerful enough to go through the neck, the chest, the wrists and imbed itself in the thigh, is that correct, as a matter of mere power?

Dr. WECHT. Yes; I believe that it is possible for that kind of ammunition to go through those several portions of human body.



Mr. CORNWELL. And if the single-bullet theory is not correct, how many bullets, in your view, did strike the two occupants of the car?

Dr. WECHT. Of course, then—let me answer that, I believe that the President was struck definitely twice, one bullet entering in the back, and one bullet entering in the back of the head. I believe that Gov. John Connally was struck by a bullet, and I believe that another bullet completely missed the car. I think that there were four shots most probably fired. I eagerly await with extreme anticipation the results of the consulting firm that I understand your committee has retained in Boston, Bolt, Beranek & Newman, concerning their interpretative studies of the motorcycle policeman's tape from that day; as to whether or not they have definitely found evidence of four shots having been fired.

But I think your question was, how many bullets struck the occupants, and I think that there is definite evidence for three. There is a possibility of more, but I can't really introduce evidence that would corroborate that; more than three.

Mr. CORNWELL. If I could direct your attention again to, I believe it was JFK exhibit F-294, which showed deformations on various bullets, and simultaneously I would like to ask if we could show the witness 399, the actual bullet.

Have you had a chance to look at the exhibit?

Dr. WECHT. Yes, sir.

Mr. CORNWELL. The question I would like to direct your attention to is under what circumstances does deformation of a bullet occur?

Dr. WECHT. I feel that when a bullet strikes a dense object, such as a distal end of a radius in an adult male, like John Connally, that there would be deformation of a measurable degree.

Mr. CORNWELL. Then, using the example of the wrist you just used, would it be accurate to state that such a bullet perhaps could have gone through the neck without experiencing substantial deformation if it went through the neck of the President alone?

In other words, that's not where you would expect substantial deformation?

Dr. WECHT. Yes, that's correct. There would not have been deformation of a substantial degree. As a matter of fact, based upon the description which we have by documented record and testimony of the physicians who examined the President at Parkland Hospital emergency room, the small even-edged, round symmetrical wound that they thought at that time, mistakenly, was an entrance wound, I would say that the bullet was not deformed, it was not wobbling or tumbling and it had not straightened out from a wobbling course only to start wobbling again.

Mr. CORNWELL. Let's again use the hypothetical of just going through the Governor's chest. Could it have gone through the chest alone, nothing else, and suffered no more deformation, in your opinion, than 399?

Dr. WECHT. You mean after emerging from the President's neck?

Mr. CORNWELL. Either way, or both, if the hypothetical varies, tell me both ways.

Dr. WECHT. I do not believe it could have gone through Governor Connally's chest because the horizontal and vertical trajectories would not have permitted the course of that bullet.

Mr. CORNWELL. I am not talking about trajectories, I am just talking about if a bullet went through the chest alone.

Dr. WECHT. In a hypothetical situation?

Mr. CORNWELL. Yes, sir.

Dr. WECHT. Doing what we believe the bullet did in President Kennedy's upper chest and neck area, and then doing what we know the bullet to have done in Gov. John Connally's chest; is that your question?

Mr. CORNWELL. Let's assume the trajectory is lined up for purposes of discussion.

Dr. WECHT. The answer is it gets back to what Mr. Purdy asked me. The answer is I think it would be possible for a bullet to have emerged with a relatively minimal degree of deformity having gone through those two parts of the human anatomy of two human beings.

Mr. CORNWELL. All right. Then, let's skip the wrist for a moment. Could it also have embedded itself to the degree that it did in Governor Connally's thigh or that some bullet apparently did and suffered no great deformity in that process?

Dr. WECHT. Yes; that would be possible.

Mr. CORNWELL. So, it is the wrist that is primarily the problem?

Dr. WECHT. Well, when you put the wrist on top, it is a cumulative thing, yes; because the rib cannot be totally ignored in a cumulative sense with the wrist. It is rib and wrist together. Rib alone; I recognize the possibility of a bullet doing that damage and emerging in this condition.

Mr. CORNWELL. Let me then rephrase it, it is the wrist which is primarily the problem, that's the one that you would expect the greatest deformation to occur in?

Dr. WECHT. Yes; especially with rib and wrist. Wrist alone, as I have already said, I believe would have produced more deformation than we see here had those injuries been noted that we demonstrated on a blow-up of Gov. John Connally's wrist X-ray a moment ago.

I just want to say that the rib, then followed by the wrist would place greater physical stress on the bullet than wrist alone.

Mr. CORNWELL. Even though the two of them were probably separated by some air between the two; is that correct?

Dr. WECHT. Yes; it is an additive effect.

Mr. CORNWELL. It then simply boils down to, as I understand it, the proposition that 399 could not have gone through the wrist and remained in that good of condition?

Dr. WECHT. I don't know what you mean by "simply" because I am also including—if you are limiting it to that, the answer is yes, but my criticism of the single-bullet theory includes much more than just deformation.

Mr. CORNWELL. May I ask the clerk to hand me the exhibit 399, the one the witness has. It's apparently our exhibit 95; is that correct?

What I would like to do now is discuss with you the implications, if any, of velocity on these hypotheticals we have just been discussing. The markings on the bullet, of course, are of critical importance; is that correct?

Dr. WECHT. Yes.

Mr. CORNWELL. They have been observed by you very carefully on prior occasions and on this occasion?

Dr. WECHT. Are you referring to the piece taken for spectrographic analysis and the deformation at the base?

Mr. CORNWELL. The bullet.

Dr. WECHT. Yes.

Mr. CORNWELL. If I were to hold the bullet up above the table, and tell you I was going to drop it, would it worry you that we might destroy some of the evidence by covering over some of the markings on the end of the bullet?

Dr. WECHT. No; unless one were talking about the possibility of doing some very refined ballistics studies.

Mr. CORNWELL. Nothing observable.

Dr. WECHT. No; I do not believe with the naked eye—

[At this point, counsel dropped bullet.]

Mr. CORNWELL. No damage will occur?

Dr. WECHT. No.

Mr. CORNWELL. What would you estimate the velocity of that to have been?

Dr. WECHT. A free-falling object, if I remember my high school physics, is about 32 feet per second; is that right, gravity?

Mr. CORNWELL. I am not an expert; I don't know.

Dr. WECHT. I am a little bit removed from my physics, but I think that rings a bell, 32 feet per second.

Mr. CORNWELL. Would it be accurate to state that at least in relation to the velocity of a Mannlicher-Carcano with the muzzle, that was virtually zero velocity that we just observed?

Dr. WECHT. Yes, in relationship to 2,000 feet per second, just a fraction thereof.

Mr. CORNWELL. Now, if we were to increase that by dropping it higher and higher or using some other method, such as perhaps embedding it in a piece of wood and hitting it, at what velocity would that bullet begin to deform if the thing it struck was a bone of the nature of the Governor's wrist?

Dr. WECHT. I cannot be certain about what the minimal velocity would be that would be required. And I would like to suggest that this question, and many others like it, which might be extremely relevant, this question could have been easily answered, Mr. Cornwell, by simply shooting 6.5 millimeter ammunition through another Mannlicher-Carcano weapon instead of engaging in cross-examination of me, although I realize you are free to do that, but this is the kind of study, sir, with all due respect, that could have been performed, and if it has been performed, I, as a member of the panel, have not been made aware of it.

Mr. CORNWELL. Would you know whether or not it would be possible to calculate the velocity at which the bullet would begin to deform upon striking a bone such as that?

Dr. WECHT. One could probably work out some experiments that would permit some reasonable conclusions in that regard. I would have to confer with experts in physics, experts in ballistics before expressing a definitive opinion that would get certainly beyond my limited realm, relatively speaking, of forensic pathology.

Mr. CORNWELL. Would it also be possible to determine at what velocity a bullet like that would shatter bone?

Dr. WECHT. Again, I believe, offhand, that such an experiment could probably be worked out within a reasonable range.

Mr. CORNWELL. Let's suppose we determined those two matters, the point at which this bullet hitting straight on, and then perhaps it was going sideways, began to deform upon hitting bone, the velocities there, and we also determined the velocity at which bone shatters, and let's just suppose, hypothetically, those two were not the same and that the bullet deformed at a higher velocity than bone shattered, would there not then be a gap between the two at which the bullet could go through bone, shatter it and suffer no deformation?

Dr. WECHT. I can't answer such a hypothetical—It really involves too much speculation. I really can't respond to that intelligently.

Mr. CORNWELL. Let's see what you could provide us as an insight on this problem. Let me ask you, would you at least know from your experience that it is a relevant factor how fast the bullet is going when it strikes bones in order to determine the amount of deformation that would occur, if any?

Dr. WECHT. To some degree, it is a relevant factor with regard to the extent and severity of such deformation.

Mr. CORNWELL. Now then, returning to the JFK exhibit F-294, you didn't tell us, I believe, when you explained the deformations there, how fast those bullets were going. Would you mind doing that?

Dr. WECHT. To my knowledge, those bullets were fired from another identical weapon, a Mannlicher-Carcano; the ammunition was identical to Commission exhibit 399. To my knowledge, the test which was set up by the Warren Commission, fired that directly through a goat carcass so that the velocity was roughly equivalent to the muzzle velocity, and similarly with the wrist of the human cadaver.

Mr. CORNWELL. Do you have any information as to how fast the bullet was traveling, whatever bullet it was, when it hit Governor Connally in the wrist?

Dr. WECHT. No; there are estimates. My recollection is that it has been estimated that when it struck his chest, it was probably down to about maybe 1,800 feet per second, or thereabout, and the wrist maybe as little as 1,200 to 1,500, something like that, but that's a vague recollection.

Mr. CORNWELL. What are those estimates based upon? What assumptions would necessarily underlie it?

Dr. WECHT. I think that they were based upon some studies that people involved in this field had performed.

Mr. CORNWELL. What I meant was, are they based on assumptions that the bullet hit nothing first and that it was going through the air from its muzzle and the muzzle was located no more or less than certain distances from the Governor, things like that?

Dr. WECHT. No; the estimate of the velocity in the Governor's chest was, of course, predicated upon their belief that the bullet had already gone through President Kennedy's back and out his neck, and their estimate of the velocity through the Governor's right wrist was based upon their speculation that that bullet had gone through the Governor's chest and President Kennedy's back.

Mr. CORNWELL. So, a comparison of 399, then, with that chart might not necessarily be valid if 399 struck bones at one velocity and the bullets on the chart struck the bones at a different velocity?

Dr. WECHT. No; I would not accept that statement, not in toto. With regard to Commission exhibit 572, the two bullets fired in the cotton wadding, that muzzle velocity was exactly the same as 399 initially and 853 through the carcass of a goat, that would have been reduced, it is estimated, about one-tenth, 10 percent of the original velocity, not terribly substantial.

Exhibit 856, again, under the premises of the single bullet theory, would have been down to anywhere from three-fifths, 60 percent, to 75 percent of the original velocity. These are all things that would have to be worked out experimentally and I very much wish had been previously.

Mr. CORNWELL. Then, just one final question. If we don't know at what precise velocity the bullet struck the wrist, what effect, if any, would it make on the single bullet theory if we could show that 399 did hit the wrist?

Dr. WECHT. There is no problem, you see, Mr. Cornwell, in setting up an experiment which would permit all three possibilities to be considered. One could set it up to have it fired.

Mr. CORNWELL. I don't think you understood the question. Let me ask it one more time.

If we could show, even though we don't know the precise velocity at which the bullet hit the Governor's wrist, if we could show that 399 did hit that wrist, what, if any, impact would that make upon your analysis of the lack of validity of the single bullet theory?

Dr. WECHT. If you were to shoot that ammunition through the wrist of the human cadaver, then you would know what damage it would produce traveling at 2,000 feet per second. If you were to set up a goat carcass or even a human chest and then the wrist, you would see and be able to measure that velocity and obtain that batch of the ammunition, and if you wanted to have something representing the President's chest and neck, you could do it with a gelatin block. So, you could do all these things.

Mr. CORNWELL. I understand. I am sorry I am having trouble phrasing my question. Let me try it a different way. You wrote an article at one point in *Modern Medicine*, October 28, 1974, in which you discussed some of the examinations that the FBI had attempted, spectrographic analysis and that sort of thing, at which point after discussing the inconclusiveness of the FBI's examinations, you stated:

If it had been found that the composition of the lead in the fragment recovered from Governor Connally's wrist wound was indistinguishable from the composition of the lead in the nearly whole bullet found at Parkland Hospital, that fact alone would lend strong support to the single bullet theory.

Do you still have that view?

Dr. WECHT. To some extent, that would be true, but in light of my new knowledge about the trajectory, particularly the vertical trajectory with the upward course through the body, then that statement would be much less definitive, much less positive than it was as expressed by me in that article a few years ago.

Mr. CORNWELL. So, in other words, if there were such evidence, it would make a substantial impact upon your analysis of the improbability of a single bullet theory, except, that of course, there is still the question of the positions of bodies in the car; is that accurate?

Dr. WECHT. Extensive, detailed, complete neutron activation analyses of all the bullets and all the fragments, including those which had not been removed, including the one which was in Governor Connally's left thigh, including the one which I understand, according to sworn affidavits, was removed from the Governor's chest, given to a nurse, who gave it to a policeman, who gave it to an FBI agent, if all those things were done, Mr. Cornwell, then I would be prepared to discuss the impact of the NAA findings on the single bullet theory.

In the absence of all NAA tests, I am not prepared to accept a piecemeal presentation of a few tests that some people in some Government agencies felt could be done and others which would not necessarily have to be performed.

Mr. CORNWELL. I have no further questions. Thank you.

Chairman STOKES. The committee, at this time, will operate under the 5-minute rule, starting with the Chair.

Dr. Wecht, you were one of a panel of nine eminently qualified forensic pathologists; is that correct?

Dr. WECHT. Yes, sir, I thank you for the characterization. I was one of nine; yes, sir.

Chairman STOKES. And you do not quarrel with my categorization of them, the other eight, as being eminently qualified, do you?

Dr. WECHT. No.

Chairman STOKES. Now, with all of you being men of a profession in which you are certainly jealous of your reputation in the field, is there any reason why these other eight men would take the position they have taken based upon anything other than medical certification?

Dr. WECHT. Mr. Chairman, you would have to ask them that question. I do not mean to be either evasive and certainly not disrespectful, but it would be presumptuous of me to speculate on that.

There are some things involving some present and former professional relationships and things between some of them, and some people who have served on previous panels. In fact, two of the members of this panel have been previously involved. One under the auspices of CBS with the Government's implied permission and delight, if not expressed sponsorship, and another one with the Rockefeller Commission.

There are things of this nature, but you would have to ask them about whatever particular motivations or thoughts they may have. I can only do my very best, sir, to present to you the evidence as I have interpreted it and give you my conclusions and opinions therefrom.

Chairman STOKES. Perhaps you can help me in this respect. Assuming I am the average American citizen who has been sitting out here today and listening to these hearings and viewing it on television as they are across the country, and when they hear the testimony as it has been reflected through Dr. Baden of the eight other forensic pathologists, as related to your testimony, tell me,

what should the average American believe in terms of the medical evidence that has been presented here today? Should they believe them or should they believe you?

Dr. WECHT. Well, I would give anything within reason to be able to find out what people who have been able to take the afternoon off and observe these hearings believe. I know that as of 1975, in a national poll conducted by CBS, certainly an agency which has not been particularly sympathetic to the critics of this business, about 85 percent of the American public was found to disagree, to reject one or more major conclusions of the Warren Commission report.

I am also mindful of the fact that in numerous other national surveys conducted by top pollsters in the past 12, 15 years, more than 50 percent of the American public has always expressed negative feelings concerning the Warren Commission report.

As I am aware of your distinguished professional reputation prior to becoming a Member of Congress, as a trial attorney, the idea, the reality of forensic scientists disagreeing in a court of law is, of course, nothing that is foreign to you.

I have witnessed it and participated in it many times. The numerical superiority that my eight colleagues have over me is something that I cannot reflect upon. It is in your hands. I have been in that position. I can only hope—you will excuse the possible seeming lack of modesty—that just maybe, and the number fits anyway with nine people, that just maybe this might be analogous to a Supreme Court Justice who sometime in the past expressed a dissent which in 10, 20, or 30 years became the law of the land.

I can only hope, sir, that might be the case here today.

Chairman STOKES. I have some other questions, but my time has expired.

The gentleman from Ohio, Mr. Devine.

Mr. DEVINE. Thank you, Mr. Chairman. I have no questions. I would just say to Dr. Wecht, I think you would probably agree that reasonable men of credibility on the same set of facts can reach different conclusions without questioning the motives of the others; isn't that true?

Dr. WECHT. Yes, sir, I do when there are reasonable differences of facts based upon interpretations. When things relate to hard, physical reality, then, sir, I cannot go along with that statement.

Mr. DEVINE. You don't say this is an exact science what we are talking about, do you?

Dr. WECHT. I believe, sir, such things as straight lines in relationship to horizontal and vertical trajectories, positions of two human beings, measurements of the Zapruder film, the timing of it, the timing of the test-firing of the Mannlicher-Carcano weapon, I believe, sir, these fall very much into the realm of the hard physical sciences as opposed to the kind of things that we, as physicians, are often involved in—did the heart attack follow the emotional or physiological distress; did the cancer come about after the blow to the breast—those are in the realm of speculation and reasonable differences.

In my opinion, I think that the evidence that has been discussed today, the physical measurements, the laws of mathematics, of physics, and so on, I believe, sir, that these do not fall within the realm of reasonable differences of opinion.

Mr. DEVINE. I am sure the other members of your panel would disagree with your conclusion.

Dr. WECHT. Yes, sir, I am sure they would.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from the District of Columbia, Mr. Fauntroy.

Mr. FAUNTROY. Mr. Chairman, I have no questions at this time.

Chairman STOKES. The gentleman from Connecticut, Mr. Dodd.

Mr. DODD. Thank you, Mr. Chairman.

Dr. Wecht, thank you for your testimony. You certainly articulated the issue before us today rather well. I would like to pursue one area of questioning with you, if I could, in the time allotted to me.

Your expertise is as a pathologist. That is your area of expertise. What I am getting at is, you don't have an expertise in photo analysis, your expertise is really as a pathologist; isn't that correct?

Dr. WECHT. Yes, sir, except to the extent that photography, studying of wounds and things of that nature, are related to the practice of forensic pathology.

Mr. DODD. Aside from the condition of Commission exhibit 399, the bullet, I gathered from your testimony that many of your conclusions regarding the single bullet theory rests to a large extent on the Zapruder film; is that a fair assessment?

Dr. WECHT. Yes, I would say that the Zapruder film is very important.

Mr. DODD. For instance, as to the positions of both President Kennedy and Governor Connally in the car, the appearances of both President Kennedy and Governor Connally at various frames in the film footage, and so forth.

Dr. WECHT. Yes, sir.

Mr. DODD. What I am trying to suggest by this line of questioning is that your expertise, using photographs and so forth, rests on making assessments of cadavers of after-the-fact circumstances, looking at wounds or photographs of wounds after a shooting, a killing has occurred, is that correct, generally speaking?

Dr. WECHT. Generally speaking, it so happens that I do a great degree of medical-legal consultation work in all kinds of personal injury actions, medical malpractice, products liability, workmen's compensation, thousands of cases in the past decade and a half, and I have had an opportunity and am called upon quite frequently to become involved in matters of medical-legal, forensic scientific nature which may not necessarily be related to a dead body.

Mr. DODD. What I am getting at is this: Aside from the Zapruder film, and I might suggest the shooting of Jack Ruby, have you ever personally witnessed a killing or have you ever had the opportunity to view film footage of an actual killing?

Dr. WECHT. A shooting, sir?

Mr. DODD. A shooting.

Dr. WECHT. I have never seen a killing by a human being by shooting. I have seen footage, yes, sir.

Mr. DODD. To what extent, how many occurrences, how many different shootings have you seen, actual different shootings of a human being, rough, ball park figure?

Dr. WECHT. Not a great number.

Mr. DODD. Two, three?



Dr. WECHT. Yes; I think, several, different film strips in various cases, documentaries.

Mr. DODD. To what extent is there a body of medical knowledge with regard to the predictable movements, predictable movements of a human body when shot?

Dr. WECHT. Some. It depends on the nature of the weapon, the ammunition, the position of the body, the nature and extent of the wounds, the physical circumstances that the body is in and so on. And these are things, of course, that we, as forensic pathologists, are called upon to reconstruct in a retrospective fashion in a fair number of cases.

I would say that it definitely could not be considered as a hard, physical science. There are biological variations; no question.

Mr. DODD. I wonder if you might refresh my memory as to the various frames in the Zapruder film. You seem to have a very good working knowledge of the various numbers of frames. The frame I want to get at is the frame where you see, first of all, Governor Connally showing appearances of being shot, what frame was that? Do you recall?

Dr. WECHT. That was frame Zapruder 237, I believe, maybe 237; I think 237. I do not know your exhibit number, but I think it was Zapruder 237.

Mr. DODD. And how many frames after that was the first appearances of President Kennedy showing evidence of being shot?

Dr. WECHT. Excuse me, sir—well, in the head wound, that was Zapruder film 313, the earlier one of the President emerging from behind the Stemmons Freeway sign, I think that was 225, Zapruder 225, when we first see the President. So that is then about 12 frames earlier that we see the President's reaction.

Mr. DODD. What I am getting at here is, given the fact there is a very limited amount of medical knowledge with regard to body movements, predictable body movements when an individual is shot, given the fact that there are apparently one or two or three or four instances where you have had the opportunity to actually see film footage of someone being shot, given the fact that your expertise is as a pathologist and not as a photo analyst, how can you state exclusively, as you do, aside from the appearance of 399 and others, that, in fact, there was not a single bullet, given the fact there is this limited amount of knowledge?

Dr. WECHT. That is very easy, sir, in this case.

The fact, the pattern that you set forth, would indeed be extremely applicable, for instance, to the head wound. What about the President, did he move backward, how could he have moved backward, should he have moved forward, and so on? That is indeed something that I have always said I can't be sure of, whether it is opisthotonos, a neuromuscular reaction or whatever.

But given the wound, Mr. Dodd, in the President's back, and knowing its trajectory, and knowing that it did not strike bone, and knowing it was moving slightly upward, then it doesn't make any difference, sir, what we may postulate about Mr. Kennedy's or Mr. Connally's movements. We know in looking at the pictures and from their eye witness testimony, and from all of the bystanders and everybody, we know that there is just no way in the world that—

Mr. DODD. Did I understand your statement, it doesn't make any difference?

Dr. WECHT. No sir, not in this case. Not in this case because we have the bullet moving upward through President Kennedy and then moving downward at a 25 degree angle of declination. There is just no way in the world that the bullet could have done that. I have never heard of an explanation from my colleagues, they just come back to the plausibility and argument—

Mr. DODD. You misunderstood me. I was using your testimony that those various frames and body movements were part of the evidence to indicate that it would be impossible for a single bullet to pass through both individuals.

Chairman STOKES. Time of the gentleman has expired but the witness can finish his answer.

Dr. WECHT. Thank you, Mr. Dodd. I apologize for not understanding your question. I agree with what you just said, and that is evidence that clearly demonstrates to me that it was impossible for 399 to have done what is attributed to it under the single bullet theory.

Mr. DODD. Thank you, Mr. Chairman.

Chairman STOKES. The gentleman from Tennessee, Mr. Ford.

Mr. FORD. Thank you, Mr. Chairman, I don't have but one question.

Doctor, the spokesman for the panel, Dr. Baden, has made the point that their findings were based upon the lack of any evidence to support any other possible alternative.

In supporting your theory, have you been privy to any other information outside of the information that this panel has been reviewing for some time?

Dr. WECHT. No, sir, other than what Mr. Stokes had asked me about before, that examination of the primary copy of the Zapruder film at Life magazine in 1966, nothing else. I also hope that I have kept more of an open mind and have also recognized that it is not my responsibility, I do not mean that I am disinterested or unmindful of the significance, but it is not my responsibility to retroactively justify and defend the investigation that was done, which I think was extremely superficial and sloppy, inept, incomplete, incompetent in many respects, not only on the part of the pathologists who did this horribly inadequate medical-legal autopsy but on the part of many other people.

This is the kind of examination that would not be tolerated in a routine murder case by a good crew of homicide detectives in most major cities of America on anybody just a plain ordinary citizen, let alone a President. So I don't get blocked, Mr. Ford, by the fact that I can't answer everything. I am fast to admit that I can't answer everything, although on one of the photos which we then didn't have a chance to get into, one that I requested Mr. Purdy to blow up, I show that the bullet that went through President Kennedy's neck could have continued on over the left side of the car, and I would like to say, sir, that that diagram was made years ago, before I knew for certain that there was an upward trajectory from the back to the neck with an upward trajectory. That suggestion that I made years ago now in my mind assumes much greater reality.

Mr. FORD. I don't have any further questions, Mr. Chairman. I yield back my time.

Chairman STOKES. Time of the gentleman has expired.

The gentleman from Connecticut, Mr. McKinney.

Mr. MCKINNEY. Doctor, this committee has got to evaluate two very extremely different positions. So in looking at your conclusions, if you were to take the three elements, the trajectory of the bullet, the condition of the bullet, or the film, which would you say, in your opinion, is the most important part of that picture, the most important issue?

Dr. WECHT. Well, Mr. McKinney, the trajectory is to some degree related to the Zapruder film.

If I had to list those in priority, sir, I probably would say the trajectory would be No. 1, because these are to me straight-line measurement calculations.

The condition of the bullet, No. 2, and the Zapruder film, which I must tie in back to the trajectories as No. 3.

That is hard to do, sir, but on the spur of the moment, I would list them in that order.

Mr. MCKINNEY. On the trajectory point, then, it is your opinion that there is no way that the President could have been in any kind of a position when he was behind that sign that would have allowed the bullet to go from low to high, rear to the front, and still have it in line to hit Governor Connally?

Dr. WECHT. No, sir, not at the point where it struck Governor Connally, not with the angle of declination that it proceeded on through the Governor.

May I just add very briefly, Mr. McKinney, of course, something that we all realize, but I would like to have on the record, that for all practical purposes, when the bullet struck President Kennedy, it was striking Governor Connally. At 2,000 feet per second it is incalculable, it is the kind of time that you and I with our reflexes and our speech and our watches can't even measure. So all of that happened in an infinitesimal moment.

The bullet is through the President and through John Connally. I cannot possibly imagine anything, and I have never heard anybody who was there in the car, behind the car or the motorcycle policemen, and so on, ever suggest that something of a dramatic nature—and it would have had to have been dramatic—had occurred vis-a-vis the physical relationship of these two men at that precise fraction of a second behind the Stemmons Freeway sign.

Mr. MCKINNEY. Were you aware of the fact that the radiologists for the committee that examined the X-rays of the President and the X-rays of Governor Connally, didn't find any metal chips or fragments in President Kennedy's neck or Governor Connally's chest?

Dr. WECHT. I am aware of the former, sir, and I believe the latter, too, insofar as the radiologist is concerned. With regard to the latter, a metal fragment in Governor Connally's chest, I am mindful of the information that I do not recall from our panel but which I am aware of, I think, from Earl Golz' column, a reporter in Dallas, and from other news media that a bullet fragment supposedly was removed from Governor Connally's chest, given by a

nurse to a Dallas policeman standing outside, who then gave it to an FBI agent.

Mr. MCKINNEY. Have you ever seen any proof of this?

Dr. WECHT. I seem to recall, Mr. McKinney, and it is vague, that there was some testimony if not some kind of documentation of the receipt that was given to the policeman by the FBI agent, but I am vague on that, sir.

Mr. MCKINNEY. If it were true that there were no traces of metal found in either one of these areas, that could explain the condition of the bullet, couldn't it?

Dr. WECHT. No, sir, because then after emerging from the chest it would have had to have struck the wrist, and as I have already explained, I do not believe that it would have been possible to produce a comminuted fracture and to have emerged in the pristine condition. Then, of course, I must again come back to the trajectory, that even with the absence of metal in the President's neck and the Governor's chest, there is no way that that same bullet could have gone through those two portions of the anatomy of the two gentlemen.

Mr. MCKINNEY. Thank you very much, Doctor.

Chairman STOKES. Time of the gentleman has expired.

The gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman.

Doctor, if the acoustical tests were to set up the exact time of the shots, and if it were possible to determine through photoanalysis the precise alinement of the bodies, and these two things turned out to be consistent with the single bullet theory, would you change your views?

Dr. WECHT. The acoustics test and more knowledge of the physical relationship of the two men, both of which, if I understand your question, sir, would permit physically—

Mr. FITHIAN. Yes.

Dr. WECHT [continuing]. The passage of the bullet in the fashion that is attributed to it. I would say that such information would go along way in making me doubt my long held beliefs, and it is all that I would ask, beyond a couple of simple experimental studies with the shooting of this kind of ammunition through some bones, and that would do it for me.

Mr. FITHIAN. Thank you.

Now, you talked about the second synchronized simultaneously fired shot possibility.

Dr. WECHT. Remote possibility.

Mr. FITHIAN. Remote possibility. Can't we as a panel dismiss this out of hand, for these two reasons; first, if it went in the President's head, and there is no exit wound somewhere else, it surely would have shown up on an X-ray somewhere in the brain area?

Dr. WECHT. Oh, yes, if it had been a penetrating missile, Mr. Fithian, and that is why I referred to frangible-type ammunition, which would not have had any degree of in-depth penetration.

Mr. FITHIAN. And, finally, the bullet itself that penetrated Governor Connally's wrist, would it have to have gone through the bone to fracture it?

Dr. WECHT. I believe with this kind of comminuted fracture, sir, yes, it would have had to have gone through the bone. I have heard

arguments advanced in our discussions and prior to that that the bullet just traversing near the soft tissues of the wrist would have produced that kind of fracture. I do not accept that at all.

Mr. FITHIAN. I am not very good at medical analysis. That is why we have you.

If the bullet went through the bone, wouldn't there have to be some sort of a hole where it went through, or the fracture itself would have to be wide enough to let the bullet go through?

Dr. WECHT. Oh, that is only——

Mr. FITHIAN. Unless it was a glancing blow?

Dr. WECHT. Yes, sir. If the bullet went through more or less in the middle of the bone, then there might be a hole, but the bullet would not have had to have gone directly through the midportion. A passageway with the bullet striking some portion of the bone could produce that kind of comminuted fracture. It would not have to leave a hole. As a matter of fact, very often they will not leave precise holes but will cause shattering of bones. I do not believe such shattering would occur by approximal passage of the bullet without some direct contact with the bone.

Mr. FITHIAN. If evidence becomes available that the fragment removed from Governor Connally's wrist matches CE-399, wouldn't this tend to impair your interpretation?

Dr. WECHT. I believe, as I had expressed previously to Mr. Cornell, that it would certainly be some reason to pause for further reconsideration, but the value of neutron activation analysis would only be of probative value in this case in my opinion, if NAA studies were done on all the bullets and the bullet fragments that are available, or that could be made available with relative ease.

Mr. FITHIAN. Finally, Mr. Chairman, I didn't quite understand your response to Congressman Dodd, but I believe I understood the gist of it, and that is that your interpretation presented here today is really based on other than forensic pathological evidence. Isn't that generally true? Because we are talking about photographic alinement of bodies and things that have really nothing to do with the actual physical evidence taken, either photos of the body or medical examinations of the body?

Dr. WECHT. I would not be able to accept that characterization because, in fact, the kinds of things that we are dealing with here arise in many homicide investigations; the study of photographs, the study of wounds, the study of the physical relationship of bodies to inanimate objects and to other people, eyewitness testimony, depositions, direct interviews with people, and so on. The only thing I haven't had——

Mr. FITHIAN. But these are not medical things, are they doctor?

Dr. WECHT. Well, what I am trying to say they all fall within the purview, indeed, of a functioning, practical forensic pathologist, and I would consider them, yes, within my realm and within the realm of any other forensic pathologist's overall review and evaluation of the case. It is the kind of thing that I have done many times and I am sure my colleagues have, too.

Mr. FITHIAN. Thank you, Mr. Chairman. I have no further questions.

Chairman STOKES. Time of the gentleman has expired.

The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Thank you, Mr. Chairman.

Just a few questions. I was going to ask you what your theory was as to what happened to the other bullet that hit one of these people if it wasn't found in the car and in any place that was hit. But, I deduced from an answer you gave to one of the other questions that your view is that it passed over the top of the car after going through the President's back and neck?

Dr. WECHT. I think, sir that that is a very real possibility.

Mr. SAWYER. Then your theory is it must have been fired from the street?

Dr. WECHT. No sir, from a position much lower than the sixth floor. If it was in the Texas School Book Depository Building, and that is a possibility I do consider, it would have been from a lower floor. You would see, sir, if you had the entire physical terrain laid out for you, that you would be able to get that kind of a trajectory.

Mr. SAWYER. I have been there, so I am familiar with it.

You also used a figure of 2,000 feet per second. Is that the correct velocity of these Mannlicher Carcanos?

Dr. WECHT. I think I have seen 1,980 and 2,000.

Mr. SAWYER. I would have thought from looking at it they would be faster than that.

Dr. WECHT. I think sometimes I have seen it up to 2,100 but I don't think I have ever seen it any higher than that.

Mr. SAWYER. Have you ever seen any studies that show what a bullet does if it hits just a twig, as far as its course and its behavior?

Dr. WECHT. Not controlled studies, sir. I have seen some bullets that have struck twigs but I have not seen or conducted experiments along those lines.

Mr. SAWYER. Well, I have seen studies that show that they go in all erratic behaviors. Just by striking a small twig in hunting studies, really is what they were, you have never seen such?

Dr. WECHT. No sir, not such studies. I do not express here the opinion that there is definitive evidence that the bullet struck a twig. I merely raise that, consider that as a possibility. I really think that it is more likely that the bullet simply struck the Governor on somewhat of a tangential fashion.

Mr. SAWYER. You feel if you were to eliminate President Kennedy from this bullet, and assume that it is other than a single bullet, now we have just a bullet striking, to begin with, Governor Connally, and going through him, as it did, and through his wrist, would you accept that the bullet, No. 399, could be in its present condition?

Dr. WECHT. No, sir, not having fractured the fifth right rib and the distal end of the radius. I do not agree that by excluding President Kennedy, I would be able to accept 399 as the subject missile.

Mr. SAWYER. Then what would you conclude happened to that bullet?

Dr. WECHT. Well, as you know, sir, there were two large fragments of bullets found on the floor of the car in the front area, I think Warren commission exhibits 567 and 569, and then there are other possibilities that one can get into speculatively about frag-

ments or a fragment from the head, fragments from the Governor's chest. There are different possibilities that one can consider.

Mr. SAWYER. But if the bullet that passed through the President's head shows from rather multiple fragments of that that are available to match those two major fragments on the floor, it would be the same bullet, then what would be your idea as to whatever happened to the bullet that hit Governor Connally, if it is not 399?

Dr. WECHT. Well, the bullet that struck Governor Connally in the chest and into the thigh might be 399, or the bullet that struck the Governor in the wrist and then in the thigh could be 399, but I do not believe that 399 would be the bullet that caused all the wounds. As to what happened to it—there are several.

Mr. SAWYER. Just come back for a minute. I asked you in the first place if we were to eliminate the President from 399 and just assume that that is the bullet that hit Governor Connally and did all the damage to Governor Connally, could you then accept that 399 would be that bullet?

Dr. WECHT. No sir.

Mr. SAWYER. You could not?

Dr. WECHT. No sir.

Mr. SAWYER. And you can't, other than claiming that it could be the two particles that were found on the floor, the two major particles, you wouldn't have any idea what did happen to the bullet then that hit Governor Connally?

Dr. WECHT. No sir; but I would like to point out, if I may reflect back to what I said before, I assume no responsibility for the investigation that was conducted.

Mr. SAWYER. I totally understand that.

Dr. WECHT. When one considers all the things that happened and did not happen, missing pieces of evidence and documents that were destroyed, and so on, I have no idea what might have happened in Dallas that day.

Mr. SAWYER. Coming to one of the two things that bothers me the most, this bullet apparently struck the Governor's wrist or the distal end of his arm with sufficient force to comminute the bones, and for people that don't understand comminuted or maybe I don't, I understand it to be shattering it into multiple pieces.

Dr. WECHT. Yes, sir; fragmentation.

Mr. SAWYER. I have heard it described as a bag of bones, in effect, by doctors.

Dr. WECHT. Yes, sir.

Mr. SAWYER. Why the force of that impact on something as free and as relatively light as an arm and hand wouldn't have itself knocked that away from the hat, that seemingly held without moving. Do you have any explanation for that?

Dr. WECHT. That is why I say, sir, that as we look at Zapruder frame 230, which, according to the Warren commission report, is a moment in time approximately 1½ seconds after the Governor is alleged to have already been shot through the wrist and continues to hold his hat, that I cannot accept that. I find it incongruous, and I do not consider it, as my colleague who testified earlier, said something, whatever his words, not unusual. I consider it very unusual.

Mr. SAWYER. Laying aside the nerve question, just the impact on something as free swinging and yet as solid as an arm bone, and with now a reduced velocity significantly below the muzzle velocity at that point, it just appears to me unreasonable that that in itself would not have knocked that hand, just by the force of it, without regard to nerves. So it wouldn't be holding that hat just like it was.

Dr. WECHT. I agree, then, that he would have lost his hat some point later on. He has the hat in 230. I agree with you.

Mr. SAWYER. Well, fine; that is all.

Mr. PREYER [now presiding]. Does Mr. Edgar want to be recognized? Has he left to vote?

[Discussion off the record.]

Mr. PREYER. I just have one question. I understood you earlier in your testimony, when you were testifying at the board, to say something to the effect that your fellow panelists deliberately refused to conduct the experiments because they knew what the result would be. Did I misunderstand you?

Dr. WECHT. That essentially is correct. They refused to go along with the pressing for the performance of these tests, and now I am speculating, because I feel that as they considered the evidence of the bullets fired at Edgewood Arsenal in 1964, they were pretty certain that in their own experience that they could not look forward to coming out with another 399.

Yes, sir, I did say that, and that is exactly what I meant.

Mr. PREYER. Well, you have testified that they are eight eminent pathologists, or forensic pathologists. Are you accusing them of bad faith in refusing to conduct experiments?

Dr. WECHT. Professional eminence and competency, sir, I believe are not exclusionary of some preconceived biases and prejudices, and vice versa. I think that one can have both. I recognize their competency, I will not apply any derogatory comments to them, I would prefer to let the facts speak for themselves, and the facts are, Judge Preyer, that they have not been at all interested, and you heard, sir, the testimony from my colleague, Dr. Baden, in pursuing this because they are not sure that they would be the same; for example, the bone of a dead person is not the same as the bone of a live person, and what would it mean, and then Dr. Baden talked about machinegun fire, et cetera.

We are not talking about the movements of the bodies, we are talking here about the shooting of bullets through inanimate objects, namely bones, recovery of those bullets to see whether they can even begin to compare to commission exhibit 399. And I frankly must say that I do not see the relevance of the comments that my friend and colleague, Dr. Baden, had made before in response to those questions about machineguns, and so on and so forth. I have seen no reason why it poses a great problem for people to be retained by this committee, this staff functioning at the pleasure and discretion of the committee, to have such experiments arranged.

Mr. PREYER. Listening to all of the evidence that we have heard here today on the behavior of bullets, I must say it impresses on me once again the limits of commonsense. Commonsense tells us that no bullet could do anything like that; but commonsense tells us the world is flat, too, and we know the world is round, and so I



think there are limits to how rationally we can think about the course of this bullet under such circumstances.

May I ask Mr. Fithian and Mr. Dodd, have you completed your questioning?

Mr. FITHIAN. I have.

Mr. PREYER. Mr. Fauntroy, have you completed your questions?

Mr. FAUNTROY. Yes, sir.

Mr. PREYER. Mr. Dodd?

Mr. DODD. Thank you, Mr. Chairman.

I just had really one other question. You may have answered it, and so I apologize if I am asking you to repeat what you have already stated in your earlier testimony.

Dr. Baden suggested that there could be a significant difference in the path of a projectile, how a bullet would react to tissue, bone and so forth, between a cadaver, a dead body and a live body. I gathered that you said there could not be, at least I got that impression.

Dr. WECHT. Not with fresh preserved bones. Bones are not extensively innervated nor are they extensively vascularized; I am not talking about dried out, dessicated bones. If one takes preserved bones, in my opinion, for the kind of experiment that we have been discussing today, there would not be any difference, and I do not accept that as a reasonable, fair or scientifically accurate difference. It is a difference without a distinction.

Mr. DODD. You mentioned earlier that in addition to tests that one might take on, for instance on a goat, I think is one of the examples you gave—

Dr. WECHT. That is what was used in 1964, sir.

Mr. DODD. Was that satisfactory to you as a—

Dr. WECHT. It is not really the size of the human rib. I see no reason why we couldn't use human ribs. If we are going to use a human cadaver for the wrist, I see no reason why they couldn't use human cadavers for the chest bone. I would prefer to try and make this as close as possible, not do what the FBI and others did back in 1964 when they wanted to see whether Lee Harvey Oswald, a poor marksman, shooting at a moving target, could do what he did, so they got the finest marksman they could find and put him on a stationary platform in an open field with no tree blocking, and they said they had duplicated what Oswald did. No, not that kind of an experiment.

Mr. DODD. So, to summarize your position, it wouldn't make that much difference?

Dr. WECHT. No sir, absolutely not.

Mr. DODD. Fine, thank you very much.

Mr. FITHIAN. Mr. Chairman, in Congressman Edgar's absence, we talked earlier about a question, let me ask it for him, since he is not back from voting yet, Doctor.

Your testimony that the bullet that exited the throat on a rising plane, is that determined by the bullet path through the body?

Dr. WECHT. Yes sir, and the study of the panel of all the information, pictures, materials, photographic enhancements, X-ray report, of the President and so on.

Mr. FITHIAN. Now, if the body, therefore, were in some position other than you thought it was, that is, with a forward lean, would that alter where you expected the bullet to continue to go?

Dr. WECHT. If the body were in a substantial forward lean it could alter it somewhat in terms of the vertical angle, but that lean would have to be very substantial to fit in with the 25 degree angle of declination, and I repeat, forgive me for being redundant, but I think the pictures just rule out to the reasonable person such an absolutely unexpected movements, I do not mean to be flippant, but clearly the President had no way of knowing he was going to be shot and he wasn't trying to dodge a bullet. He was sitting there, was waving to the crowd, and then the car went behind the Stemmons Freeway sign. He wasn't even familiar with—in terms of his blocking Mr. Zapruder's picture—he didn't know he was being blocked out from Mr. Zapruder's camera. He was just waving to the crowd, and he was sitting in this position at 225, Zapruder frame 225. There is just no way to account for or speculate on such a dramatic movement in less than 1 second.

Then, of course, we have the horizontal angle as well as the vertical angle to contend with.

Chairman STOKES. Time of the gentleman has expired.

The gentleman from Pennsylvania, Mr. Edgar.

Mr. Edgar. Thank you, Mr. Chairman.

Doctor, I was curious. At the beginning of your testimony, you talked about the interest that you have in obtaining the brain for further analysis, and some criticism of our committee and its staff for not doing enough to secure that brain. Is that correct?

Dr. WECHT. Yes sir; whoever it is that is responsible, I have raised the question and have put it in writing, that if an eminent group of House of Representatives Members, a bipartisan group, does not have the authority, then I did ask the question, who does?

Mr. EDGAR. Are you aware of all the steps that our committee has taken to secure the brain tissue?

Dr. WECHT. Only what I have been told by Professor Blakey, by members of the staff. I have not spoken with any Member of the House, any member of your committee.

Mr. EDGAR. What would you have done more than the listing that we have provided you of the actions that we have taken in order to secure the missing brain?

Dr. WECHT. I would get the best trained investigators, homicide detectives, or their equivalent and with an attorney for proper legal guidance and so on. I would do this under the imprimatur of the honorable Chairman of this committee. I would go back to day one and work up with Admiral Burkley and then over to the National Archives on April 26, 1965, I would get the people who were in charge of the Archives. I would depose them under oath. I would follow right through with Mrs. Lincoln, Senator Robert Kennedy's then secretary, who is supposed to have been involved in some way. I would follow through with everybody under oath, and I would, please correct me if I am wrong, I would use the power of subpoena, which I think your committee has. Maybe I am wrong about that.

Mr. EDGAR. If all of those actions were taken and the missing brain was still not made available to the committee, what then would you do?

Dr. WECHT. Well, then, of course, I do not suggest that anybody be put in jail, but I do suggest, Mr. Edgar, that at that point it would be a matter of record, we would know what had happened to that information, to that evidence, and we would know who is responsible for it and that would be the end of it.

I certainly do not ask anything superhuman and I do not suggest that somebody necessarily be fined or incarcerated, but if this has happened, then I would readily stand corrected. If it has not been done in that kind of intensive fashion, then I must with all due respect, say that something is missing.

I reject and find it personally insulting when comments are made like those expressed by Mr. Burke Marshall in the past, that it is ghoulish, and so on, to ask where the President's missing brain is, and who removed it from the National Archives.

Even one of the forensic pathologists, before he became a member of this panel, a forensic pathologist, had made a similar statement, when I was an earlier critic. They have all come around now to recognizing that it was a horrible autopsy. For 10 years you must understand they felt I was being unduly critical, now they all understand what a ridiculous job was done. He said, this forensic pathologist, that I was being ghoul in trying to pursue the brain's location.

I am not suggesting that it be made the cover of Time or Newsweek magazine. The examination would be performed in the most private, discreet circumstances by a competent neuropathologist and forensic pathologist. That is all I am talking about.

Mr. EDGAR. I appreciate your concern and I don't think that in my question I was indicating that it was all a problem of being ghoulish.

Dr. WECHT. No, not you, sir.

Mr. EDGAR. I wonder if Mr. Blakey could for the record indicate in summary form some of the steps that we have taken in order to secure this missing brain?

Mr. Blakey. Mr. Edgar, let me review for you some of the facts.

Following the autopsy of President Kennedy, Robert I. Bouck, the head of the Protective Research Division of the U.S. Secret Service in 1963, received all of the materials relating to the autopsy from Agent Kellerman, and maintained these items in the White House under security for Dr. George Burkley the White House physician.

On April 22, 1965, Robert F. Kennedy authorized a release of all of these materials to Mrs. Evelyn Lincoln, who then had an office in the National Archives. Mrs. Lincoln was in the process of assisting in the transfer of President Kennedy's official papers to the National Archives.

In response to this order, Mr. Bouck and Dr. Burkley prepared an inventory list and transferred these materials to Mrs. Lincoln. Included in those materials was one stainless steel container, 7 inches in diameter and 8 inches—7 by 8, containing the inventory list indicated gross material. The best speculation is that stainless steel container held the brain.

On October 31, 1966, Burke Marshall, a representative of the Kennedy family, formally transferred the autopsy material to the Archives. I don't mean this physically, because the materials were allegedly in the Archives at the time in the custody of Mrs. Lincoln. When that transfer occurred, the steel container was not included.

The committee, as I indicated this morning has conducted a comprehensive investigation in an attempt to locate the missing materials. The people interviewed have included Dr. Burkley, Dr. Humes, Mr. Bouck, Ramsey Clark, Mrs. Lincoln, Ms. Angela Novelli, Robert Kennedy's secretary, Dr. Finck, and Mr. Marshall, and all of the relevant Archives people.

As I indicated this morning, over 30 people have been either interviewed or deposed. The closer they came to the chain of custody they were deposed. We've even interviewed all of the people associated with the reinternment of the President's body. That interviewing and deposition process has not indicated with certainty what happened.

As I indicated earlier this morning, a Kennedy family spokesman did indicate that Robert Kennedy expressed concerns that these materials could conceivably be placed on public display many years from now and he wanted to prevent that. I would infer from that that the most likely result is that the President's brother destroyed the documents. But there is no proof; no documents but the materials. Dr. Wecht, if you can suggest anybody else that we can interview or anybody else that could be deposed I can assure you there is no reluctance on the part of this staff, under the direction of Chairman Stokes, to do so.

Mr. EDGAR. I thank the chief counsel for the summary of our efforts to secure the missing materials.

I have no further questions, Mr. Chairman.

Chairman STOKES. Thank you, Dr. Wecht. I think I have one, maybe two more questions.

As a forensic pathologist, are you automatically qualified also as a ballistics expert?

Dr. WECHT. No, sir, except with regard to the impact, damage, trajectories, and relationships of bullets to the human body. As a separate, distinct science, not related to human wounds, the answer would be no. I am not a criminalist or a ballistics specialist.

As a forensic pathologist, I am involved very frequently in the evaluation of gunshot wounds, different kinds of ammunition, weaponry, et cetera, in its relationships to wounds inflicted upon the human body, angles, degree, mortality, ability of the victim to have moved, walked, talked, direction of fire, sequence of shooting, and things like that.

Chairman STOKES. And would it be fair to say, also, that most of your experience in terms of the wounds has been with gunshot wounds as opposed to rifle wounds?

Dr. WECHT. Yes, sir, by far, many more handguns but a fair number through the last 20 years I have been in pathology, since I started my training, have involved rifles, carbines and, of course, shotguns, but predominantly, as I am sure in every jurisdiction in this country, the great percentage of gunshot wounds in murders, suicides and accidents involve handguns.

Chairman STOKES. Thank you very much.

Are there any further questions from any members of the committee?

Mr. FAUNTROY. Mr. Chairman?

Chairman STOKES. The gentlemen from the District of Columbia, Mr. Fauntroy.

Mr. FAUNTROY. Thank you. I was not present at the time Dr. Wecht made reference to experiments that he felt could have and should have been conducted that would have cleared up some questions which he apparently still has.

Do I understand that it is your belief that a separate shot entered the body of Mr. Connally from the rear and that that shot damaged his wrist and lodged in his knee and in his thigh?

Dr. WECHT. I believe, yes, Mr. Fauntroy, that a bullet other than 399 caused some of the damage to Governor Connally, that 399 might have—excuse me, I do not believe that 399 caused the damage to Governor Connally. I believe that another bullet struck Governor Connally, and I believe that there was a possibility of fragments from the President's head wound, that bullet, there is a possibility of a fragment from that shot having struck Governor Connally.

Mr. Fauntroy. So, do you believe that one bullet caused all of the damage to Governor Connally?

Dr. WECHT. That is a possibility that I cannot exclude, but there are other possibilities that would have to be considered.

Mr. FAUNTROY. What kind of experiment do you envision that could establish that, for example, the missile that shattered his wrist did or did not lodge in his thigh?

Dr. WECHT. That one could be simulated, Mr. Fauntroy, by just using one human cadaver set in a position similar to that which was occupied by Governor Connally.

Mr. FAUNTROY. Where would the entry wound be found?

Dr. WECHT. The entry wound would be found on the dorsal or back surface of the lower portion of the forearm above the wrist crease at the same location that the bullet struck Governor Connally.

Mr. FAUNTROY. So that you envision that bullet coming from in front?

Dr. WECHT. No, sir.

Mr. FAUNTROY. Was his arm not in front of his body?

Dr. WECHT. Yes, sir, but the bullet would have come from the rear and would have struck him on this dorsal surface and exited on the ventral or volar surface.

Mr. FAUNTROY. And then into the thigh like this—

Dr. WECHT. Yes; possibly into the thigh; yes, sir. He was holding his arm thusly, Mr. Fauntroy, holding his hat, and so the shot, I believe, would have come from the right rear, not from the front.

Mr. FAUNTROY. Is it your view that you could take a cadaver, sit it in a car or place it in that position and you would get the exact same reaction from a bullet fired from a theorized distance?

Dr. WECHT. Yes; the distance could be determined within a very close range by talking with Governor Connally and studying the Zapruder film.

Of course, more than one bullet would be fired in the experiments which I have postulated, just as the Warren Commission people or the individuals functioning in their behalf in 1964 used several goat carcasses and several human cadavers, and just as Prof. John Nichols in Kansas, for instance, has used more than one set of bones for these tests.

Mr. FAUNTROY. And that you could reliably say that what happened to one cadaver, one wrist, happened to Governor Connally; that's your view?

Dr. WECHT. My view is, sir, that, again, numerous subjects, animals, cadavers, should be employed and all of the retrieved ammunition studied very carefully. I repeat that I am not holding out personally for a percentage—proof that it happens more than 50 percent of the time—because I don't think that would be reasonable unless one conducted, oh, maybe 500 or 1,000 such shootings. Then at that point, I think you would have to say it can't happen. But I want to see one bullet, just one, from as many animal carcasses and human cadavers as can be obtained, just one bullet breaking two bones.

That's really the key. I have, of course, answered your question about the wrist and the thigh, but I should like to repeat that the major emphasis, from my standpoint, in terms of the near pristine state of 399, is related to its presumed trajectory through two bones so that it would be necessary in order to simulate the conditions of the Kennedy-Connally shooting to have that ammunition go through a rib and a radius.

Mr. FAUNTROY. That is precisely why the question came to mind. I just wonder how you could do that. You have to be a pretty good marksman to reproduce that.

Dr. WECHT. Yes, sir, these things would be fixed, sir, in a kind of a vise-like fashion by appropriate equipment so that there would be no movement or flapping or so on.

Mr. FAUNTROY. So that someone could hit the back exactly where the wound that Mr. Connally had, is alleged to have been and could hit the rib just where it was supposed to have been hit and could have passed through and hit the wrist just the way it was supposed to have been hit and fall into the thigh just where it had fallen and we could reproduce it?

Dr. WECHT. You would not have to depend upon the bodies being set up in such a fashion that the bullets will go through. You can set it up so that the bullets cause this bone damage. Remember, the soft tissue is not going to detract from the damage. It may not add much to it, but it certainly is not going to detract from it. Therefore, if you just have the bones set up with the distances of rib to wrist and wrist to thigh and shoot through them, as has been done without any problem, so all you have to do, is draw a circle or make an "X", and an expert marksman will do that 100 times out of 100, or close to it. You don't have to worry about soft tissues.

Again I repeat, these very studies have been performed by Dr. John Nichols shooting through two bones.

Mr. FAUNTROY. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired. The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Just one question. I think I understood you to say that it is your view that these wounds that Connally received were from fragments from the head wound the President received.

Dr. WECHT. I said, sir, that one of the possibilities for one of the wounds either in the wrist or the thigh, possibly the chest, but less likely, might, might have been from a fragment of the bullet that struck the President's head.

It is not a possibility that I cling to. I just say that it is a physical possibility to be considered.

Mr. SAWYER. But doesn't the Zapruder film show that Governor Connally was hit before the President received that hit in the head, which is quite visible in that film?

Dr. WECHT. Yes, sir, that's a very excellent point.

Mr. SAWYER. It is destructive of that theory, isn't it?

Dr. WECHT. And thank you very much for correcting me. I am wrong on that. I completely withdraw. I thank you very much.

Mr. SAWYER. You are entirely welcome.

Dr. WECHT. I have been saying that, and I have not been corrected. I apologize.

Chairman STOKES. The time of the gentleman has expired.

Are there any other members seeking additional recognition?

[No response.]

Chairman STOKES. Dr. Wecht, at the conclusion of any witness' testimony before this committee, he is entitled to five minutes in which to explain his testimony or to in any way amplify or expand upon it. On behalf of the committee, I extend to you at this time the 5 minutes, if you so desire.

Dr. WECHT. I would like to thank you, Mr. Chairman, and the members of the House Select Committee on Assassinations for having afforded me this opportunity to meet.

I am particularly grateful for the fact that you gentlemen have seen fit to stay here for this time, and I am deeply appreciative of the personal courtesy that has been extended to me.

I should like to thank Professor Blakey for having recommended to the committee that I be permitted to testify, something certainly that he did not have to do. I have enjoyed working with all the members of the committee and especially with Mr. Andy Purdy, who has been most helpful, extremely cooperative and who was, I think, extremely adroit in his handling of the elicitation of my direct testimony today.

I would want to say that I am pleased that hearings of this nature are being conducted. I am very sorry that they were not conducted back in 1963 and 1964 when more people were around and more fresh evidence could have been obtained.

I think that whatever the truth may be, and hopefully, we will ultimately come to know it, that there is much that must, as a matter of record, be pointed out with regard to the manner in which these things have been handled. I think that, for instance, our panel was charged with addressing ourselves to the performance of the autopsy in this case and in the words, I think, of Professor Blakey, to set forth in our final report, as part of everything else, a protocol, a modus operandi in cases of this nature that would stand for all times for the foreseeable future in forensic pathology—which I wholeheartedly agree with.

I believe this has not been done thus far, although I have not seen the final draft of the proposal. I do not feel that this should be done because of any ad hominem criticism of the three pathologists who were involved in the autopsy, but because it is important to have such a protocol should any case like this ever arise in the future.

I believe that the Federal Government should address itself to this question of what will happen if any particular figures, be they Congressmen, Senators, judges, Cabinet officers, Vice President, President and so on, are assassinated. God forbid that it should ever happen again, but it is not an impossibility certainly. What would happen in that kind of a case, where would the post mortem examination be performed, what would be the conduct of the medical-legal investigation?

I would like to say there have been all kinds of speculations in this case through the years and all kinds of input from many people. I believe that I would be less than candid if I did not express publicly what I have said many times to others and in other public forums, that I feel that in the past, there has been a mental block, there has been an impediment, a formidable obstacle, indeed, which I recognize of a political nature that I think prevents many individuals from just letting it all hang out in this case. I think that this comes back to the single bullet theory because it is clearly recognized by everybody that the moment you abandon the single bullet theory, that is the moment that you are into two people who were shooting, that is the moment that you are into Black's Legal Dictionary definition of a criminal conspiracy as well as the definition of the statutes of every jurisdiction and the Federal Government of this country.

I think that this is recognized by many people and I think it is a step that many individuals find some difficulty in considering.

The President is gone, beloved as he may have been. We cannot bring him back. This would be of such a nature, the concept of political assassination, in effect, a political coup d'etat, that we simply cannot consider it ever occurring in this country. It can happen in the totalitarian nations of Eastern Europe, it might happen in the emerging nations of Asia or Africa, it certainly can be expected to happen in the banana republics of Central America, it might even happen in a Western democracy, but never, never in our country. I think that it can happen. Whether it did or not, I do not know.

Obviously, I have no personal knowledge of who the assassins were and what their motivations were. I am not an expert on that. Just some general beliefs that are, indeed, related to my political biases, I am sure. But I think that it is most important that this scientific evidence, not to denigrate the significance or importance of any other evidence and the competency of all the people and the tremendous work that other panels, individuals in this committee and staff, may have done and that will be deliberated upon, reviewed and analyzed and discussed in the days and weeks ahead, but I must say that this evidence is the foundation, because as long as the single bullet theory is clung to, then whether people consciously or subconsciously realize it, they are able to hold on to the sole assassin theory.



Everything else at that point becomes either academic or speculative—did Oswald know Ruby, was Oswald going to Ruby's home, what was J. D. Tippit doing there—important things, but things probably that this group of human beings, given the absence of the major actors in this drama today, will never be able to answer.

I very much hope that this evidence will be thoroughly reviewed. The fact that it is an eight to one decision, so to speak, of this forensic pathology panel, hopefully will not sway the members of this committee, especially those of you who are attorneys, and Judge Preyer, who has been both an attorney and a member of the judiciary, and that you will consider the evidence on its own merits.

I hope that it will be possible for more definitive evidence to emanate from the tests being conducted by the Boston firm, that more investigation will be permitted, that Professor Blakey's committee, staff will continue to be funded through your committee.

I thank you, sir, for your courtesy. And I hope that something of a definitive nature will emanate in the weeks ahead.

Chairman STOKES. Thank you, Dr. Wecht, very much, personally for being a member of this very distinguished panel of medical experts.

We thank you for the time you have expended on behalf of this committee working with that panel of experts and certainly for the point of view you have expressed here today. We are indeed grateful to you for that, also.

So, we think you certainly have performed a service, and we thank you for having been a witness here today.

Dr. WECHE. Thank you, sir.

Chairman STOKES. Thank you.

There being nothing further to come before the committee, the committee is adjourned, then, until 9 a.m. tomorrow morning.

[Whereupon, at 6:11 p.m., the committee recessed, to reconvene at 9 a.m., Friday, September 8, 1978.]



# INVESTIGATION OF THE ASSASSINATION OF PRESIDENT JOHN F. KENNEDY

FRIDAY, SEPTEMBER 8, 1978

HOUSE OF REPRESENTATIVES,  
SELECT COMMITTEE ON ASSASSINATIONS,  
*Washington, D.C.*

The committee met at 9:09 a.m., in room 345, Cannon House Office Building, the Hon. Louis Stokes (chairman of the committee) presiding.

Present: Representatives Stokes, Preyer, Fithian, Edgar, Devine, and Sawyer.

Staff present: G. Robert Blakey, chief counsel; Clifford A. Fenton, Jr., chief investigator; Kenneth D. Klein, assistant deputy chief counsel; Gary T. Cornwell, deputy chief counsel; James Wolf, staff counsel; Leodis C. Matthews, staff counsel; Elizabeth Berning, chief clerk, and Donald A. Purdy, Jr., staff counsel.

Chairman STOKES. A quorum being present, the committee will come to order.

The Chair recognizes Professor Blakey.

## NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND STAFF DIRECTOR

Mr. BLAKEY. Thank you, Mr. Chairman.

The last witness to be called on the general question of the autopsy is Dr. Charles S. Petty. Dr. Petty received a M.D. degree cum laude from Harvard Medical School in 1950 and completed his residency in pathology in 1955 at New England Deaconess Hospital in Boston. Dr. Petty is certified in the areas of pathological anatomy, clinical pathology, and forensic pathology by the American Board of Pathology. He is a fellow of the American Academy of Forensic Science, the American Association of Pathologists, the American Society of Clinical Pathologists, and the College of American Pathologists.

It would be appropriate now, Mr. Chairman, to call Dr. Petty.

Chairman STOKES. The committee at this time calls Dr. Petty.

Doctor, would you stand and raise your right hand to be sworn. Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

## TESTIMONY OF DR. CHARLES S. PETTY, M.D.

Dr. PETTY. I do.

Chairman STOKES. Thank you, you may be seated.

Mr. Blakey.

Mr. BLAKEY. It would be appropriate now, Mr. Chairman, to begin the questioning of Dr. Petty.

Chairman STOKES. The Chair recognizes the gentleman from North Carolina, Mr. Preyer.

Mr. PREYER. Thank you, Mr. Chairman.

Good morning, Dr. Petty. It is good to have you with us today and I join the chairman's expression yesterday in thanking you, and Dr. Baden, and Dr. Wecht for all of the hard work you have put in on this and the time you have taken from your already busy lives to work on this.

Dr. Blakey has recited your impressive credentials and I won't go through the process of qualifying you. Suffice it to say you are one of the nine forensic pathologists serving on the select committee autopsy panel, is that correct?

Dr. PETTY. Yes, sir, I am.

Mr. PREYER. I believe you are a member of the subcommittee, the members of which had never reviewed the evidence in this matter before, is that correct?

Dr. PETTY. You are correct, sir.

Mr. PREYER. As I understand it, there are two subpanels. One subpanel consisting of Dr. Weston, Dr. Spitz, and Dr. Wecht had reviewed the evidence prior to this occasion. Your subpanel members had not reviewed it in the past?

Dr. PETTY. That is correct, I had no opportunity or interest in reviewing the things, the entire information, before I was asked to serve on the panel.

Mr. PREYER. Had you ever expressed any opinion about the injuries or the result of the autopsy, had you ever spoken about it or written about it before you examined the evidence?

Dr. PETTY. No, sir, I have neither spoken about it, lectured about it, written about it or in any way uttered any opinions concerning this assassination.

Mr. PREYER. You had not formed any opinion about the result of the autopsy?

Dr. PETTY. That is correct.

Mr. PREYER. Were you in the hearing room yesterday and did you hear all of the testimony of Dr. Baden and Dr. Wecht?

Dr. PETTY. I was here for some 9 hours yesterday and listened avidly to everything that was said.

Mr. PREYER. Both of these gentlemen are distinguished pathologists and they disagreed, as you know. Dr. Wecht does not believe in the single bullet theory. He is a distinguished pathologist whose views deserve our serious consideration.

Dr. Baden is equally distinguished.

As I understand it, Dr. Wecht disagrees with the panel's conclusions on the single bullet theory. He not only disagrees with it, as I understand it, but he believes the evidence shows it is demonstrably false.

I would like to ask you, do you believe on the available evidence that the single bullet theory is valid and that Governor Connally and President Kennedy were hit by the same bullet?

Dr. PETTY. Yes, sir, I believe that they were struck by the same bullet and I have so previously stated in the preliminary report of the panel.

Mr. PREYER. Would you summarize briefly your reasons why you believe this to be the case?

Dr. PETTY. Yes, sir, I will be very glad to, Mr. Preyer.

I think it is necessary at this point to sum up, in a sense, the flight of the bullet and its effect on those it struck. The bullet that struck the late President in the upper right back area and then went on to penetrate the soft structures of the neck and to exit in the front of the neck was, as has been indicated already, traveling in a somewhat upward direction anatomically speaking.

Anatomists many years ago decided—the better to understand each other—to place a body in a specific position and to relate all of the descriptions of the landmarks of the body to the body in that position. That position actually is a person standing erect facing forward with both palms turned forward. This is the anatomic position and in tracing the in-shoot wound on the back of the late President and connecting it with a more-or-less straight line with the out-shoot wound on the front of the neck, the bullet will have followed a slightly upward direction. But the President was not upright at the time he was shot, he was certainly not in the anatomic position, and this explains, I believe, the objection that Dr. Wecht had and his argument that he could not understand how the bullet pursued a downward track from where it was discharged, then an upward track in the President and then a downward track into Mr. Connally.

A second point that must be mentioned:

The bullet that penetrated the back of the President exited the front, struck no bone. If it did strike any bone, the bone that it struck was fragile and certainly not markedly disrupted. It did not go through his spinal column. It did not go through bone that was solid and hard and offered great resistance to passage. In effect; it went through several inches of very soft tissue.

There is no evidence on the X-rays that the bullet broke up in passing from the back to the front. There was no deformity, in my opinion, of the bullet as it went through the President.

Now, the second object that this single bullet struck was Mr. Connally sitting somewhere in front of the President, and this is another point that Dr. Wecht has brought up repeatedly, and that is that there was no way to join by means of a straight line the bullet existing from the President and striking the Governor. Indeed, there was one diagram yesterday that was showing the bullet making more-or-less right angle turns, which I am certain did not happen. As a matter of fact, I would suggest that from looking at the films taken of the actual assassination that the apparent relative positions of the President and the Governor are somewhat misleading, that is, that one cannot determine by looking at a flat two dimensional view of one side of the limousine and the contained individuals precisely what relationship they had one to another.

Next, the bullet in striking Mr. Connally did not penetrate the chest in the usual sense of the word. The bullet did indeed enter the back and side of the chest near the armpit, and it did indeed follow the course of the rib on its lateral or outer aspect, and it did indeed exit beneath the right nipple, but there is no evidence that that bullet actually penetrated the rib. Indeed, one of the surgeons who

cared for the Governor, Dr. Shaw, stated to me that the bullet did not penetrate the lung but that the rib was shattered, and it is my opinion that this bullet in slapping against the rib shattered it in a place that the rib is quite vulnerable, and then proceeded to follow rather closely the slope of the rib and then finally to exit in the front of the chest.

The X-rays fail to show any evidence of particles of metal in the chest. Therefore, in my opinion, the bullet was not significantly deformed during its passage in the chest of the Governor.

Next. The bullet did indeed enter the wrist, and although the reports are somewhat difficult to understand, it apparently entered more on the back of the wrist and then exited more on the front of the wrist, and again as in the chest wound, this was a tangentially placed shot which shattered the bone—there is no question of that—it shattered and caused a comminuted fracture of the radius, and then went on to exit.

Here for the first time, fragments of bullet substance are found, and it is here, in my opinion, that the bullet first significantly deformed.

Then having exhausted itself, and at a very low velocity, it continued on to bounce in and out of the thigh of the Governor.

Now, let me recapitulate this. The bullet penetrated one individual without deformity, leaving none of its metal behind. In the second person it penetrated the chest, slapping in a tangential manner against the rib, fracturing the rib, and damaging incidentally the underlying lung, because the rib was thrown against the lung, and then went on again without leaving any of its substance so as to enter the wrist where it finally left off a portion of its substance, not much, but some.

There is nothing here that is unusual or spectacular or unexpected. This is the behavior of a full metal jacketed bullet, a bullet covered in all areas except the base by means of the firm, hard, tough, not easy to deform jacket.

Now, the reason that this ammunition is used militarily was explained yesterday. The reason that such ammunition is not used by law enforcement officers, one of the major reasons, is that such bullets do go through people and strike others, and every law enforcement agency in the world is concerned about this.

In conversations here with the Capitol Police, such individuals present here in this room are carrying soft ammunition with hollow points so that the bullets will not go through the assailant and strike an unwary onlooker.

This ammunition that was used in the assassination was designed to go through people and it does not surprise me nor does it surprise the remainder of the panel, with the exception possibly of Dr. Wecht, that the bullet went on through one person, slapping the chest of another, proceeding through the wrist and winding up in the thigh of the individual.

There is another point I would like very much to make along this line, and that is there has been some surprise indicated on the part of some individuals that there was no dropping of the Stetson that Governor Connally was carrying. If one looks at the films and one looks at the position of the governor's hand, and then realizes that the bullet was proceeding slightly from the back of the wrist

to the front, one would realize immediately that the force of the bullet would tend to drive the wrist further against the thigh and it would not, in my opinion, tend to flap the wrist out to the side or laterally, as some people have claimed.

Also, there is some concern on the part of some individuals that we don't know what the reaction of the total body is to shooting, and there is some reluctance, I believe, on the part of individuals to realize that there may be different reactions to being struck by a bullet exhibited by different people, and yet in this same film we see two people who were shot, we know they were shot, we can actually see the wounding of them, and these two individuals reacted quite differently, one from the other.

There is great biological variation in how individuals react to receiving wounds. This doesn't surprise me at all. We see in our daily practice of forensic work individuals who are wounded and don't realize they are wounded. We see other individuals who, being struck a nonlethal wound; drop to the floor saying good God, I am dead. Individuals struck by bullets react in different ways.

One other thing that I must mention: the term frangible bullet was introduced yesterday by Dr. Wecht, who I believe, as I understand him, feels that there is a possibility that there was a simultaneously fired or synchronized shot somewhere from the right front or right side striking the President in the area where the skull was already blown away.

Now, about frangible bullets causing such injury or causing injuries in individuals. I happen to be a coauthor of the only paper that has ever been written about the wounding capabilities of frangible bullets. Frangible bullets are bullets that are designed to be used in shooting galleries. These are bullets that are specifically designed to break up on the backdrop of the shooting gallery, so as not to ricochet and cause injury to either the shooters or to the people who work in the gallery.

Such bullets usually are formed of iron filings or small granular pieces of iron bound together by some organic substance, so that upon breaking up they break into numerous pieces. Such bullets and the breakup products of bullets are easy to detect in X-rays. There are no such fragments in the X-ray of the late President's head.

There was no frangible bullet fired.

I might also add that frangible bullets are produced in 22 caliber loads and they are not produced in larger weapons.

There is no evidence in the X-ray of the President's head of a frangible bullet shot. If there were, I would expect to see square appearing particles of which are not present and, furthermore, if such a bullet were fired into the side of the head, through the aperture caused by the exiting large bullet, I would expect those pieces of the frangible bullet to have continued over to the left of the head and there would be material, metallic material easily identifiable seen in the left side of the brain. There are no such fragments present.

It is for these reasons that I do not find it difficult to believe in a single bullet passing through the late President Kennedy and continuing on through the chest, wrist, and winding up finally in the thigh of the Governor.

Does that answer your question, sir?

Mr. PREYER. Very definitively, Dr. Petty. You have anticipated and answered every question I intended to ask you. Let me ask this question: Would it be accurate, or in your opinion, did the bullet go through the wrist bone of Governor Connally? Perhaps I am using a layman's term and not a scientific term. You mentioned that the wrist bone was shattered. Is it accurate to say that the bullet went through the wrist bone?

Dr. PETTY. I don't believe it did. One cannot be certain by reading the reports of Dr. Gregory, who was the attending physician at Parkland Hospital, as to whether or not the bullet actually went through the bone.

There is no specific X-ray evidence that it did indeed penetrate and go through or drill through, as one might say, the bone.

However, there are no, as far as I know, there are no views of the wrist area taken from a different viewpoint, other than having the wrist and hand spread out flat and parallel with the surface of the X-ray film. There were none taken from the opposite—or lateral—view, as far as I know.

So, I can't tell you and answer specifically, but I see no defect in the bone that would make me believe that the bullet, in fact, literally passed through the bone itself.

Mr. PREYER. Thank you. The other area I had intended to go into, and I think you have covered it, is the question of whether the President was struck from the side or the right front by a frangible bullet, which I think, in fairness to Dr. Wecht, he described as a remote possibility, but let me ask one concluding question on that. In your opinion, does the available evidence permit the conclusion that to a reasonable degree of medical certainty, there was not a shot from the side or from the front which struck the President?

Dr. PETTY. From the available information, there is no evidence whatsoever that the President was shot either from the side or from the front. The only wounds that he has, in my opinion, are the wounds from the back; one in the back of the shoulder, one in the back of the head.

Mr. PREYER. Thank you.

Mr. Chairman, there were other issues raised during the testimony yesterday, but I understand there will be other expert witnesses this morning who will be called and whose expertise is more immediately relevant to some of those questions. So, I have no further questions of Dr. Petty at this time.

Chairman STOKES. The time of the gentleman has expired. Do any other members of the committee seek recognition.

[No response.]

Dr. Petty, any witness appearing before our committee is entitled under our rules to an additional 5 minutes when he has concluded his testimony for the purpose of making any statement he so desires relevant to his testimony.

You may explain your testimony, amplify it or expand upon it in any way you so desire. I extend to you at this time 5 minutes for that purpose.

Dr. PETTY. You are very kind, sir. I hope that my explanation has been lucid, clear, short, and understandable.



I would say only one thing, I have never worked with a group of individuals, and I am speaking now of the staff of the committee, that have shown any more consideration and kindness to me than this group. You have all made me feel very much at home, very much a part of Government, and I appreciate it very much.

You are extremely courteous, kind and I have enjoyed my brief stay here. Thank you.

Chairman STOKES. We certainly want to, once again, thank you for having lent yourself to the service of the U.S. Congress and to the American people. You certainly, in a very articulate way this morning, have been extremely helpful to this committee, this panel. We thank you very much for your service.

Dr. PERRY. Thank you, Mr. Stokes.

Chairman STOKES. The Chair recognizes Professor Blakey.

**NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND  
STAFF DIRECTOR**

Mr. BLAKEY. Thank you, Mr. Chairman.

Mr. Chairman, so far this week, the committee has heard testimony relating to President Kennedy's trip to Texas, the nature and extent of his wounds as well as those inflicted on Governor Connally, the number of bullets that struck President Kennedy and the direction from which they were fired.

For the rest of today, testimony will be taken from experts in the general field of ballistics, specifically including: One, an expert in wounds ballistics, or the science of bullet effects on the human body; two, a panel of experts in firearms analysis; and, three, an expert in neutron activation analysis, which is a method of analyzing bullet or other samples for their trace element characteristics, which makes possible conclusions about the probability of common origins.

It may be helpful before hearing from these experts, however, to review or to set out several of the issues that the committee will be examining today.

First, what is the validity of the single bullet theory? That is, did the slightly damaged bullet that was recovered and marked by the Warren Commission as exhibit 399 traverse the President's neck and cause all of Governor Connally's wounds?

Second, what is the best explanation for the apparent rearward movement of the President's head at the time of the fatal shot, as it is portrayed in the Zapruder film.

Third, what are we able to determine about the rifle found on the sixth floor of the Texas School Book Depository and identified as the one used to assassinate President Kennedy, as well as the revolver found at the scene of the murder of Dallas police officer J.D. Tippit?

Finally, what can our firearms experts tell us about the bullets fired in the Kennedy assassination and the Tippit murder in terms of type, number of bullets fired on, and so forth?

Since the turn of the century, when it first became possible to photograph bullets in flight, scientists have been collecting data on the trajectory and stability in flight of bullets. A highly specialized area in this general field of ballistics has been developed in recent years. It is a science of what occurs to a bullet when it strikes,

enters, and traverses a human body. It is called wounds ballistics and there are two important aspects of it here.

First, the determination of the factors involved in the potential of a projectile to cause injury, namely, its velocity, shape, momentum, energy and power; and second, the determination of the nature of the damage to tissues as a result of a projectile striking a human body.

The Warren Commission ordered wounds ballistics experiments in an effort to determine if the wounds to President Kennedy and Governor Connally could have been caused by the Mannlicher-Carcano rifle allegedly found in the book depository.

The tests were conducted by the Wounds Ballistics Branch of the U.S. Army Chemical Research and Development Laboratories at Edgewood Arsenal, Md. The Army measured the penetrating power and flight stability of the bullets fired by the Mannlicher-Carcano and it simulated the wounds to President Kennedy and Governor Connally by shooting anesthetized goats and materials that replicate the human body.

In part, as a result of these tests, the Commission concluded: One, that Governor Connally's wounds were caused by one bullet and that the bullet that traversed the President's neck probably then proceeded to inflict all of the wounds to Governor Connally.

Two, that a bullet fired from the Mannlicher-Carcano rifle at a distance of approximately 270 feet would cause a wound similar to the wound discovered in the President's head.

The committee has analyzed the reports of the tests at Edgewood. It also considered having a series of its own tests conducted. Rather than ask the Army to do additional experiments, it solicited a proposal from a private contractor, H. P. White Laboratory of Bel Air, Md. The company expressed its professional view that efforts to replicate the assassination would always be subject to theoretical questioning, since no material reacts in the exact manner of live human tissue when fired into.

Moreover, it is impractical to expect to be able to recreate Commission exhibit 399 by shooting bullets through a series of various substitute materials, such as gelatin blocks and bone fragments.

The main reason was the extreme unpredictability of the yaw motion of a bullet in flight as it traverses, exits, and re-enters a series of targets. The company, nevertheless, did propose shooting through smooth bore rifles in a series of tests estimated to cost in the first series, \$20,000, but it was not at all optimistic about exactly reproducing what occurred in Dallas. Indeed, the company indicated that the number of shots required to produce the chance result of Commission exhibit 399 could range from one up to infinity.

The committee discussed the proposal with Mr. Larry Sturdivan, a wounds ballistics expert employed by the Army, and it got advice from a specialist in scientific methodology, Dr. Gerald Gordon. The decision was made not to undertake expensive and perhaps useless further testing for the following reasons: Results of the tests with materials other than human bodies could always be theoretically questioned by those who would quarrel with its results.

Two, the number of shots to obtain a statistical sample could not be reasonably determined.

This next point is perhaps subtle but it is nonetheless important and I might add it is one often misunderstood by laymen, such as myself. It is an example, I think, of what Chairman Preyer indicated yesterday about commonsense.

The scientists we consulted indicated that under the best possible circumstances, the experiments could only yield a statement about probabilities. That is, there was no way, in their judgment, to prove scientifically that Commission exhibit 399 could not have inflicted the damage attributed to it by the Warren Commission.

The most such tests could establish is that such a series of events, that is, the wounding of both President Kennedy and Governor Connally, could have occurred, not that they actually did not occur. Consequently, the test could only raise a question about probabilities, something we already knew. The tests could not answer the question that everybody wants to have answered, can you prove or unequivocally disprove what happened in Dealey Plaza?

Mr. Sturdivan, who will be our next witness, received an M.S. degree in statistics from the University of Delaware in 1971 and a B.S. degree in physics from Oklahoma State University in 1961. He has studied mathematics and computer sciences at the Ballistics Institute of the Ballistic Research Laboratory, Aberdeen Proving Grounds, Md., and he has been a physical scientist with the Wounds Ballistics Branch of the Aberdeen Proving Ground Vulnerability Laboratory since 1964.

Mr. Sturdivan is the author of numerous professional articles and he is a frequent consultant in wound ballistics for such agencies as the Law Enforcement Assistance Administration and the Department of Justice as well as NATO.

Mr. Chairman, it would perhaps be appropriate for me to note now, for those who will follow carefully Mr. Sturdivan's testimony, that during that testimony, certain films will be shown. Those films involve the shooting of live and anesthetized goats. The Army, who prepared the films, has asked the committee to indicate to those who watch them that these experiments are not now being conducted. It also suggested, and I think perhaps rightly, that those who might be of delicate sensibility or small children should not watch these films.

Mr. Chairman, it would be appropriate now to call Mr. Sturdivan.

Chairman STOKES. The committee calls Mr. Sturdivan.

Would you raise your right hand and be sworn? Do you swear the testimony you give before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. STURDIVAN. I do.

Chairman STOKES. Thank you, you may be seated.

**TESTIMONY OF LARRY STURDIVAN, PHYSICAL SCIENTIST, ABERDEEN PROVING GROUND VULNERABILITY LABORATORY, ABERDEEN, MD.**

Chairman STOKES. The Chair recognizes Counsel Charles Mathews.

Mr. MATHEWS. Mr. Sturdivan, would you state your name for the record?

Mr. STURDIVAN. Larry M. Sturdivan.

Mr. MATHEWS. What is your occupation?

Mr. STURDIVAN. I am a research physical scientist.

Mr. MATHEWS. How long have you been employed as such?

Mr. STURDIVAN. Over 14 years.

Mr. MATHEWS. And where are you employed, Mr. Sturdivan?

Mr. STURDIVAN. At the Chemical Systems Laboratory, the Edgewood area of Aberdeen Proving Ground, Md.

Mr. MATHEWS. What is Aberdeen Proving Grounds? That is, what is its function and purpose?

Mr. STURDIVAN. Located at APG are a collection of a great number of U.S. Army agencies who conduct research development test and evaluation of weapons, vehicles, and other equipment for the Army and for other DOD agencies, and other Government agencies.

Mr. MATHEWS. Within the Edgewood Laboratories of Aberdeen Proving Ground, what specifically are you involved in?

Mr. STURDIVAN. Well, we do work in the general areas of wound ballistics and application of mathematics to chemistry. In wound ballistics, we do studies on human vulnerability and protective devices, which includes trauma from ballistic projectiles. For example, bullets from handguns, hunting rifles or military rifles, fragments from exploding munitions, such as grenades and artillery; blunt trauma from debris from explosions, for example, or riot control devices, combat simulation devices which have fallen short among troops; blunt trauma behind body armor, that is, bullet-proof vests and flakjackets which have stopped the bullets and fragments and other debris.

Mr. MATHEWS. What specifically, Mr. Sturdivan, are your exact duties within your laboratory?

Mr. STURDIVAN. Generally, I'm in the business of producing predictive models of effectiveness of weapons, studying the behavior of bullets inside tissue and tissue simulant and exterior ballistics, of course.

Mr. MATHEWS. Would it be safe to say you study the characteristics of bullets in flight, you study the characteristics of bullets as they penetrate solid masses and you also study the characteristics of bullets once they enter the human body and the effect of those bullets on the human body?

Mr. STURDIVAN. Well, yes.

Mr. MATHEWS. Would you describe that as the wound ballistics field?

Mr. STURDIVAN. Yes, generally, the wound ballistics field is a little broader, and perhaps more descriptive in the thoughts of some. At our laboratory, we try to concentrate on the predictive models of behavior of bullets, particularly the full-jacketed military bullets that we are used to dealing with, their behavior in gelatin tissue simulant. In fact, one of the things I have recently been working on is a predictive model of what the behavior of the bullet would be in gelatin as a function of its physical characteristics, such as mass, velocity, location of the center of gravity and several other esoteric characteristics.

Mr. MATHEWS. But my previous statement would be more or less correct, you are involved in those type of studies; that is, characteristics of bullets?

Mr. STURDIVAN. Right.

Mr. MATHEWS. Are you considered an expert in the wound ballistics field?

Mr. STURDIVAN. I would think so; yes.

Mr. MATHEWS. How many additional experts would you say are presently in the United States or the world, for that matter?

Mr. STURDIVAN. Well, outside of a handful of experts within our own laboratories, there probably are very few, even in the free world. Some people do experiments, research, and various aspects of like blunt trauma from automobile accidents, and things like this, but as far as the whole wound ballistics field, there are very few experts.

Mr. MATHEWS. How many experts would you say are presently residing in the continental United States?

Mr. STURDIVAN. Maybe half dozen, and they are all within our laboratories.

Mr. MATHEWS. And they all work within Edgewood Laboratories?

Mr. STURDIVAN. Yes.

Mr. MATHEWS. How long have you worked in the wound ballistics field?

Mr. STURDIVAN. Over 14 years.

Mr. MATHEWS. Over 14 years.

Mr. STURDIVAN. Yes; my entire Federal service.

Mr. MATHEWS. Mr. Sturdivan, has your laboratory ever conducted any experiments or studies on the characteristics of the Mannlicher-Carcano rifle and the 6.5 millimeter bullet?

Mr. STURDIVAN. Yes; in 1964, we performed tests at the request of the Warren Commission in connection with their investigation into the assassination of President Kennedy.

Mr. MATHEWS. And what type of tests did you perform?

Mr. STURDIVAN. Well, we did air retardation, retardation in a gelatin tissue simulant, tests of cadaver wrists, some skulls, and into some anesthetized animals.

Mr. MATHEWS. Why don't we try this. Before we attempt to get into testimony that will bear directly on the assassination of President John F. Kennedy, why don't we attempt to explain the terminology and methodology that is utilized in the wound ballistic field.

For that purpose, could we have the bullet brought up to Mr. Sturdivan, the bullet and the cartridge?

When you use those two devices for your explanation, let's assume that the cartridge is in the chamber; the bullet is detonated. What happens then? Explain by holding up one of those exhibits and explain precisely what happens from the moment the bullet is detonated.

Mr. STURDIVAN. The bullet begins to move down the barrel of the rifle. As it does, it engages the grooves and the raised areas between the grooves of the rifle, which are called lands, which impart a spin to the bullet. This spin is 1 turn in 8 to 14 inches, depending on the characteristics.

Mr. MATHEWS. Why is the spin necessary?

Mr. STURDIVAN. The spin is necessary to give it stability in the air, stability like a spinning top, a child's top, which will stand on its end while spinning. This is called gyroscopic stability. Now, as the bullet emerges from the end of the rifle, the hot expanding gases that have been pushing it down the barrel are then free to expand. As those gases expand, they move past the bullet creating a temporary instability in the bullet much like tapping the side of the spinning top.

As that happens, the bullet begins to go through a gyrating, wobbling motion where its yaw increases, yaw being the angle of the bullet measured with its line of flight. It bobs in and comes back and then out again in what we call an epicyclic motion.

The bullet, of course, has been designed to be stable and, therefore, this yawing motion, this wobbling motion, damps out very quickly so that, oh, at less than 100 meters, it will approach a very, very small yaw and sit spinning for the next 200 or 300 meters.

Mr. MATHEWS. Will that yaw have any effect at all on the velocity of the bullet as it goes through the air?

Mr. STURDIVAN. Only in a negative manner. If the yaw is excessive, the drag will be excessive. The loss of velocity will be excessive and that is the reason most bullets are designed to fly at very low yaw.

Of course, far down range, several hundred meters, the yaw begins to grow. Then the bullet eventually would lose all gyroscopic stability and start tumbling end over end.

Mr. MATHEWS. Now, you said after about 100 meters, I believe, the bullet will begin to stabilize?

Mr. STURDIVAN. Well, it is stable from the moment that it emerges from the muzzle. At about 100 meters it reaches a very low yaw, perhaps less than a degree, in most cases.

Mr. MATHEWS. Does stability have any effect on velocity, as the bullet is flying through the air?

Mr. STURDIVAN. Only in that it affects the yaw.

Mr. MATHEWS. Will you say that the Mannlicher-Carcano 6.5-millimeter bullet, is a stable bullet?

Mr. STURDIVAN. It is a very stable bullet, perhaps one of the most stable bullets that we have ever done experimentation with.

Mr. MATHEWS. And how do you determine the characteristics of bullets in flight? What devices are utilized in your field to determine these characteristics?

Mr. STURDIVAN. Well, we use a number of devices like—

Mr. MATHEWS. Let me at this time, direct your attention to what has already been marked "JFK exhibit F-111."

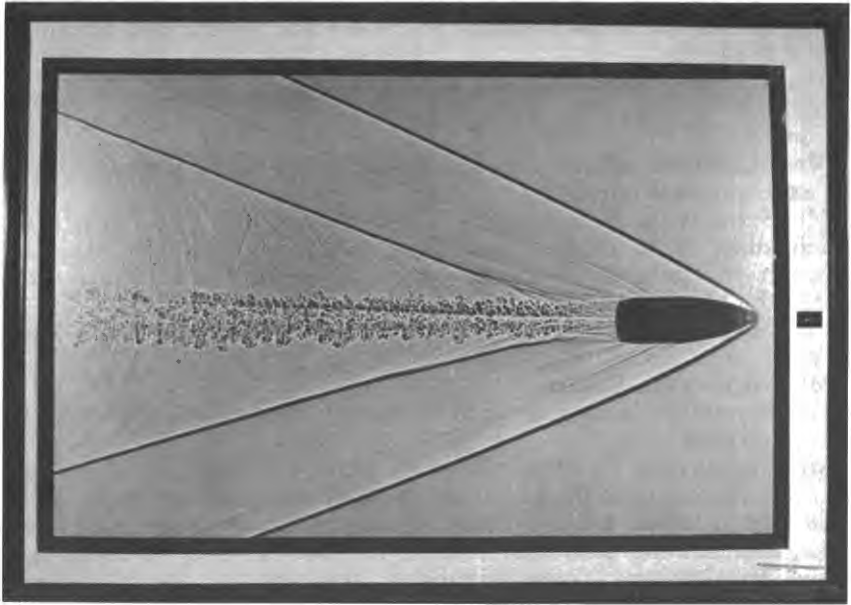
Mr. STURDIVAN. Very well. I will go ahead while they are putting it up.

We sometimes fire through pairs of metallic coated screens which are set so that a chronometer can measure the time between those pairs of screens.

We also take flash shadowgraphs of projectiles. What you have displayed here is a flash shadowgraph of a projectile in the air.

Mr. MATHEWS. Will you describe this exhibit, 111, for the benefit of the committee?

[JFK exhibit F-111 follows:]



JFK EXHIBIT F-111

Mr. STURDIVAN. Very well. This picture was taken by casting a shadow of a bullet on a piece of photographic film obtained from a very short duration flash, such as a spark or an exploding wire. Not only do you see the bullet but you see the turbulent wake of the bullet and the shock wave, the bow wave coming off of the point of the bullet, and the second shock wave coming off of the rarified turbulent wake. This is characteristic of a supersonic bullet.

A subsonic bullet will not cause a shock wave such as this. We will take pictures like this and a shadowgraph of the bullet, for instance. Let's presume that this is the horizontal view. We will take a second view of the bullet from right angles. From this we can measure, from the two angles, the three-dimensional yaw.

We might also have a second shadowgraph taken some few meters down range, so that we can calculate the velocity from the shadows. The exact distance between shadows divided by the time gives us an estimate of the velocity.

Mr. MATHEWS. Fine. Thank you.

Could you now begin to characterize for us the type of devices or materials that are utilized in the study within the wound ballistics field, for example, do you use human cadavers for experimentation in the wound ballistics field?

Mr. STURDIVAN. Not as a matter of course, really. We used cadaver wrists in the 1964 Warren Commission study at the request of the Warren Commission, and dried human skulls that we had obtained from the biological supply houses, but ordinarily we do not use human material; no.

Mr. MATHEWS. What other kind of substances are utilized for experimentation purposes?

Mr. STURDIVAN. We use sometimes animal tissue but for the most part we use a tissue simulant, 20 percent gelatin gel, which is cast into blocks.

Mr. MATHEWS. Gelatin gel, is that like Jello?

Mr. STURDIVAN. Well, Jello is probably about 5 percent gelatin. We use a stiffer composition about 20 percent gelatin.

Mr. MATHEWS. Is that as good as human parts or human tissue for experimental purposes?

Mr. STURDIVAN. For studying the characteristics of bullets, it is much superior to human or animal tissue because you can see through the gelatin. You can watch the behavior of the bullet inside the block with high-speed movies.

Mr. MATHEWS. You indicate you also use animal tissue, is that correct?

Mr. STURDIVAN. Yes, sir.

Mr. MATHEWS. Is that as good as human tissue for experimentation purposes?

Mr. STURDIVAN. For the effects on human beings, no, of course not. But then we don't get that many volunteers. [Laughter.]

Seriously, when we are studying the characteristics of tissues itself, and not the characteristics of the bullet, then we must use tissue because the tissue simulant, the gelatin doesn't bleed, doesn't have nerves or vessels. Animal tissue in general is not that different from human tissue in its characteristics, density, conductivity of the nerves and so forth.

Mr. MATHEWS. Mr. Sturdivan, let's make a couple of assumptions. Let's assume a gelatin block is set up, the rifle is fired, the bullet penetrates a more solid mass than air, what happens then and describe for us the effects on velocity, stability, yaw as that bullet goes through a more dense material.

Mr. STURDIVAN. You have to remember that tissue is about 800 times denser than air and, consequently, all of the effects that are caused on the bullet are much magnified. Its drag is increased by 800 times. In fact, it loses its gyroscopic stability, and the yaw immediately begins to grow. As the bullet enters and penetrates the tissue, it will grow to—depending on the bullet—perhaps nearly 180° or even to 270° of yaw. Eventually, the bullet, if it would go continuously through the medium without stopping, would eventually end up moving sideways at 90° or 270°.

Mr. MATHEWS. Could you explain that by utilizing what has been previously marked JFK exhibit F-112, F-113, F-114, F-310, and F-116?

Can you step over?

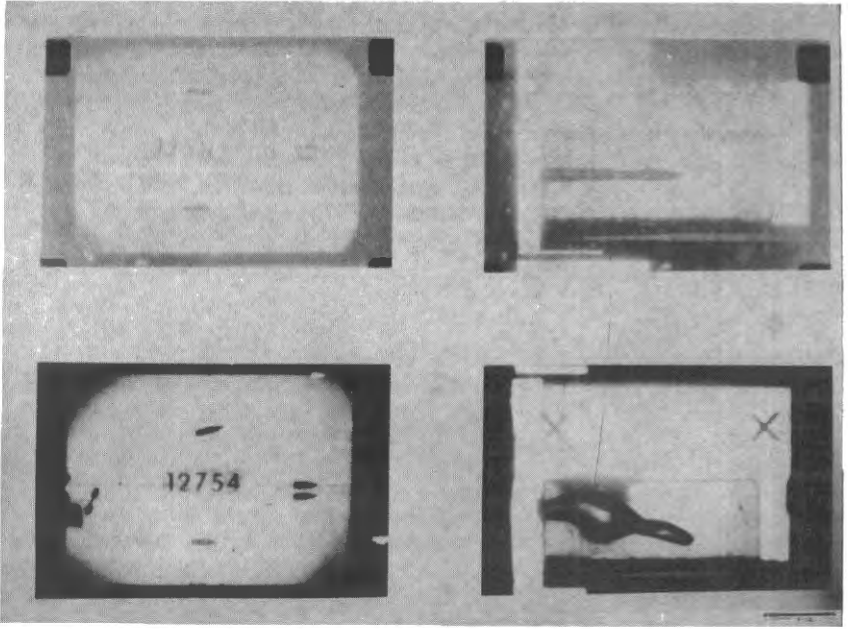
Mr. STURDIVAN. Very well.

Mr. MATHEWS. Mr. Chairman, could we have JFK exhibits F-112, F-113, F-114, F-310, and F-116 incorporated in the record, please?

Chairman STOKES. Without objection, they may be incorporated into the record at this point.

[The above referred to JFK exhibits F-112, F-113, F-114, F-310, and F-116 follow:]

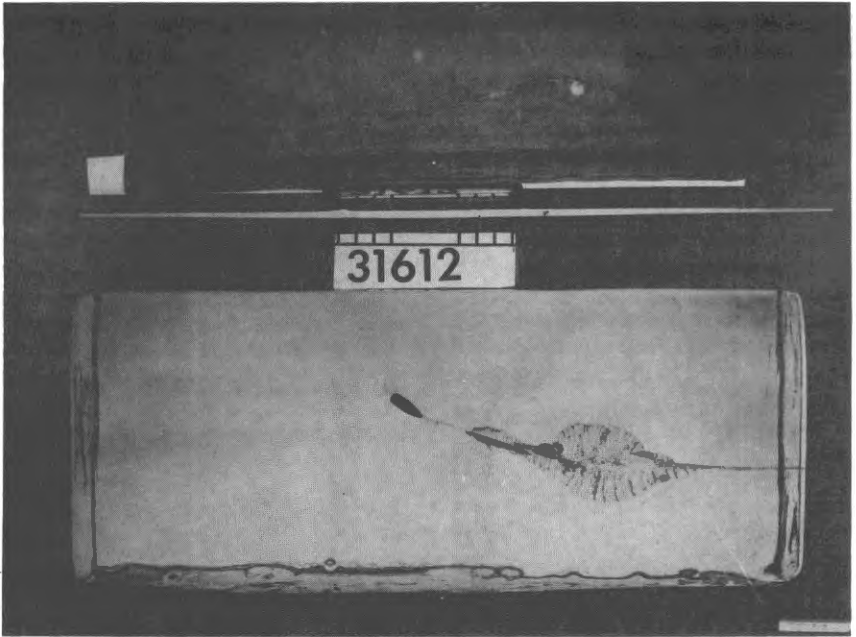




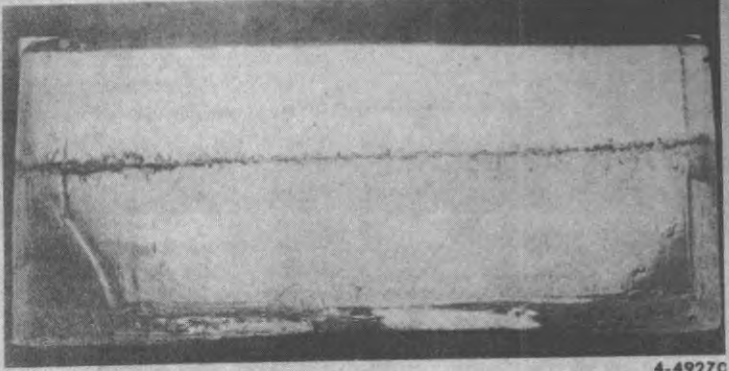
JFK ЕХНІВІТ F-112



JFK ЕХНІВІТ F-113

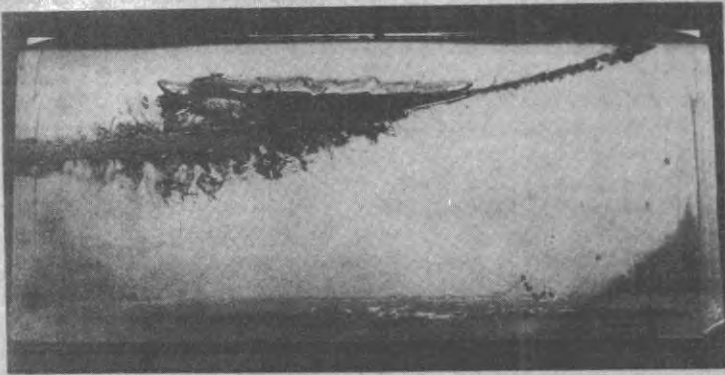


ЖК Ехнівт F-114



A

4-4927C

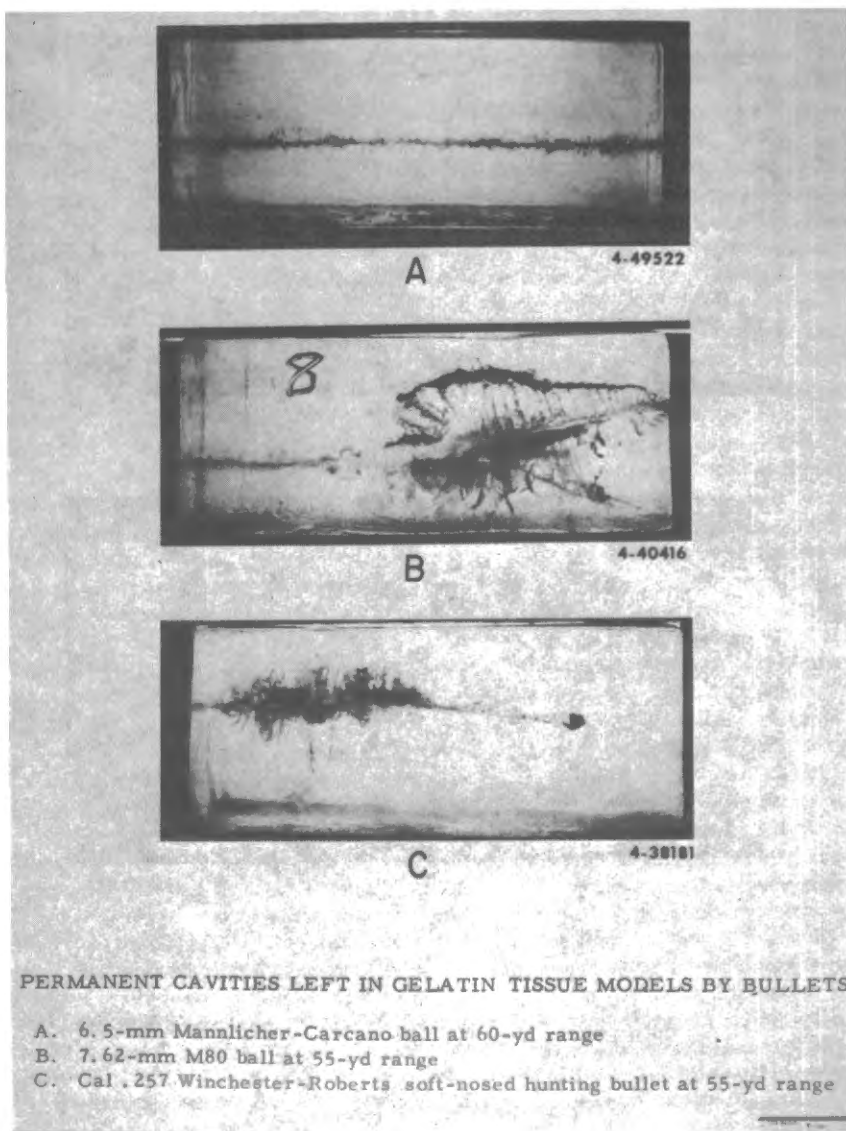


B

4-49271

PERMANENT TRACTS LEFT BY 6.5-MM BULLETS IN 20% GELATIN  
AFTER PERFORATING RETARDATION TARGETS

- A. Tract left by stable bullet
- B. Tract left by unstable bullet



## JFK EXHIBIT F-116

Mr. STURDIVAN. Starting first with F-112, you see here a spark shadowgraph, a flash X-ray, of a bullet in flight, and this is taken in a 45° angle mirror so that we are getting orthogonal views of the bullet. As you can tell from this, it has very small yaw.

This is a frame of one of the high speed movies that we have taken. It runs approximately 27,000 frames per second, and so effectively stops the bullet in flight. As you can see, the penetration into the gelatin block is very straight, indicating that the yaw is not dramatically increasing at this point.

This is a similar .30-caliber bullet, which is caught in flight and shows a component of yaw in one direction. Of course, the component is missing from the other view. This yawing bullet strikes the gelatin block, and rapidly increases in yaw. The maximum yaw, 90° occurred about here. It goes on through 180° at this narrow pinched in waist and then begins to grow back again and is actually probably moving sideways here at the point where the film ends.

That essentially expresses how the yaw grows. Of course, the velocity of this bullet [indicating unyawed bullet] is much higher because it is not yawed and the drag force is not nearly as great as it was with this bullet [indicating yawed bullet].

We have similar views on exhibit F-113. It shows a view of an M-193 bullet. This is the bullet that is fired from the M-16 rifle that was used extensively in Vietnam. It is a caliber .22 but at a high velocity, approximately 3,000 feet per second.

This bullet entered, and as you can see, it goes nice and straight for a little while. Then the yaw increases dramatically. The pressure is increased dramatically and the bullet begins to fragment, pieces are broken off, the bullet continued, although the track is not clearly visible, from here it continues to exit from the corner of the block.

Mr. MATHEWS. Mr. Sturdivan, could you also speak up, please?

Mr. STURDIVAN. F-114 is the same bullet at a lower velocity. That velocity would be encountered at about 800 meters per second. The lower velocity doesn't make any difference on the way in which the yaw grows. It comes in, the yaw grows, it tumbles then ends up moving backward at the point where it stops.

This bullet, of course, was not deformed because the pressures, due to the lower velocity, were never high enough to deform the bullet.

Mr. MATHEWS. The next exhibit, Mr. Sturdivan, should be F-310 on your left.

Mr. STURDIVAN. F-308.

Mr. MATHEWS. On your left, sir. Let me ask you a question in F-114, why did that bullet enter straight and then yaw upward—right behind you?

Mr. STURDIVAN. The bullet entered straight because it was unyawed in normal flight, and bullets are engineered to be stable and, therefore, it strikes at low yaw. When it is unstable inside the block, naturally unstable inside the block, it yaws dramatically, in every case. All bullets are unstable in tissue, which is 800 times as dense as air.

Mr. MATHEWS. The point being is that all bullets do not go straight when they enter a solid mass.

Mr. STURDIVAN. Oh, no bullet actually goes straight when it enters a solid mass. The lift forces, which are better shown, I think, on—

Mr. MATHEWS. Will you explain exactly what that exhibit is? F-310—

Mr. STURDIVAN. F-310 shows a picture of a Mannlicher-Carcano bullet, which, as I said, was one of the most stable bullets we have ever studied. This bullet perforated—the upper bullet perforated 15 inches, 38 centimeters, of gelatin tissue without appreciably increasing in yaw. You see some evidence of it right at the end, the

yaw is beginning to increase. This is because it struck stably, even though it had perforated a 4-inch gelatin target ahead of it.

Chairman STOKES. Would you have the witness suspend for a moment until we get the sound system worked out here?

Mr. MATHEWS. Yes, sir.

Chairman STOKES. Mr. Sturdivan, speak a little louder, if you would, please, sir, because members of the committee are having extreme difficulty in hearing you.

Mr. STURDIVAN. I am sorry. Perhaps if I hold the mike up closer to my mouth.

Chairman STOKES. That does help, thank you.

Mr. MATHEWS. As you address yourself to F-310, will you explain precisely what that particular experiment was meant to achieve?

Mr. STURDIVAN. Yes, sir. This is part of the Warren Commission exhibit and the experiment that was done for the Warren Commission. I am not sure whether it was introduced into the evidence or not. This was a firing to the Mannlicher-Carcano bullet, a 6.5 millimeter, through some 13½ centimeters, which is approximately 4-inch gelatin blocks, then through an air space and allowed to strike a second block. This is only two of the examples of several shots that were made.

In the upper view, the bullet struck at very low yaw and kept its stability through the 15 inches. That bullet, after passing through the first target, struck the second target in an unstable or yawed position, then this curving path is what resulted.

The bullet enters, and because the flow of the gelatin around the bullet is not perfectly symmetric, it develops a lift, much like an airplane wing, and will deviate from its path, making a curved path through the gelatin. This is evident particularly in F-114 as well. The lift forces cause the bullet to make a curved path through the gelatin.

Mr. MATHEWS. So we say F-310 and F-114 are consistent with the theory that a bullet could enter one man straight, in a straight trajectory, and on exiting that man be curved slightly?

Mr. STURDIVAN. Well, let's put it this way. With most military bullets, like the M-193, the bullet would curve almost immediately because the yaw begins to grow almost immediately. With the Mannlicher-Carcano bullet, it is much more stable, the yaw begins to grow much more slowly, and it curves much more slowly. So that at a target of 4 or 5 inches of soft tissue, that bullet would not deviate appreciably from its path.

In a much longer track, particularly if the bullet were unstable when it struck, it would in fact deviate from its path. It would not go in a straight line.

Mr. MATHEWS. Again, Mr. Sturdivan, in JFK exhibit F-113, which is the second one on your left, what caused the bullet to break up, what factors cause a bullet to deform?

Mr. STURDIVAN. It is the force. The force developed on the bullet exceeded the strength of the bullet and, therefore, it caved in and began to deform.

Mr. MATHEWS. Let me, Mr. Sturdivan, direct your attention to JFK exhibit F-116. Could you describe for the benefit of the committee exactly what experiments were conducted utilizing this particular exhibit?

Mr. STURDIVAN. Very well. The upper one, labeled A, is again a Mannlicher-Carcano bullet, not striking another target previously but striking this as the initial target, and as you can see, it is quite stable all the way through the 15 inches of gelatin.

The block labeled B is an example of a 7.62 millimeter M-80 bullet, which is fired from the M-14 rifle. That is the NATO standard .30 caliber bullet.

As you can see, it was initially stable, it caused a nice clean track, began to yaw, and at approximately 10 inches was at 90 degrees, continued to yaw on past and exited probably something less than 180°.

The third block, labeled the caliber 257 Winchester Roberts, is a normal, typical hunting bullet that has a soft nose. Of course, a hollow point would behave exactly the same. It has a very short stable track, but the bullet begins to expand immediately on impact, and the only reason that it has any short track is that it takes it a finite time to expand into its final deformed condition, and its drag force is much increased as it begins to expand. This is a positive feedback loop.

As it expands, the drag force increases. As the force increases that increases the expansion. So it rapidly expands causing this massive wound track early in the block and then comes to a rest.

This explains the difference between a military bullet and a soft nose hunting bullet. The military bullet being solid depends on its yawing to deform, whereas the hunting bullet will deform immediately.

Mr. MATHEWS. Are you able to predict the drag force on the bullet, scientifically?

Mr. STURDIVAN. Well, yes, for military bullets in particular we are able to predict the drag forces with some precision.

Mr. MATHEWS. And how are you able to do that?

Mr. STURDIVAN. Well, through our mathematical models of the physics of what happens to bullets in gelatin.

Mr. MATHEWS. Let me direct your attention to JFK exhibit F-115. Can you explain briefly for the benefit of the committee how many people in the wound ballistics field are able to predict drag force?

Mr. STURDIVAN. This is a very simple drag force equation, actually attributed to Sir Isaac Newton, the man who invented calculus, also invented ballistics, I guess.

Typically, you might see the drag force as a function of the other variables. The way I have expressed it here, the drag force is divided by the presented area. This gives us the pressure on the bullet, and the units that we would be most familiar with in describing this pressure would be in pounds per square inch. At some level of pressure any material will deform.

So, here is the drag pressure, which is a function of a dimensionless drag coefficient, multiplied by the density of the material that it is flying through, and the square of the velocity.

So, we can see here all of the essential elements that contribute to increasing force. With an increase in density, as I said awhile ago, moving from a very small density in air to 800 times that density in gelatin increases the drag force by 800 times. Moving

from a relatively low velocity to a high velocity dramatically increases drag force and pressure.

In fact, the pressure increases much more rapidly than the velocity does because of the square term.

Mr. MATHEWS. So with that formula are you able to predict when the bullet will begin to deform?

Mr. STURDIVAN. To a certain extent; yes. I must point out for the physicists in the audience that this is an oversimplification. The first order effects of drag force are density. There are also viscosity, which is like the friction that is encountered in going through material, that is the second order effect, and the strength of the material is the third order effect. Since I have excluded everything except the density variable these could only be considered rough approximations.

But for a guiding metal jacketed bullet like the Mannlicher-Carcano, as I recall, the yield pressure of this bullet is 3.8 times 10 to the 10th dynes per square centimeter, which to most people is absolutely meaningless, but it means the bullet is approximately 4 times the strength of bone.

Mr. MATHEWS. So at what velocity will a bullet begin to deform?

Mr. STURDIVAN. OK, the bullet would begin to deform, if it strikes say, soft tissue, at something—remember, the density of soft tissue is around one, the density of water, and it will begin to deform at something in excess of 2,000 feet per second. In other words, at the muzzle velocity of the Mannlicher-Carcano.

If it strikes bone, which is twice as dense, then it would begin to deform nose on at approximately 1,400 feet per second. If the bullet turns sideways, which is a weaker orientation, it will deform down to around 1,000 feet per second.

Mr. MATHEWS. Did you bring along with you today, Mr. Sturdivan, some films to show the committee to demonstrate that precise point?

Mr. STURDIVAN. Yes sir, I did.

Mr. MATHEWS. Could we have about a 1-minute recess in order to set up the projector?

Mr. Chairman, before that, could we have incorporated into the record JFK exhibit F-115?

Chairman STOKES. Without objection, it may be entered into the record at this point.

[The above referred to JFK exhibit F-115 follows:]

$$F/A = C_D \rho V^2$$

Drag Force Formula  
Exhibit JFK F-115



Mr. FAUNTROY [presiding.] In the opinion of the Chair, we should wait until the members have returned from this vote before showing the film, so we will remain in recess. I will ask that the lights be put back on. Thank you.

[Brief recess.]

Mr. PREYER [presiding]. The committee will come to order, please.

Mr. Mathews, are you ready to proceed? Mr. Mathews, Mr. Sturdivan?

Mr. MATHEWS. We are ready to proceed, Mr. Chairman.

May we have incorporated into the record JFK exhibit F-117, the movie film which will be shown?

Mr. PREYER. Without objection, so ordered.

Mr. MATHEWS. Mr. Sturdivan, will you first explain for the benefit of the committee and the gallery exactly what the film is about to show?

Mr. STURDIVAN. What we are going to see here is a gelatin block being struck by a .30 caliber, that is, a 7.62 millimeter military bullet. It will be coming in from the left, strike the block at approximately 2,800 feet per second. First, I will run the film at approximately 24 frames per second. I will go through and then I will back up and explain frame-by-frame what is happening.

[First film shown.]

This is the first frame that you can see the bullet. It is beginning to penetrate the left-hand side of the block. It travels in a reasonably straight line. The yaw is beginning to increase at this frame, the second frame. The yaw has dramatically increased. You can begin to see the radical velocity of the tissue simulant as it is thrown away from the bullet that is moving through the gelatin.

Many people have called this a shockwave, but the bullet is actually not moving at the speed of sound in gelatin. The speed of sound in gelatin is approximately 5,000 feet per second. This bullet is moving at less than half that velocity. Here the gelatin is being pushed out of the way as the bullet goes through. It has to be very greatly accelerated to be moved out of the way at the instant that the bullet is passing.

That radial velocity is imparted not only to the material that is in contact with the bullet, but everything all the way out to the outside of the block. That radial velocity continues after the bullet has gone.

The bullet has passed, the cavity is still opening up because of that radial velocity. That is not an air-filled cavity, that is a vacuum cavity and because the gelatin is still moving—

Mr. MATHEWS. Pull your mike up, please.

Mr. STURDIVAN. Did I lose my mike again?

Mr. MATHEWS. You have it now.

Mr. STURDIVAN. Because the gelatin is still moving in a radial manner, it continues to move out and the air from outside will move inside the cavity. This is why often they find debris like pieces of clothing, buttons, twigs, dirt, and all sorts of things drawn into wound cavities in combat. That is because the tremendous radial velocity of the gelatin creates the vacuum that pulls the air and the debris in with it.

Let me run this one on through and we will see a second gelatin block, identical to the first. This is a 6 by 6 inch gelatin block approximately 15 inches long. The second gelatin block which we will see in a moment—

Mr. FAUNTROY. Will the gentleman yield for just a moment? Those last pictures were the pictures of the gelatin after the bullet had left?

Mr. STURDIVAN. Yes.

Mr. FAUNTROY. So, the bullet was not there when all that movement was taking place?

Mr. STURDIVAN. That's right. It was the radial velocity, the tremendous momentum, the radial momentum that was left in the block that caused it to gyrate like that.

Mr. FAUNTROY. Thank you.

Mr. MATHEWS. So, Mr. Sturdivan, that radial velocity created a force, a form of energy within the block itself?

Mr. STURDIVAN. Right, well, the kinetic energy of the bullet was deposited within the block and that kinetic energy is what gives rise to the radial velocity.

Mr. PREYER. Let me ask that the rear door be closed, please, so that we don't have that extra light in the room.

Excuse me, Mr. Mathews.

Mr. STURDIVAN. I will continue with this one. This one is a caliber 223, that is the M-193 bullet from the M-16 rifle again, the Vietnam rifle, traveling at approximately 3,200 feet per second.

Now, this one, as you can see, well, it's much higher velocity. It went in with a reasonably straight path and then tumbled very quickly. The drag force, the pressure, that was exerted on this bullet at that point caused it to breakup. Each of those little points that you can see looks like fingers pointing to the right. Each of those little points is a separate fragment.

Mr. MATHEWS. At what velocity do you think that bullet broke up at?

Mr. STURDIVAN. The bullet broke up at almost its muzzle velocity. The bullet would break up, as I said before, at anything above 1,000 feet per second; well, it would begin to deform at about 1,000 feet per second.

But remember, the higher the velocity is, the higher the forces are and the much more extensive the break up is. In this case, we saw a very high velocity, very high pressure and very extensive breakup.

The major part of the bullet is at the top of the block. As you can see, this block gets a tremendous radial velocity because of the much greater expenditure of energy.

That bullet is just about to leave the top of the block toward the right point. It is very faint, but you can see the bullet or a fragment of the bullet suspended in air above the block right outside the cavity.

Another couple of frames, it is moving at a reasonably low velocity now. It is sitting right at the corner of the fiducial marker above the block, the major fragment of the bullet.

The remaining fragments of the bullet are still within the block. As you can see, the block continues to gyrate. The cavity collapses and then rebounds, opening up slightly again. The bullet, the piece

that escaped, is long gone but the block continues to gyrate under the influence of the energy that was deposited in it.

That terminates the first section of the film.

Mr. MATHEWS. Can we have the lights, please? Mr. Sturdivan, will you have your seat, please?

Let me pose a couple of questions about radial velocity. Is that the same as shockwaves?

Mr. STURDIVAN. Oh, no. No, the bullet is moving at subsonic velocities inside the block and the radial velocities are just the reactions of the pressure moving away from the bullet, away from the line of flight. There is momentum in each little piece of gelatin. But, of course, the total momentum is conserved.

Mr. MATHEWS. Mr. Sturdivan, let me direct your attention to JFK exhibits F-273, F-320, and F-294.

[JFK exhibits F-273, F-294, and F-320 were entered previously.]

Mr. Sturdivan, this committee heard testimony yesterday from Dr. Wecht that indicated, in his opinion, that the bullet struck President Kennedy in the skull, or the neck, I should say, the back of the neck. Excuse me, his rear back of his neck, and then passed straight through, which is shown by the exhibit on the left. The question I want to pose to you is this, since you are a scientist and I assume being a scientist, you have a better than average understanding of mathematics. Assume you are a professor in a major college or high school.

If you had a student and he came to you and presented this as evidence of what occurred in Dealey Plaza on November 22, 1963, would you give him an "A" for bringing a piece of scientific analysis or would you give him an "A" for speculation and explain why you will give him an "A" for one or the other.

Mr. STURDIVAN. Well, it is difficult to evaluate just a final drawing. Of course, you would have to go through the mathematical manipulations that went into such an analysis. I would presume that the individual had much more information than we have presently been given; that is, the Zapruder film shows a horizontal view of the President, the Governor and the car and from that view alone, it would be virtually impossible to reconstruct a plan view that is shown here; it is at 90°.

The relative position of the two people would be impossible to determine from that film alone.

Mr. MATHEWS. What other factors would you need to know before constructing that exhibit?

Mr. STURDIVAN. We would have to have the position of the two people, not only their position of their center of mass, which Dr. Wecht indicated yesterday would not change very much in a major part of a second, but you would have to know the exact position of the head, the neck, whether a person was moving at the time, had stopped to look down at something on the floorboard. In other words, the exact position of each occupant of the car would have to be determined from something other than the Zapruder film.

Mr. MATHEWS. We have to know the speed of the automobile, the elevation of the automobile?

Mr. STURDIVAN. The fact that it was going down a slight incline, which was changing.

Mr. MATHEWS. Would the weather have any factor or play any role?

Mr. STURDIVAN. Weather? Probably not, except for the initial velocity of the bullet which happens to be a little higher in warm weather because the cartridge is hotter. But that is masked within the normal variance of the velocity of the bullet, anyway.

Mr. MATHEWS. What would you say, as a scientist, that the probability is of recreating that event?

Mr. STURDIVAN. Well, given sufficient evidence, the probability would be quite high. But then, I am not in a position to state whether there is sufficient evidence to reconstruct such a drawing. Certainly Dr. Wecht didn't give us sufficient information yesterday to allow a reconstruction of this event.

Mr. MATHEWS. Thank you. Do you care to comment on any of the other exhibits?

Mr. STURDIVAN. Now that it is here, perhaps we could go into the relative deformation of the several bullets that are shown on the exhibit to the right. I can't remember the number.

Mr. MATHEWS. I believe that is JFK exhibit F-294.

Mr. STURDIVAN. On F-294, it shows the picture of five bullets. Commission exhibit 399, of course, is the infamous bullet. The commission exhibit 572, as I understand it, were a couple of bullets that were recovered in cotton-waste media, which, incidentally, is a little denser than tissue and, therefore, caused perhaps a little more extensive deformation than a soft recovery in gelatin would have.

Exhibit 853 is a bullet that has ricocheted from the rib of a goat carcass, as Dr. Wecht indicated. However, let's remember that the goat, which is roughly 100 pounds, is much, much smaller than Governor Connally and, therefore, the bullet passed through a relatively small amount of soft tissue before it hit the bone and, therefore, lost correspondingly less velocity.

So, we would have to say that the striking velocity on that bullet, C.E. 853, was much in excess of the striking velocity on Governor Connally, even if the bullet had passed through nothing before it hit Governor Connally.

C.E. 856 is a bullet that was shot directly into a cadaver wrist without passing through anything before it hit. It is characteristic of the kind of deformation that you would expect of a bullet that strikes at high velocity. In other words, this was direct proof that the bullet that struck Governor Connally's wrist was not at high velocity; that is, CE-399 was not at high velocity. Otherwise, it would have been deformed as this bullet was in striking dense bone.

Mr. MATHEWS. Thank you, Mr. Sturdivan.

Let me direct your attention now to JFK exhibits F-255 through F-258, which is frame 313, 14, 15 and 16 of the Zapruder film, and JFK exhibits F-66 and F-53.

The committee has received some evidence to the effect that the second shot that hit President Kennedy entered through the rear of the skull and out the right front.

As you can see from the exhibits, the President's head seemed to have exploded. This explosion has led many people to conclude that the President may have been shot with an exploding bullet or a

frangible bullet. By studying these exhibits, could you comment on whether that theory is a possibility?

Mr. STURDIVAN. Literally, an exploding bullet would be a bullet which would have some high explosive incorporated within the structure of the bullet that would be detonated at impact on bone or soft tissue. Such bullets do exist.

A frangible bullet is one that is made to deform very rapidly and, in fact, most of them are made of some sort of matrix with metallic powder inside that matrix. And essentially, I think that you could probably not tell the difference between the skull that had been hit with an exploding bullet, one that had been hit with a frangible bullet or one that had been hit with a hollow point or soft nose hunting bullet or a hard jacketed military bullet that had deformed massively on the skull at impact.

In fact, all of those situations would look, in a film like this which was taken at ordinary speeds, to be very similar.

Mr. MATHEWS. Mr. Sturdivan, taking a look at JFK exhibit F-53, which is an X-ray of President Kennedy's skull, can you give us your opinion as to whether the President may have been hit with an exploding bullet?

Mr. STURDIVAN. Well, this adds considerable amount of evidence to the pictures which were not conclusive. In this enhanced X-ray of the skull, the scattering of the fragments throughout the wound tract are characteristic of a deforming bullet. This bullet could either be a jacketed bullet that had deformed on impact or a soft-nosed or hollow point bullet that was fully jacketed and, therefore, not losing all of its mass.

It is not characteristic of an exploding bullet or frangible bullet because in either of those cases, the fragments would have been much more numerous and much smaller. A very small fragment has very high drag in tissue and consequently, none of those would have penetrated very far.

In those cases, you would definitely have seen a cloud of metallic fragments very near the entrance wound. So, this case is typical of a deforming jacketed bullet leaving fragments along its path as it goes.

Incidentally, those fragments that are left by the bullet are also very small and do not move very far from their initial, from the place where they departed the bullet.

Consequently, they tend to be clustered very closely around the track of the bullet.

Mr. MATHEWS. So, your testimony is you can state for the record that as a result of JFK exhibit F-53, you can state the President was not hit with a frangible bullet or an exploding bullet; is that correct?

Mr. STURDIVAN. That's correct.

Mr. MATHEWS. Again, Mr. Sturdivan, looking at exhibit F-53, can you tell us, based on your expertise in the wound ballistics field, where the approximate track of the bullet that traveled through the President's skull was located?

Mr. STURDIVAN. There is extensive deformation at the top of the skull which indicates that the radial velocity that was imparted to the tissue, broke it open and, therefore, relieved the pressure at the

top, well, either to the right or the left, since you can't distinguish on an X-ray.

You would presume, then, that the soft tissue, which was badly damaged, would have moved somewhat in the direction of that relieved pressure and, therefore, would be displaced somewhat upward from the original track. So, I would place the original track as being somewhat lower than that trail of fragments indicated through there; certainly not much lower.

Mr. MATHEWS. So, it is your opinion that it was more likely that the President was shot in the upper portion of the skull as opposed to the lower?

Mr. STURDIVAN. Right, there is no indication of any track in the lower half of the skull. It definitely was in the upper part.

Mr. MATHEWS. Thank you.

Now, Mr. Sturdivan, according to your testimony, the President was not shot with an exploding bullet. What scientific reasons do you have for the fact that his skull exploded?

Mr. STURDIVAN. As we saw in the gelatin blocks, the tremendous radial velocity that is imparted to the tissue, soft tissue, as the bullet goes through, probably in this case having massively been deformed by impact on the skull. The drag force is very high. The radial velocity is high, exerting tremendous pressure on the inside of the skull. And this literally lifts the skull up, fractures it and allows some of the soft material to move between the cracks.

Mr. MATHEWS. Have you ever conducted any experiments which would verify that theory?

Mr. STURDIVAN. Yes; in the 1964 study for the Warren Commission, we did do several studies on skulls.

Mr. MATHEWS. Did you record those studies?

Mr. STURDIVAN. We recorded them in still cameras and also with movies.

Mr. MATHEWS. Do you have that film today?

Mr. STURDIVAN. Yes, I do.

Mr. MATHEWS. Before you show it to the committee, could you explain briefly what they should look for in analyzing this film?

Mr. STURDIVAN. Before the lights go out, the film is of 4 of 10 skulls that were shot at our laboratory with the Mannlicher-Carcano 6.5 millimeter. The bullet will be coming in from the left toward the right. The skulls have been filled with gelatin and coated with gelatin in the semblance of the subcutaneous tissue under the scalp. At the point of impact, there's a piece of goat skin with hair intact which simulates the scalp and the hair of the possible victim.

The movies were taken at approximately 2,200 pictures per second. Since the projectile is moving at roughly 2,000 feet per second, we could expect a motion of about 12 inches, 12 to 14 inches between frames as the bullet comes in.

Mr. FAUNTROY. Will the gentleman yield? As you prepare to show the movie, is it my understanding that you used the Mannlicher-Carcano rifle that was found on the sixth floor of the Texas School Book Depository Building or was this another rifle?

Mr. STURDIVAN. Well, sir, we had two rifles. Both of them were used fairly extensively, but we did not want to over-use the Oswald rifle because of the wear and the change of the characteristics. So,

I cannot state for a certainty which of these were shot with which rifle. But, some of them were shot with the Oswald rifle and some with the other rifle.

Mr. MATHEWS. Thank you.

Mr. Chairman, may we have JFK exhibits F-304 and F-305, the movie films which will be shown, entered in the record?

Mr. PREYER. Without objection, so ordered.

[Showing of second film.]

Mr. STURDIVAN. There is another section of film here, before we get to the skulls, which we forgot to mention. Perhaps we should go ahead and go through it since it is already there. This is a can of tomatoes which I think demonstrates some of the principles of physics that are involved here.

The picture will be much the same as those with the skull. The bullet will be coming in from the left, will strike the can and you will see pieces of the can moving toward the right in the direction of the bullet, but you will also see pieces of the can moving in other directions. Notably, the top of the can will be moving back toward the left in the direction from which the bullet came.

You notice the backsplash as the bullet has entered the left-hand side of the can. The material is beginning to move back out. This is called the backsplash of the projectile.

In the next case, the bullet is still within the can and, in fact, has stopped within the can.

Mr. MATHEWS. Was that a 6.5 millimeter?

Mr. STURDIVAN. No; this was some other bullet. I am not sure what the identity of the bullet was. It is probably a caliber .22.

I apologize for the darkness of these films, but this will begin the skull sequence. The first one is light so let me run right through it. You will see what happens to the skull taken at high-speed movies.

Mr. MATHEWS. Could you explain, first, the skull itself, the composition?

Mr. STURDIVAN. The skull was, as I said, the dried skull, obtained from a biological supply house, was filled with gelatin tissue simulant and the shiny effect on the outside is a coating of gelatin on the outside of the skull. To the left is a piece of goat skin simulating the scalp and hair. I will run right through the first one which is rather dramatic, and I will stop action on the second skull [describing second skull impact].

The bullet has come in from the left, has impacted the skull through the scalp simulant and is now within the skull. As you can see, the radial velocity that is imparted at the first part of the track has begun to crack the back piece of the skull.

This is the very next frame. It shows the fragmented bullet and fragments of the skull being blown away from the front of the skull.

Mr. MATHEWS. The bullet is gone now; is that correct?

Mr. STURDIVAN. Pieces of the bullet have exited the skull. It is hard to tell whether they have actually gone out of the frame or whether they may be incorporated into that white mass which is mostly bone with a little bit of gelatin tissue simulant in it.

As you can see, the radial velocity has already begun to fracture the skull extensively along and across suture lines.

As you can see, each of the two skulls that we have observed so far have moved in the direction of the bullet. In other words, both of them have been given some momentum in the direction that the bullet was going. This third one also shows momentum in the direction that the bullet was going, showing that the head of the President would probably go with the bullet.

This is amplified, however, in these skulls because they are not tied to a human body. They are free to move from the table.

Also, you will see that as the skull goes forward, some of the material of the skull and the contents were blown out toward us. Consequently, the opposing momentum carries the skull away from us, rotates it away from us so that we can actually see the bottom part of the skull in this shot. In fact, all 10 of the skulls that we shot did essentially the same thing. They gained a little bit of momentum consistent with one or a little better foot-per-second velocity that would have been imparted by the bullet and they also lost material toward us, that is, toward its right and, therefore, rotated toward its left.

That terminates that sequence of film.

Mr. MATHEWS. Could we have the lights, please?

I have one final question for you, Mr. Sturdivan, and in answering that question, let me direct your attention to JFK exhibits F-307 and F-306.

Mr. Sturdivan, as you can see of JFK exhibit F-307, which is on my left, the hole location is approximately in the top of the President's skull. As you can see from exhibit F-306, the hole location is at the bottom of the President's skull. F-306 is a skull that was utilized by Edgewood Laboratories for their experiments for the Warren Commission; is that not so?

Mr. STURDIVAN. Yes, it was, that is one of the skulls, probably one of the skulls we saw in the film sequence.

Mr. MATHEWS. My question is this: Would the location of the hole in the President's skull make any change in your testimony as to the explosive effect that occurred within the skull?

Mr. STURDIVAN. Oh, no. Once the bullet enters the soft material within the skull, the radial velocity is imparted and the effect is exactly the same no matter at what point it enters.

The only effect might be in which portion of the skull was actually blown out. In other words, it might blow out a little higher and a little more toward the top if the bullet entered a little more toward the top rather than blowing out on the side as is indicated in the second exhibit.

Mr. MATHEWS. Mr. Chairman, could we have exhibits F-306 and F-307 incorporated in the record? In addition, could we have F-111 and F-255, F-256, F-257, and F-258 incorporated in the record, please?

Chairman STOKES [presiding]. Without objection, they may be entered into the record at this point.

[JFK exhibits F-111, and F-255 through F-258 were entered previously.]

[The above-referred-to exhibits, JFK exhibits F-306 and F-307 follow:]





4-49542

A



4-49539

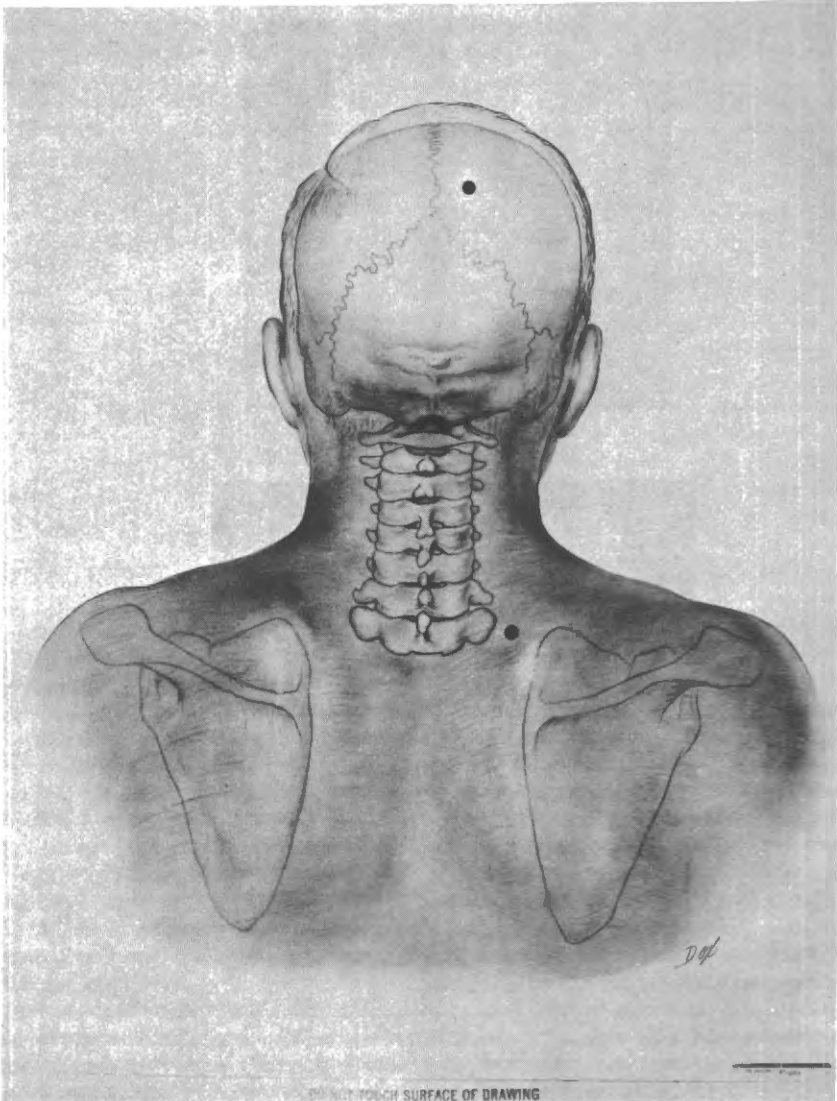
B

SKULL DAMAGE PRODUCED BY THE 6.5-MM MANNLICHER-CARCANO  
BULLET AT 90-YD RANGE

A. Entrance wound

B. Exit wound

JFK Exhibit F-306



JFK EXHIBIT F-307

Mr. MATHEWS. Also, Mr. Chairman, I have no further questions of this witness.

Chairman STOKES. The Chair will first recognize the gentleman from the District of Columbia, Mr. Fauntroy, for as much time as he may consume, after which the committee will go to the 5-minute rule.

The gentleman from the District of Columbia, Mr. Fauntroy.

Mr. FAUNTROY. Thank you, Mr. Chairman, and thank you, Mr. Sturdivan, on behalf of the nonphysicists on the panel and in the country. You have given us, I think, an adequate introduction to

wound ballistics and the science of the effects of bullets on the human body.

I think I am fairly familiar now with things like yaw and velocity and drag and trajectory and stability. But I think I am more interested in having you to help us with some hypotheticals relative to the subject of this investigation, and for this purpose, I would like to place in view JFK exhibits Nos. F-113 and F-116 and F-81. As they are being placed there, Mr. Sturdivan, I would like to have you analyze with us a few hypotheticals.

Let's assume three things. First, the rifle is a Mannlicher-Carcano of the kind found on the sixth floor of the Book Depository. We have that rifle here. You might want to just lift it for us. Let's assume that is the first.

Second, the bullet is a 6.5-millimeter bullet, and, third, the shot came from the sixth floor of the Texas Book Depository Building. What would be the striking velocity of a 6.5-millimeter bullet fired from the building and hitting a man in the upper right back?

Mr. STURDIVAN. Well, the muzzle velocity of this bullet varies between 2,000 and 2,200 feet per second. It will have lost some velocity in traversing some distance. Say at 100 yards it would have about 1,800-feet-per-second velocity. One hundred yards was roughly, I think, the distance we are talking about here. So that would be 1,800 feet per second.

Mr. FAUNTROY. And that is the velocity at which it would probably have hit a body from the distance that we know is from the sixth floor to where the President was at the time that his body was struck?

Mr. STURDIVAN. Yes, sir.

Mr. FAUNTROY. Could the bullet have gone through his neck at that time?

Mr. STURDIVAN. Oh, yes; this bullet if only encountering a few inches of soft tissue would go through losing almost no velocity, 100 feet per second or thereabouts.

Mr. FAUNTROY. So that while it was fired when it left the muzzle, it would have been over 2,000 feet, by the time it hit it would have been about 1,800 feet per second?

Mr. STURDIVAN. Yes.

Mr. FAUNTROY. And exiting the body, not striking any bone?

Mr. STURDIVAN. Without striking any bone.

Mr. FAUNTROY. Striking flesh it would have lost another what?

Mr. STURDIVAN. One hundred feet per second or so. Being a little less than maybe 1,700 feet per second at that point.

Chairman STOKES. Would the gentleman yield?

Mr. FAUNTROY. I would be very happy to.

Chairman STOKES. Was there something the gentleman wanted done with the rifle?

Mr. FAUNTROY. No, you can put that back, please.

Now, once the bullet exited the neck, having gone through the flesh, what would have been the condition of the bullet?

Mr. STURDIVAN. Well, it would have been given some—as I stated earlier, the bullet is unstable in tissue, the yaw begins to grow, with a Mannlicher-Carcano this growth of yaw is relatively mild, but it would have been given a little bit of angular momentum, so it would come out at some yaw, an increasing yaw. Of course, as it

came into the air, it would be again in a low-density medium and therefore would tend to stabilize out again, so the yaw that was imparted would begin to damp out.

Mr. FAUNTROY. So it would yaw a little coming through but would be pretty much straight?

Mr. STURDIVAN. It is still very straight but its angular momentum is such that as it comes out it is turning.

Mr. FAUNTROY. I see.

Mr. STURDIVAN. OK.

Mr. FAUNTROY. Could it have struck another man sitting directly in front of the first man?

Mr. STURDIVAN. If the initial trajectory had been into that man, yes, because it would not have deviated significantly from its original trajectory.

Mr. FAUNTROY. What would have been the nature of the entrance hole in the second body after passing through the first?

Mr. STURDIVAN. OK, if you will recall, I said that the bullet takes a bobbing motion. It has some yaw and then it decreases almost to zero yaw, then it goes back up again. It depends on exactly what orientation it had at the moment of striking the next body as to what the entry hole would be like. It could be perfectly round, if the yaw were nearly zero, or it could be elongated, if the bullet were yawing at that point.

Mr. FAUNTROY. Did you conduct any experiments to determine how much yaw a 6.5 millimeter coming through a mass like that which was the neck of the President had and, therefore, what kind of angle it would have hit another body?

Mr. STURDIVAN. Well, we did get imprints on the velocity screens between the first target and the second target, which I showed a moment ago. And on those screens we saw about an equal proportion of round holes and elongated holes, indicating that the bullet was bobbing in and out and it was striking at random orientation into those screens.

Mr. FAUNTROY. All right, now, the bullet passes through the second body, and, say, nicking a rib, and having entered, you say, on a yaw—I guess that is the proper way to put it—slightly angular—having pushed through that way. What would be the nature of its velocity, having left the body as we are theorizing here, just below the nipple—what would have been the condition of the bullet?

Mr. STURDIVAN. OK, our predictive equations apply only to soft tissue, and so consequently I wasn't able to predict what this composite of soft tissue and bone would really have done. Consequently, I would have to rely on the experiments that we did in 1964, shooting glancing blows off of rib—the ribs of goat carcasses, and then scaled those effects up to a much larger man, like the size of Governor Connally.

Now, with the 250-plus-foot-per-second loss in the goat, that would scale up to perhaps a 400-foot-per-second loss in the Governor, given that the bullet entered at normal obliquity, that is, without yaw. It would have, of course, been somewhat higher than that, had it hit in a yawed orientation; Some 400-foot-per-second-plus of loss.

Mr. FAUNTROY. The bullet left the gun at 2,000 feet. Do you think at the point it would have struck the first body it was going at about 1,700?

Mr. STURDIVAN. 1,700 to 1,800.

Mr. FAUNTROY. Feet. It would have lost how much going through, you said?

Mr. STURDIVAN. About a 100. So it is after going through it is perhaps 1,700 feet per second, or a little less, at striking the second body. There it would lose another 400-plus feet per second and exited, say, somewhere between 1,100 and 1,300 feet per second, roughly.

Mr. FAUNTROY. That is velocity at which it is moving?

Mr. STURDIVAN. At the exit of the second target.

Mr. FAUNTROY. Would that be enough velocity to shatter a wrist bone?

Mr. STURDIVAN. Oh, yes. My calculations, rough calculations have shown that when striking the bone it would comminute the bone at anything above about 700 feet per second. So it still has nearly twice that velocity and certainly it would have enough to comminute a bone.

Mr. FAUNTROY. And lodge in the left thigh?

Mr. STURDIVAN. Well, yes; after going through the bone it would, of course, again have lost a considerable amount of velocity, but there is no reason to believe that it would not have enough remaining velocity to penetrate some more soft tissue, although it probably would not have had much in excess of 700, perhaps even less than that. So it probably would not have fractured another bone. In other words, if it had continued on the same path and struck the thick bone it would not have fractured it, it would have stopped.

Mr. FAUNTROY. Let's go back to the starting point, say, of a second hypothetical, that is, let's assume that a second bullet fired from approximately the same position, using the same rifle and bullet, is on its way, and it hits the second man, in the same place in the back, without striking the first man.

Mr. STURDIVAN. Yes, sir.

Mr. FAUNTROY. What would be the striking velocity there?

Mr. STURDIVAN. Well, it wouldn't really be that much higher than it would have been striking the first target. Striking the second target it is 1,800 feet per second. That is, striking the second target without striking the first.

OK. I see puzzlement, let me recapitulate.

In the first case, your first hypothetical, the striking velocity on the first target was around 1,800 feet per second. If it missed the first target it would have essentially the same striking velocity when it hit the second target, which is to say about 1,800 feet per second.

Now, the difference in the striking velocity, having gone through the first target or not having gone through the first target, would make essentially no difference in our predicted behavior in the second target. There are too many other variables; the amount of bone that it actually contacted, whether it contacted the bone directly or whether it hit it a grazing blow, or whether the bullet actually missed the bone, and if that extensive cavity fractured the

bone, would make a considerable difference in the remaining velocity of the bullet.

So to boil it all down, the effect in the second target, which would represent Governor Connally, would be almost indistinguishable in the two cases.

Mr. FAUNTROY. How about the entry wound, what would be the nature of that if it were directly?

Mr. STURDIVAN. Well, there is a fairly good probability that that entry wound would be elongated if it had went through another target before—it probably would have been elongated.

Mr. FAUNTROY. That is, it may have gone that way rather than that way [demonstrating]?

Mr. STURDIVAN. Yes, sir.

Mr. FAUNTROY. Is that what you are saying?

Mr. STURDIVAN. Yes.

Mr. FAUNTROY. If it went directly there first, is it likely that you could have gotten that same effect?

Mr. STURDIVAN. Oh, no. If it had struck without having previously encountered another target, it would never have been elongated. This bullet is too stable. It would have had to be a nice round hole, presuming that it struck reasonably normally to the surface.

Mr. FAUNTROY. I will have to review, I can't recall, staff will bring me up to date on whether or not that entry wound was—it was a round hole, all right.

Again, in our second hypothetical question, assuming this bullet traveled at a downward trajectory and exited below the right nipple, smashing into the right wrist and then into the left thigh, would the exit velocity have been greater in the first hypothetical, where it goes through two bodies, or in the second, and what difference, if any, would that have made in the nature of the wrist wound?

Mr. STURDIVAN. Well, in the second case, where it struck without having struck a previous target, the entry velocity would be somewhat higher, but depending on the exact effect on the bone, the amount of deformation and so forth, it might well have been deformed a little more because it struck the rib at a little higher velocity and, therefore, it would have had a little higher drag after having gone through the rib, consequently the exit velocity would probably not have been much different and the effect on the wrist would probably have not been much different.

Mr. FAUNTROY. How much damage would have been done to the bullet in the first hypothetical, as compared with the second, going through two and going through one?

Mr. STURDIVAN. Well, because it had traversed a little less soft tissue before striking the bone it might have struck the rib at a little higher velocity and therefore have been a little more deformed in the second case.

Mr. FAUNTROY. In the first case, therefore—

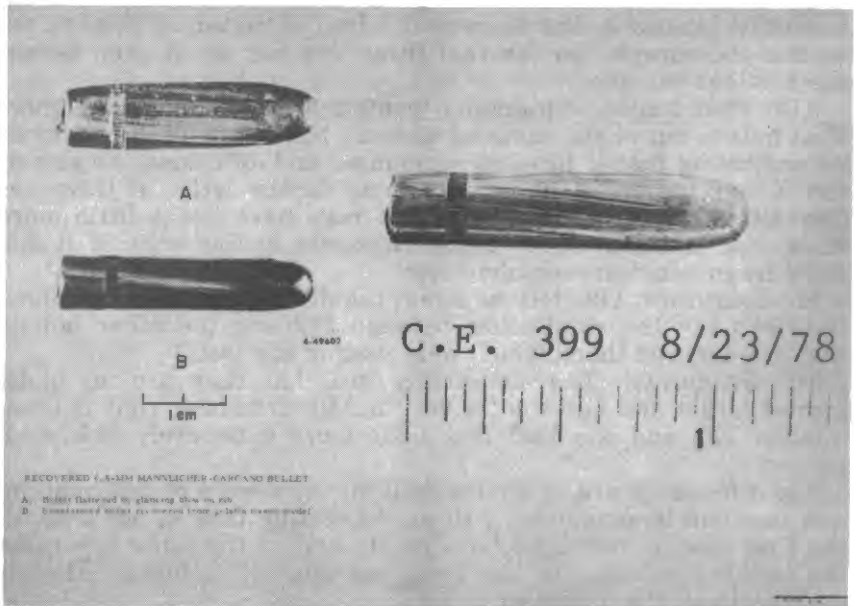
Mr. STURDIVAN. In the first case less deformation to the bullet.

Mr. FAUNTROY. Mr. Sturdivan, I would like to direct your attention to JFK exhibit F-118. There are blowups—the one on the right—blowups of two 6.5-millimeter bullets, and a blowup of what is now familiar to you as Commission exhibit 399, the bullet be-

lied to have been the bullet that went through the body of both President Kennedy and Governor Connally.

You have done some experiments with those bullets, have you not?

[JFK exhibit F-118 follows:]



JFK EXHIBIT F-118

Mr. STURDIVAN. Yes sir. In exhibit 118, the two bullets on the left were experimental bullets that were fired at Edgewood Arsenal. The one labeled B went through approximately 30 inches of gelatin and was soft recovered, and if one were to apply the word to a bullet, this would be pristine bullet, perhaps the only one that we have seen so far.

The bullet labeled A was one of those which was fired into the carcass of a goat and glanced off the rib. You can't see quite so clearly as you could on the original bullet, but there is some lead extruded from the tail of that bullet, it is flattened and lead has been squeezed out, much like toothpaste out of a tube.

Mr. FAUNTROY. That has troubled me. Why does that happen? In some of them I notice it doesn't happen, you don't have that toothpaste effect. Why is that on some of the bullets?

Mr. STURDIVAN. Well, that is the method of deformation of the bullet. The first thing that happens when the bullet begins to deform is that the jacket is flattened out and the softer lead core is extruded through the only opening, that is, the opening in the base, like toothpaste out of a tube.

As the bullet continues to react to the pressure, to deform further, it gets much flatter and more lead is extruded. If the pressures are higher than that, the bullet might begin to break up, pieces of the jacket to peel off, or the bullet to break along the

cannelure lines you see in the photograph into two or more pieces. What we see here is the first stage of the deformation of a bullet, mild squeezing of the jacket with some extrusion of lead through the tail.

In Commission exhibit 399 we see less flattening, which would indicate that it struck bone at a somewhat lower velocity than did the bullet labeled A. But there is still lead extruded, as you can see on the photograph. On the real thing you can see it even better, there is lead extruded.

Also, that bullet, Commission exhibit 399, is somewhat lighter than bullets out of the same lot or some box of ammunition should be, indicating that it has lost some mass and, of course, we saw in the X-rays yesterday it did lose mass in the wrist of Governor Connally, although in my opinion it may have lost a little more mass than is indicated by those fragments in the wrist. If it did, those fragments were somehow lost.

Mr. FAUNTROY. OK, tell me again the differences or the similarities, let's say the similarities between 399 and the other bullets that are pictured there, which were used in the tests?

Mr. STURDIVAN. The similarities are that they are an undeformed bullet and one that is very mildly deformed, that is Commission 399, and one that is a little more extensively deformed, labeled A.

The differences are, of course, only in the degree of deformation, and that can be explained, I think, by stating that in one case, in the first case, it struck no bone at all, and in the other two cases the striking velocity on the bone was slightly different. That is essentially all the differences.

Mr. FAUNTROY. Mr. Sturdivan, based on your professional experiments conducted by your laboratory, is it possible, in your opinion, for a single 6.5-millimeter bullet to inflict the injuries that were found on the neck of the President and on the torso, wrist, and thigh of Governor Connally?

Mr. STURDIVAN. Yes, sir; it is quite possible that one bullet could have done all of that damage.

Mr. FAUNTROY. Mr. Chairman, I think I will yield at this time to other members who may have questions. I would like to have those exhibits, if they have not already been entered into the record, to be entered at this time.

I have been reminded there is another film that I want to look at, and I don't want to look at, but I think perhaps we had better do it, and that is, as you know, Mr. Sturdivan, I have been concerned about what appears to be the backward movement or rearward of President Kennedy at the time that he was hit with the second shot, and as you may recall, Dr. Baden yesterday, at least explained to us why it was the panel of forensic pathologists' view that the bullet which struck President Kennedy in the head came from the rear, due to something that they called beveling.

Mr. STURDIVAN. Yes, sir.

Mr. FAUNTROY. And that gives me some assistance as a layman in understanding why he would come back, but I wonder if you would care to share with us what experiments you have done that suggest that what we see in the film is really reaction to a shot



from the rear, and I know that you have done some experiments. I think we ought to share those at this time.

Mr. STURDIVAN. First, I had an exhibit I don't think has been entered into the record. It is the one with the momentum equation. I think that would help with the explanation.

Mr. MATHEWS. That should be JFK exhibit No. F-303.

Mr. STURDIVAN. Again, I don't want to try to snow the panel with a lot of equations. I think it is important here to point out that there is a significant difference between kinetic energy and momentum. As you see on top of this exhibit F-303, the energy, one-half mass times the velocity squared, is an expression of what shall we say, the destructive capability of the projectile, and as we all know from our familiarity with Einstein, that energy is conserved. Also momentum is conserved. But in this case, the conservation of momentum is slightly different from the conservation of energy.

Conservation of momentum is a vector quantity, that is, it has direction. If a projectile were moving along and then struck another object, then both of those objects would move off with exactly the same momentum that the first object had coming in. In other words, the linear momentum, the product of the mass and velocity, is conserved and the direction is conserved.

Let's apply both of these to a hypothetical bullet that is striking a head and losing some velocity.

Now, the next line labeled momentum lost, all I have done is taken the product of the mass—this is 162 grains divided by 7,000—which gives us the mass of the bullet in pounds. Multiply that mass of bullet in pounds times 800 feet per second, the velocity lost, and we have a quantity, an unusual quantity, 18.4 pound feet per second of momentum which has been deposited by the bullet.

Now, in the head of the President—and I am only giving you a very rough figure here—we take that momentum, 18.4 and divide by the mass of the head, which I have guessed at as being about 15 pounds, which would produce a net velocity of 1.2 feet per second in the head.

This is consistent with the velocity that we saw in the skull films, 1.2 feet per second. That is the velocity of a rapid nod. It is not a tremendous velocity.

Mr. FAUNTROY. Let's try it this way. Let me have JFK exhibit Nos. F-255 to F-258, which are frames 313, 314, 315, and 316 of the Zapruder film. Put those four up for me, and while that is being done, Mr. Chairman, I would like to put JFK exhibit No. F-303 in the record.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[The above referred to JFK exhibit No. F-303 follows:]

$$\text{ENERGY} = \frac{1}{2} MV^2$$

$$\text{MOMENTUM} = MV$$

MANNLICHER CARCANO BULLET

$$\text{MOMENTUM LOST} : \frac{162}{7000} \times 800 = 18.4 \text{ LB. FT./SEC.}$$

HEAD OF KENNEDY-

$$\text{VELOCITY GAINED} : \frac{18.4}{15} = 1.2 \text{ FT./SEC.}$$

$$\text{ENERGY DEPOSITED} : 1100 \text{ JOULES} \approx 800 \text{ FT.LB.}$$

Exhibit JFK F-303

JFK EXHIBIT F-303

Mr. FAUNTROY. The exhibits which are being placed show, as I say, a rearward thrust of the President's head and his upper body, a fraction of a second after he was shot in the head, and the assassination critics have insisted this rearward thrust clearly indicates that the shot came from the front, the theory being that the force and momentum of the bullet, Mr. Sturdivan, carried the President's head toward the rear of the limousine.

Mr. STURDIVAN. As we can see from the chart, this velocity of 1.2 feet per second is not the kind of velocity that would throw the President bodily around backwards, forwards, or in any direction no matter which direction the bullet came from. The deposit of momentum from the bullet is not sufficient to cause any dramatic movement in any direction. It would have a very slight movement, assuming that the bullet hit him in the back of the head. It would have a slight movement toward the front, which would very rapidly be damped by the connection of the neck with the body.

In other words, the head would begin to move and then the body would be dragged forward with it at a much lower velocity. Certainly not a very large velocity. Not throwing anybody anywhere.

In fact, I conclude from these films that, since the President does have motion, that it must have arisen from another source, that is, it could not have been the momentum of the bullet.

Mr. FAUNTROY. Have you done any experiments to illustrate to us what you are saying to us?

Mr. STURDIVAN. Yes, we have. It is some archival film that I dug out of our film library back at the laboratory. There was some film taken years ago, and let me explain before we go into the film what is going to happen, what it is.

What I interpret this as is a neuromuscular reaction.

Mr. FAUNTROY. That is the President moving back—

Mr. STURDIVAN. The President's motion is a neuromuscular reaction. Nerves are stimulated by other nerves, by electricity, by chemical means, or they can also be stimulated by mechanical means, and we have all had experiences with that when you bang your crazy bone, you get a stimulus of the nerves, a motion sometimes, sometimes a partial paralysis for a little while. This is mechanical stimulation of the nerves.

This mechanical stimulation, once it starts to move down the nerve, looks exactly the same as any other nerve impulse does. And if this mechanical stimulation is in a motor nerve, that is, one that moves muscles, then the muscle will move.

Now, the extreme radial velocity imported to the matter in the President's head, the brain tissue, caused mechanical movement of essentially everything inside the skull, including where the cord went through the foramen magnum, that is, the hole that leads out of the skull down the spinal cord.

Motion there, I believe, caused mechanical stimulation of the motor nerves of the President, and since all motor nerves were stimulated at the same time, then every muscle in the body would be activated at the same time.

Now, in an arm, for instance, this would have activated the biceps muscle but it would have also activated the triceps muscle, which being more powerful, would have straightened the arm out. With leg muscles, the large muscles in the back of the leg, are more powerful than those in the front and, therefore, the leg would move backward. The muscles in the back of the trunk are much stronger than the abdominals and, therefore, the body would arch backward. The same phenomena has been observed many times by hunters in the Southwest where I came from. Some members of the committee may very well have some experience with shooting jackrabbits.

Mr. FAUNTROY. Shooting jackrabbits?

Mr. STURDIVAN. Yes, sir. Occasionally you will see a jackrabbit sitting. He is hunched down on his back legs which, being the powerful running muscles, are like sitting on coiled springs. When the jackrabbit is shot through the head every muscle is stimulated, those powerful running muscles overpower everything and the jackrabbit springs into the air.

Obviously his motion upward is not as a result of forward momentum of the bullet. Other hunters may have observed the same thing in other animals.

So what we have in the film is a dramatic example taken at 2,200 feet per second of a goat, a live goat, being shot through the head, with a bullet. This is essentially the same technique of euthanasia, that they use in slaughterhouses. In other words a projectile is shot into the brain and the animal is dead essentially at the time the bullet hits, but the nerves and the muscles which are still alive, and very much capable of response, show a dramatic response of this neuromuscular stimulation. So if you are ready we can go to the film.

Mr. FAUNTROY. Let's illustrate that.

Chairman STOKES. If the gentleman would yield.

Mr. FAUNTROY. I would be happy to yield to the chairman.

Chairman STOKES. Prior to the production, the Chair wants to engage counsel for the committee, Mr. Mathews, in a colloquy relative to the film prior to its being shown. Will the counsel advise the committee as to the source from which you procured this film?

Mr. MATHEWS. These films were procured, Mr. Chairman, from Edgewood Arsenal by way of Mr. Larry Sturdivan. As he indicated, these films are in the archives at the arsenal, and these experiments are no longer being conducted by the Department of the Army or the Department of Defense.

[The goat shooting film is marked as JFK exhibit F-309 for identification.]

Chairman STOKES. And do I also understand that the House Select Committee on Assassinations has not caused any experiments of this nature or any similar nature to be conducted?

Mr. MATHEWS. That is correct, Mr. Chairman.

Chairman STOKES. Thank you. I yield back to the gentleman of the District of Columbia.

Mr. FAUNTROY. Thank you, Mr. Chairman. I was just consulting with some of my colleagues here to see if any of them had ever shot a jackrabbit, in which case I would depend upon their judgment as to whether one hit in the head will raise it straight up in the air. I have been advised by the counsel that I might ask a member of the staff who had done the same.

Mr. FITHIAN. If the gentleman would yield, I have many years ago hunted these animals and what Mr. Sturdivan has testified to is not at all unusual.

Mr. FAUNTROY. Thank you.

Mr. Sturdivan, we are ready to see what happens to muscles.

Mr. STURDIVAN. Let me stop the film here and explain what is going to happen.

This goat is standing with his horns taped to a bar, only to preserve the aiming point of the bullet, which will come in from the right this time, not from the left, from the right, will strike the goat between the eyes. The black tape is there only to show the relative motion which we were presuming was going to be small. I should say they were presuming, since this film was taken back around 1948, I believe.

The first sequence will be a normal 24-frame-per-second view of this. This is a real time. First, we will observe the neuromuscular reaction, the goat will collapse then, and by the wiggling of his tail and the tenseness of the muscles we will see what I think has sometimes been called the decerebrate rigidity, and that takes place about a second after the shot and then slowly dissipates and you will see the goat slump, obviously dead.

The decerebrate reaction and terminus of the decerebrate reaction.

Now, this sequence will show the same goat, exactly the same shot, but in this case the movies are taken at 2,400 frames per second. I forgot to mention that the bullet is a .30-caliber military bullet. If I can stop this at an appropriate point.

Now, if you will look up at the forehead of the goat you may see a very small white spot, which was not visible on the last frame. If you can't, don't worry about it. What it is is the bullet entering the

head of the goat. And if I can make sure that I have it going forward now. Four one-hundredths of a second after that impact then the neuromuscular reaction that I described begins to happen; the back legs go out, under the influence of the powerful muscles of the back legs, the front legs go upward and outward, that back arches, as the powerful back muscles overcome those of the abdomen. That was it.

Now, we will show a sequence here which I think will prove my assertion. This goat was shot under identical circumstances as the last one was except he is dead before the shot. The straps that you see are suspending him but he is free to swing. If you pushed on his head he would swing gently back and forth in this rack.

The bullet will come in from the right, again moving toward the left. In this case, the bullet is deflected as it goes out of the skull, and impacts on the goat near the spine, and then as you may have been able to see very dimly right behind the goat the bullet emerges from the back. It has deposited another few pound-feet per second of momentum in this goat. And then let me run it on through at real speed so you can see how much displacement that goat is given by the momentum that is deposited by the bullet.

If we can bring the house lights up, it will run for another 5 minutes without showing any movement in the goat.

Mr. MATHEWS. Lights, please. That's fine, please resume your seat.

Mr. FAUNTROY. Thank you.

What you have said to us, therefore, is that in the first instance the bullet in the first hypothetical, moving at the speed that you have suggested, would have come through the President's neck without much loss in velocity?

Mr. STURDIVAN. Right.

Mr. FAUNTROY. It would have had some, I would say, wobble, you would say yaw?

Mr. STURDIVAN. Yes.

Mr. FAUNTROY. Coming out because of what it hit? That it could possibly then go into the body of Governor Connally, in front of him, with a slight yaw, or at approximately the same speed, because it encountered no substantive resistance? Is that your testimony?

Mr. STURDIVAN. Roughly the same speed, not much loss in velocity?

Mr. FAUNTROY. And that it, your expert judgment, is logical that it could exit in Governor Connally's body do the damage that it did to the wrist and still lodge in the left thigh?

Mr. STURDIVAN. Yes, sir.

Mr. FAUNTROY. On the question of the apparent rearward motion of the President, you attributed that to nerve reactions to the massive activity in the brain?

Mr. STURDIVAN. Yes, sir; the neuromuscular response to the trauma in the brain.

Mr. FAUNTROY. And that the trauma there was caused by radial forces after the bullet had exited?

Mr. STURDIVAN. Yes, sir. During and after the——

Mr. FAUNTROY. During and after?

Mr. STURDIVAN. The passage of the bullet; yes. In other words, the radial velocity if imparted as the bullet goes through and continues after the bullet is long gone.

Mr. FAUNTROY. That explains the explosion?

Mr. STURDIVAN. Yes, sir, the explosion effect and the subsequent neuromuscular reaction that occurs roughly four one-hundredths of a second later.

Mr. FAUNTROY. Thank you, Mr. Chairman, I have no further questions, perhaps members of the committee may wish—

Chairman STOKES. The time of the gentleman has expired.

The Chair recognizes the gentleman from Connecticut, Mr. Dodd.

Mr. DODD. Thank you very much, Mr. Chairman.

Thank you, Mr. Sturdivan, for your time. I just have a couple of questions I would like to ask.

Yesterday, we had differing testimony. Maybe I should preface my remarks by asking you this: Do you have any specific background in anatomy. I noticed looking at your résumé your physics and statistics. Are you qualified to talk about anatomical responses and so forth, and, if so, what is your background in that area?

Mr. STURDIVAN. Yes, sir, I did take a considerable amount of biology in high school and college. I took some graduate courses in physiology, and then, of course, I continued that biological training on the job, because it is necessary part of wound ballistics.

Mr. DODD. You have had experiences in that during the duration of your professional experience?

Mr. STURDIVAN. Yes, sir, and before and during the duration.

Mr. DODD. Yesterday, Dr. Wecht and Dr. Baden, as far as I was concerned, anyway, disagreed on the response of human tissue, dead human tissue and living human tissue. Could you comment at all on that? Is there a significant difference or a substantial difference in testing projectiles, bullets, and so forth, through a cadaver as opposed to a living tissue?

Mr. STURDIVAN. Well, if you are looking for the effects on the tissue, the film was a dramatic example of how different it can be, in one case the neuromuscular action is there in live tissue and is obviously impossible in the dead tissue. If you are looking for the effects on the bullet, it would be very difficult to distinguish between the live and dead tissue.

In fact, there is enough biological variances so that I would presume that one group of living tissue would differ significantly from another group of living tissue. You can tell this by the next steak you bite on. Sometimes you get a tender steak, sometimes you get a tough one. There is a tremendous biological variance which probably masks out the difference.

Mr. DODD. As far as any dramatic effect on a bullet, the difference between living tissue and dead tissue would be minimal, is that right?

Mr. STURDIVAN. It would not be dramatic, I wouldn't expect it to be any different.

Mr. DODD. You showed us a film here of a living goat and what happened when that animal was struck in the skull, and then you showed us a film of a goat that was already dead. What would happen or could we predict anything dramatic occurring if you had a wounded animal and its anatomical response?

According to the films we see, the Zapruder film, it would appear that President Kennedy was first shot through the back, through the neck, then the skull shot. Would that shot, assuming, one, that it had not touched his spinal cord, have caused him to react the way he did at the time of the skull shot; and two, assume that it did touch the spinal cord, would there be dramatic differences in response, or is the time lapse too long to make any difference?

Mr. STURDIVAN. Well, of course it could not have struck his spinal cord directly because it would have had to penetrate through the body of the vertebrae to do so. But it would certainly—you see, a while ago I may have misled a little bit, I said there was no shock wave associated with a bullet passage. There is no shock wave in the tissue because the bullet is moving subsonically. There is a small shock wave caused by the impact.

In other words, the smacking force of the bullet impacting on the surface sends off a small shock wave. It is a matter of conjecture as to whether that shock wave would be strong enough to cause a mechanical stimulation of the cord, or whether if it did nick the small projection out from the side of the vertebrae, if the bullet passed near enough to that to fragment it, that the act of fragmenting that piece of bone might have been enough to cause a mechanical stimulation of a cord or a part of the cord or the radical velocity of the tissues.

As it moves out from the cavity it might well displace the cord through the holes that exist between the vertebrae where the nerves come out, and so forth. So, yes, a bullet passing that near the spine of the President could have caused a stimulus to his cord which would cause, or part of his cord, which might cause a visible reaction, but I can state with no certainty whether that would or would not have happened.

Mr. DODD. Are most of these tests that we saw conducted in 1964?

Mr. STURDIVAN. The Warren Commission tests were conducted in 1964. The goat films were conducted—they were taken in 1948, or thereabouts.

Mr. DODD. This is 1978. Would you do anything differently? Have we reached a state-of-the-art that we can be more specific and more scientific in terms of tests such as this, in order to reach conclusions. Thirty years ago, I presume that we have advanced scientifically in this area?

Mr. STURDIVAN. Well, yes. Humans have not changed significantly in that time, I don't imagine. Certainly the advance of science has carried us to greater heights, if you wish.

Mr. DODD. What would you do differently? What sort of test would you perform today, obviously excluding the ghoulish ones. Are there things that could be done today differently in order to conduct better tests?

Mr. STURDIVAN. Well, if we had knowledge—it is not a change in capability so much as a change in information, I think. If we had known that the critics were going to talk about massive deformation of bullets on cadaver wrists, we might have shot some bones, not necessarily wrists, but bones of equal size, at lower velocity, showing that the bones can be deformed when the bullet is not. But of course, we could have done that in 1964.

Mr. DODD. Would you recommend that today? Would you recommend we try and do something like that today?

Mr. STURDIVAN. As a scientist, I am totally confident that there is some point at which the velocity of the bullet will fall below the point where the bullet will be deformed, and that that is significantly above the velocity at which bone will be deformed. We know the mechanical properties of the gilding metal jacket, mechanical properties of bone, and we know there is a gap between.

The bullet is stronger than the bone, so there is some velocity at which we will smash bones but not smash bullets. At some lower velocity it would break bones but not smash them, in terms of bending, leverage, and so forth, might fracture a bone, but it would not cause a comminuted fracture. As some other lower velocity, it would just bounce off.

Mr. DODD. My time is running short here but I would like you to answer my question. The critics have raised the question.

Mr. STURDIVAN. Right.

Mr. DODD. And as a scientist, with those questions raised, do you think it is worth our while to conduct that kind of a test?

Mr. STURDIVAN. Personally, I don't. I can't answer from a viewpoint of somebody who is trying to quiet the critics.

Mr. DODD. Thank you.

Thank you, Mr. Chairman, I appreciate you letting me raise my questions out of order.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Ohio, Mr. Devine.

Mr. DEVINE. Mr. Chairman, could I request that exhibit No. 399 be handed to the witness. I would ask you, Mr. Sturdivan—is that correct?

Mr. STURDIVAN. Yes, sir, it is.

Mr. DEVINE. Did you have an opportunity at any time to examine the bullet that was found on the stretcher at the Parkland Hospital?

Mr. STURDIVAN. No, not this closely, sir.

Mr. DEVINE. Not on any previous occasion?

Mr. STURDIVAN. No, I never looked at it.

Mr. DEVINE. I would ask you to look at that particular exhibit that is in your hand at the moment and look at the configuration, any deformities that may appear thereon.

Mr. Sturdivan, we had before this committee a number of experts in many fields. We had one photographic analyst. We have had forensic pathologists. We had experts in many fields and we asked their opinion about a number of things and you obviously are an expert in the field of ballistics.

Based on what you know about the assassination of President Kennedy, the fact that a bullet entered the back of President Kennedy and emerged and conceivably then entered the body of Governor Connally and emerged and lodged itself some place going through the wrist, and perhaps the thigh, and perhaps that being the bullet that ended up on the stretcher in Parkland, in your opinion, as an expert, could the bullet that you hold in your hand now have passed through two bodies and touched some bone tissue and still emerged in that condition that some described as nearly pristine?



Mr. STURDIVAN. Yes, sir, it could have. The amount of soft tissue that it went through before it struck bone, the amount of bone that it struck, which wasn't extensive, at least before the wrist, the small amount of deformation indicating that it did not go through a great deal of bone at high velocity, which would have deformed it, caused it to have high drag, and so forth.

This bullet is quite capable of having gone through that much tissue; yes. It is slightly deformed which, through my calculations, indicate it must have been deformed on bone since it could not have deformed in soft tissue.

Mr. DEVINE. That is your best judgment as an expert in the field of ballistics; is that correct?

Mr. STURDIVAN. Yes, sir, it could have inflicted that damage.

Mr. DEVINE. Mr. Chairman, I have only one other question of Mr. Sturdivan. Again, as an expert in the field of ballistics, you are not troubled having seen the Zapruder pictures that the head moved in an anterior direction or posterior direction, I guess, the same direction from which the bullet was allegedly fired, that does not trouble you as an expert in the field having conducted tests in ballistics?

Mr. STURDIVAN. No, sir, the momentum of the bullet could not have thrown him in any direction violently. The neuromuscular reaction in which the heavy back muscles predominate over the lighter abdominal muscles would have thrown him backward no matter where the bullet came from, whether it entered the front, the side or the back of the head.

Mr. DEVINE. Then, to put it another way, it is entirely consistent that if the bullet came from the back, that the head may have also gone in a rearward position.

Mr. STURDIVAN. Yes, sir.

Mr. DEVINE. Thank you, Mr. Chairman.

Chairman STOKES. Mr. Sturdivan, do I understand that prior to Mr. Devine showing you this exhibit and asking you about it, that you had not previously been presented with this particular exhibit by anyone?

Mr. STURDIVAN. No, I had never held it in my hand before.

Chairman STOKES. The gentleman from Tennessee, Mr. Ford.

Mr. FORD. Thank you, Mr. Chairman.

I want to explore the damage caused to the skull due to what you call drag force and the different types of bullets.

I am not quite clear on drag force or the type of bullet, whether it is soft or hard bullet. Could you explain that?

Mr. STURDIVAN. Yes, sir, if I could recall that exhibit—

Mr. FORD. I don't have the exhibit number. Maybe Mr. Mathews, the counsel, could give us the number.

Mr. STURDIVAN. Mr. Mathews, do you remember the exhibit which has the drag force equation on it?

Mr. MATHEWS. That is F-115.

Mr. STURDIVAN. Congressman, as I pointed out before, the drag force is usually presented as an equation with the drag force on one side and everything else, including the "A" [mean presented area], on the other side. With the "A" on the other side, meaning that it would be multiplied by all of those other terms, this equation expresses the force that is exerted on the bullet.

Simultaneously, the bullet, of course, exerts the same force on the tissue. As that "A" increases dramatically, as the bullet goes from its normally oriented position to a 90-degree position, the area that you see increases dramatically and, therefore, the force increases dramatically.

As a bullet deforms, it also increases its presented area and, therefore, a deformed bullet will have a much higher drag than a nondeformed bullet.

The greater the deformation, the greater the velocity, the greater the force, the more dramatic that explosive effect is.

Mr. FORD. How long from the time that the bullet entered President Kennedy's head did the skull explode into fragments?

Mr. STURDIVAN. If you recall in the movies of the skull, the skull began to fragment while the bullet was still in passage and so, therefore, you might say that the skull began to come apart almost immediately, within microseconds of the impact continuing to fracture and move outward.

Mr. FORD. I am still concerned about the question I think my colleagues, Mr. Fauntroy, along with Mr. Devine, mentioned earlier about the direction of the bullet and the movement of President Kennedy's head and the time from the bullet entering the back of his head and the skull exploding? Why did the muscles in the neck and the back react to move the head backward rather than in the direction the bullet was traveling, which would have been forward?

Mr. STURDIVAN. The direction that was imparted by the bullet going forward would have been overcome by the neuromuscular reaction in about four one-hundredths of a second, if we can believe what happened to the animal would be the same in the human being.

Four one-hundredths of a second, I think, is well between frames on the Zapruder film. So, we wouldn't expect to see any forward motion of the head before we saw the violent backward movement caused by the neuromuscular reaction. In other words, there was very little time for him to move forward before he began to go backward.

Mr. FORD. Mr. Chairman, I don't have any further questions.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman. Mr. Sturdivan, have you or haven't you viewed the pathological data pertaining to the entrance wound in Governor Connally's back?

Mr. STURDIVAN. Yes, I did review the—

Mr. FITHIAN. I wanted to clarify something here. Perhaps I misheard. I thought in the exchange with Congressman Fauntroy, it was said that the hole was a round, penetrating hole, and I thought that the information we had before the panel yesterday was that it was sort of horizontal, as though the bullet struck somewhat perpendicular to the back.

Mr. STURDIVAN. As I recall from reviewing the same material that the forensic pathologists reviewed, the entry hole had been excised and destroyed by the surgeons at Parkland Memorial, but that a subsequent description of that hole was given which, as I recall, was elliptical, and in attempting to make a drawing of the shape of that hole, the surgeon drew an ellipse on a piece of paper.

The ellipse that was drawn measured 8 millimeters by 15 millimeters. However, I am not sure that indicated the size of the hole so much as the elliptical shape.

Mr. FITHIAN. So, is it your judgment, then, that the bullet had to have struck something else and was tumbling when it hit Governor Connally?

Mr. STURDIVAN. If it indeed had the shape that was described, then it would have to have been yawed and having been yawed, it would require that it struck something else before it struck the Governor.

Mr. FITHIAN. Thank you. In your experience with gelatin and other tissues, if the block is horizontal and the bullet is fired exactly in the horizontal plane, it seemed to me that in several experiments that you showed us that the bullet, as it went into the gelatin, had an upward bend to it; is that correct? Is that usual?

Mr. STURDIVAN. Yes, that happens universally. When the bullet begins to yaw, it develops a lift, like an aerodynamic lift on an airplane wing.

Mr. FITHIAN. And it doesn't make any difference which way it is yawing?

Mr. STURDIVAN. It will move in the direction it is yawing. If it yaws upwards, then it will tend to move upward. If it yaws down, then it would tend to move down.

Mr. FITHIAN. So, then, it is pretty specifically related to the angle at which it entered the tissue?

Mr. STURDIVAN. Exactly so. Unfortunately, the entrance yaw is unpredictable as to direction, so you really can't predict whether it is going to go upward, downward or to the right or left.

Mr. FITHIAN. I have one other question I would like to raise, Mr. Sturdivan. When the—I think you used the term radial velocity—builds up as it did inside President Kennedy's skull, you described very vividly that it was that force that caused the skull to blow away. If that were the element in determining the motion of the head, in what direction would the head have moved?

Mr. STURDIVAN. From looking at the exhibit, I think it is Zapruder frame 313, it looks to me that the material from the President's head is moving upward and toward the observer which would have been out to the right side of his skull.

Having relieved the pressure on that side and not having relieved the pressure on the other side would have pushed the President's head toward his left.

Mr. FITHIAN. Insofar as most of the missing skull fragments are forward in the forward half of the skull, would that have tended to contribute at all to the backward motion of the head?

Mr. STURDIVAN. It is possible that there would have been enough momentum lost in a forward direction that the skull might have moved backward or at least not move forward as rapidly as it would have otherwise.

However, if you recall, in the skull films, most of the momentum was to the side causing the skull to have a reaction in the opposite direction. But each of the skulls did move forward in the direction that the bullet took.

Mr. FITHIAN. But in those, the entry was considerably lower than in the actual case; isn't this correct?

Mr. STURDIVAN. Yes, but the exit, which is more important here, was approximately in the right place. That is, the fragments of the skull were moving out from essentially the same place. Where you are getting at is; no, I cannot exclude the fact the loss of momentum from the skull fragments leaving could have imparted a slight rearward motion, but that motion would not have been as dramatic as we saw.

Chairman STOKES. The time of the gentleman——

Mr. FITHIAN. I have one more question, Mr. Chairman. Thank you. Isn't a dry skull harder than a living one?

Mr. STURDIVAN. On the contrary, it is not quite as hard.

Chairman STOKES. The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. I mainly want to see if I have gotten the import of what I consider to be the main thrust of your testimony. Do I understand correctly that the bullet striking the President's head would not have imparted any really perceptible motion in one direction or the other as far as the Zapruder film was concerned?

Mr. STURDIVAN. That is true, sir.

Mr. SAWYER. And that I presume, is what was illustrated on the striking of the dead goat that was hanging in suspension even though it went through the skull and lodged or hit the spine, that it didn't, at least I didn't perceive it moving, was that the objective of that test?

Mr. STURDIVAN. Yes, it was, sir. In fact, there was motion there but it was so slow that it was not perceptible on the film.

Mr. SAWYER. That was at a very high speed film, too, I assume.

Mr. STURDIVAN. It was 2,400 frames per second. Approximately 100 times the normal framing rate for a camera.

Mr. SAWYER. And the backward or stiffening back, and so forth, of the live goat, or the goat that was being killed by being shot in the head while it was alive, was due to that same muscular reaction of the back muscles you talked about as opposed to any force of the bullet?

Mr. STURDIVAN. Oh, yes, definitely, sir.

Mr. SAWYER. One other point that I would like to be sure that I have, too, and that is that if we assume that the deforming or destruction or damaging speed of a bullet is, let's say, 1,100 feet per second or lower or higher, and a bullet strikes an object that deforms or destructs, let's say, at a speed or an impact speed of 300 feet per second, that the bullet, as long as it is below its impact, its damage speed, can destroy or shatter the object with the lower damage threshold and itself not sustain any measurable damage because it is below its destruct or damage point: do I understand that correctly?

Mr. STURDIVAN. That is exactly true, sir. That, I think, may explain the statement of Dr. Baden when he said he observed a great number of handgun bullets which had smashed bones and not been severely deformed themselves because handgun bullets do typically strike around 1,000 feet per second, or less, which, according to my crude calculations, is below the deformation point of a bullet and certainly above the deformation point, the smashing point of a bone. So, I think that is dramatic evidence that it is true, there is that effect.

Mr. SAWYER. And in watching the Zapruder film where the President was struck in the back and through the throat as opposed to the second shot, you observed, I am sure, that the President raised his hands to his throat at that point, which, I presume, would indicate that the spinal cord was clearly not severed or he would not have been able to do that.

Mr. STURDIVAN. Right. If the spinal cord had been severed then he might not even have exhibited the neuromuscular reaction that I explained before.

Mr. SAWYER. But certainly, if it was severed that high, he would not have been able to raise his arms to the point of the wound.

Mr. STURDIVAN. No, sir.

Mr. SAWYER. Thank you. That is all I have, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired. The gentleman from Pennsylvania, Mr. Edgar.

Mr. EDGAR. Thank you, Mr. Chairman. I just have one question and then a comment which I would like to make.

Let's speculate for a moment that the three shots that left the right rear some place traveling in the direction of the car, that the first shot struck President Kennedy, causing him to clutch his throat, enter his back and come out his throat and that the second bullet struck Mr. Connally directly, going through his chest cavity, striking his rib, hitting his wrist, lodging in his thigh and that the third shot struck the President in the head causing the massive wounds that have been described over the last couple of days.

It's a different speculation than the one-bullet theory. What, in your area of expertise, leads you to believe that that speculation could not be true?

Mr. STURDIVAN. Well, in fact, nothing within my area of expertise leads me to believe that that could not be true.

Mr. EDGAR. So, it is possible that the second shot that I am speculating could have entered Governor Connally without passing through another person?

Mr. STURDIVAN. The only evidence that we have is the description of the entry wound on Governor Connally as being elliptical, which indicates that that bullet hit something before it hit Governor Connally.

Now, if it went if it went through 10,000 leaves or a few small twigs, it would be below the point where it would deform the bullet or deflect it to any considerable extent. It could have been yawed. So, as far as I am concerned, as an expert, I can only state that that bullet had been yawed before it hit Governor Connally, if it caused an elliptical wound in his back, which has been described.

Mr. EDGAR. Would it not be elliptical if it entered at an angle?

Mr. STURDIVAN. Yes, but if you make some geometrical drawings, you will find that in order for the ellipse to be roughly twice the diameter in one direction that it is in the other, it would have had to have entered at an angle that was 60 degrees from the normal. In other words, if this is a normal entry wound, it would have had to have been tilted 60 degrees from that or only 30 degrees parallel to the surface.

A bullet entering at that angle would have had to have roughly turned a 60-degree angle upon entry in order to exit out the front of the Governor and bullets just don't make abrupt 60-degree angle

turns. Consequently, I can conclude from that, since the path was predominantly forward, that it was not an acute angle but a yawed bullet that entered him.

Mr. EDGAR. Thank you.

Just one final comment. I think it was unfortunate that you had not seen directly the physical evidence that we shared with you, the actual bullet that we have been discussing for most of the day. I do think, for the record, we should indicate that later today, we will have before us four members of a panel who will be able to talk in more detail about ballistics and deal with a number of other factors relating to the bullet itself, and they have had the opportunity to see that bullet as well as the guns that were used in this event.

Thank you, Mr. Chairman.

Mr. STURDIVAN. If I may. No, I had not held the bullet in my hand before, but I had studied, of course, the photographs and had access to the amount of deformation, and so forth, information on the amount of deformation.

Mr. EDGAR. Thank you.

Chairman STOKES. The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. I just want to clarify something. I think you may have used an inadvertent word that I wanted to be sure was either corrected or confirmed. You said for the bullet to enter in an elliptical or create an elliptical entry wound into the back of Governor Connally, it would have had to have been deformed going through something before, whether it be the President's body or not. I don't know that you meant that.

From your earlier testimony, I thought you said it would not deform going through soft tissue, rather, would yaw as opposed to being deformed; am I correct on that?

Mr. STURDIVAN. I probably was speaking too fast. I intended to say that the bullet would have been undeformed, not deformed, but merely yawed by hitting something else.

Mr. SAWYER. Thank you.

Chairman STOKES. The time of the gentleman has expired.

Let me just ask one or two clarifying questions. You have just mentioned the fact you were shown photographs of exhibit CE 399; is that correct?

Mr. STURDIVAN. Yes, sir, I was.

Chairman STOKES. And asked for your opinion based upon a photograph? Were you asked for an opinion based upon a photograph?

Mr. STURDIVAN. I was asked for an opinion with respect to the amount of deformation, and so forth, based on photographs.

Chairman STOKES. Right. So, what you are saying here today, you were consulted with reference to this particular missile?

Mr. STURDIVAN. In interviewing by the staff, we did cover that point several times, yes, sir.

Chairman STOKES. That was our staff you have reference to, the House Select Committee staff?

Mr. STURDIVAN. Yes, your staff, the staff of your committee.

Chairman STOKES. Thank you. Counsel for the committee, Mr. Mathews.

Mr. MATHEWS. Mr. Chairman, could we put into the record JFK exhibit F-117, which is the gelatin shot film; JFK F-304, which is the tomato shot film; JFK F-305, which is the skeleton experiments; and JFK F-309, which is the goat shooting film. If I may have that made part of the record, Mr. Chairman.

Chairman STOKES. Without objection, they may be entered into the record at this point.

[JFK exhibits, F-117, F-304, F-305, and F-309, are retained in committee files.]

Chairman STOKES. Mr. Sturdivan, as a witness before our committee, under our rules, you are entitled to 5 minutes at the conclusion of your testimony for the purpose of explaining or amplifying, or in any way expanding upon the testimony you have given this committee.

On behalf of the committee, I, at this time, extend to you 5 minutes for that purpose.

Mr. STURDIVAN. Thank you, sir. I don't think that I have anything really to add to the testimony, to amplify, or so forth.

I should, however, mention the fact that I am not here as a representative of the U.S. Army, that the opinions that I represent here are my own.

Although the Army has very graciously allowed me administrative leave to appear as an expert witness, I am not a representative of the Army, and I do wish to thank the members of the committee and the members of the staff, especially Mr. Mathews, for the help that they have given me and the support, particularly when the microphone failed, and for dragging me through relatively unscathed.

Thank you very much.

Chairman STOKES. Thank you, you have been very helpful to the committee. We appreciate the cooperation you have given the committee and the staff. We appreciate having had your testimony here today. Thank you very much.

The Chair will recess the hearings until 1:30 this afternoon. We will reconvene at 1:30.

[Whereupon, at 12:25 p.m., the hearing recessed, to reconvene at 1:30 p.m.]

[Additional material included at the request of Congressman Timothy Wirth.]

## A physicist examines the Kennedy assassination film\*

Luis W. Alvarez (Nobel Prize in Physics 1968)  
Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720  
(Received 26 January 1976)

The motion picture film of the Kennedy assassination taken by Abraham Zapruder was one of the most important exhibits examined by the Warren Commission. The author uses the tools of the physicist to draw some conclusions that escaped the notice of the Commission and its expert FBI photointerpreters. Among the subjects treated are (1) the timing of the gun shots, (2) a theoretical and experimental investigation of the "backward snap" of the President's head immediately after he was killed—yielding the surprising result that it was consistent with a shot fired from the rear, (3) the speed at which the camera was running, and (4) a previously undetected deceleration of the President's automobile just before the final shot. The emphasis throughout is not on the assassination but rather on the application of elementary physics principles to the solution of practical problems.

### EDITOR'S NOTE

We publish this article by Luis Alvarez for its unique pedagogic usefulness. It brings to bear on a matter of public concern powerful and simple physical arguments that are within the reach of introductory physics students. It shows a physicist at work employing qualitative arguments, estimates, measurements, and calculations appropriate to the problem and to the accuracy of data available.

As always, we welcome readers' responses to this article and will select some for publication according to their appropriateness and the space available. We are interested in comments on procedures which Professor Alvarez uses to reach his conclusions and on the pedagogic uses to which the article can be put. We do not feel that this Journal is an appropriate forum for a discussion of alternative theories of the assassination.

### I. INTRODUCTION

In the eleven years since the Warren Commission published its 26-volume report<sup>1</sup> on the assassination of President Kennedy, a controversy has continued over the validity of the Commission's findings. Dozens of books and countless articles have been written to show, for example, that Lee Harvey Oswald had nothing to do with the event, or that he was part of a conspiracy with the CIA or other parties in planning the assassination. Some of the books, such as Mark Lane's *Rush to Judgment*,<sup>2</sup> were best sellers. In December 1966 *Esquire* published an article<sup>3</sup> listing 35 different theories that had been advanced by as many authors, each suggesting a variation on the Warren Commission's official scenario of the assassination. And since then, many more theories have appeared.

In the light of such a long history of unsettled controversy, the reader might well wonder why yet another author would feel moved to write on the subject. The reasons are quite simple; in the first place, I continue to read, and to hear on radio and television that, "The laws of physics require that the President must have been shot from the front, whereas the Warren Commission places his assassin, Lee Harvey Oswald, behind him."

Such statements involve the backward snap of the President's head, immediately after the shot that killed him. I will show, both theoretically and experimentally, that such statements are simply incorrect; the laws of physics are

more in accord with the conclusions of the Warren Commission than they are with the theories of the critics.

My second reason for writing this report is to show how an experienced physicist attacks a new problem. Textbooks tend to indicate that problem solving in physics is a straightforward matter; one proceeds step by step from the input data to the final answer. But in real life, as I will show, a physicist makes many mistakes, and backs up to correct them, one by one. (To those who feel the personalized style of this report is an uncorrected error, I apologize; the earliest version was intended only for a few friends, where the liberal use of personal pronouns wouldn't cause offense. When the report was finally finished, the task of squeezing all the first person singular pronouns out of the text seemed too formidable, so the author hopes the reader will accept his apology.)

After a decade of exposure to the various theories of the assassination, I have at least one advantage over the earlier writers. I've watched each new writer in turn criticize the earlier ones for speaking authoritatively in areas in which they weren't experts. I will, therefore, speak with authority only in areas in which a judge would most probably accept me as an "expert witness." For this reason, the reader will be spared any thoughts of mine on conspiracies, medical reports, the CIA, or ballistics. I haven't counted the number of times I have agreed with, or disagreed with the Commission's findings; I've done both in several different instances.

One of the aspects of physics that makes it appealing to those of us who practice it as a profession is that calculations and the results of experiments can be repeated at will. So all of the interesting observations I've made on the Zapruder assassination movie film can be repeated by anyone sufficiently interested in such matters. (And all of them have been duplicated at least once by others.) Most of the conclusions I reach will seem reasonable to physicists, but in one case I will simply give my "best guess," and not try to do any more persuading.

This report will cover my analysis of several events appearing in the assassination film, some theoretical calculations relating to the "head shot," and some firing range experiments that validated the theoretical conclusions based on the laws of physics as I have taught them for the past 40 years. My observations, analyses and conclusions also relate to the timing of the shots, the speed at which the camera was



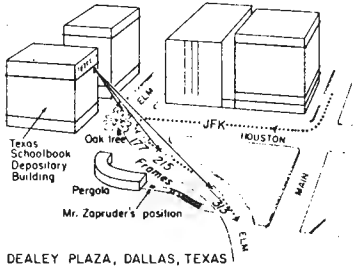


Fig. 1. Dealey Plaza, Dallas, Texas, 22 November 1963. President Kennedy's route is shown down Main Street and Houston Street, turning onto Elm Street, in front of the Book Depository Building, where Lee Harvey Oswald was employed. Mr. Zapruder photographed the President's car throughout its passage along Elm Street, until it disappeared under an overpass. Physical evidence will be presented for three shots, at Zapruder frames 177, 215, and 313.

running—both matters of some dispute, and to a sharp deceleration of the President's car just before the President was killed. To the best of my knowledge, this strange behavior on the part of the President's driver has gone unnoticed by everyone else; I suggest a reason for it.

In pointing out some conclusions that seem persuasive to me as a physicist, I do not wish to give the impression that I think that a physicist's way of arriving at "the truth" is the best way or the only way. It works well in the world of physics and so long as I confine my attention to the physical evidence in the Kennedy assassination, I feel that my conclusions can be of help in elucidating what took place in Dealey Plaza, Dallas, on 22 November 1963 (see Fig. 1).

## II. THE FILM, THE COMMISSION, AND THE CRITICS

A remarkable moving picture record of President John F. Kennedy's last living moments was taken by Abraham Zapruder in Dallas on 22 November 1963. The Zapruder film was viewed several times by the Warren Commission, and extensive testimony was presented to the Commission by FBI photoanalysts who had made detailed studies of the film, frame by frame. Nevertheless, a good many substantive observations were missed by the photoanalysts, and some of the information they gave to the Commission was incorrect.

With the publication of the 26-volume series containing the evidence presented to the Warren Commission,<sup>1</sup> together with a transcript of the hearings, a group of "Warren Commission Critics" came into being. These critics, or assassination buffs as they are sometimes called, have gone over the voluminous "exhibits" with fine-toothed combs, and have found many errors and contradictions. The assassination buffs attribute most of the errors to more than the sloppiness of a rapid publishing effort; they feel that the Warren Commission didn't do a thorough enough job in investigating many leads, and some of them take the position that the Commission actually ignored or suppressed evidence that Oswald was part of a conspiracy.

I was quite unaware of the strong criticism of the Warren Commission's actions when I first drew some conclusions from a study of the Zapruder film. A simplified and not too convincing report on my analysis of the timing of the shots was presented in a four-hour CBS documentary television program, "The Warren Report," 25-28 June 1967, the text of which is reproduced in Stephen White's book on that documentary.<sup>4</sup> It is difficult to explain a rather technical matter to a lay audience, and in a short space of time. I hope that the lifting of such limits in this report will permit me to explain the methods I used and the conclusions I drew.

## III. HOW MANY SHOTS WERE FIRED, AND WHEN?

Publication of the Warren Commission Report and its supporting documentation initiated an intense controversy involving the timing of the shots. Witnesses testified that as few as two and as many as six shots were fired.

The Commission, noting among other bits of evidence, the presence of three spent cartridge cases on the sixth floor of the Book Depository Building near the abandoned Mannlicher-Carcano rifle, concluded that three shots had been fired by Oswald. They decided that one of the shots missed the car; this missing shot could have been either the first or second one fired, but the Commission favored the hypothesis that the second shot was the one that missed. The Commission decided that of these two early shots, the first one probably passed through the President's body before wounding Governor Connally of Texas, who was riding on a "jump seat" just ahead of the President, and the third one struck and killed the President in frame 313. Governor Connally stated quite positively (in the 25 November 1966 issue of *Life*) that he wasn't wounded by the first shot; his testimony was based on his recollection that he heard a shot, turned around, and was later wounded. His story agrees better with the shot timing to be developed in this section, which in turn is not in conflict with the Commission's "allowed but not favored" conclusions. My reasons for preferring physical evidence to the recollections of even the best witnesses are highlighted by noting that the Governor was not even aware that he had received bullet wounds in his wrist and in his thigh until after he had been admitted to the hospital and operated upon.

Several years after I wrote the previous sentence, I read a fascinating article in *Scientific American* by a man who qualified as an expert on the reliability of "eyewitness testimony." Robert Buckhout wrote:

"Eyewitness testimony is unreliable. Research and courtroom experience provide ample evidence that an eyewitness to a crime is being asked to be something and do something that a normal human being was not created to be or do. Human perception is sloppy and uneven, albeit remarkably effective in serving our need to create structure out of experience. In an investigation or in court, . . . [the prosecution and the defense], and usually the witness, too, succumb to the fallacy that everything was recorded and can be played back later through questioning."

The above-mentioned issue of *Life* arrived on the day before Thanksgiving, and because of it I got very little sleep that long holiday weekend. It contained a set of reproduc-

tions in color of selected frames from the Zapruder film, illustrating the controversy between the Commission and the Governor. With my many years of experience in analyzing bubble chamber film, plus some moonlighting activities in photographic detective work as a background, I soon found myself completely engrossed in the Zapruder frames. My first observations and their subsequent "explanation" turned out, as I showed later, to be quite incorrect. But by the time I knew my first conclusions were wrong, I had devoted so many hours to a study of the pictures that I was subsequently able to see some things that I do believe have significance.

My attention was drawn to the way the flag, at the left front fender of the President's car, changed its shape from frame to frame in the *Life* photographs. I remembered that at Almagordo, Enrico Fermi had almost instantly measured the explosive yield of the first atomic bomb by observing how far small pieces of paper which he "dribbled" from his hand, were suddenly moved away from "ground zero" by the shock wave. (He had a precomputed table of numbers in his pocket, so he knew the explosive energy of the bomb long before any of the official measurements had been analyzed.) I thought I detected a deformation of the Presidential flag under the influence of the shock wave generated by a nearby bullet. From an elementary calculation involving the known properties of shock waves from bullets, and an assumption as to the surface density of the flag, it seemed to me reasonable to believe that the motions I detected were indeed due to the action of shockwaves. If such a conclusion could be confirmed, the vexing questions concerning the timing of the shots might be solved. (My knowledge of the strength of shock waves from bullets came from an experience I had in World War II, with W. K. H. Panofsky, who had built and was testing a "firing error indicator." This device was towed behind a plane, in a "sleeve," at which gunners fired for practice. It contained two microphones that recorded the shock waves from passing bullets.)

The frames reproduced in *Life* showed a total of only 1.3 sec of the critical moments in Dallas, so I had to wait until the following Monday to examine the sequence of 160 frames in the Law School Library's copy of the Warren Commission "exhibits."<sup>6</sup> When I saw the full set of frames, it was clear that the flag was simply flapping in the breeze. But the thought that effects of the individual bullets might show in the film was still very much in my mind. As I scanned the selected color photographs in *Life* and the full set of black and white copies in the exhibits, I noticed a striking phenomenon in frame 227 (Fig. 2). All of the innumerable pointlike highlights on the irregular shiny surface of the automobile were stretched out into parallel line segments, along the "8 o'clock - 2 o'clock" direction. In the plane of the automobile, the parallel streaks appeared to be about 10 in. long.

To appreciate the significance of the streaks, one must remember that each frame of moving picture film is not an instantaneous snapshot, but a time exposure that lasts for about one-thirtieth of a second. For a point of light on the car to be spread out into a streak on the film, the optical axis of the camera must have an angular velocity relative to the line joining the camera and that point of light. If most of the frames had shown streaking, one would simply have concluded that Mr. Zapruder was a "sloppy tracker" who couldn't follow the motion of the President's car as it moved

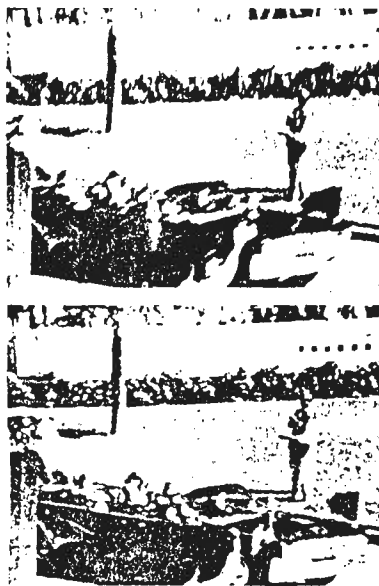


Fig. 2. Zapruder frames 227 (top) and 228 (bottom). Note that the highlights on the car which appear in frame 228 as points, are drawn out into streaks (along the 8 o'clock - 2 o'clock direction) in frame 227.

past him, as he "panned" his camera to keep the President in his field of view. But the highlights showed as sharp points of light in most of the frames.

If we "transform" to a rotating coordinate system in which the car and the camera axis are at rest, we can better understand the significance of the streaks. In this system, a streak means that the camera axis has an angular velocity relative to the coordinate axis, and this means that a torque has been applied to the camera to produce the angular acceleration that gave rise to that angular velocity. Such a torque could be produced by a muscle spasm, or by a passing shock wave from a bullet. (I guessed that the frightening crack of a bullet in Dealey Plaza would set Zapruder's neuromuscular system into a temporary spasm. This phenomenon was demonstrated in the CBS documentary series, as we shall see.) For a long time, I thought that I had been the first person to attribute significance to the streaks I've just mentioned. But apparently Harold Weisberg did it first in his book *Whitewash*.<sup>7</sup>

My interest in moving picture camera jitter arose when I was photographing animals in Africa in the summer of 1962. I was bothered by my inability to suppress all visible jitter in a long focal length movie camera used without a tripod, and I started thinking of ways to build optical compensators so that hand-held movie shots would not ex-

hibit the jitter that usually distinguishes amateur movies from those made on tripods by professionals. One night in Nairobi, I invented a solution to the problem. The Bell and Howell Company, which incidentally built Zapruder's camera, was supporting my development of working models of the movie camera stabilizer at the time the President was shot, and my U.S. camera stabilizer patents are owned by Bell and Howell. In the course of my work in movie camera stabilization, I learned that the jitter frequency of a hand-held optical device does not depend to first order upon the weight or the moment of inertia of the device, in spite of what a physicist's intuition would suggest, but instead depends mainly on the time constants of the neuromuscular-feedback system. Most people have a peak in their jitter power spectrum at about 3 cycles/sec. As we shall soon see, this frequency appeared in Zapruder's jitter spectrum when his neuromuscular system was set into oscillation—presumably by the sharp "crack" of the bullets.

Many people who have heard of my observation of "streaks" in the Zapruder film have concluded that the presence of such streaks is the important phenomenon, and that if someone tabulated the frames showing streaking, he would be repeating my observations. Even though CBS presented the data in this highly oversimplified manner, the presence of the streaks simply indicates that the angular velocity of the optical axis of Mr. Zapruder's camera (about a nearly vertical direction) did not match the angular velocity of the President's car, as it drove down Elm Street (Fig. 1). Such a mismatch in the two angular velocities would cause the image of the car on the 8-mm film to move relative to the edges of the "filmgate," during the roughly 30-msec exposure, and this motion would give rise to the streaking of the pointlike highlights. It is obvious that no information of any importance can be attached to such streaking, because no one can perform "hand tracking" accurately enough to avoid all streaking.

My observations involved the measurements of the streaking, but I didn't plot the meaningless streak length—proportional to the mismatch in angular velocity,  $\Delta\omega$ —but instead, the angular acceleration,  $\alpha$ , averaged over two successive frames. Under normal conditions, when  $\Delta\omega$  is large enough to give appreciable streaking, the angular acceleration—given by the *difference* in the lengths of the streaks in two successive pictures—is too small to be measured, since the streak lengths in successive frames are almost equal. The plot I made and showed to my friends at CBS is reproduced in Fig. 3. The frame number runs vertically, as on the film itself, and the angular acceleration of the camera axis is plotted horizontally. Since each measure of  $\alpha$  involves the subtraction of streak lengths,  $\Delta\omega_{n+1}$  and  $\Delta\omega_n$ , on two successive frames, the value of  $\alpha_{n+1/2}$  is plotted at a "half integral frame number," midway between the two frames whose subtracted streak lengths are involved. In order to find  $\alpha$ , one needs to know the "sign" of each of the two  $\Delta\omega$ 's to be subtracted. In other words, we must find out for each streaked frame whether the camera axis was moving toward the back or toward the front of the car. It turns out that the sign of  $\Delta\omega_n$  can be found quite unambiguously, simply by observing where the camera was pointing on the  $n-1$  and the  $n+1$  frames. When I was assigning a plus or minus sign to each of the  $\Delta\omega$ 's by this technique, I found that the only place this technique didn't work was for frames 314 and 315. A closer examination showed that the numbering of these two frames had simply

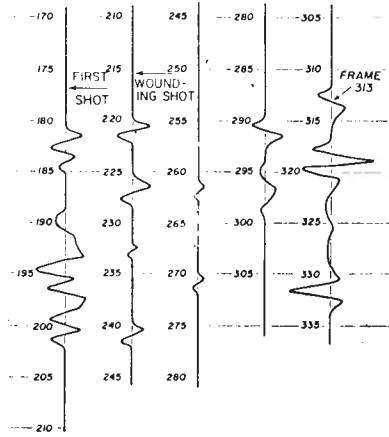


Fig. 3. Angular acceleration of Mr. Zapruder's camera, frame by frame. The frame numbers run vertically from 170 through 334. The angular acceleration for the  $n + \frac{1}{2}$  frame is plotted as abscissa, in arbitrary units. Each such acceleration is determined by subtracting the length of the streak in the  $n$ th frame from that in the  $n + 1$  frame, after assigning an algebraic sign to the streak length in each frame. (See text for details.) Accelerations plotted to the left are "clockwise looking down." Shots are associated (in the text) with pulse trains starting at about 182, 221, and 313.

been interchanged in the "exhibits," and when they were properly labeled, the signs of all  $\Delta\omega$  could be determined without ambiguity. Although I later found that the interchange of these two frames was well known to the assassination buffs, the manner in which I detected it convinced me that my determination of the signs of the  $\Delta\omega$ 's, and therefore the signs and magnitudes of the  $\alpha$ 's were completely objective.

Figure 3 is a reproduction of my original graph of angular acceleration versus frame number. Angular accelerations plotted to the left correspond to motions of the camera axis that are "clockwise looking down." (The motion of the car and of bullets from the Book Depository are also clockwise looking down, as seen by Mr. Zapruder.) Thus the torque acting on the camera between frames 312 and 313 was "negative," meaning that it could have been caused by a direct interaction of the shock wave from the bullet that hit the President in frame 313, with the left hand side of Mr. Zapruder's camera. (This is important because the impact of the bullet can be seen in frame 313, and there isn't enough time available for the relatively sluggish neuromuscular system to have produced the observed torque on the camera axis.)

When I saw Fig. 3 for the first time, I felt confident that the trains of pulses of angular accelerations were largely the results of the excitation of Zapruder's neuromuscular system, by the sounds of bullets in Dealey Plaza. I had no experimental data to show that a camera would undergo such

violent angular accelerations if held by a person who was startled by the sound of gunfire. But such a test was made for CBS by a firm well known to physicists—Edgerton, Gernsmaier, and Greer—and films of the test were shown on the CBS program. While the audience watched, cameras held by two separate cameramen shook quite violently in response to gunfire, as Walter Cronkite was saying.<sup>8</sup>

"Just as a rough check on [the Alvarez] theory, we decided to try it ourselves, using other cameramen holding similar cameras, standing on a rifle range, filming an automobile while a rifleman fired over their heads.

"These two volunteers are aiming their cameras at a parked limousine. Their instructions: 'Hold the cameras as steady as possible, and keep filming no matter what happens.' The shots will come between them and the car. The cameramen are as far from the firing platform as Mr. Zapruder was from the sixth floor of the Book Depository. [Sound of gunfire in background.]

"The reaction was obvious. The film taken by these cameramen showed the effect of the shots, despite instructions to hold steady. Even in steadier hands, motion was always noticeable. This frame shows highlight dots around the car's windshield. In reaction to a shot, the dots changed to crescents. And in the following frame they became streaks, comparable to streaks found in some frames from Mr. Zapruder's film."

In view of these tests, I feel that few persons would now dispute the cause and effect relationship between the shots in Dealey Plaza and at least some of the trains of streaks in Mr. Zapruder's otherwise well-tracked movies. If we accept this relationship, we can use the locations of the trains of streaks to shed useful light on the important question of the timing of the shots. No conclusions of the Warren Report have been so disputed as those concerning the timing of the shots, and the damage done by each bullet. Most observers remembered that three shots were fired, but the recollections embraced a range from two to six. Three spent cartridge cases lay on the floor by Oswald's Mannlicher-Carcano rifle abandoned near the sixth floor window of the Book Depository, overlooking Dealey Plaza. According to the Warren Commission Report, p. 110,

"... the nearly whole bullet discovered at Parkland Hospital [to which the President was taken directly from Dealey Plaza] and the two larger fragments found in the Presidential automobile, which were identified as coming from the assassination rifle, came from at least two separate bullets and possibly from three."

One of the "boundary conditions" on the timing of the shots (assuming there were three—one from each ejected cartridge) was the FBI's finding that a skilled marksman could not space his shots more closely than 2.3 sec, or 42 frames of Mr. Zapruder's camera, with its measured frame rate of 18.3 per second. (I will discuss the frame rate later in this article.)

No problem was involved in deciding when the third and fatal bullet was fired: the gory photograph labeled frame 313 settled that question quite conclusively. The fates of the first and second bullets were debated at length by the Commission, and the following conclusion emerged: a bullet, fired in a one-second interval between frames 206 and 225, wounded the President by passing through his neck, and then wounded Governor Connally, who was seated just ahead of the President. This so-called "single bullet theory" as we have already learned, was later challenged by Governor and Mrs. Connally.

The Commission decided that the other bullet was never recovered, and after giving reasons to suggest that it could have been fired either before or after the shot that was identified as wounding the two men, the Commission favored the suggestion that the unrecovered bullet was fired after the one that wounded them.

If we now look at Fig. 3 in the light of this background material, we see that the obvious shot in frame 313 is accompanied immediately by an angular acceleration of the camera, in the proper sense of rotation to have been caused directly by shock-wave pressure on the camera body. The human nervous system cannot transmit signals fast enough for the angular acceleration between frames 312 and 313 to have been caused by Mr. Zapruder's muscles reacting to impulses from a brain that had been startled by the shot that killed the President. The expected neuromuscular reaction occurs about one-quarter to one-third of a second later, as shown by the large accelerations near 318. (I'll adopt five frames as Mr. Zapruder's experimentally determined reaction time, for reasons to be discussed later.) Another large acceleration peak occurs about two-thirds of a second after this group, so we observe three out of a possible four pulses spaced very nearly the canonical one-third of a second apart. For those readers who are surprised that the neuromuscular response time is so long, let me recall a common "parlor trick": *A* bets *B* that if *A* drops a vertically held dollar bill without any warning, *B* cannot stop its fall by pinching his fingers together, if his fingers are poised, ready to clump together, at the bottom edge of the bill. The fact that the bill can almost never be stopped (unless *A* gives a precursor signal with his fingers) indicates that a nervous system "on hair trigger" takes more than one-sixth of a second (3.1 frames) to respond to an optical stimulus.

If we look between frames 206 and 225, the one-second interval in which the Commission suggested the "wounding shot" was fired, we see the start of a one-second-long train of pulses, spaced very nearly one-third of a second apart. We further note that the initial pulse of the series, at 221.5, is not in the proper direction to have been caused by a direct interaction of the shock wave with the camera; the camera turns toward, rather than away from the shock wave. The shock wave from a bullet fired from the Book Depository toward the car in its position at the time of frame 221 would have been considerably weaker at Mr. Zapruder's station than the shock wave in frame 313, so the lack of a direct physical interaction at the time of this earlier shot is not surprising. I therefore conclude that the accelerations at 220.5 and 221.5 were caused by Mr. Zapruder's neuromuscular response to an earlier stimulation. If we use Mr. Zapruder's thereby observed oscillation period of about five frames (which is close to the expected value), we place the "wounding shot" at about 215.5. I find it most interesting

that although the determination of 215.5 as the frame number of this shot was derived directly from the appearance of the streaks, it is exactly halfway between two limits, only one second apart, set by the Warren Commission from very different data.

If we convert the Commission's language into the vernacular of the physicist, their conclusion could be stated: "The bullet that wounded the President and Governor Connally occurred at frame  $215 \pm 10$ ." Although I would not have expected the conclusions of two such different studies to agree so closely, it is true that my estimated frame number for one of the two disputed shots agrees with the Commission's best estimate to within less than one-tenth of a second. The Commission based its findings largely on an examination of what the people in the car were doing; President Kennedy "seemed to be reacting (in frame 225) to his neck wound by raising his hands to his throat."<sup>9</sup>

I will ignore the two small accelerations between frames 245 and 280; each is caused by a single frame in which I judged that highlights might be smeared slightly more than the normal smearing caused by the imperfections of the half-tone process. I will return later to the short sequence of significant pulses starting at 290 since they require an explanation. They seemed to me to have less intensity, and to last a much shorter time than the three sets of pulses I identified as being triggered by bullets. I eventually found what I think is a reasonable explanation, not only for these angular accelerations, but also for a puzzling deceleration of the President's car at the same time—but that is getting a bit ahead of the story.

Because of the quietness of the acceleration graph between the pulse trains starting at 221 and 313 (except for the pulses which I feel have other explanations), and because of the obvious train of pulses starting at 182, I favor the view that the Commission's "missing shot" initiated this first train of pulses. My best estimate of the time of this shot is therefore 182 minus 5 (for Mr. Zapruder's calibrated time delay), or frame 177.

The Commission noted that about that time, the President's car was partially obscured from the sixth floor window, as it passed under a large tree. In a very thorough reenactment session in Dealey Plaza, photographs were taken by the FBI from the window near which the rifle and three spent cartridge cases were found. A limousine was moved along Elm Street, into positions corresponding to known frame numbers, and the Commission report reproduced sample groups of corresponding pictures: (1) from Mr. Zapruder's camera, (2) from the FBI camera in the sixth floor window showing the appearance of the limousine and a man sitting in the President's seat, and (3) from an FBI camera with a field of view equal to that of Mr. Zapruder's movie camera, located at the position from which he photographed the assassination. The FBI pictures corresponding to frames 166 and 186 are reproduced in the Commission's report, and both show that the President was clearly visible through the branches of the intervening tree in both views. It appears that the President had been unobscured before 186, during which time the gunman would have had a good opportunity to track him, and match the angular velocity and angular position of his gun with that of the President's body. The fact that the President's head might have been partially obscured by branches for one-half a second, at frame 177, would not, in my opinion, have had any appreciable effect on the gunman's tracking

ability, or feeling of confidence that his aim was good. Anyone who has ever driven a car in a heavy rainstorm, with a slow windshield wiper will realize that a partial loss of visual acuity for a half-second would not seriously affect a gunman's ability to perform good tracking, particularly when most of the car was still clearly visible through the holes in the trees. And if we remember that the decision to squeeze the trigger must have been made a few tenths of a second before the bullet was fired, the effect of the obscuring tree should have been negligible on the actions of the gunman, for a shot fired at frame 177.

I find it strange, on reading the testimony of experts on firearms (which I certainly am not), that they all looked at the photographs taken through the trees and testified whether or not a gunman could have fired at particular frame numbers. They treated the subject as though it was static—as though the gunman was presented with a stationary target behind a tree. They looked at the still photographs taken from the window in this static way, and decided that the gunman could have fired at certain frame numbers (when the President's body showed through a hole), but not at other times, when it was eclipsed. I can appreciate how they could have said such things under the stress of the investigation, when asked to comment on a set of still pictures, but I am surprised that no one mentioned what the real situation was like, with a large moving object containing a specific target fixed in its moving frame, that had a very nearly constant angular velocity with respect to the gunman. I don't believe a gunman would have been deterred from firing at frame 177, and I consider it most likely that the shot fired at that time was the one the Commission concluded missed the car and was unrecovered.

To return to the FBI's (assumed) minimum possible firing interval of 2.3 sec, we should compare this time with my best estimate of the time interval between what I identified as the first two shots. From frame 177 to frame 216 is 2.13 sec. To make this conform to the 2.3-sec limit, it is only necessary to change the timing of the two shots by one and a half frames each; if the first occurred at 175.5 and the second at 217.5, the time interval would be  $42/18.3 = 2.3$  sec. Such a procedure of altering estimated numbers within their known errors is a standard technique in my own physics specialty of bubble chamber event analysis. We have complicated computer programs that alter measured angles and measured momenta of tracks (within the known errors) to match the constraints imposed by the laws of conservation of energy and momentum. Just as a bubble chamber physicist uses a "fitting routine" to make his events match a known constraint, I have shown that I can fit the 2.3-sec time interval constraint by two small adjustments in estimated frame number. Since the two changes of  $\pm 1.5$  frames are small compared to the extrapolation of five frames each, made to arrive at the two unfitted estimates, and since no one would really believe that such extrapolations were more accurate than 1.5 frames, I believe that the fitting procedure is justified. However, if the reader dislikes this fitting procedure, he can still accept my "unfitted estimates," by learning that the CBS testis turned up a "technician who had one hit and two misses" (at a moving car, in a three-dimensional mockup of the Dealey Plaza) "in 4.1 sec."<sup>10</sup> This is remarkably like the apparent performance of the marksman identified by the Commission as Lee Harvey Oswald and reduces the permissible time interval to 2.05 sec, which is within my unfitted estimate of 2.13 sec.

Let me now summarize the conclusions of this section. By an analysis of "streaks" in the Zapruder film, I identified the precise timing of two shots that had been pinpointed by other means by the Warren Commission. So far as I know, there is no real controversy concerning the timing of these two shots. I found evidence that convinced me that a third shot was fired at about frame 177. This firing time is allowed by the findings of the Warren Commission, even though they favored the idea that the "third shot" was fired between the two that they identified as surely hitting President Kennedy. And finally, this firing sequence is consistent with the memories of Governor and Mrs. Connally.

What limitations can be placed on these observations? If, as many people have suggested and continue to suggest—two shots hit the President almost simultaneously from opposite directions, at frame 313 and very shortly thereafter, could I have detected this multiple firing? The answer to that question is "no." To be detected by the "streak method," two shots must be spaced by about 2 sec to be resolved as two separate shots, rather than a single shot followed by a slower than normal recovery time for Mr. Zapruder's neuromuscular system. But in the next section, I will be able to shed some light on the question of the "shot from the front."

I was bothered for some time by the weaker set of pulses lasting a shorter time, that show in Fig. 3, from frames 290 through 298. They don't look like the ones that seemed clearly associated with bullets. But obviously they required an explanation. I'll give my best explanation for them in the final section of this report, but I don't feel as certain about that explanation as I do about the other three cases.

#### IV. WHY DID THE PRESIDENT'S HEAD SNAP BACKWARD AFTER THE FATAL SHOT?

I must apologize for the tone of the following section, which may sound cold blooded and devoid of human feeling. My long delay in publishing this analysis derives largely from my feelings of inadequacy after many attempts to soften its impact. But I am finally convinced that the conclusions I reach in this section are important, and I have therefore done my best to make the text as free from emotional content as possible. John Kennedy was one of my personal heroes, and I had the pleasure of talking with him on two occasions. His death touched me deeply, and I hope the reader will bear that in mind as he studies this section.

Paul Hoch, who was then a graduate student at Berkeley, tried to interest me in one of the hottest and longest surviving controversies arising from a study of the Zapruder film. (It was the subject of several radio and television shows in April 1975, and testimony concerning it was taken during the Congressional Hearings on the CIA, in June 1975.) This controversy involves the unexpected behavior of the President's head immediately after it received the final and mortal shot. Everyone who studied the behavior of the people in the Zapruder film agreed that immediately after this shot, the President's head and body moved suddenly backward. The sixth floor window of the Texas Book Depository Building was behind the car, and the Warren Commission concluded that Lee Harvey Oswald shot the President from that window. Why then did the President's head recoil toward, rather than away from the gun as the

laws of physics would seem to demand? The assassination buffs argued at length about this action. I shall mention only three persons out of a great many who concluded in writing that the President was shot from the front. In his *Rush to Judgment*,<sup>8</sup> Mark Lane said, "So long as the Commission maintained the bullet came almost directly from the rear, it implied that the laws of physics vacated in this instance, for the President did not fall forward." Josiah Thompson, Professor of Philosophy at Haverford College, wrote a book that devoted a good deal of space to this problem.<sup>11</sup> He concluded that immediately after the President was wounded in the head from behind, another bullet fired from in front of the car hit his head and drove it back, by momentum conservation, toward the rear of the car. District Attorney James Garrison of New Orleans made similar claims in the highly publicized trial of Clay Shaw, in 1969. The thrust of all these arguments is that if the President was shot from two directions, almost simultaneously, there must have been a conspiracy, in contradiction to the Warren Commission's basic conclusion that Oswald acted as an independent agent.

Paul Hoch often pressed me for an explanation of the odd behavior of the President's head, and although I hadn't observed it myself, I usually suggested that the head had probably been held erect by muscles controlled by the brain, and that when the controls were suddenly damaged, the head fell back. I was finally convinced that this explanation was incorrect after Paul Hoch handed me a copy of Thompson's book as I was leaving Berkeley for the February 1969 meeting of the American Physical Society in St. Louis. On the plane I had time to study the book carefully. It is beautifully printed, with excellent photographs and carefully prepared graphs. When I studied the graph showing the changing position of the President's head relative to the moving car's coordinate system, I was finally convinced that the assassination buffs were right; there had to be a real explanation of the fact that the President's head did *not fall* back, but was *driven* back by some real force.

And the answer turned out to be simpler than I had expected. I solved the problem (to my own satisfaction, and in a one-dimensional fashion) on the back of an envelope, as I sat in solitary splendor in the beautiful suite that the St. Louis hotel management supplied me in my capacity as president of the APS.

I concluded that the retrograde motion of the President's head, in response to the rifle bullet shot, is consistent with the law of conservation of momentum, if one pays attention to the law of conservation of energy as well, and includes the momentum of *all* the material in the problem. The simplest way to see where I differ from most of the critics is to note that they treat the problem as though it involved only two interacting masses: the bullet and the head. My analysis involves three interacting masses, the bullet, the jet of brain matter observable in frame 313, and the remaining part of the head. It will turn out that the jet can carry forward more momentum than was brought in by the bullet, and the head recoils backward, as a rocket recoils when its jet fuel is ejected. (Col. William H. Hanson came to the same conclusion, independently.<sup>12</sup>)

If a block of wood is suspended by strings from the ceiling, it is called a ballistic pendulum, and physicists or gunsmiths can calculate the velocity of a bullet shot into it to be

$$v_B = v_W M_W / M_B \quad (1)$$

where  $v_W$  is the velocity of the wooden block after it stops the bullet, and  $M_W$  and  $M_B$  are the masses of the wooden block and bullet. Equation (1) follows directly from the law of conservation of momentum:

$$v_B M_B = v_W M_W \quad (2)$$

In using a ballistic pendulum, we normally forget that the collision of bullet and wooden block is very inelastic. Of the incoming kinetic energy of the bullet, only a small fraction  $f$  appears as kinetic energy of the moving wooden block; the remaining fraction  $(1 - f)$  goes into heating the wood. If  $M_B \ll M_W$ ,

$$\begin{aligned} KE_W &= f (KE_B) \\ M_W v_W^2 / 2 &= f \times M_B v_B^2 / 2 \end{aligned} \quad (3)$$

From (3) and (2),

$$f = M_B / M_W \quad (4)$$

For the case of a 10-g bullet, and a block weighing 10 kg, it can be seen that 99.9% of the incoming kinetic energy goes into heating the block, and only 0.1% appears as mechanical energy. Ballistic pendulums are designed so that they contain the inelastically dissipated energy. Unfortunately, the human head is not able to contain the major fraction of the energy carried in by the bullet. This tragic aspect of the assassination is clearly visible in frame 313 of the Zapruder film, and is discussed in detail in the reports of the autopsy surgeons.

The mechanism of the retrograde recoil turns out to be rather simple, if one remembers that 99.9% of the incoming energy must be accounted for. The momentum associated with a given amount of kinetic energy varies as the square root of the mass of the object carrying that kinetic energy:

$$p = (2MK)^{1/2} \quad (5)$$

where  $p$  is the momentum, and  $K$  is the kinetic energy of the object with a mass  $M$ .

Figure 4 shows what happened when my friends and I fired bullets at melons that had been wrapped with Scotch glass filament tape, to mock up the tensile strength of the cranium. Under the influence of the bullet, some of the material making up the melon breaks through the reinforcement, and carries momentum in the forward direction. (Frame 313 of the Zapruder film shows this same phenomenon.) As we shall now see, the momentum carried forward in this way can be much larger than the momentum brought in by the bullet. For example, if the bullet weighed 0.1% of the melon weight, and if 10% of the incoming kinetic energy was used to propel 10% of the jet expelled forward, then the momentum of the jet expelled forward would be  $(10)^{1/2}$  times that of the incoming bullet. (I will use subscripts,  $b$  for bullet,  $j$  for forward moving jet, and  $m$  for melon.)

$$\begin{aligned} p_j &= (2M_j K_j)^{1/2} = (2 \times 100M_b \times 0.1K_b)^{1/2} \\ &= (10)^{1/2} (2M_b K_b)^{1/2} = (10)^{1/2} p_b \end{aligned} \quad (6)$$

since  $M_j = 0.1M_m = 100M_b$ ,  $K_j = 0.1K_b$ . The melon would then recoil backward with about twice the velocity it would have been expected to go forward, assuming it were made of wood. This is because the melon, acting at first as a ballistic pendulum, acquires a forward velocity equal to  $v_{m|HP}$

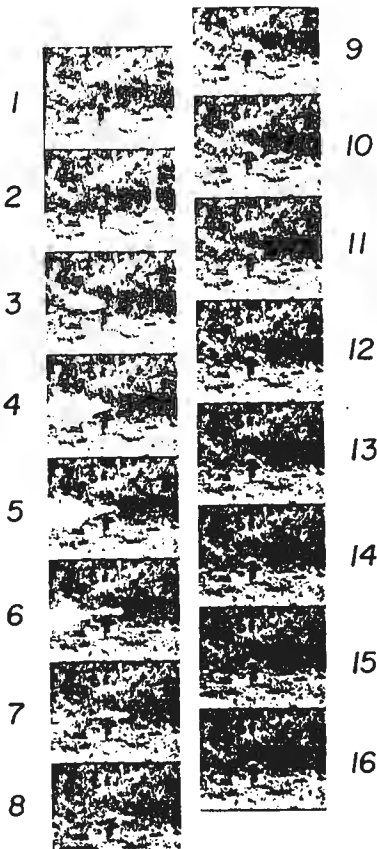


Fig. 4. Retrorecoil in a tape-reinforced melon hit by a high-velocity bullet. The bullet came from a rifle off the right-hand side of the frames. The forward jet (to the left) propelled the melon "backwards." (See text.)

$= p_b / M_m$ . (The notation  $v_{m|HP}$  means the velocity one would expect the melon to have if it contained all the kinetic energy of the bullet, as a ballistic pendulum does.) But in the center of mass system of the melon, which is moving "forward" with the expected velocity, a jet moves forward with momentum equal to  $(10)^{1/2} p_b$ —as we have just seen. It gives the melon an equal and opposite momentum, in the moving (CM) system; in that system,  $p_m = -(10)^{1/2} p_b$ . If we neglect the 10% loss of mass by the melon to the jet, the recoil velocity of the melon (in the CM system) is

$-(10)^{1/2}$  times the "expected value." Since velocities add vectorially, the final velocity of the melon (in the laboratory system) is  $[1 - (10)^{1/2}] v_{in}$ . Since the square root of 10 is close to 3.16, the observed velocity of the melon is about  $-2v_{in}$ .

If one wants to know more about the details of the transfer mechanism of kinetic energy from the bullet to kinetic energy of the fragments thrown forward, he will have to ask someone more knowledgeable in the theory of fluid mechanics than I am. My intuitive feeling is that the conical shape of the interaction zone is the key to the nonnegligible efficiency of energy transfer. (It is clear that an appreciable mechanical energy transfer is only possible if the incoming energy can avoid "being thermalized.") The conical region is defined by the small entrance hole and the much larger exit hole in the melon. Transmission lines with tapered internal conductors are efficient transformers of electrical energy, and a tapered bullwhip can smoothly transform the energy given to a large mass, by the flick of the wrist, into roughly the same energy of a much smaller mass at the tip of the whip. The "crack" of the whip occurs when the tip of the whip goes supersonic. I believe that in a somewhat analogous manner, but of course in the opposite direction, the kinetic energy of the bullet is given in a "tapered region" to a progressively larger mass in the melon, to achieve the modestly efficient energy transfer that is demonstrated in our experiments.

Now that I've given the theory of the "jet recoil mechanism," I'll describe the experiments that gave rise to Fig. 4. When I showed my simple calculations to Paul Hoch, he said that no one would believe my conclusions (including himself) unless we could demonstrate the retrograde recoil on a rifle range, using a reasonable facsimile of a human head as a target. I discussed my theory with my longtime friend and associate at the Laboratory, Sharon "Buck" Buckingham. Buck is an enthusiastic deer hunter, and he offered his services if I would buy the melons into which he would fire the shots.

Buck did his first experiments in June 1969 at the San Leandro Municipal firing range. Before he started shooting, all the expert marksmen in attendance told him that he was wasting his time—*one said*, "I've been around guns all my life, and you must be out of your mind to believe something you hit with a bullet will come back toward you." Most of the targets were melons that Buck had reinforced by wrapping with 1-in. Scotch "filament tape," as mentioned earlier.

The results of the first test shootings were encouraging in that most of the reinforced melons were driven by their shots toward the gun as I expected, rather than away from the gun "as the laws of physics require."

Paul Hoch expressed an interest in the results of this test, but said that he wouldn't ask his fellow buffs to believe them unless he had photographic evidence to document the case. Paul enlisted the help of Don Olson, another physics graduate student and assassination buff, who had a remotely controlled Super 8 movie camera, and I was present as an observer. We were all impressed to find that Buck's early results could be duplicated before the camera. The performances were now more uniform, with six out of seven reinforced melons clearly recoiling in a retrograde manner toward the gun. (According to Paul Hoch, the other one "just rolled around a bit.")

Figure 4 is an enlargement of a section of the film

showing shot number 4. The frame rate is 24 per second. The gun, a 30.06 rifle, is about 30 m out of sight on the right-hand side of the photographs. Its 150 grain hand-loaded soft-nosed<sup>11</sup> bullet hit the melon with a velocity of about 3000 ft/sec; the 6.5 Mannlicher-Carcano rifle found near the sixth floor window of the Book Depository building fired a 160-grain bullet at about 2165 ft/sec. (I am told that at a distance of 265 ft, the measured slant range from the Book Depository window to the President in frame 313, the bullet would have slowed down to about 1800 ft/sec.)

To relate these experiments to the melancholy affair in Dallas, we can use Thompson's<sup>11</sup> carefully measured velocity of the backward motion of the President's head. He finds that it was about 2.6 ft/sec, averaged over eight frames. In Fig. 4, the measured retrograde velocity of the melon is 4.5 ft/sec. It is obvious that if the melon had been hit by a slower bullet, and had been connected to a large mass, simulating a torso, rather than being free of restraint, it would also have moved back more slowly. But in spite of what appears to me to be a good semiquantitative match in velocities, we must remember that the important question at issue here is not the *magnitude* of the velocity, but its *direction!*

I believe that our experimental demonstration of retrograde recoil in head-like objects will convince most people that the laws of physics do not require a second assassin to have been firing at the President from the "grassy knoll," ahead of the car. It is important to stress the fact that a taped melon was our *a priori* best mockup of a head, and it showed retrograde recoil in the first test. If we had used the "Edison technique" and shot at a large collection of objects, and finally found one which gave retrograde recoil, then our firing experiments could reasonably be criticized. But as the tests were actually conducted, I believe they show it is most probable that the shot in frame 313 came from behind the car; after all, the jets visible in frame 313 were what suggested this mechanism to me.

Many of the assassination buffs wrote to Hoch to say that neither my "back of the envelope" numbers nor the experimental results agreed with Professor Thompson's measured head velocities. So, in case any readers of this article may be similarly bothered, I should point out that the three numbers I used in my analysis (two mass ratios and an efficiency) were each assumed to have the value of  $10^i$ , where  $i$  is a positive or negative integer. In spite of this highly quantized nature of the input data, the calculated and observed velocities differ by only a factor of 3. The assassination buffs who argued with Paul Hoch in a quantitative way (neglecting the important sign of the velocity) usually suggested that I was assuming that the mass of the jet (10%) was too high. But they missed the fact that, if either this assumed mass ratio or the assumed efficiency of energy transfer were *reduced* by a combined factor of almost 10, the calculated and observed velocities would be equal. In addition, frame 313 shows that the event wasn't one dimensional, as the model was; the two jets visible in frame 313 have vertical components that would lower the longitudinal component of momentum, bringing the theory closer to the actual event. I don't want to be that quantitative; the theory wasn't designed to calculate the velocities to high accuracies—but to show qualitatively that the head could jerk backwards.

I will end this section by saying what I think can be concluded from our experiments. It is possible to disprove



a theory, but never to prove one; no matter how often a theory has given correct predictions in the past, a single (repeatable) counterexample invalidates that particular theory. (Newton's theory of gravitation was disproven in this manner.) For these reasons, I believe that those arguments for a second assassin that derive from President Kennedy's head movements after frame 313 are now clearly invalid; a documented counterexample is now available to disprove the assertions of many writers concerning the consequences of Newton's laws of motion. I am convinced that everything that is known about the motion of the President's body in that short time interval is consistent with a shot from above and behind, where the sixth floor window of the Book Depository building was situated. But by the argument given earlier in this paragraph, I obviously can't prove that the bullet came from that window.

Dr. John K. Lattimer recently published an article<sup>14</sup> entitled "Observations Based on a Review of the Autopsy Photographs, X-rays and Related Materials of the Late President John F. Kennedy." Dr. Lattimer was apparently the first physician without governmental credentials to be given access to this material, which had been restricted for more than eight years, at the request of the President's family. Dr. Lattimer's article, published several years after the shooting experiments described above, says

"These observations, made possible by actually seeing the autopsy photographs and the clothing, (and added to the previous laboratory and autopsy findings) have answered some of the questions that were in the mind of the author and have revealed no incompatibilities with the concept that two high-speed bullets hit the President, both fired downward and from the rear, as from the sixth floor of the Book Depository Building. There were no signs of bullets or bullet wounds or bullet fragment tracks through the President's body running in any other location or direction, such as transversely, or from the front, to indicate bullet "hits" from any of these directions upon the President's head, body or limbs."

Several critics of the Warren report had predicted that when a "nonestablishment" expert on bullet wounds, such as Dr. Lattimer (with his "questions") was finally permitted to see the autopsy films, the "head shot from the front" would be confirmed. But Dr. Lattimer has ruled it out quite unequivocally.

Although Dr. Lattimer is now classified as a urologist, his biographical sketch<sup>14</sup> shows that he is an expert in the relevant fields:

"In World War II, Dr. Lattimer was a military surgeon in the European Theater of Operations and had experience with military missile wounds of all types, almost always using X-rays for their localization. He served as a firearms range officer and also did experimental work on the wounding capabilities of various missiles on human tissues."

#### V. HOW FAST WAS THE CAMERA RUNNING?

Everyone who has watched football on TV knows that it is easy to distinguish a slow motion "instant replay" from the real thing, even when the play-back rate is not much

slower than the normal rate. The clues come largely from our memorized knowledge of the oscillation frequency of the legs of runners moving at their fastest possible rates, and from our memory of the way objects fall in a "one-g" gravitational environment.

But Mr. Zapruder's camera showed an automobile in which the occupants were for the most part sitting still, together with images of two motorcycle policemen who sat immobile on their seats all the while. The background comprised fixed structures, plus a few spectators who appeared to be standing still as the camera panned past them as it followed the President's car. So the clues we see in "instant replay football" on TV seem to be denied us in the Zapruder film.

If one accepted the FBI's subsequently measured frame rate of 18.3 per second for Mr. Zapruder's camera, the car was moving at a speed of approximately 12 mph. But an FBI report stated that, "The camera was set to take normal speed movie film or 24 frames/sec." Had the camera actually been operating at that rate, it would have been exceedingly difficult—if not impossible—to devise a sequence of Mannlicher Carcano rifle shots that would have been within human capability, and therefore the multiple gunmen theories—so popular with many of the Warren Commission critics—could not have been ignored. (The higher the frame rate, the shorter is the time between any pair of numbered frames.) The Bell and Howell camera used by Mr. Zapruder had a "normal" button position, and a "slow motion" position, and I believe the intent of the FBI report was simply to answer the question, "Did Mr. Zapruder use normal or slow motion speed in taking his pictures?" Since the normal speed of 16- or 35-mm *sound* moving pictures is well known to be 24 frames/sec, I believe that the FBI was in turn saying, in effect, "He used normal speed." (I am now using my legally acceptable status as a "camera expert" to give an opinion outside the field of physics; I was for several years a salaried consultant to the Photoproducts Division of the Bell and Howell Company.) Actually the "slow motion frame rate" on the Zapruder camera was closer to 48 frames/sec.

I tried for some time to find a way to convince myself that the frame rate was 18.3 per second, and not the much higher "slow motion rate." But as I looked at the pictures again and again, I couldn't find a clue that could distinguish pictures of a car moving at 10 mph, together with some people who moved slowly, from pictures of a car moving at about 30 mph, with the same people still moving slowly, but not quite so slowly. I was about to give this problem up as hopeless when I noticed the action of a man standing beyond the car, as seen by the camera. He was clapping as the President drove by—a gesture that was common in the Kennedy era.

An elementary analysis of the muscle power involved in clapping shows that the power required, for a given maximum hand spacing, varies as the cube of the clapping frequency. The average velocity of the hands varies directly with the frequency, so the energy expended per cycle varies as the square of the frequency. Power is the time rate of expenditure of energy, so it involves an additional factor proportional to the frequency. It turns out that we can use the spectator's apparent clapping frequency, together with his observed and very natural maximum hand separation of about 1 ft. in the same way we use a running back's leg rate, to decide if we are watching live action, or slow motion "instant replay."

The spectator appears to move smoothly across the film from the right-hand edge, and about 1 (assumed) sec later (18 frames) disappears out of view beyond the left-hand edge. His apparent motion is of course due to Mr. Zapruder's panning action to follow the car. The clapping is shown in Frames 278 through 296 (Fig. 5), and even though the man's image is blurred because of the panning, it is evident that he has executed between  $3\frac{1}{2}$  and 4 full clapping cycles. I will assume that his apparent clapping frequency is 3.7 cycles/sec, and will ask how much greater this could be—due to a higher frame rate—and still be within reasonable human limits. The key to this particular analysis is the existence of the aforementioned cube law relating clapping frequency and muscle power. If a person doubles his clapping frequency, at constant amplitude, he must expend eight times as much power. The "steepness" of the cube law is what gives one the ability to distinguish film speeds by observations of clapping behavior, but only if normal clapping behavior is not too far from the "power barrier."

To answer this question, I clapped in synchronism with a metronome set at the assumed rate of 220 beats/min. I found I could clap quite comfortably at this rate of 3.7 per second, but I couldn't do so at twice the rate, with the same amplitude; to make 7.4 cycles/sec, which was an obviously unacceptably high rate, I had to reduce my amplitude considerably. I could just make it at 1.5 times 3.7 cycles/sec, but the effort felt quite unnatural. I am confident that anyone who repeats these experiments, as I have just done after a hiatus of several years, will be convinced that Mr. Zapruder's camera was running at very nearly 18 frames/sec. (It was certainly not running at 48 frames/sec, and I believe that 24 frames/sec can be ruled out, as well.) Although there is apparently no longer a serious controversy relative to frame rates, I wanted to share with my physicist readers the pleasure I had in discovering a "cube law clock" in the film.

#### VI. WHY DID THE PRESIDENT'S CAR SLOW DOWN ABRUPTLY JUST BEFORE THE FATAL SHOT?

The Commission was aided in its interpretation of the films by an FBI photoanalyst, Mr. Lyndal L. Shaneyfelt. My first disagreement with his testimony comes on p. 155 of Vol. V, where he was running the Zapruder film for Allen W. Dulles and John J. McCloy, members of the Commission. After the expert had made a comment relative to frame 222, the following conversation took place:

*Mr. Dulles:* Jerky motion in Connally in the film.

*Mr. Shaneyfelt:* There is—it may be merely where he stopped turning and started turning this way. It is hard to analyze.

*Mr. Dulles:* What I wanted to get at—whether it was Connally who made the jerky motion or there was something in the film that was jerky. You can't tell.

*Mr. Shaneyfelt:* You can't tell that.

Since Fig. 3 shows some "jerky motion" immediately after frame 222, it is a reasonable assumption that this is what had caught Mr. Dulles's attention. It was too bad that Mr. Dulles answered his own question concerning the possibility of distinguishing between the motion of a man in the

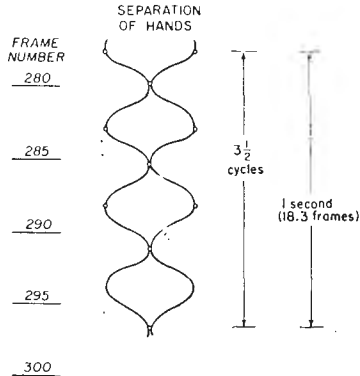


Fig. 5. Hand clapping at  $3\frac{1}{2}$  cycles/sec by a spectator allows film speed to be determined, within important limits. (See text.)

car, and a movement of the film (camera) as a whole. Mr. Dulles was an experienced intelligence agent, and his practiced eye caught an important clue, but he too quickly dismissed it as undecipherable, which, of course, we now know it wasn't. The expert photoanalyst put the lid on the matter by his polite endorsement of Mr. Dulles's error.

My second disagreement with this same FBI photoanalyst came when he testified concerning his inability to pinpoint the President's car, at frame 313, by examining the Zapruder film. He had this to say<sup>15</sup>:

"Yes, I might state first that all of the other (re-actment) photographs were reestablished on the basis of the Zapruder film, using reference points in the background of the pictures.

"As is apparent here from the photograph of the Zapruder frame 313, there are no reference points. There is just a grassy plot. So there is no reference point on which we can reestablish the position of the car in the roadway.

"For this reason it was necessary to use the Nix film of the head shot and the Muchmore film of the head shot to establish this position in the road." [These films were shot from amateur movie cameras located on the opposite side of the street; one of them showed some identifiable background close to Mr. Zapruder's position, including Mr. Zapruder himself, instead of the plain grass that showed at that time in the Zapruder film.]

Mr. Shaneyfelt pinpointed the location of the car in 13 (or perhaps more) frames from 161 to 255, in which interval, there were architectural background features that were easily identifiable in the Zapruder frames. And as he said, the position of the car in frame 313 was determined from the two other films. These data were used in the FBI re-actment studies in Dealey Plaza. An open automobile, similar to the one in which the President rode, was moved in turn to the 14 (or more) positions as determined in the

films. At each position, it was photographed (1) by a still camera with the same angular field as Mr. Zapruder's movie camera, from his original location, and (2) from the sixth floor window of the Book Depository building, through the rifle scope of the rifle found at that location immediately after the assassination. For each of these 14 selected frames, the Exhibits<sup>16</sup> show photographs (1) and (2), together with the original Zapruder frames; in the case of frame 313, the corresponding frames from the Nix and Muchmore films are shown, together with still shots of the stationary car from the Nix and Muchmore locations.

In addition to the several pictures corresponding to each of the 14 locations, the exhibits also tabulate various measurements made at the 14 locations. These include the distance of the car from a benchmark on Elm Street ("station C"), the distance between the rear seat of the car and the sixth floor window of the Book Depository building, and the angle of depression of the rifle sight in that window. The distances are given to the nearest tenth of a foot; they are probably accurate to somewhat better than 1 ft.

As any physicist would do, I plotted the tabulated distance of the car from "station C" against frame number for these 14 selected frames. This graph is shown in Fig. 6, and all the points except that for frame 313 lie on a line with a slope equal to 11.8 mph. It is clear from the dispersion of the (Zapruder) points from a straight line that the final point (determined from the Nix and Muchmore films) does not lie on the extrapolated line. Two explanations are possible: the position of the car at frame 313 was incorrectly determined, or the car slowed down somewhere between frames 255 and 313. Neither of these possibilities seemed reasonable to me when I first saw Fig. 6, so I set myself the task of finding out which explanation was correct. (I did this work, and the analysis of the clapping, during the Christmas vacation following the publication of the November 26, 1966 issue of *Life*.)

The first relevant observation I made was that contrary to what Mr. Shaneyfelt said in his testimony, it was a trivial exercise to determine precisely where the car was at each of the 79 frames from where his "Zapruder data" stopped (at frame 255) to the final published frame, number 344. What he apparently failed to realize was that the approximately ten persons who were standing on the featureless background were "reference points" exactly as useful as if they were set in concrete. Their usefulness comes from two independent considerations. There is a linear relationship between any horizontal interval on the original film (or on the half-tone reproductions in the Exhibits) and the corresponding angular interval subtended at Mr. Zapruder's camera. In other words, every time the camera panned through an angle  $\theta$ , a fixed object in the field of view moved to the left in the picture, a distance of  $k\theta$ . The value of the constant  $k$  (the focal length of the camera lens) could be determined with the aid of an accurate plan of Dealey Plaza, showing Mr. Zapruder's station. (The camera had a zoom lens of variable focal length, which I found had been used at very nearly its longest value.) From such a plan, one can measure the angles subtended by many architectural features, visible in the frames. Those angles, which can be measured with a high degree of precision, can be divided by the accurately measurable corresponding intervals on the film (or on the half-tone reproduction) to give the corresponding value of  $k^{-1}$ . From then on, we can immediately tell from what angle the camera is being panned, frame

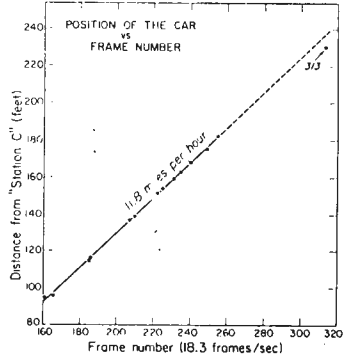


Fig. 6. Position of the President's car as determined by the FBI. Note that point 313 does not lie on extrapolated line.

by frame, by simply measuring the displacement of any stationary object in the field of view. That stationary object can be a concrete pole, or equally usefully, a person's foot that is temporarily bearing his weight, and is therefore fixed to the ground.

Since I didn't have an accurate enough plan of Dealey Plaza, I couldn't evaluate  $k$  with an absolute uncertainty as small as the relative uncertainty with which measurements could be made on the half-tone reproductions. (The FBI could have done that with the theodolite they used in the reenactment session.) But that minor lack of absolute precision will have no effect on the very accurate measurements of the relative speed of the car before and after the strange and previously unseen deceleration I am about to describe. But before describing that event, I should mention that in one sequence, when no spectators are in the background, another interesting reference mark is available on the plain grass behind the car, in frames 313-334, the last ones reproduced in the exhibits. This mark is a white streak, whose position can be seen to move progressively across the film gate, in that sequence of 22 frames. It is clear that the white streak is really the image of a small shiny object that is reflecting sunlight into the camera lens. In this sense, it corresponds directly to one of the highlights on the car; it is "streaked" in every frame because the camera axis is moving relative to it in all frames.

Figure 7 shows the angular position of the car as a function of frame number, from frame 260 to the end of the sequence - a 4-sec interval of time in which the President was fatally wounded. This figure could have been drawn as an extension of the Commission-derived Fig. 6, which ends at frame 255, but I wanted the scale enlarged because the new individual points are now more precisely known. And all of this is in a region where the background

"... is just a grassy plot. So there is no reference point on which we can reestablish the position of the car in the roadway."<sup>15</sup>[!]

The extreme smoothness of the curve comes from the fact

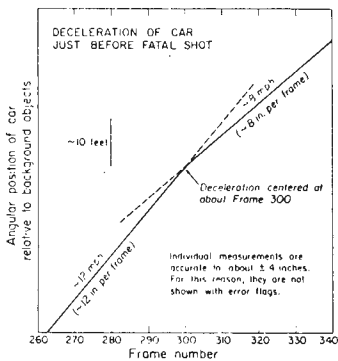


Fig. 7 Position of the President's car as determined in this paper. (See text.) Note the sudden deceleration of the car about one second before the President was fatally wounded (in frame 313). If error flags not shown, the 75 separate points have errors comparable to the width of the two straight lines.

that the smearing due to the camera accelerations (see in Fig. 3) cancels out; the measurements are made from a highlight on the car, to one of the reference points on the (featureless) "grassy plot" that I've just discussed. Any "jiggle" of the camera axis moves both of these reference points (on the car and on the ground) by the same distance on the film, leaving the distance between the two images on the film unchanged. These distances are plotted against frame number in Fig. 7, and I estimate that each point has a relative uncertainty of about 4 in. "in real space." The car had an average velocity of about 12 mph or about 12 in./frame interval. I would normally show all the measured points on a curve such as this, but the scatter of the 75 points about the "best fit" two line segments is less than the width of the lines.

The car was moving almost exactly at  $90^\circ$  to the camera axis for these few seconds; one can easily check this by noting that the image of the horizontal strip separating the front and back compartments of the open car appears as a vertical stripe in one of these frames from Mr. Zapruder's downward-looking camera. For this reason we can translate relative positions of a car highlight and the background object on a frame-by-frame basis directly into the velocity of the car, simply by measuring the slope of the graph in Fig. 7.

The heavy car decelerated suddenly for about 0.5 sec (10 frames), centered at about frame 299, reducing its speed from about 12 mph to about 8 mph. Since the car was certainly being operated in some low gear ratio, the deceleration was no doubt caused by the driver reducing his foot pressure on the accelerator pedal. The question is then, "Why did the driver suddenly slow down at a time when a more natural reaction would be to speed up and weave to left and right, to avoid being hit again." I worried about this for some time, without finding any satisfactory answer. But then I found some testimony concerning a police siren that was remembered to have come just after the President was

killed (in frame 313). The many inconsistencies in the various witnesses' remembrances of exact times in this critical period made me feel that it was permissible to suggest that the siren, from an escorting police vehicle behind the President's car, had come a few seconds *before* the fatal shot. It would be most probable that an escorting officer, having heard one shot, and seeing the President wounded by a second shot, would hit the siren button when I'm suggesting he did. If the siren sound became apparent to Mr. Zapruder at frame 285, we would expect him to respond at frame 290, where we see the "unexplained and relatively weak angular accelerations" starting. We don't know the reaction time of the driver, but if it was 0.5 sec (9 frames), then he would lift his foot from the accelerator at frame 294, as Fig. 7 shows he did. Everyone will recognize that such a reaction on the part of the driver would be an unavoidable conditioned reflex; we all learn that when we hear a siren suddenly turned on, just behind our car, we lift our foot from the accelerator pedal. I haven't been able to think of any other reason why the driver of a car that has just stopped one or two high velocity rifle bullets would suddenly *slow down* his rate of travel.

The driver of the car, Agent William R. Greer, recalls that he speeded up the car in this period<sup>17</sup>:

*Mr. Arlen Specter:* Do you recollect whether you accelerated before or at the same time or after the third shot?

*Mr. Greer:* I couldn't really say. Just as soon as I turned my head back from the second shot, right away, I accelerated right then. It was a matter of my reflexes to the accelerator.

*Mr. Specter:* Was it at about that time that you heard the third shot?

*Mr. Greer:* Yes, sir; just as soon as I turned my head.

*Mr. Specter:* What is your best estimate of the speed of the car at the time of the first, second, or third shots?

*Mr. Greer:* I would estimate my speed was between 12 and 15 mph.

*Mr. Specter:* At the time all of the shots occurred?

*Mr. Greer:* At the time the shots occurred.

But since Fig. 7 shows that the car was still moving at the slower rate through the last of the published Zapruder frame number 334 it is apparent that Mr. Greer's memory doesn't jibe with the recorded facts. This is what Professor Buckhout pointed out in his article on the reliability of eyewitness testimony<sup>2</sup>; all past events aren't recorded in a person's memory as on a magnetic tape, to be recalled later. That is why I find the photographic record so interesting; it doesn't have the normal human failings.

Certainly, the car eventually speeded up, and this is doubtless what Agent Greer recalled. In view of the disparity of several seconds between what the agent remembered of this terrible event and what actually happened, the reader may come to accept my conclusion that memories of the siren were similarly off by a few seconds. That's all it takes to turn the otherwise fantastically absurd deceler-

ation of the car into a reasonable conditioned reflex on the part of the driver to the sound of a siren going off in his ear, and to shake up Mr. Zapruder at the same time. But as I said in the introduction, I can't prove that this is the way it happened.

As stated earlier, the streaks in the "grassy plot" were doubtless made by a small object reflecting light from the sun into the lens of Mr. Zapruder's camera. Figure 8 shows how this streak moved across the film gate in the camera (frames 313-334). This particular interval of just more than 1 sec coincides exactly with the climax of the events in Dealey Plaza. The President has just been fatally shot as the streak appears in the background, labeled 313. In the following second, Mr. Zapruder experiences great difficulty in continuing his earlier smooth tracking. He sees clearly in his view finder what has happened to his President, and it is a traumatic experience for him:

*Mr. Zapruder:* I heard a second shot and then I saw his head opened up and the blood and everything came out and I started - I can hardly talk about it. [The witness crying.]<sup>18</sup>

But to return to the streaks in Fig. 8, let us first realize what that figure would have looked like if the shots had not been fired. Mr. Zapruder's tracking ability has been checked during the quiet periods of Fig. 3; a given highlight on the car, in those periods, stays pointlike, and at a fixed location in the film gate. Under such circumstances, a point of light in the background, such as that shown in Fig. 8, would move across the film gate on a straight line, at constant velocity. But because the camera shutter closes between exposures, while the film is being "pulled down," the straight line just mentioned would appear as a "dashed line" drawn by a draftsman using a straightedge.

Contrast the evenly spaced dashes on a straight line that Zapruder was capable of "drawing," with the dashes of Fig. 8 which appear to have been drawn by a spastic; that might even be the correct word to describe Mr. Zapruder's condition in that ghastly second after frame 313. (Until I realized that the labels on frames 314 and 315 had been interchanged in the exhibits, I thought Mr. Zapruder had lost even more control of his muscles than he actually had.)

Starting at frame 331, we see the streaks move up to the right and then back quite rapidly to the left. This phenomenon might be related to the "crescent"-like streaks seen in the CBS tests.<sup>8</sup> In Fig. 3, I couldn't plot this two-dimensional excursion of the camera axis, but one can see from that figure, at frame 332, that something pretty violent is happening. If I'd had access to the enlarged color prints that Governor Connally is shown viewing in *Life*, it would have been worthwhile plotting tracking curves like Fig. 8, for the whole sequence of frames. My reason for saying this is that such a curve complements an acceleration graph, such as Fig. 3. Ideally, the two should yield the same information, but in practice, the tracking curve shows more. This can be seen by comparing Fig. 8 with Fig. 3, in the vicinity of frame 325. From Mr. Zapruder's measured oscillation time of five frames, I expected to see an acceleration peak in Fig. 3, near this frame. But I've already mentioned the fact that of all the expected ones, a third of a second apart, only this peak was missing. However, a glance at Fig. 8 shows that there was quite a space in Mr. Zapruder's relatively smooth tracking curves at this point. This

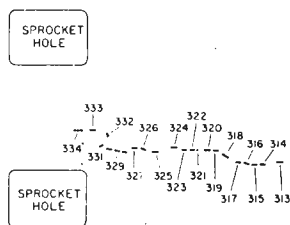


Fig. 8. "Streak" in the grass. The motion of Mr. Zapruder's camera axis is shown in two dimensions during the 1.2-sec period immediately following the fatal shot. (See text.)

example illustrates the fact that tracking curves are more sensitive than the angular acceleration graphs that derive from subtracted streak lengths.

I'll close this section by recalling that the wealth of data shown in Fig. 8, encompassing the climactic second in Dealey Plaza, involves a time period when an FBI photointerpreter told the members of the Warren Commission that from those pictures alone, there was no way to tell where the car was. I hope that this section will demonstrate what I've long felt—that the testimony of a physicist could have been of help to the Warren Commission, as it searched for the truth in early 1964.

#### ACKNOWLEDGMENTS

As I've indicated in the body of this paper, I've had help from several friends in the shooting experiments, particularly "Back" Buckingham and Don Olson. Paul Hoch was for a long time my most knowledgeable and severest critic. In the absence of his always friendly but persistent criticism, this report of my study of the Zapruder film would have been much less convincing than I now hope it is. His vast store of knowledge concerning all aspects of the assassination was of great help to me, in my position of having read almost nothing of the literature critical of the Warren Commission's Report. His help in such matters is clearly evident in the text, where I acknowledge the work of others who anticipated conclusions that I reached later, but independently. Paul made many suggestions for improvements in a 1970 draft of this report, almost every one of which I incorporated. I don't believe we've discussed the assassination more than once or twice since then, and I haven't talked to Paul since I started the final rewriting a few months ago. He is now writing a book on the assassination, and we are agreed that although we each learn from the other, when final versions are being written, only one person can be responsible. And finally, I would like to acknowledge a great deal of constructive editorial criticism and help from Richard A. Muller.

\*This work was done with support from the U.S. Energy Research and Development Administration. Any conclusions or opinions expressed in this report represent solely those of the author and not necessarily those of the Lawrence Berkeley Laboratory nor of the U.S. Energy Research and Development Administration.

<sup>10</sup> *Hearings Before the President's Commission on the Assassination of President Kennedy* (U.S. GPO, Washington, DC, 1964).

<sup>11</sup> M. Lane, *Rush to Judgment* (Holt, Rinehart and Winston, New York, 1966), p. 55.

<sup>12</sup> *Squire*, 205 (December 1966).

<sup>13</sup> S. White, *Shall We Now Believe the Warren Report?* (Macmillan, New York, 1968).

<sup>14</sup> R. Buckhout, *Sci. Am.* 231, 23 (December 1974).

<sup>15</sup> Reference 1, Vol. XVIII, pp. 1-80.

<sup>16</sup> H. Wernberg, *Whitewash* (Wernberg, Hyattsville, MD, 1966; reissued by Dell, New York, 1966).

<sup>17</sup> Reference 4, p. 228.

<sup>18</sup> Reference 1, Report, p. 98.

<sup>19</sup> Reference 4, p. 82.

<sup>20</sup> J. Thompson, *Six Seconds in Dallas* (Geis, 1967).

<sup>21</sup> W. H. Hanson, *The Shooting of John F. Kennedy: Our Assassin, Three Hits, No Misses* (Naylor, San Antonio, 1969).

<sup>22</sup> The fact that the bullets were soft nosed, rather than fully jacketed (as the Mannlicher-Carcano bullets were), was apparently important in intensifying the explosive jet effect. Dr. John K. Lattimer tells me that when he repeated our melon experiments with a duplicate of Oswald's weapon and jacketed cartridges, the effect was not as vigorous nor as dependable, even though it did occur about half the time. When he repeated it on skull models, however, the effect was still *more* violent than ours, even with the jacketed bullets.

<sup>23</sup> Dr. J. K. Lattimer, Resident and Staff Physician, 34 (May 1972).

<sup>24</sup> Reference 1, Vol. V, p. 159.

<sup>25</sup> Reference 1, Vol. XVIII, pp. 86-313.

<sup>26</sup> Reference 1, Vol. II, p. 119.

<sup>27</sup> Reference 1, Vol. VII, p. 57.

## AFTERNOON SESSION

Chairman STOKES. The committee will come to order.

This Chair recognizes Professor Blakey.

Mr. BLAKEY. Thank you, Mr. Chairman.

Mr. Chairman, the testimony now to be taken concerns forensic firearms identification—the science of identifying fired bullets and cartridge cases with particular firearms. But first, some background information will be helpful. Soon after the assassination, Dallas police suspected the shots originated at the Texas School Book Depository. At 1:13 p.m. central standard time Deputy Sheriff Luke Mooney discovered three used cartridge cases lying on the floor near the southeast corner window of the sixth story. The cartridge cases were later turned over to the FBI.

At 1:22 p.m. Deputy Sheriff Eugene Boone and Deputy Constable Seymour Weitzman discovered a bolt-action rifle equipped with a telescopic sight. It was also on the floor of the sixth story of the book depository, near the northwest corner. Weitzman—though neither he nor Boone actually handled the rifle—described it as a 7.65 German Mauser, although it was subsequently determined to be a 6.5 millimeter Mannlicher-Carcano Italian military rifle. It contained one round, a full copper-jacketed military-type bullet manufactured by Western Cartridge Co.

As the officers were collecting assassination evidence in the Book Depository, Officer J. D. Tippit was shot and killed in the Oak Cliff section of Dallas, several miles away from the Book Depository. Four spent .38-caliber cartridges were found at the scene of the Tippit murder.

Before 2 p.m., Lee Harvey Oswald was arrested as a suspect, not in the President's assassination, but in the Tippit shooting.

He was apprehended after a scuffle in the Texas Theater, and he was carrying already a .38 Smith & Wesson special designed to fire .38 Smith & Wesson ammunition. Although the revolver had been rechambered to fire .38 special ammunition, it had not been rebarreled.

At approximately 1:55 p.m., a bullet was found on a stretcher in the emergency area of Parkland Hospital. O. P. Wright, Director of Security, was notified, and he turned the bullet over to Secret Service agents. It was the one the Warren Commission was later to label exhibit 399.

Other evidence that was recovered in the aftermath of the assassination included missile fragments from the Presidential limousine, fragments from Governor Connally's wrist, and fragments from the President's body. In addition, a bullet that had been

recovered in an attempted assault on Gen. Edwin A. Walker in Dallas on April 10, 1963, would become the subject of evidentiary significance in the assassination.

The Warren Commission relied on FBI facilities for firearms identification of the missiles and fragments. [Firearms identification, of course, is the process in which missiles and fragments are examined for characteristics that precisely identify the weapon from which they were fired.] The Commission concluded from the FBI tests that CE-399, and the two fragments found in the limousine that were large enough to test reliably, had been fired by the Mannlicher-Carcano retrieved from the Texas School Book Depository. It also determined that the three cartridge cases found in the Book Depository had been ejected from the chamber of the Mannlicher-Carcano. The FBI was unable, however, to link the bullet fired at General Walker with the rifle, though it said the badly mutilated bullet showed the characteristics of a round that had been fired by a Mannlicher-Carcano.

As for the evidence in the Tippit shooting, the bullets removed from the officer's body could not be linked to Oswald's revolver. This was attributed to the erratic bullet behavior caused by re-chambering. The empty cartridge cases found near Tippit's body were never the less connected to Oswald's revolver.

The critics have used the ballistic evidence to cast doubt on the Warren Commission conclusions. Edward Jay Epstein, for example, in his book *Inquest*, contends that there remained in Governor Connally's body more bullet fragments than could have been left by CE-399. Many critics, for that matter, have maintained as the testimony has shown in these hearings, that CE-399 could not have remained virtually intact after causing the many severe wounds the Governor received.

To conduct a comprehensive scientific examination of the firearms evidence, the committee chose a panel of experts who had no prior affiliation with the case. The panel was charged with resolving the following issues:

1. The character and characteristics of the evidence—the Mannlicher-Carcano retrieved from the Book Depository, the .38 revolver allegedly found in Oswald's possession, and missiles and fragments that have been associated with the assassination.

2. The possibility that a 6.5-millimeter Mannlicher-Carcano could easily or not be mistaken for a 7.65 German Mauser.

3. Whether the cartridge cases found on the floor of the sixth story of the Texas School Book Depository, the bullet found at Parkland Hospital and the fragments removed from Governor Connally, the limousine and the President's body can be connected to the Mannlicher-Carcano.

4. A number of related issues raised by critics, for example, was the scope on the Mannlicher-Carcano mounted for a left-handed marksman?

Members of the Firearms panel on hand today are: Mr. Monty C. Lutz, Mr. Donald E. Champagne, Mr. John S. Bates, Jr., and Mr. Andrew M. Newquist.

Mr. Lutz holds a B.S. degree in criminal justice from the University of Nebraska. He presently is a firearms and tool mark analyst with the Wisconsin Regional Crime Laboratory, New Berlin, Wis.

Mr. Champagne is presently a firearms and tool mark examiner with the Florida Department of Criminal Law Enforcement in Tallahassee. He previously served for 15 years as a firearms and tool mark examiner in the Crime Detection Laboratory in Ottawa, Ontario.

Mr. Bates is the senior firearms examiner in the New York State Police Laboratory at Albany. He has been a lecturer at the State University of New York at Albany, the New York Police Academy and the New York State Municipal Police Training Council.

Mr. Newquist is a special agent and firearm, tool mark and latent fingerprint examiner for the Iowa Bureau of Criminal Investigation. He is a member and a past president of the Association of Firearm and Tool Examiners, and he currently is on its executive committee.

Serving as technical assistant to the firearms panel is Mr. George R. Wilson. Through his assistance, the facilities at the Metropolitan Police Department Firearms Laboratory here in the District of Columbia were secured. His expertise in the area of firearms identification greatly assisted the panel's conduct of its inquiry.

It would be appropriate Mr. Chairman, at this time to call the panel as a whole.

Chairman STOKES. The committee at this time calls the panel forward.

Would each of you gentlemen raise your right hand to be sworn.

Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

**TESTIMONY OF FIREARMS PANEL: MONTY C. LUTZ, DONALD E. CHAMPAGNE, JOHN S. BATES, JR., AND ANDREW M. NEWQUIST**

Mr. LUTZ. I do.

Mr. CHAMPAGNE. I do.

Mr. BATES. I do.

Mr. NEWQUIST. I do.

Mr. WILSON. I do.

Chairman STOKES. Thank you. You may be seated.

The Chair recognizes committee counsel James McDonald.

Mr. McDONALD. Thank you Mr. Chairman.

Members of the firearms panel, have you completed your tests of the firearms evidence in the assassination of President John F. Kennedy?

Mr. LUTZ. Yes, sir, we have.

Mr. McDONALD. And do you have a report ready at this time to present to the committee.

Mr. LUTZ. Yes, sir.

Mr. McDONALD. Mr. Chairman, I would like with your permission to have the clerk receive a copy of the firearms panel report, and identified for the record as JFK exhibit No. F-275.

Chairman STOKES. Without objection.

[JFK exhibit No. F-275 will be published as an appendix to the committee's final report.]

Mr. McDONALD. The first exhibit, Mr. Chairman, is CE-139.



For the record, would each of the panel members please identify himself, starting with Mr. Lutz on my left.

Mr. LUTZ. Monty C. Lutz, from the Regional Crime Laboratory, Wisconsin State.

Mr. CHAMPAGNE. Donald Champagne from the Florida Department of Criminal Law Enforcement Crime Laboratory in Tallahassee, Fla.

Mr. BATES. John S. Bates, Jr., New York State Police Scientific Laboratory, Albany, N.Y.

Mr. NEWQUIST. Andrew Martin Newquist from the Iowa Department of Public Safety Bureau of Criminal Investigation, Des Moines, Iowa.

Mr. WILSON. George R. Wilson, Metropolitan Police Department, Firearms Identification Section, Washington, D.C.

Mr. McDONALD. Thank you, Mr. Chairman, our first exhibit this afternoon has been previously identified here today as Warren Commission exhibit 139, and for purposes of our report and testimony we wish it to be identified with JFK exhibit No. F-276.

Chairman STOKES. It may be so identified.

[Warren Commission exhibit No. 139 is identified as JFK exhibit F-276 and a photograph made for the record.]



JFK EXHIBIT F-276

Mr. McDONALD. And with your permission, Mr. Chairman, I would like to approach the representatives of the National Archives to retrieve Warren Commission exhibit No. 139, the Mannlicher-Carcano rifle found on the sixth floor of the Texas School Book Depository building.

Mr. Chairman, the first series of questions will be directed to Mr. Monty Lutz.

Mr. Lutz, have you seen the exhibit before you before?

Mr. LUTZ. Yes, sir, I have.

Mr. McDONALD. And where have you seen it?

Mr. LUTZ. This I first observed at the National Archives for a cursory inspection of it in November of 1977 and later made subsequent examinations of it at the Metropolitan Police Crime Laboratory here in Washington, D.C.

Mr. McDONALD. Would you please move the microphone closer to you.

And, Mr. Lutz, before we go any further, would you please examine Warren Commission exhibit 139 to assure us that it is in an unloaded state.

Mr. LUTZ. It is unloaded.

Mr. McDONALD. Did you check this exhibit this morning, Mr. Lutz, to assure yourself that it was the same weapon that you have test fired for this committee?

Mr. LUTZ. Yes, sir; I did.

Mr. McDONALD. How did you identify it?

Mr. LUTZ. I removed the butt plate from the rear of the weapon, identified my initials that I had placed on the firearm at the time that I examined it at the laboratory.

Mr. McDONALD. And your initials are still on there?

Mr. LUTZ. Yes, sir; that is correct.

Mr. McDONALD. And when you conducted firearms tests of this weapon, was there a representative of the National Archives present at all times?

Mr. LUTZ. Yes, sir.

Mr. McDONALD. Mr. Lutz, what kind of rifle is CE-139?

Mr. LUTZ. This particular rifle is a 6.5 millimeter Mannlicher-Carcano bolt action rifle.

Mr. McDONALD. And would you tell us what is the nature and the characteristics of that rifle, and if you would like to stand and hold it and explain to us we would appreciate it.

Mr. LUTZ. The characteristics of this rifle is that it is a six shot repeating rifle. It is clip-fed with the capacity of a six round in-line clip being capable of being loaded and inserted into the top of the magazine, in the magazine area. It is a bolt-action rifle, and is of Italian manufacture and 6.5 millimeter Mannlicher-Carcano caliber.

Mr. McDONALD. Can it be described as an automatic weapon.

Mr. LUTZ. No, sir; it cannot.

Mr. McDONALD. Thank you, Mr. Lutz, you may place the weapon down.

Mr. Lutz, could a 6.5 millimeter Mannlicher-Carcano rifle be easily mistaken for a German Mauser, and before you answer the question, if we could have marked for identification JFK exhibit F-96. If you would utilize the chart in explaining your answer.

Mr. LUTZ. In regards to that question, there are considerable similarities between the 6.5 millimeter Mannlicher-Carcano rifle in conjunction with numerous rifles of several countries and several sources of origin. The similarities with the 7.65 German Mauser are quite a few. The similarities that would be noted between the Carcano and the 7.65 German Mauser are depicted in this particular photograph that I have here. The photograph that I have put together represents several rifles that have the general class characteristics or the overall silhouette design for this particular rifle.

The features that could possibly be confused with the Mannlicher-Carcano rifle and an Argentine Mauser would be the Mannlicher-type magazine protruding from the bottom of the receiver area. The feature that is common on all bolt action rifles, the operating handle or the bolt handle protruding from the right side, on all of these rifles.

Mr. McDONALD. Mr. Lutz, would you please tell us which one is the Mannlicher-Carcano in that composite photograph.

Mr. LUTZ. The photographs that I have are a series of photographs involving the Mannlicher-Carcano being the second one from the top of the photographic display. This is a rifle of the same model type and general characteristics as the questioned rifle, CE-139. It is not CE-139 but a rifle just like it. The second one from the top. The similarities that are available and quite noticeable and might be confused with an Argentine Mauser rifle, manufactured in Germany, can readily be seen.

The magazine, the general silhouette being quite similar. This rifle comes in quite a few different lengths and different models. This is one of the longer rifle versions. This comes with another model that has a shorter barrel and is quite similar even in length to the Mannlicher-Carcano. So we have that feature. This one has been sporterized and the wood lightened. Normally the military version has a darkened stock, a dull finish. These again being similar between the Carcano and the German Mauser, or in this case the Argentine Mauser manufactured in Germany. So these similarities are the same.

We will find bayonet studs on many of the rifles, so that this is not just a unique feature to the Carcano. A protrusion that the bayonet would be attached to is quite frequently encountered on all of these rifles.

So many of these rifles could very easily have been confused with a Mannlicher-Carcano to the person who did not make a complete and thorough examination of that particular rifle.

Mr. McDONALD. Can you determine the caliber of a rifle merely by looking at it?

Mr. LUTZ. No, you cannot, because many times the differences in caliber is a few thousandths of an inch. The difference between a 6.5-millimeter Carcano bullet, or the muzzle, the barrel itself, the inside diameter, and the difference between it and the 7.65 German Mauser is only a few thousandths of an inch, 40-some thousandths of an inch difference. We are speaking of .265 inches in diameter for the 6.5 Mannlicher-Carcano bore diameter and we are speaking of .313 inches of diameter for the Argentine Mauser made in Germany.

Mr. McDONALD. To a casual observer would it be easy to mistake a Carcano for a Mauser?

Mr. LUTZ. Yes, sir; I believe it would.

Mr. McDONALD. Thank you very much.

Mr. Lutz, if you could return to your seat.

Mr. Chairman, may JFK exhibits F-96 and 97 be marked for identification and received into the record.

Mr. PREYER [presiding]. Without objection, so ordered.

[JFK exhibits F-96 and F-97 were marked for identification and received into the record.]



JFK EXHIBIT F-96



JFK EXHIBIT F-97

Mr. McDONALD. Mr. Lutz, perhaps if you could just stay right there and I will ask you a question. Have you examined the scope, the rifle scope, attached to CE-139?

Mr. LUTZ. Yes, sir, I have.

Mr. McDONALD. Perhaps if you could put the microphone back on.

What kind of scope is it?

Mr. LUTZ. This is a four-power Ordinance Optics telescopic sight with a crosshair reticle.

Mr. McDONALD. Would you in your opinion classify it as an accurate scope?

Mr. LUTZ. The accuracy is fairly undependable, as far as once getting the rifle sighted in and it is very cheaply made, the scope itself has a crosshair reticle that is subject to movement or being capable of being dislodged from dropping, from impact, or a very sharp recoil. So the accuracy would be somewhat questionable for this particular type of a scope.

Mr. McDONALD. Would you please describe for us how this scope is mounted on 139?

Mr. LUTZ. This scope is mounted with a set of split rings that surround the circumference of the scope, to three-quarter-inch diameter tube. They are screwed into place to the mount and then that mount attached to the left side of the receiver, two holes are drilled into the receiver. This is not a standard military attachment as the rifle would be manufactured at the factory. The holes have to be drilled into the receiver. Those holes then threaded and the mount attached to the left side of the rifle.

Mr. McDONALD. Are you saying if the scope were mounted at the factory it would be mounted in a different fashion?

Mr. LUTZ. Normally this scope is not attached at the arsenal that would manufacture it, it does not have an attachment for a scope.

Mr. McDONALD. Does the method of mounting the scope on a rifle affect or have any influence on whether the rifle can be fired by a left-handed person?

Mr. LUTZ. The manner in which it is attached does not dictate whether it can be fired either left or right handed.

Mr. McDONALD. Well, with the scope on 139, could it be possibly classified as a left-handed scope?

Mr. LUTZ. Definitely not. There is no such thing as a left-handed scope.

Mr. McDONALD. While you have got the weapon in your hand, let me ask you this; in your examination of 139—and when I say you I also refer to the panel itself. As a group you examined all of the evidence; is that correct?

Mr. LUTZ. That is correct.

Mr. McDONALD. Did you examine the iron sight?

Mr. LUTZ. Yes, sir, I did.

Mr. McDONALD. And tell us, if you would, what you mean by iron sight.

Mr. LUTZ. The iron sights are the standard sights that are placed on the firearm at the time it is manufactured at the military arsenal. In this particular firearm we have a block of metal that is attached to the area immediately in front of the chamber area. It is

a fixed rear sight. There is a notch. A V-shaped notch in this piece of metal that acts as the rear sighting alinement device.

Mr. McDONALD. I am sorry.

Mr. LUTZ. This is the rear portion. The front sight is attached with a fixed front blade also. This particular arrangement then allows the sighting arrangement to be made through the notch in the rear sight, lining up the front sight in that notch, and having a fixed sight that cannot be adjusted for windage or elevation, zeroed in for one particular setting.

Mr. McDONALD. Would it be possible to attain the same accuracy with the iron sight on that rifle as it would with the scope, for an average marksman, at a distance of well, say less than 100 yards?

Mr. LUTZ. Yes, it would be very likely to be able to do that.

Mr. McDONALD. Mr. Lutz, in your examination of 139, did you test the trigger to determine whether the weapon has what is known as a hair trigger?

Mr. LUTZ. Yes, sir; I did.

Mr. McDONALD. And, first of all, would you tell us what is a hair trigger?

Mr. LUTZ. A hair trigger normally is defined as a trigger that can be released with a very light pressure being applied to that trigger. The figure that we, the panel, have arrived at is around 16 ounces, or 1 pound or less. It must fall within that category to become what I consider and we as the panel consider a hair trigger, a very light trigger, so that a light amount of pressure is applied, and then the sear is released and the firearm will fire with that light touch.

Mr. McDONALD. What is the result of your examination of 139 regarding hair trigger?

Mr. LUTZ. Our examination of the trigger pull of this firearm revealed it to have approximately 3 pounds for a trigger pull.

Mr. McDONALD. Would you classify that as a hair trigger?

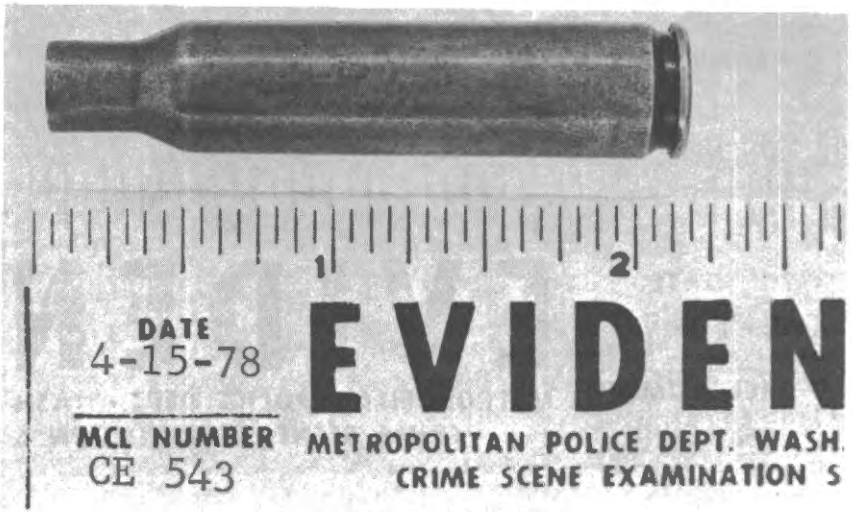
Mr. LUTZ. No, I would not.

Mr. McDONALD. Thank you. You can place the weapon down.

Next, Mr. Chairman, a series of questions will be directed to Mr. Champagne.

At this time I would request that the Chair request the clerk to present to the panel Warren Commission exhibits CE-543, 544, and 545, which correspond to JFK exhibits F-277, F-278, and F-279, and photographs provided for the record.

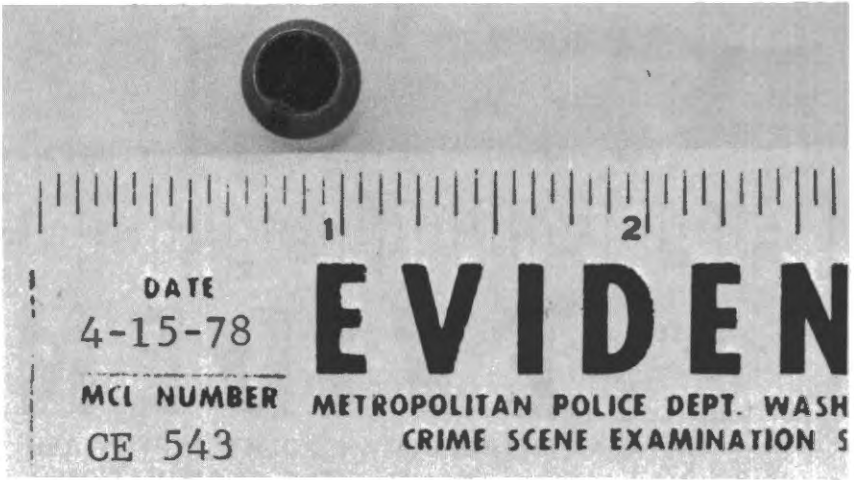
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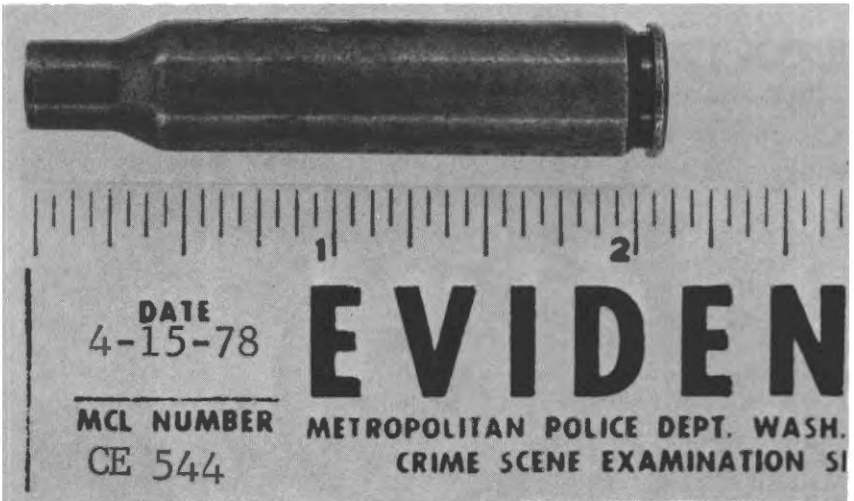
JFK ЕХНІВІТ F-277-A



JFK ЕХНІВІТ F-277-B

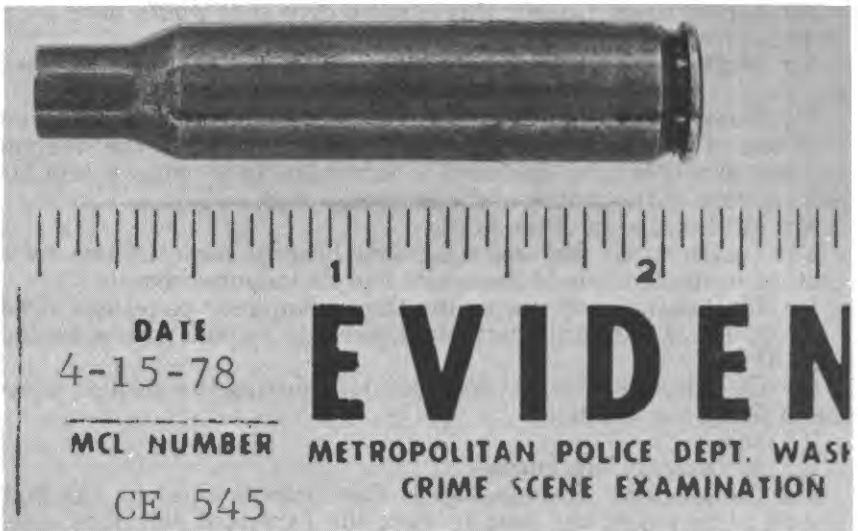


JFK Exhibit F-277-C



JFK Exhibit F-278





JFK EXHIBIT F-279

Mr. McDONALD. Mr. Champagne, have you had a chance to look at exhibits 543, 544 and 545? Have you seen them before?

Mr. CHAMPAGNE. Yes, sir; I have.

Mr. McDONALD. And where have you seen them?

Mr. CHAMPAGNE. At the Metropolitan Police Department firearms identification section.

Mr. McDONALD. And what are the cartridge cases that you are now looking at?

Mr. CHAMPAGNE. These are three 6.5 millimeter caliber Western Cartridge Co. cartridge cases.

Mr. McDONALD. And are those the cartridge cases found on the sixth floor of the Texas School Book Depository building?

Mr. CHAMPAGNE. Yes, sir.

Mr. McDONALD. Have you examined CE-543?

Mr. CHAMPAGNE. Yes, sir; I have.

Mr. McDONALD. Mr. Chairman, if we could now have JFK exhibit No. F-98. Mr. Champagne, have you seen that photograph before?

Mr. CHAMPAGNE. Yes, sir; I have.

Mr. McDONALD. Does the photograph accurately depict the condition of the exhibit that you have in front of you at the time of your examination?

Mr. CHAMPAGNE. If I may look at it.

Mr. McDONALD. Please do.

Mr. CHAMPAGNE. Yes, sir. This composite photograph depicts CE-543 and in particular the area of the mouth that has an indentation in it. This is shown primarily in the lower left-hand photograph. It is rather difficult to see but it is there. It can also be seen to a certain extent in the upper left-hand photograph in this area.

Mr. McDONALD. Mr. Champagne; as you have testified, this was one of the cartridges found on the sixth floor of the School Book Depository Building and the mouth has a dent. Could that dent have occurred during the loading process.

Mr. CHAMPAGNE. No, sir; this is not a dent that would have been in the cartridge case during the loading process.

Mr. McDONALD. Could it have occurred during the ejection process?

Mr. CHAMPAGNE. Yes; during the testing of the weapon we found that one of the tests that were fired and ejected from the weapon by the panelists also included a cartridge case with a similar deformation of the mouth of the cartridge case.

Mr. McDONALD. In other words.

Mr. CHAMPAGNE. We also examined Federal tests. Of two tests that we examined, one of them also had an indented mouth.

Mr. McDONALD. Are you saying then when your panel test fired CE-139, out of four fired cartridges, one was ejected with a dented mouth?

Mr. CHAMPAGNE. Yes, sir, that occurred during the ejection process in firing the weapon.

If I may.

Mr. McDONALD. Yes, please.

Mr. CHAMPAGNE. The ejection is that process whereby the bolt handle is moved to the rear to eject the expended cartridge case, ejecting the cartridge case out of the weapon.

Mr. McDONALD. Now, when you tested the rifle, the panel tested the rifle, of your panel members, who ejected the shell or cartridge case that came out with the dent?

Mr. CHAMPAGNE. Mr. Lutz.

Mr. McDONALD. Would Mr. Lutz please come forward and demonstrate to us how you ejected to cause a dent in the test cartridge case.

Mr. LUTZ. The particular amount of force that I used to extract and eject the cartridge case from the weapon was much in the manner that I would consider to be employed during an attempt to rapidly fire the firearm. The cartridge was fired with the bolt being closed and then with considerable speed and pressure being applied, opening it and pulling the bolt to the rear and holding it to my side, and in a manner very rapidly, kicking the cartridge back and ejecting the cartridge and causing it fall to the floor.

Mr. PREYER. Mr. Edgar.

Mr. EDGAR. Mr. Lutz, would you turn so we can see it.

Mr. LUTZ. In this manner, where I have grasped the bolt forward, the cartridge had been fired, moved away from the firing tube holding the bolt handle and then pulling it back with a violent move duplicating what I deemed to be a rapid sequence of firing, operating the handle to rapidly fire the firearm.

Mr. McDONALD. Thank you.

Mr. Champagne, we have before you on the easel JFK exhibit No. F-100. Does that accurately portray the four spent cartridge cases that your panel test fired?

Mr. CHAMPAGNE. Yes, sir, it does.

Mr. McDONALD. And does one of the four cartridge cases have a dent?

Mr. CHAMPAGNE. No. 2 has the dent in the mouth.

Mr. McDONALD. Could we place before the panel JFK cartridge cases No. F-280, please?

Are those the cartridge cases that the panel test fired?

Mr. CHAMPAGNE. Yes, sir.

Mr. McDONALD. How do you know, sir?

Mr. CHAMPAGNE. The container has our initials on it.

Mr. McDONALD. Mr. Champagne, in your examination of those cartridge cases, did you compare your panel test cartridge cases, JFK No. F-280 with CE-543?

Mr. CHAMPAGNE. Yes; we did.

Mr. McDONALD. As a result of your examinations, what conclusions did you come to, and if we could have JFK chart F-99 placed on the easel, if you would use that in explaining your answer.

Mr. CHAMPAGNE. To answer your question, we did come to a conclusion with respect to the tests that we had fired and exhibit CE-543. The conclusion we came to was that exhibit CE-543 was fired from the rifle.

Mr. McDONALD. And which rifle are you referring to?

Mr. CHAMPAGNE. Exhibit CE-139.

The conclusion that we came to was based on a number of factors. The tests were compared microscopically with CE-543 in a number of areas. One of those areas was in the firing pin impression. The firing pin impression is an indentation in the primer of the center-fire cartridge. It is caused by the impingement of the firing pin on the soft metal of the primer. Any individual identifying features that may be present on the firing pin are then impressed into the metal of the primer. These can be in the form of machining marks that are put on there during the time of manufacture or they can be in the form of irregularities that are put on the firing pin impression during its use during its lifetime.

Some of the marks that we found, and this is a photograph taken through a comparison microscope, shows exhibit CE-543 in the left-hand side of the field and panel test No. 1 in the right-hand side of the field. There's a dividing line through both of these. In the comparison microscope, we take two physically separated objects and bring them together optically. It is almost as if we cut the two in half physically and bring them together. We do this through the prismatic bridge system of the comparison microscope. So that we have two objects brought together microscopically side by side and adjacent to one another.

In the firing pin impression, we have a series of irregularities that show up and go from one side of the dividing line to the other indicating that the same firing pin caused the marks on both cartridge cases.

In the lower photograph, we have what are known as extractor marks. Each extractor in each firearm has its own individual peculiarities. When the cartridge case is extracted from the weapon and thrown out of it, the extractor will leave irregularities or individual identifying marks on the rim of the case. In the lower photomicrograph, we have CE-543 and panel test 3.

We have the same type of situation here where we have the dividing line down the center. We have a series of striations that have been put on the rim of the cartridge cases and you can see that there is a correspondence there among those striations.

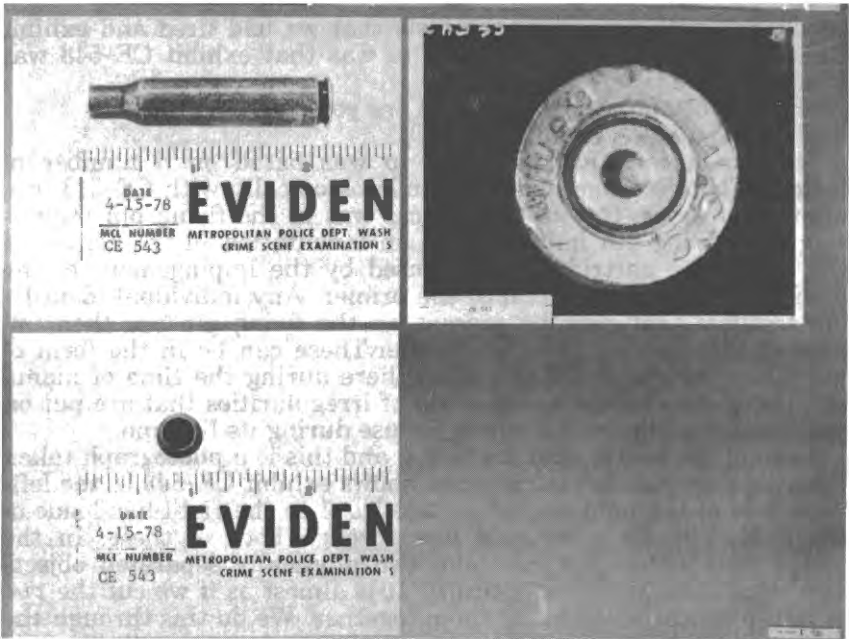
There were other areas that we examined as well as these two, breech face marks and some other marks that were not of a suitable nature for photographing. As a result of examination of all

these marks, we came to the conclusion that CE-543 was fired in the exhibit rifle.

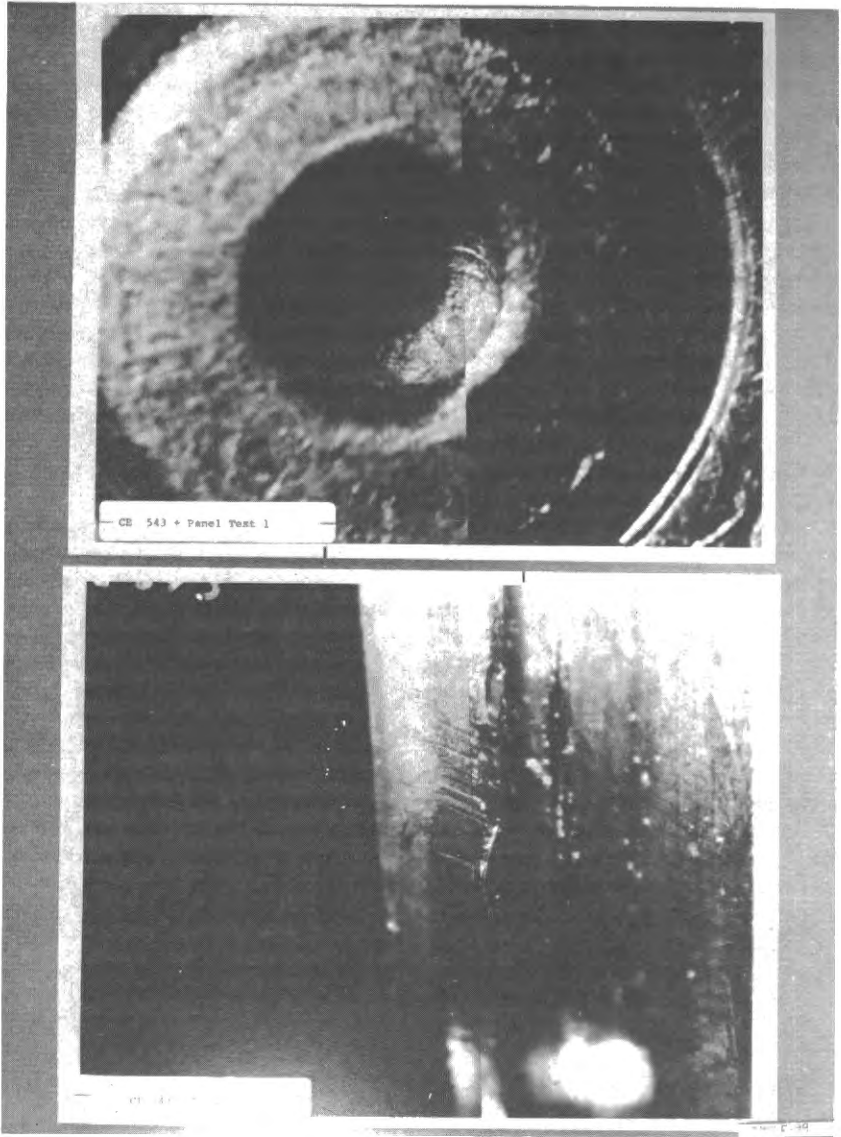
Mr. McDONALD. Thank you, Mr. Champagne. Mr. Chairman, I would like to move JFK exhibits F-99, F-98 and F-100 be received into the record at this time.

Chairman STOKES. Without objection they may be received in the record at this time.

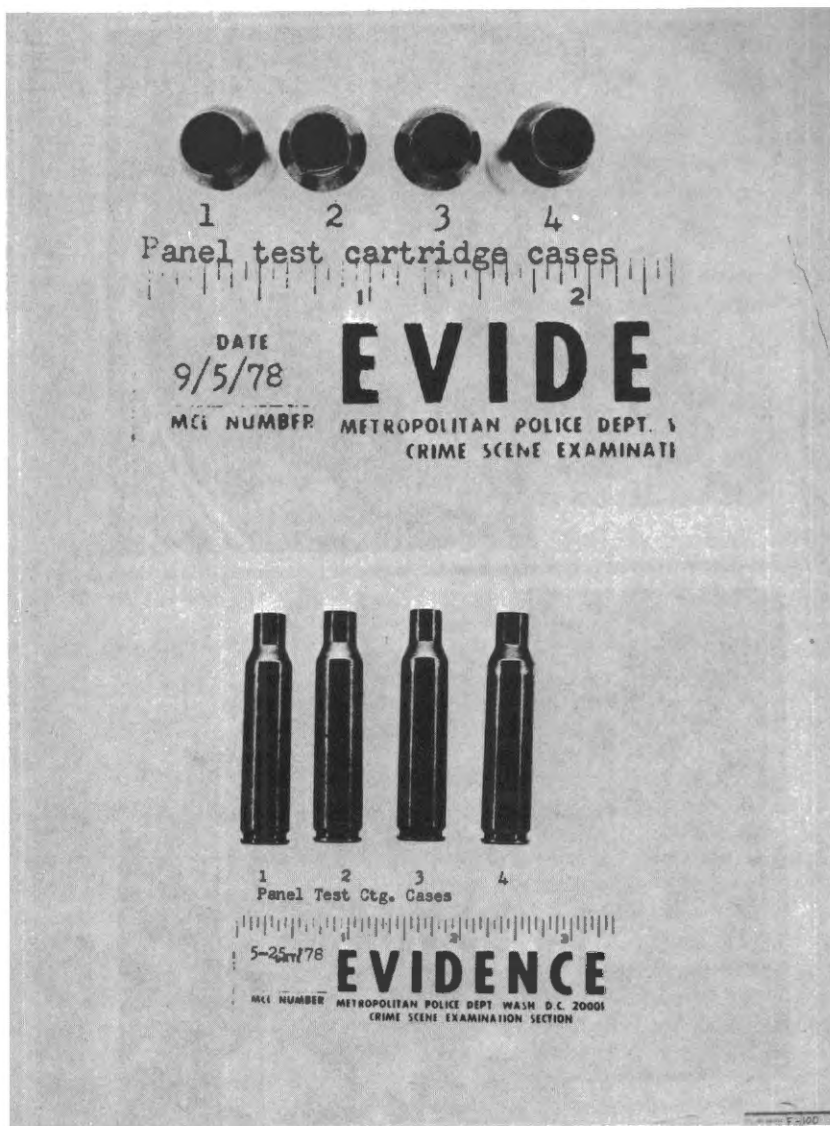
[JFK exhibits F-98, F-99, and F-100 were received into the record.]



JFK EXHIBIT F-98



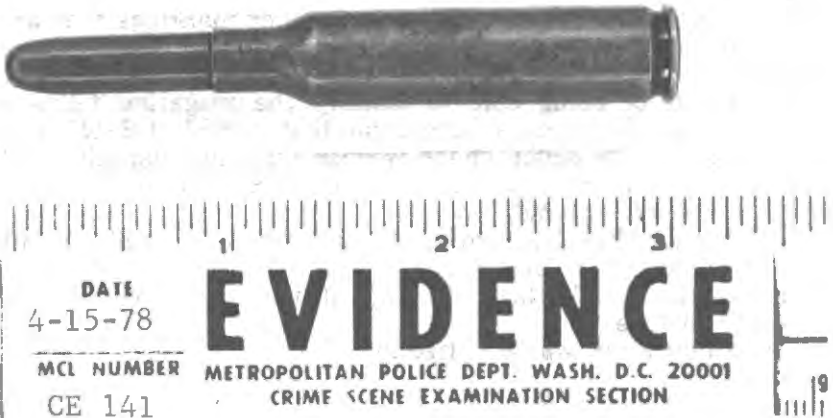
JFK ЕХНІВІТ F-99



JFK Exhibit F-100

Mr. McDONALD. And would the clerk present to the panel Warren Commission CE-141, which is the unfired cartridge found in Oswald's rifle on November 22, 1963. If the clerk would present that to the panel, which has been given JFK No. F-281, and also if the clerk would hand the panel its own test cartridge which has been given the number JFK F-333. And if we could have the chart F-101 placed up on the easel and ready to go.

[JFK exhibit F-281 was presented to the panel and a photograph made for the record.]



JFK EXHIBIT F-281

Mr. McDONALD. Mr. Champagne, you have had placed before you CE-141. Would you please examine what that is?

Mr. CHAMPAGNE. CE-141 is an unfired 6.5 millimeter cartridge.

Mr. McDONALD. Have you seen that cartridge before?

Mr. CHAMPAGNE. Yes, sir.

Mr. McDONALD. And you also have in front of you the unfired cartridge, your own panel test bullet?

Mr. CHAMPAGNE. Yes, sir; I have.

Mr. McDONALD. And you have seen that before?

Mr. CHAMPAGNE. Yes, sir.

Mr. McDONALD. Have you examined both of these items for magazine follower markings?

Mr. CHAMPAGNE. Yes, sir.

Mr. McDONALD. And would you please explain to the committee using exhibit F-101, which is on the easel, what the results of your findings are?

Mr. CHAMPAGNE. This is a composite photograph of CE-141. The top photograph depicts the unfired cartridge. The bottom photograph is an enlargement of a photomicrograph taken on the comparison microscope showing on the left-hand side CE-141 and a panel test cartridge that was not fired in the weapon but worked through the action. This shows the magazine follower marks that resulted in the movement of the unfired cartridge through the action of the weapon and also the magazine follower marks found

on the unfired cartridge that was reportedly removed from the chamber of the weapon.

Mr. McDONALD. Mr. Champagne, what are magazine follower marks?

Mr. CHAMPAGNE. Magazine follower marks are those marks that are placed on the sides of the case by the metal floor plate in the magazine of the weapon. This is placed on the last cartridge in the magazine. It would be the first cartridge placed in the magazine and the last cartridge to come out of the magazine.

Mr. McDONALD. Are these magazine follower marks unique to a particular rifle?

Mr. CHAMPAGNE. Yes, sir, just as any other markings that are placed on ammunition components by a weapon, these are also unique to a particular magazine follower.

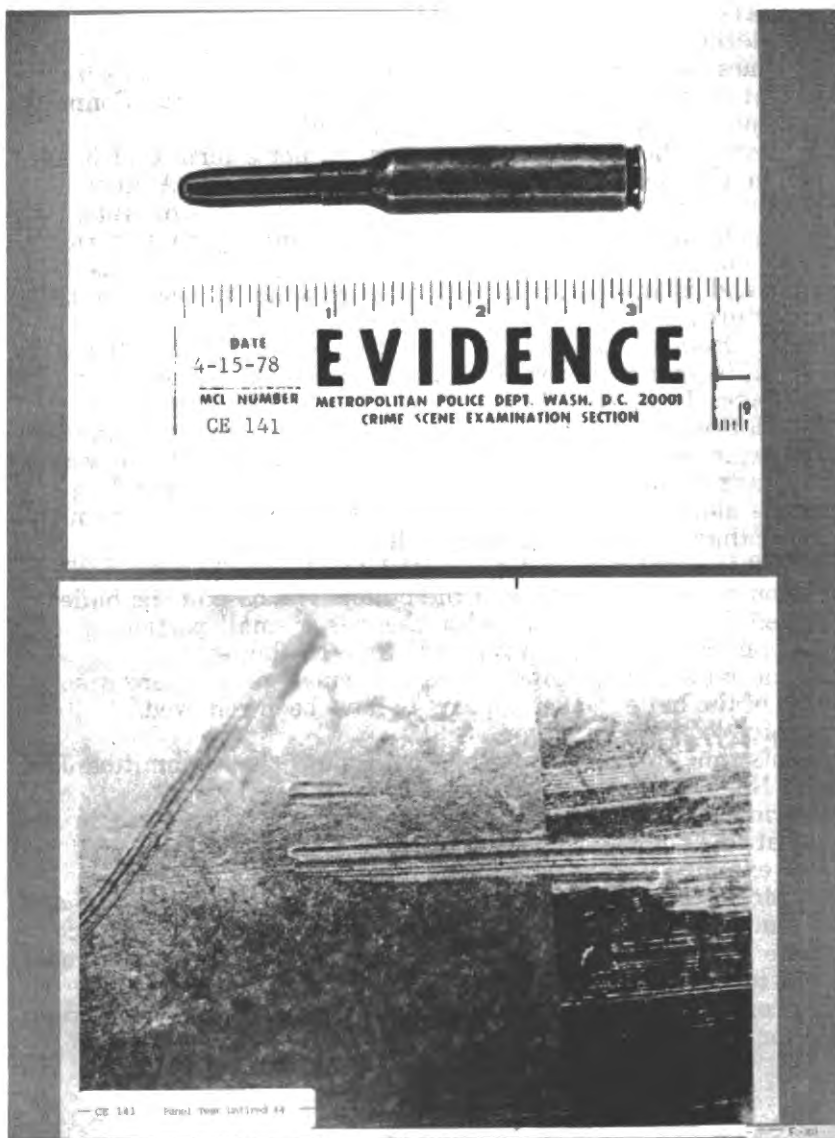
As a result of being able to identify the magazine follower marks, it was the panel's conclusion that exhibit CE-141 was worked through the action of the weapon from the magazine and not placed into the magazine by hand. I am sorry, into the chamber of the weapon by hand.

Mr. Chairman, I at this time would move that JFK exhibit F-101 be admitted into the record at this time.

Chairman STOKES. Without objection, it may be entered into the record at this time.

[JFK exhibit F-101 was admitted into the record.]





JFK EXHIBIT F-101

Mr. McDONALD. Thank you, Mr. Champagne.

The next series of questions will be directed to Mr. Bates and if the clerk would place before the panel CE-399, which has been referred here to day as the pristine bullet, JFK No. F-95, and if you would please place JFK F-102 on the easel.

Mr. McDONALD. Mr. Bates, have you seen Commission exhibit 399 before?

Mr. BATES. Yes, I have.

Mr. McDONALD. Have you had a chance to examine it?

Mr. BATES. Yes, I have.

Mr. McDONALD. Mr. Bates, it has been referred to today and at other times as the pristine bullet, the bullet that travelled through President Kennedy and ultimately lodged in Governor Connally. Would you explain to us what a pristine bullet is?

Mr. BATES. The term "pristine bullet" is not a term that is used by us in the forensic firearms identification field. A dictionary definition of pristine includes, one, the earliest period or state, two, uncorrupted, three, being fresh and clean. Thus in these terms, a pristine bullet would mean to us to be a bullet that has been unfired and is in the same condition as when it was originally manufactured.

Mr. McDONALD. So as a firearms expert, would CE-399 that is on the easel, to your right, would that be considered a pristine bullet?

Mr. BATES. No, it would not.

Mr. McDONALD. And would you please go to the easel and just demonstrate some of the deficiencies in the bullet, if you would.

Mr. BATES. First and most importantly, CE-399 has rifling impressions along the outside surface of the bullet. This is from the barrel of the firearm through which it is passed.

CE-399 is slightly curved along its lateral axis. There is a slight extrusion of lead at the base of the bullet. The base of the bullet is deformed. It is not circular. Also, there is a small portion of lead which appears to have been removed from the bullet.

On the nose of the bullet, there is a small area where a small portion of the bullet jacket appears to have been removed.

Mr. McDONALD. Thank you.

At this time, Mr. Chairman, I would move that committee JFK exhibit No. F-102 be received into evidence.

Chairman STOKES. Without objection, it may be received in the record at this point.

[JFK exhibit F-102 was entered previously.]

Mr. McDONALD. Mr. Bates, the FBI test fired CE-139 in 1963 and fired a number of rounds of ammunition. Have you had a chance to examine CE-572, K-1-A and K-1-B, which if the clerk would present to the panel.

[JFK exhibit F-282 was presented to the panel and a photograph made for the record.]



JFK EXHIBIT F-282

Mr. McDONALD. Mr. Bates, have you seen those exhibits before?

Mr. BATES. Yes, I have.

Mr. McDONALD. And are those the FBI test fire bullets from 139?

Mr. BATES. Yes, they are.

Mr. McDONALD. Did you and your panel conduct an examination of those bullets?

Mr. BATES. We did.

Mr. McDONALD. Would you please tell us what examination you did, and you can use committee exhibit F-103, which is on the easel, to assist you in your explanation.

Mr. BATES. First of all, the panel conducted a physical examination of each of the bullets and its physical condition. Then the members of the panel, including myself, conducted a comparative microscopic examination of both of the bullets in exhibit 572. They were microscopically compared against each other.

Mr. McDONALD. Did you compare the FBI test bullets with your own test bullets that you recently fired out of 139?

Mr. BATES. Yes, we also made a microscopic comparison of that.

Mr. McDONALD. And what did the comparison show?

Mr. BATES. The results of this examination indicated that we could not determine whether the FBI test bullets were, in fact, fired from the rifle, CE-139.

Mr. McDONALD. And would you please explain your answer?

Mr. BATES. Based upon the microscopic comparison, there were differences in the individual identifying characteristics found within the land and groove impressions on the FBI test bullets and on the panel test bullets.

Mr. McDONALD. Just so we are clear, when you are speaking of bullets, you are referring to the tip of what would be known as a cartridge, the complete projectile would be called the cartridge; correct?

Mr. BATES. No; the loaded projectile in the cartridge case is the cartridge. The bullet is the portion, or tip that is released upon firing of the cartridge.

Mr. McDONALD. And you are saying in your test fires, your comparison with the FBI test fires, you could not say that those bullets came from CE-139?

Mr. BATES. That is correct.

Mr. McDONALD. Would you have expected that result considering the number of times that CE-139 has been fired over the years?

Mr. BATES. Yes, we would have.

Mr. McDONALD. Would you explain?

Mr. BATES. Our inability to identify our panel tests with each other and the failure to identify the panel tests with the FBI tests is believed by us to be due by one or a combination of several factors. No. 1, repeated test firing of CE-139 over the years causing extensive changes in the individual rifling characteristics within the barrel of the weapon. No. 2, natural variations caused by the high velocity of the 6.5 bullet resulting in extreme heat and friction during the passage of the bullet through the bore of the weapon.

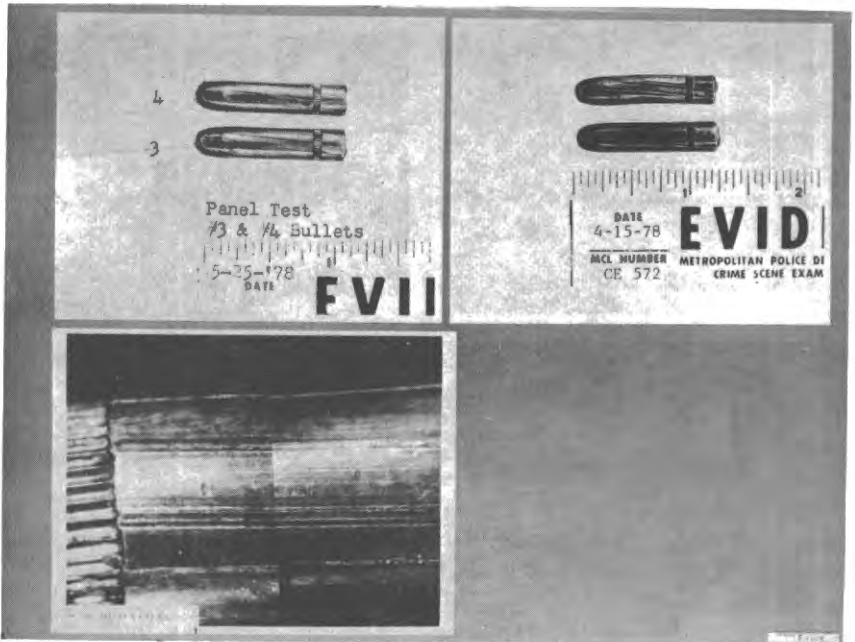
And No. 3, deterioration of the rifling surfaces over an extended period of time due to the absence of proper cleaning, maintenance and/or protective lubrication.

Mr. McDONALD. So what you are saying though, you can't compare the bullets but, of course, we have had previous testimony regarding the cartridge cases with firing pin impressions and the like and because of the deterioration in the barrel, it has made it impossible to match up your test fires with the FBI test fires, is that correct?

Mr. BATES. That is correct, yes.

Mr. Chairman, may we have JFK exhibit F-103 received into the record?

Chairman STOKES. Without objection it may be received.



JFK EXHIBIT F-103

Mr. McDONALD. Mr. Bates, another area of inquiry, was the FBI's comparison of the pristine bullet found on Governor Connally's stretcher with the FBI test-fired bullet, CE-572? Did you conduct an examination regarding this area?

Mr. BATES. Yes, I did.

Mr. McDONALD. Will you please tell us what you did and what the findings are of the panel?

Mr. BATES. The panel, including myself, conducted comparative microscopic examinations of CE-399 against both of the FBI test bullets, CE-572.

Mr. McDONALD. What findings did you make?

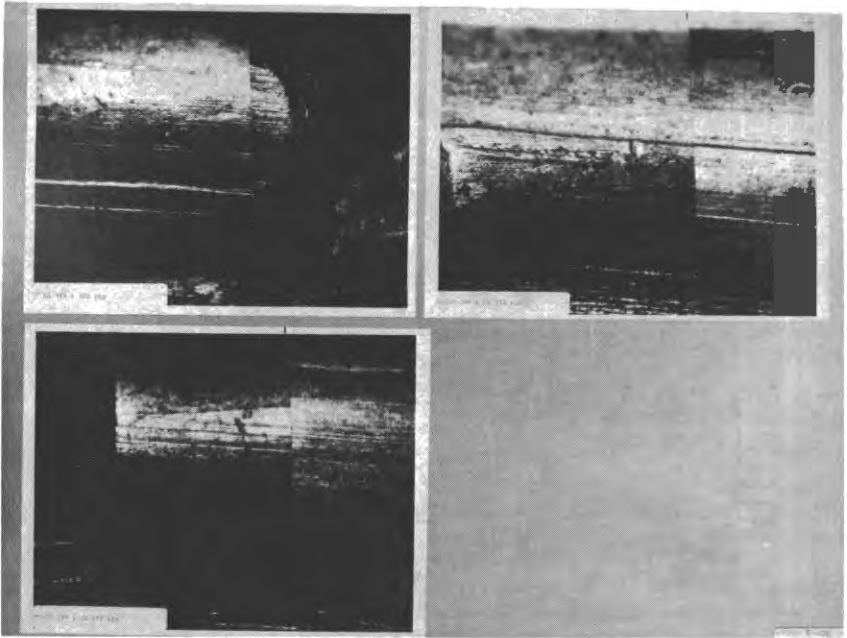
Mr. BATES. As a result of our comparative microscopic examinations, it is our opinion that the bullet, CE-399, was fired through the same firearm barrel that fired the FBI tests, CE-572.

Mr. McDONALD. Thank you.

Mr. Chairman, if committee exhibit F-104 would be received into the record at this time, I would so move.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[Committee exhibit F-104 was entered into the record.]



JFK EXHIBIT F-104

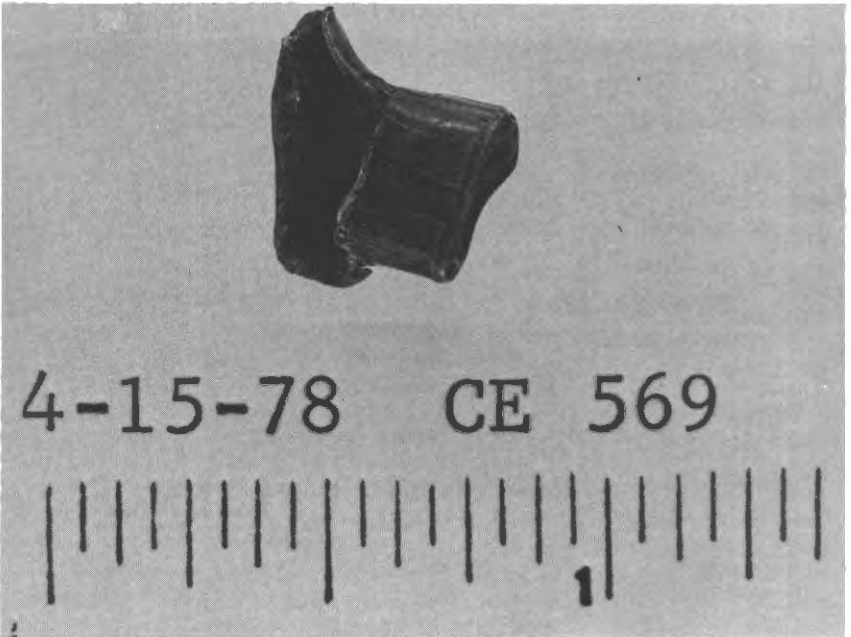
Mr. McDONALD. The next series of questions will be directed to Mr. Newquist. If the Clerk would present Mr. Newquist and the panel with Commission exhibits 567, which is the fragment found on the right front seat of the Presidential limousine, CE-569, the bullet fragment found on the right front floor, CE-840 found under the left jump seat occupied by Mr. Connally, CE-842, a bullet fragment found in Governor Connally's arm and CE-843, a bullet fragment recovered from President Kennedy's brain.

[JFK exhibits F-284 through F-288 were presented to the panel and photographs made for the record.]

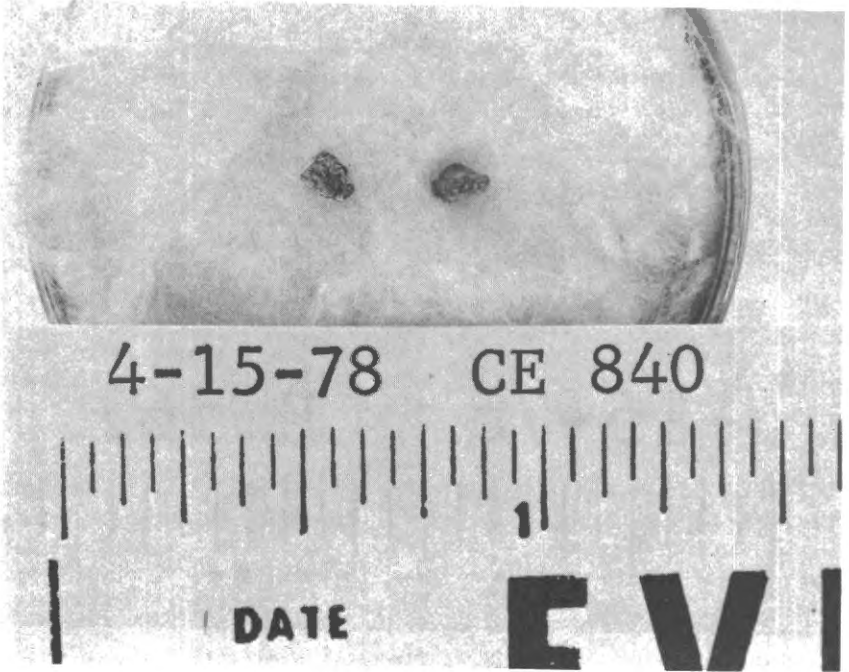
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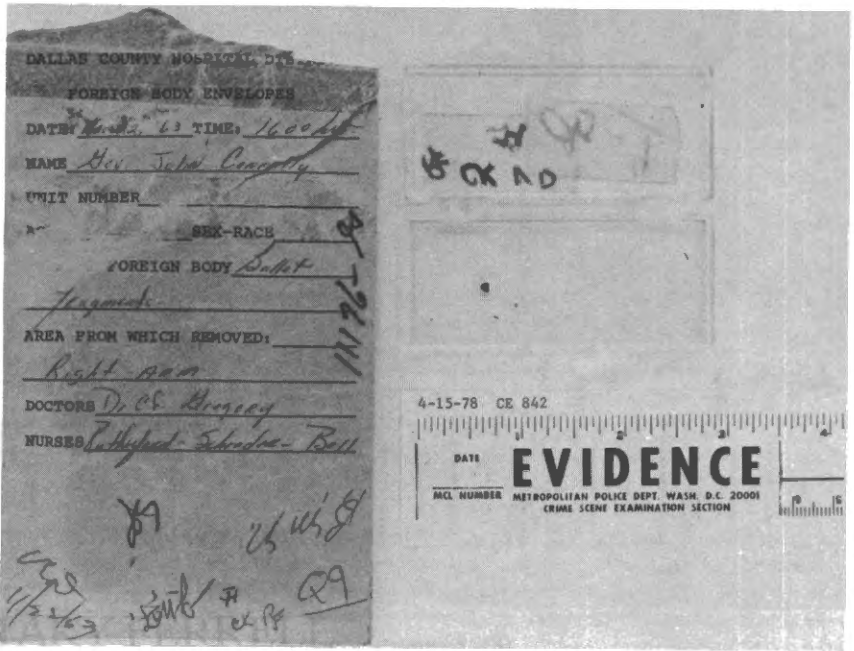
JFK EXHIBIT F-284



JFK EXHIBIT F-285

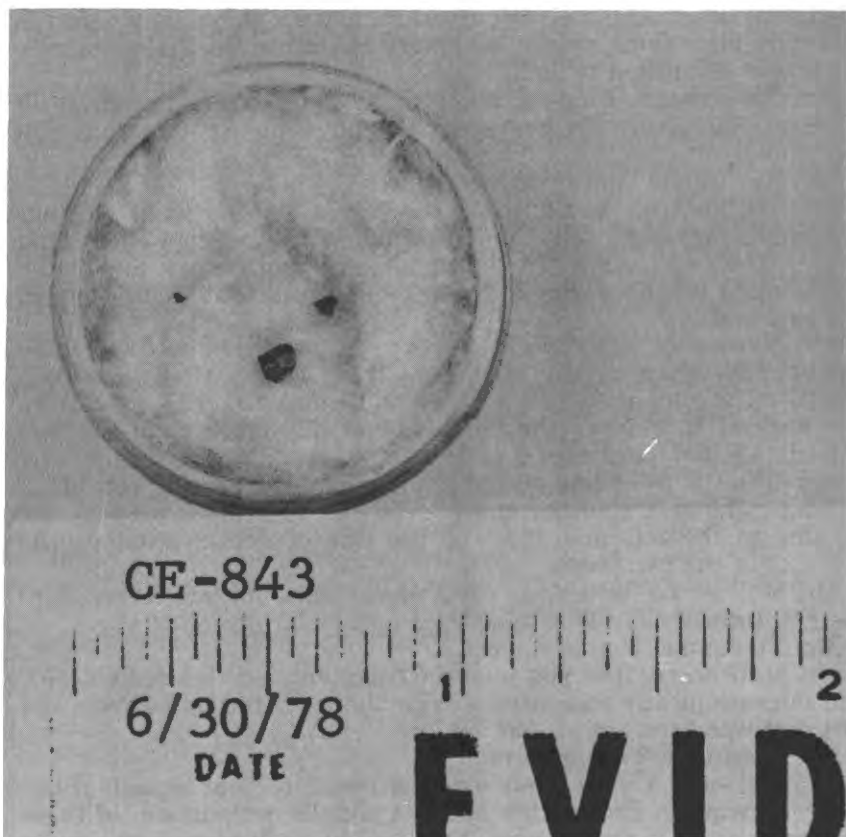


JFK EXHIBIT F-286



JFK EXHIBIT F-287





JFK EXHIBIT F-288

Mr. McDONALD. Mr. Newquist, have you seen those exhibits before and had a chance to look at them?

Mr. NEWQUIST. I have.

Mr. McDONALD. Have you examined them before?

Mr. NEWQUIST. I have.

Mr. McDONALD. And are those the same exhibits that were in the company of the National Archives people when you examined them and are they in the same condition now?

Mr. NEWQUIST. They are.

Mr. McDONALD. And if the clerk would put up committee exhibit F-105.

Mr. Newquist, have you examined the bullet fragments I have previously identified?

Mr. NEWQUIST. I have.

Mr. McDONALD. Would you please use committee exhibit F-105, and if you would approach the easel, explain to the committee your examination, and the results of your examination.

Mr. NEWQUIST. The examination that was conducted on these exhibits by myself and the panel was first that a work sheet was

made out describing the various exhibits, their shape, any deformities, any identifying marks that were contained on the containers they were submitted to us in.

Mr. McDONALD. First of all, Mr. Newquist, does the chart in front of you accurately represent the physical evidence that you examined?

Mr. NEWQUIST. That is correct, it does.

Mr. McDONALD. Would you please explain to us what analysis you conducted regarding CE-567 which is in the upper left-hand corner, the two exhibits in the upper left-hand corner, and if the clerk would put up JFK exhibit F-106, I think that would help in the explanation.

Mr. NEWQUIST. After work sheets had been filled out describing the exhibits, their various markings, their weight, they were then placed on a comparison microscope and compared with tests from the Federal to observe the similarity or dissimilarity of the two objects. CE-567 comparison is in the lower enlarged photomicrograph. The CE-567 being on the left side and the Federal test being on the right side showing the identifiable individual area in the middle; to the left and right of the line of demarcation or the splitting of the two photographs.

Mr. McDONALD. When you say Federal tests, you are referring to the FBI tests of CE-139 in 1963?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. And you took the fragment, is it labeled CE-567, and microscopically compared it with the test-fired bullet from the FBI that was fired out of 139?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. And what was the result of your examination?

Mr. NEWQUIST. From mine and the panel's comparison, of these two exhibits, it is our opinion, they had been fired from the same firearm.

Mr. McDONALD. In other words, CE-567, which was the bullet fragment found on the front seat of the Presidential limousine, it is your conclusion through your analysis that it was fired from CE-139, which is before us this morning?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. What did you do regarding CE-569?

Mr. NEWQUIST. The same being true for CE-569, it was placed on a microscope and compared with the FBI test bullets fired from the Oswald rifle to observe the similarity or dissimilarity, the result or a photographic representation of the identification is in the upper photograph. CE-569 on the left side of the line of demarcation, the FBI test, CE-572 is on the right side showing the concurrence of the individual characteristics as seen on the comparison microscope.

Mr. McDONALD. And the conclusion is that they were both fired from the same weapon?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. Could you move your microphone just a little bit higher? We are having difficulty hearing you.

In effect, what we are doing, we are taking the actual evidence that the FBI used, the test-fired bullets, the fragments found in the

Presidential limousine, and you are taking those and independently reevaluating them again in 1978; is that correct?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. And you are reaching the same conclusion that the FBI reached 15 years ago?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. Would you please explain what the panel did regarding CE-840?

Mr. NEWQUIST. The lead fragments in CE-840 were weighed to get the work sheet prepared, describing them and noting any identifying initials placed on the exhibit prior to being submitted to us. That is all the further, or no other examination was conducted on this exhibit.

Mr. McDONALD. And that would be the same for CE-842 and CE-843?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. Mr. Newquist, if you would, using the upper portion of 106, would you explain to us what lands and grooves are.

Mr. NEWQUIST. Lands and grooves are commonly referred to as rifling, or is the rifling of the inside bore of the firearm. After a barrel blank is drilled for the approximate bore diameter, then grooves are cut into it. The lands are the raised portions and the grooves are the lower portions within the bore. At the same time the cutting tool is passed through the bore of the barrel, it is given rotation, either to the left or to the right, depending upon the manufacturing specifications prior to manufacture. When a bullet is fired down the rifle barrel, it takes on the impressions of the land and grooves, and rotation of the direction of twist to add stability to it in flight.

They are imparted to the bullet and referred to as land impressions and groove impressions because they are a negative of the barrel itself.

Mr. McDONALD. Thank you. If we would now have JFK F-107 placed on the easel, and if the clerk would show Mr. Newquist Commission exhibit 573 identified here as JFK F-289. CE-573 is what is known as the Walker bullet. The allegation being made that Lee Harvey Oswald attempted to assassinate General Edwin Walker on November 10, 1963. CE-573 was the bullet found embedded in the wall of his home.

[Warren Commission exhibit 573 corresponds with JFK exhibit F-289, which is the physical evidence, represented by JFK F-107 that will subsequently be introduced into the record.]

Mr. McDONALD. Mr. Newquist, have you seen CE-573 before?

Mr. NEWQUIST. I have.

Mr. McDONALD. You have just looked at it again. Is it the same exhibit on which you conducted an examination?

Mr. NEWQUIST. It is.

Mr. McDONALD. Would you please tell us what examination you did perform on CE-573.

Mr. NEWQUIST. A work sheet was prepared by myself and the panel members on the description of the damaged bullet, knowing damage, knowing the weight, knowing the number of lands and grooves, direction of twist, also identifying markings placed on containers that were submitted to the panel in.

CE-573 was then placed on a comparison microscope and compared with the test fire bullets, CE-572 from the Oswald firearm.

Mr. McDONALD. If we could put up JFK exhibit F-103.

Mr. Newquist, did you find similar class characteristics, between the Walker bullet, CE-573, and the panel test bullets that you have before you?

Mr. NEWQUIST. Yes, class characteristics of CE-573 and the class characteristics of the bullets, CE-572, the Federal test from the Oswald firearm and also the panel test fired from the Oswald firearm were consistent in number, width, and direction of twist.

Mr. McDONALD. Could your panel reach a conclusion as to the rifle of origin for CE-573 using the evidence available to you?

Mr. NEWQUIST. Would you repeat the question?

Mr. McDONALD. Were you able to reach a conclusion as to what rifle fired CE-573, the Walker bullet?

Mr. NEWQUIST. No, we were not, due to the distortion of CE-573, and lacking a significant correspondence of individual characteristics with the test, no conclusion could be reached. However, no significant difference was observed from CE-573 to CE-572, no gross difference was noted to indicate that it had not been fired from it.

Mr. McDONALD. But what you are saying is, through distortion, because of impact, the peculiar identifying marks were not able to be found by your panel on CE-573?

Mr. NEWQUIST. That is correct.

Mr. McDONALD. And was this the conclusion that the FBI reached in 1963?

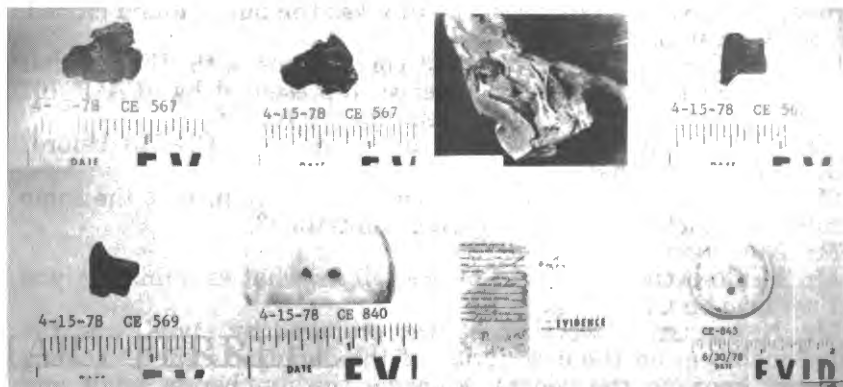
Mr. NEWQUIST. That is correct.

Mr. McDONALD. Thank you very much.

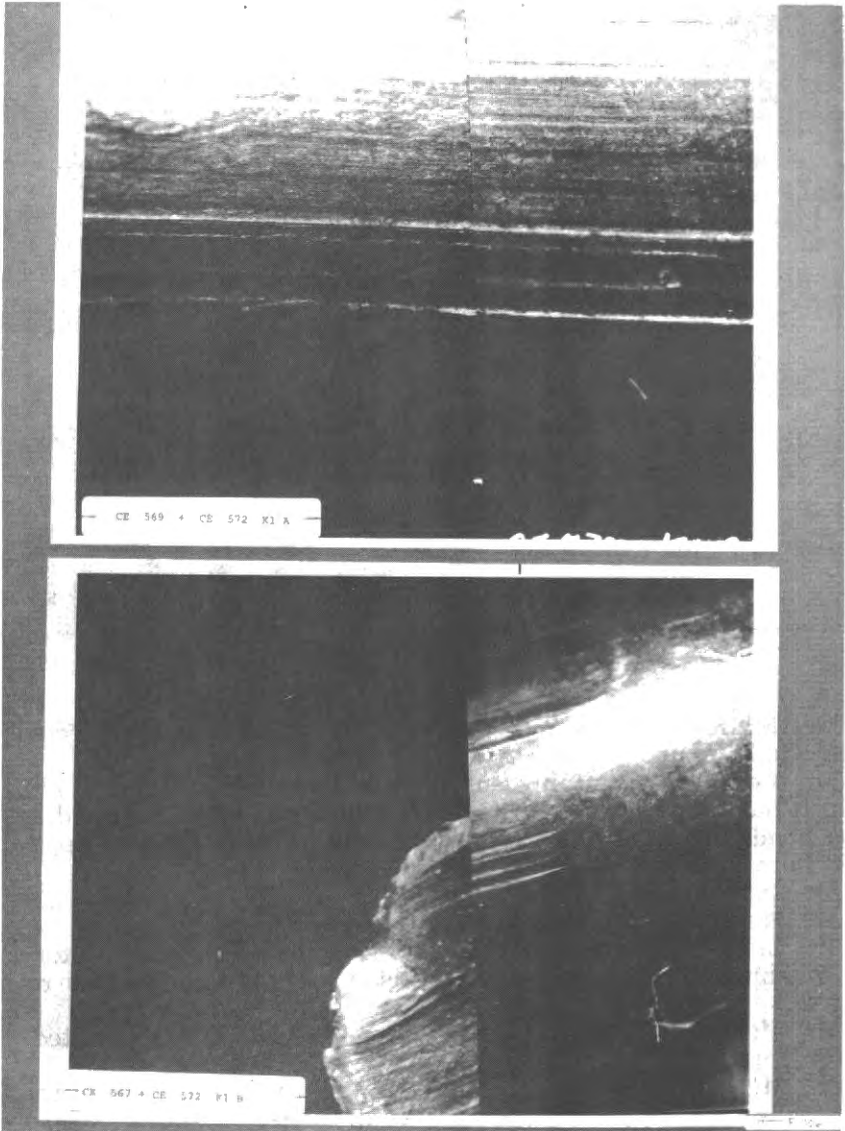
At this time, Mr. Chairman, I would move that committee exhibits F-105, F-106, and F-107 be received into the record at this time.

Chairman STOKES. Without objection, they may be entered into the record at this point.

[Committee exhibits F-105, F-106, and F-107 were received into the record.]



JFK EXHIBIT F-105



JFK Ехнівіт F-106



JFK EXHIBIT F-107

Mr. McDONALD. The next series of questions will be directed again to Mr. Lutz.

Mr. Conzelman will present to you Commission exhibit 143, which has been give JFK No. F-290, which has been identified as the handgun used by Lee Harvey Oswald to shoot Officer Tippit. Mr. Lutz, have you seen that weapon before?

Mr. LUTZ. Yes, sir, I have.

Mr. McDONALD. And where have you seen it?

Mr. LUTZ. I observed this at the Metropolitan Police Laboratory in Washington, D.C., where I conducted various tests on this revolver.

Mr. McDONALD. And is that the same weapon that you tested?

Mr. LUTZ. Yes, it is.

Mr. McDONALD. When you tested it, was a representative of the National Archives present with you at all times?

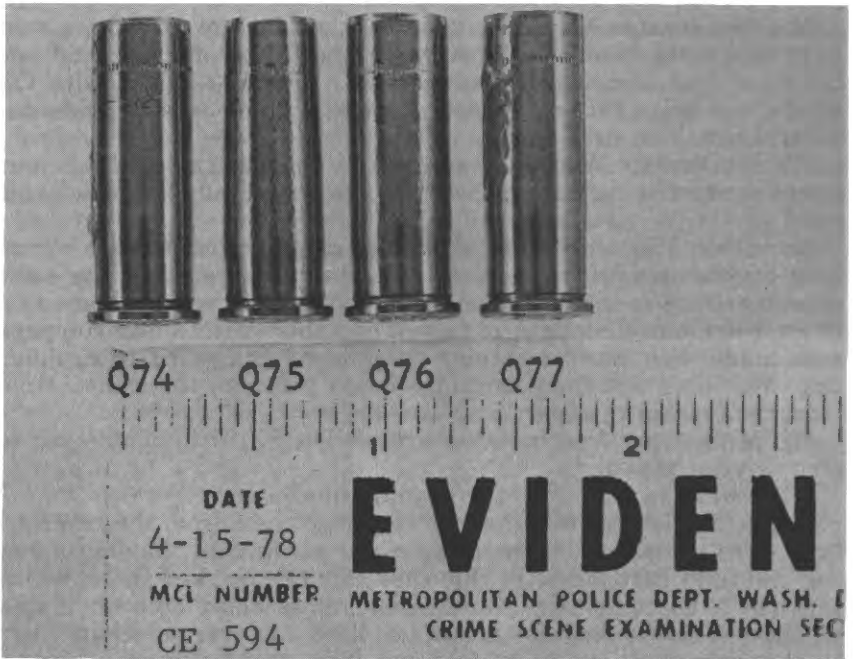
Mr. LUTZ. Yes, he was.

Mr. McDONALD. I take it that is the same when you tested CE-139?

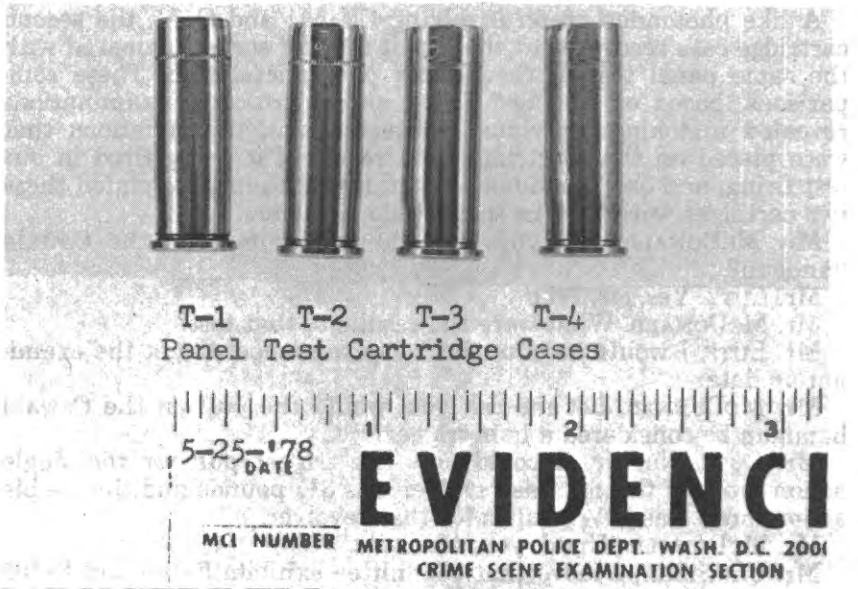
Mr. LUTZ. Yes, sir.

Mr. McDONALD. If we could also present to the panel the cartridge cases from the Oswald handgun, CE-594, Q-74, 5, 6, and 7, identified as JFK F-292, and at the same time the test cartridge cases which have a JFK exhibit number of F-293.

[JFK exhibits F-292 and F-293 were presented to the panel and photographs made for the record.]



JFK EXHIBIT F-292



JFK EXHIBIT F-293

Mr. McDONALD. Mr. Lutz, you have in front of you the actual cartridge cases found at the scene of the Tippit murder, and you have the four cartridge cases that your panel test fired with Oswald's handgun. Do you recognize each of those sets of evidence?

Mr. LUTZ. Yes, sir, I do.

Mr. McDONALD. Would you please tell us what examination your panel conducted regarding the cartridge cases and Oswald's handgun?

Mr. LUTZ. The four fired .38 special cartridge cases were examined for the overall appearance, the manufacturer, and the basic characteristics of the cartridge cases. Worksheets were prepared on them, the identifying data recorded, and then microscopic comparisons made with these cartridge cases being compared in conjunction with four test-fired cartridge cases that we, the panel, fired from the Oswald revolver.

Mr. McDONALD. You may use exhibit No. F-109 to enable you to give us your answer.

What was the result of your examination?

Mr. LUTZ. Having test fired the cartridge cases from the revolver, they were compared on the comparison microscope, having one of the test-fired cartridges, in this case CE-594, marked Q-77, which was one of the four being Remington Peters manufacturer, placed on the left stage, and one of our test-fired revolver cartridge cases on the right side, our panel test one. This photomicrograph shows the primer area of the particular cartridge cases. We are looking at the enlarged portion of it with the striations caused by the breech face and the indentation on the primer.

A like photomicrograph involving CE-594 and Q-74, the second cartridge case recovered at the Tippit murder scene, compared with the same panel test in the bottom photomicrograph. These comparisons, based on our test firing and microscopic examinations revealed matching individual characteristics, the striations that were placed on that cartridge as a result of it being fired in our test firing, and on the evidence cartridges, and in our opinion these two cartridges were fired in the Oswald revolver.

Mr. McDONALD. Did you test the trigger pull on the Oswald handgun?

Mr. LUTZ. Yes, sir, I did.

Mr. McDONALD. What were the results of that test?

Mr. LUTZ. I would have to check my worksheet to get the examination data.

Mr. McDONALD. Let me ask you, would the pull on the Oswald handgun be considered a hair trigger?

Mr. LUTZ. No, sir, it could not. The trigger pull for the single action mode of fire for this revolver was 3½ pounds and the double action mode was 10¼ pounds for that revolver.

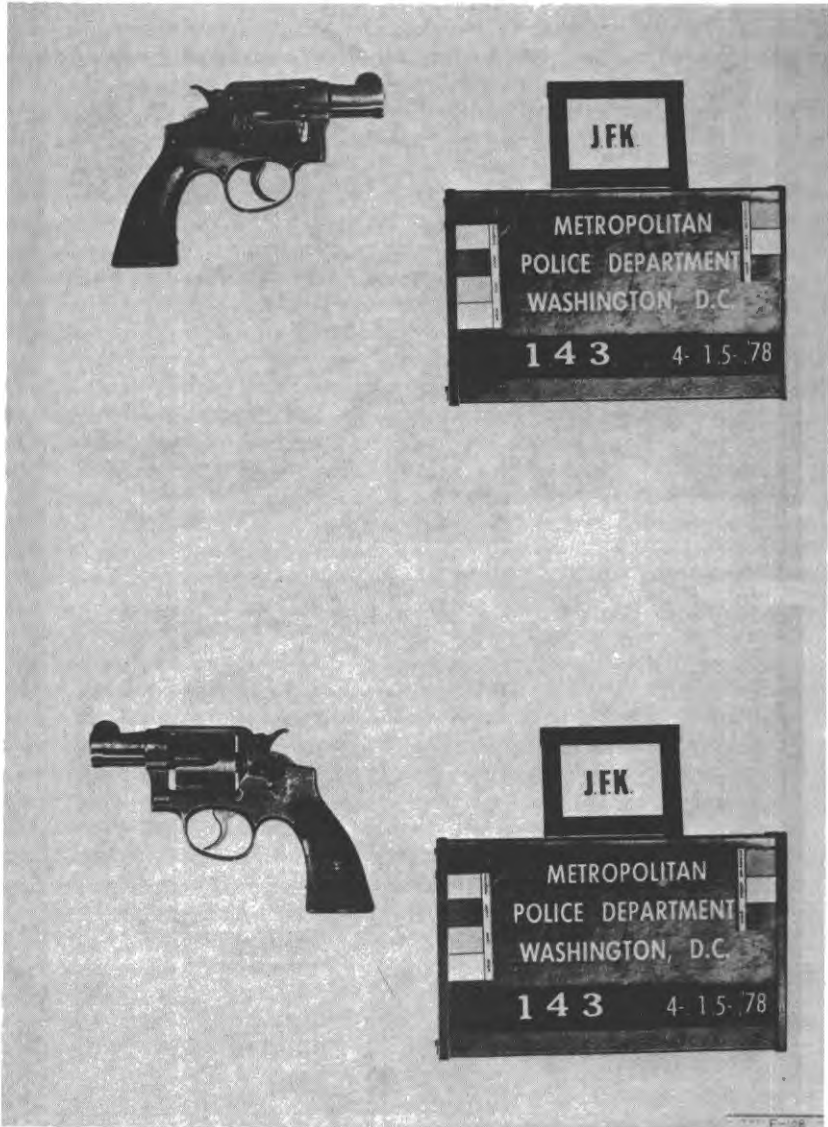
Mr. McDONALD. Thank you, Mr. Lutz.

Mr. Chairman, I move that committee exhibits F-108 and F-109 be received into the record at this time.

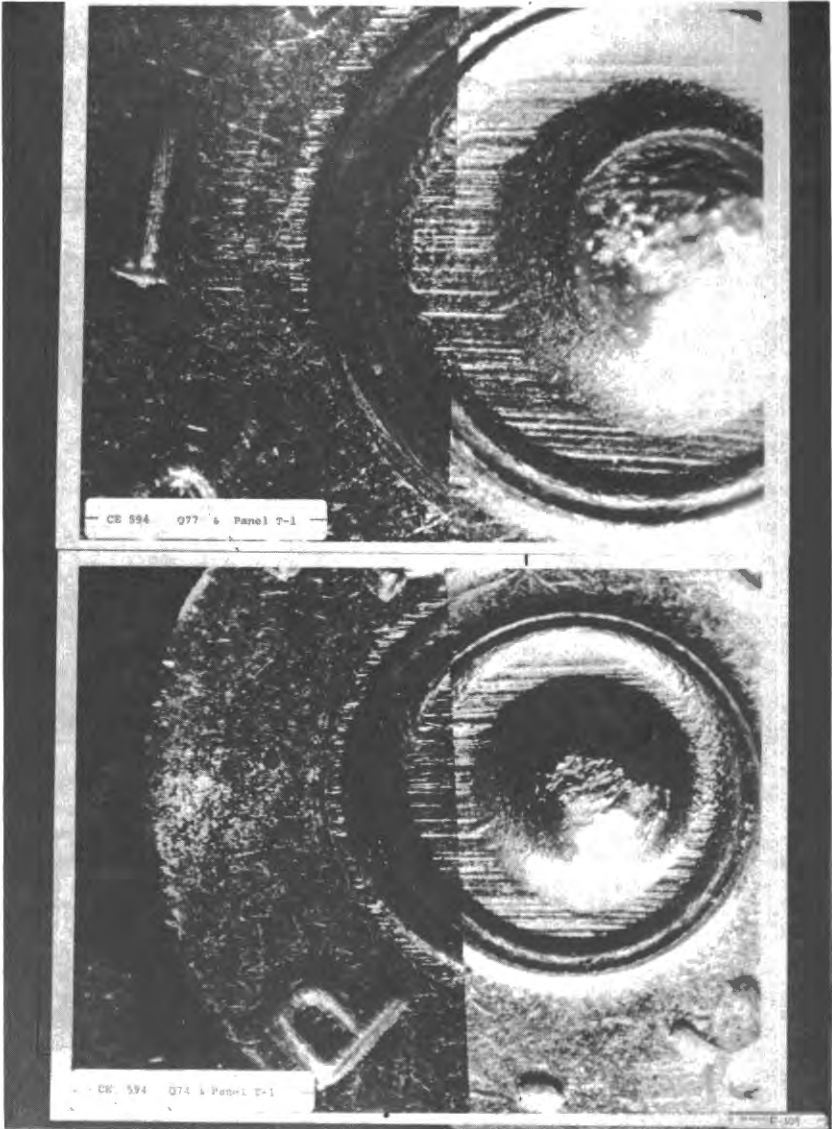
Chairman STOKES. Without objection, they may be received.

[JFK committee exhibits F-108 and F-109 were received into the record.]





JFK EXHIBIT F-108



JFK EXHIBIT F-109

Mr. McDONALD. The next and last series of questions will be directed to Mr. Champagne.

Mr. Conzelman, would you please hand Mr. Champagne the committee exhibit which has been marked F-110, the handgun allegedly used by Jack Ruby in the shooting of Lee Harvey Oswald. Mr. Champagne, have you seen that weapon before?

Mr. CHAMPAGNE. Yes, sir, I have.

Mr. McDONALD. And where have you seen it?

Mr. CHAMPAGNE. At the Metropolitan Police Department Firearms Section.

Mr. McDONALD. What kind of weapon is it?

Mr. CHAMPAGNE. This is a .38 special caliber Colt Cobra revolver. It bears serial No. 2744-LW. It is a 2-inch barrel, lightweight revolver with a 6-shot cylinder.

Mr. McDONALD. Is there anything out of the ordinary about that handgun?

Mr. CHAMPAGNE. There is nothing out of the ordinary about the weapon other than the fact that it does have a hammer shroud on it.

Mr. McDONALD. Would you please explain what you mean by a hammer shroud?

Mr. CHAMPAGNE. A hammer shroud is an attachment that covers most of the hammer of the weapon.

Mr. McDONALD. What is it used for?

Mr. CHAMPAGNE. On a lightweight short-barreled weapon many people carry it in their pocket. A hammer shroud is designed to prevent snagging of the hammer on the clothing when the weapon is removed from the pocket.

Mr. McDONALD. Is that shroud put on at the factory or is it put on at a gun shop, do you know?

Mr. CHAMPAGNE. There was no way of determining whether it was put on at the factory or at some later date.

Mr. McDONALD. And, Mr. Champagne, did you test the trigger strength, the trigger pull of that handgun?

Mr. CHAMPAGNE. Yes, sir.

Mr. McDONALD. And would you please tell us the results of that test?

Mr. CHAMPAGNE. The amount of pressure required to pull the trigger single action is approximately 5 pounds; double action is approximately 10½ pounds.

Mr. McDONALD. And would you consider that to be a hair trigger?

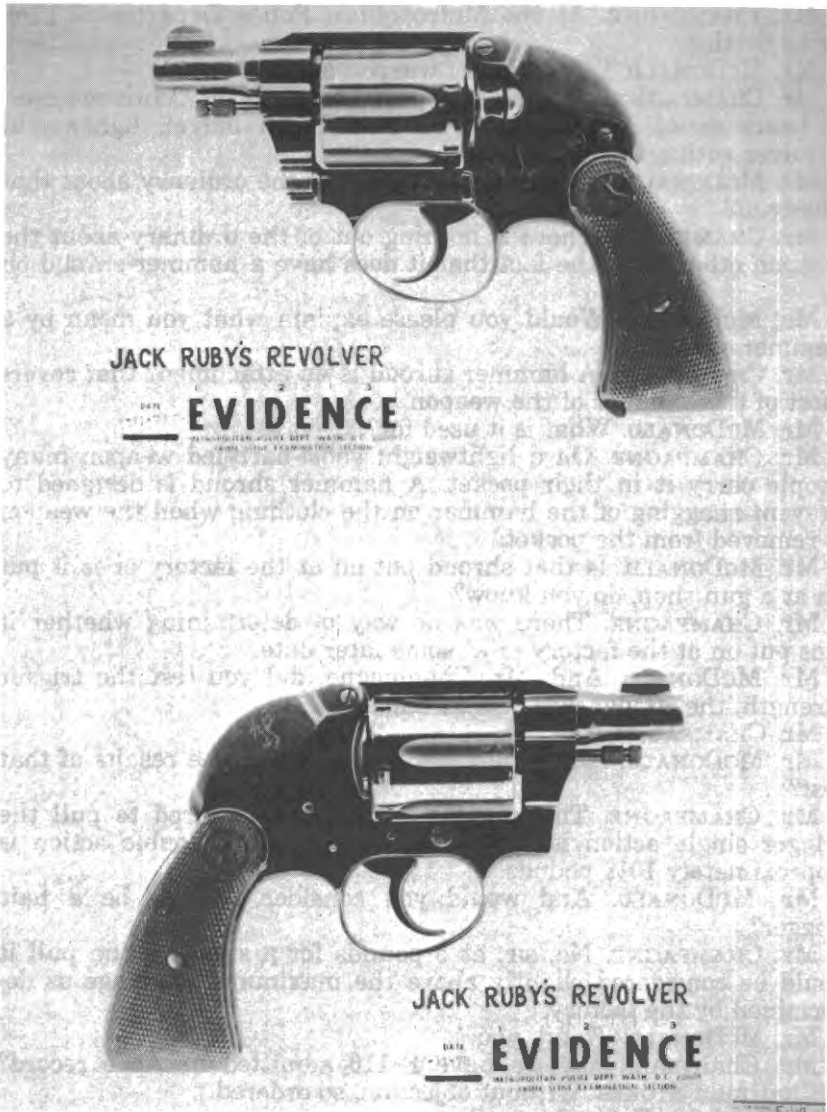
Mr. CHAMPAGNE. No, sir, at 5 pounds for a single action pull it could be considered slightly above the maximum poundage as determined by the factory.

Mr. McDONALD. Thank you.

Mr. Chairman, may we have F-110 admitted into the record?

Chairman STOKES. Without objection, so ordered.

[JFK exhibit F-110 follows:]



JFK EXHIBIT F-110

Mr. McDONALD. Mr. Lutz, I failed to ask you one question. What specific kind of handgun is that, the Oswald handgun?

Mr. LUTZ. This is the .38 special revolver manufactured by Smith & Wesson. It was originally designed to chamber the .38 Smith & Wesson cartridge. It had been rechambered. The length of the space inside the cylinder allowing the cartridge to be seated in the cylinder had been extended to now accept the longer .38 special cartridge that it is presently chambered for.

Mr. McDONALD. Thank you. Mr. Chairman, I have no further questions.

Chairman STOKES. The Chair is planning to recognize the gentleman from Pennsylvania, Mr. Edgar, who has had to go to the floor for a vote that is presently on the floor. We can recess for just a couple of moments, about 5 minutes, I would say.

[A brief recess was taken.]

Mr. PREYER [presiding]. The committee will come to order, please.

The Chair recognizes the gentleman from Pennsylvania, Mr. Edgar.

Mr. EDGAR. Thank you, Mr. Chairman.

I would like to welcome the panel and thank you for your testimony today. I have a series of questions that I would like to ask.

I wonder if Mr. Lutz and Mr. Champagne could come in front of the table because I have questions relating to the rifle itself and its action.

Could you use the neck mike and lift the rifle.

Mr. Lutz, perhaps you can take the rifle in hand.

I was interested in seeing you handle the rifle and talking about the action of the rifle. I have just a couple of questions relating to the rifle itself.

Could you describe the magazine section of the rifle and how that works?

Mr. LUTZ. The magazine section is this attached area, a fixed box-type magazine, that is part of the trigger guard protruding from the bottom of the stock. It is the large metal object that you see on the lower silhouette. The magazine itself consists of the follower, the steel or metal arm that is inside of the receiver, that is pushed down as the cartridges are inserted into the top of the firearm, and then that steel or metal arm is on a spring that pushes on the bottom cartridge and is part of the magazine and causes the feeding of the system to operate inside of the rifle as it is loaded.

Mr. EDGAR. So it would be accurate to say that there isn't a portable magazine that is clipped into the rifle and clipped out again, that the magazine is part of the rifle itself.

Mr. LUTZ. That is correct as opposed to the detachable magazine that could be removed and taken out of the rifle.

Mr. EDGAR. The reason for asking that question is that it was not clear to me when we were talking about some of the markings on the last bullet, that it had to come from being loaded first in that magazine. I know that there are rifles that do have detachable magazines, but it cannot be detached on this rifle?

Mr. LUTZ. That is correct, the follower itself is an integral part of the rifle and the magazine itself is attached to the receiver and cannot be removed by simply pulling it from the rifle.

Mr. EDGAR. How would you load the rifle?

Mr. LUTZ. This rifle can be loaded in two ways. If an individual wanted to insert a single cartridge, a separate clip would not be required. The bolt would be opened. Normally the rifle would be pointed down or in some way so that the cartridge could be fed in by hand into the chamber area of the rifle. Then the bolt would be closed on that cartridge and you would be able to fire the rifle with a single round.

The normal procedure to load the rifle with more than one round would be to insert a number of cartridges, one through six, in the clip, in this case a brass clip. They are inserted into this and it acts as a retainer or a holder for the cartridges. They are then inserted into the open area by pushing it down. The bottom of the bottom cartridge is forcing the follower all the way to the bottom. It pushes it down and is forced to the extreme bottom and goes into a locked position allowing you then to push the bolt handle forward stripping the first cartridge from the top of the clip and inserting it into the chamber area of the rifle.

Mr. EDGAR. The cartridge clip was removed from CE-139 by Lieutenant Day of the Dallas Police Department on November 22, 1963 at the crime laboratory for the police department. Shouldn't a clip automatically fall out once the last cartridge has fed into the chamber?

Mr. LUTZ. This rifle is designed to incorporate that feature so that the last cartridge is stripped out of the clip, then that allows the clip itself to fall or to drop from the opening that you see in the bottom of the box magazine. However, in many cases, and in this particular case, where we functioned the rifle, fed cartridges through it, we found this clip to stay in the rifle after the last round had been stripped and fed into the chamber. Because the lips or the edges of the clip many times will open up, they will spring against the walls on the inside of the box magazine and it will hang up in that area, and even though it is supposed to drop out, many times it will hang up in the box area.

Mr. EDGAR. So that in this case, while it is normal for the clip to fall automatically, because of that particular problem with the clip, it remains in the rifle?

Mr. LUTZ. Yes, sir, many times it will.

Mr. EDGAR. Can you describe the bolt action once again? I recognize that we are not trying to get sequence of time here, but it is a relatively short period of time in which three shots are fired. Can you describe in laymen's terms how the bolt action would work in order to fire off three shots?

Mr. LUTZ. To fire three cartridges the procedure would be either (1) putting a cartridge into the chamber and two or more into the clip, and then allowing the bolt to be closed forcing the top cartridge down so that the bolt would close over it and on to the cartridge that had been inserted into the chamber, or putting three in the clip and stripping the top one from the clip, three or more, and loading it in that manner. To do this the cartridges would be inserted, the bolt handle grasped, pushed forward, and then crammed down to lock the bolt into the receiver and prepare it for firing.

Mr. EDGAR. Could you do that three times quickly?

[Demonstration.]

Mr. EDGAR. Now that it just moving the bolt action, that is not putting the gun up for sighting and preparing it for firing, you are just moving the bolt that quickly?

Mr. LUTZ. That is correct, yes sir.

Mr. EDGAR. Are magazine follower markings, like those found on CE-141, only found on the last cartridge regardless of how many

cartridges are loaded into the clip? I think you had suggested this earlier.

Mr. LUTZ. Yes sir, they would because the follower is contacting that bottom cartridge and pushing it up.

Mr. EDGAR. Is it reasonable to believe that there were at least four cartridges placed in this rifle, in light of the fact that three were found on the ground and one was found remaining, so that there were at least four; is that correct?

Mr. LUTZ. Yes, sir, that would be quite logical.

Mr. EDGAR. Do the magazine follower markings found in CE-141 indicate that the clip was used?

Mr. LUTZ. Could I defer that question to Mr. Champagne?

Mr. EDGAR. Sure.

Mr. CHAMPAGNE. Yes. Without the clip the weapon would not function properly. The cartridges would lie loose in the magazine.

Mr. EDGAR. How many bullets does the clip actually hold?

Mr. CHAMPAGNE. The clip will hold six rounds or less.

Mr. EDGAR. But it is the last bullet that has the markings, and that is the first one placed in, it is the last one remaining?

Mr. CHAMPAGNE. That is correct, it is the last cartridge that has the markings on it, the last one to leave the magazine.

Mr. EDGAR. In your test firings of the rifle, where you by accident created the cartridge with the dent on it, similar to the one that was found in the Texas book depository, what were you firing at and where were you firing?

Mr. LUTZ. This was a single cartridge being inserted into the chamber and firing into a cotton waste recovery box, a box approximately 12 to 14 inches in dimensions in width, approximately 10 to 12 feet long, filled with a recovery material, a cotton waste material, backing away from the box, a foot or two, and pointing the muzzle into the box and then firing into it, in order to recover the projectile.

Mr. EDGAR. But you weren't firing with clip—using the clip, were you?

Mr. LUTZ. No sir; I did not.

Mr. EDGAR. Did anyone on the panel fire with the clip in?

Mr. LUTZ. I do not believe so; no, sir.

Mr. EDGAR. What was the reason for that?

Mr. LUTZ. There were no particular markings that we were able to identify as having come from the clip, nor were we checking for time firing or sequential firing in any way in that respect.

Mr. EDGAR. Let me ask you some questions about the scope itself. You described the scope earlier as being totally attached to the rifle. Can you explain that again?

Mr. LUTZ. Yes, sir; the scope is attached on the lefthand side, attached by two small metal screws that can be removed by backing them off and the entire mount comes off once those two screws are backed off and pulled away from the receiver.

Mr. EDGAR. But it is not just an unhooking of a latch or the removal of a clip to get the scope off, you actually physically have to use a tool to get it off?

Mr. LUTZ. Yes, sir, that is correct.

Mr. EDGAR. And you indicated earlier—I believe, one of the panel members did—that it would be possible for an average marksman

to shoot fairly accurately with the rifle without using the scope; is that not correct?

Mr. LUTZ. Yes, sir, that would be.

Mr. EDGAR. Can you describe further why that is so? Why wouldn't you use the scope in every occasion, if it is connected to the rifle?

Mr. LUTZ. This scope, I will apply the principle to it. We are dealing with a four-power or a magnification of 4. The field of view is 18, meaning an 18-foot circle at 100 yards. So it is a 4 x 18 scope, a relatively small circle to locate your target in when you are firing and recovering from the recoil in successive shots. So to aline your target to get a sighting position, by placing the stock into the shoulder, the head has to be adjusted or moved slightly to the left to aline the way that the scope is mounted on the left-hand side and get into position to fire.

The scope itself is also designed so that the crosshair, the reticles, do not remain in the exact center position. When you adjust windage or elevation those crosshairs move, so that you are not looking dead center in the object itself.

A more natural and easier form or position to fire is to put the rifle against the shoulder, the cheek on the stock, and look right down the center, straight ahead from where you are now positioned, and aline the iron sights, the fixed iron sights that are presently on the rifle.

Mr. EDGAR. Can you demonstrate the holding of the rifle in a position of firing at a target (a) using the scope, and (b) without the scope? Fire toward the screen there.

Mr. LUTZ. The best position using the scope would be placing the stock against the shoulder, the left hand on the upper forearm of the rifle, gripping the stock area and the trigger finger going into the trigger guard, and I am now using the scope itself. The crosshairs are close to the center of the objective area. To get exactly on center I have to raise my head an inch or so, with the cheek of my face away from the stock. If I put my face onto the stock I cannot see through the objectives of the scope. The scope is slightly to the left and is considerably higher.

So I must raise my face off of the stock and a little bit higher to get a position. To sight through the iron sights, they are not obstructed by the scope, because the scope is mounted high enough, I can see under it. I can place it into a better position by putting my cheek on the stock, finger on the trigger, and I have a more solid position and easier position to recover to once the rifle has fired.

Mr. EDGAR. Are you indicating that in rapid-fire use of that rifle it would probably be easier to use the rifle without using the scope?

Mr. LUTZ. For me it would be considerably easier, yes.

Mr. EDGAR. Considering the physical layout of Dealey Plaza, would the shots at the President have been more feasible without a scope for a person of less than marksman proficiency, in other words, for someone not as proficient as a police sharpshooter?

Mr. LUTZ. I believe that it would. The ability to grasp the rifle and put it into the shoulder and recover after each firing is considerably easier using just the iron sights.



Mr. EDGAR. Does any member of the panel have any differing points or related points that they would like to make in relationship to the questions that we have asked revolving around the rifle?

Mr. BATES. No.

Mr. NEWQUIST. No.

Mr. WILSON. No, sir.

Mr. EDGAR. When the assassination occurred, many people in Dealey said they saw puffs of smoke coming from the direction of the grassy knoll. Do rifles or handguns emit smoke that is discernable to the human eye?

Mr. LUTZ. Yes, sir; they do.

Mr. EDGAR. Does that particular rifle emit any smoke when it is fired?

Mr. LUTZ. During the test firings, I did not make observations concerning this particular rifle. I believe Mr. Bates may have some data on that that he could give you, sir.

Mr. EDGAR. Mr. Bates.

Mr. BATES. During the test firing, even though we were firing at the cotton box and the water recovery tank from a very short distance, it was possible to observe some smoke emitting from the muzzle of the weapon.

Mr. EDGAR. This is going to be difficult. Can you describe what the smoke looked like? I mean it is not billowy smoke and—

Mr. BATES. No; it appeared as a very thin haze of a light or whitish type of smoke. It was very difficult to evaluate the quantity of smoke emitted during our firing, especially when using the cotton bullet-recovery box. This was due to the muzzle of the rifle being held in close proximity to the front of the box. As the rifle was fired, the expansion of the propellant gasses forced cotton to blow out of the box, partially obscuring some of the smoke.

Mr. EDGAR. From the experience of the panel members, if a gun similar to this particular weapon were fired out of doors, would the smoke emanating from this type of a rifle exhibit more or less smoke than a lighted cigarette?

Mr. BATES. Possibly similar.

Mr. LUTZ. Possibly I could assist somewhat in that. I have fired a rifle of the same dimensions as the ones that was in the photographic display that I had. I observed, or I had another person fire it while I was observing, in bright sunlight. I found not a puff of smoke but the gray smoke in an outdoor condition being expelled from the front of the muzzle during firing of the same type of ammunition, and then I used some Italian surplus ammunition and some Swedish commercial ammunition, each of them given a considerable amount of smoke. It could be readily detected as a result of being fired from a similar rifle.

Mr. EDGAR. Thank you.

Let me draw your attention now to Oswald's revolver that was used, at least that is exhibit here, CE-143.

In describing the firing of that revolver you used the phrase single and double action mode of firing, and you indicated that the pressure to pull the trigger single action was different than the double action mode.

Can you explain for me what you mean by the single- and double-action mode of firing?

Mr. LUTZ. Yes, sir. The single action is describing that process where the revolver is fired. Normally the cylinder will be swung to the left, cartridges will be inserted into the chamber or chambers of the cylinder, the cylinder closed, and then the revolver can be fired single action by cocking the hammer, pulling it to the rear, in some way, normally with the thumb applying pressure, pulling it back, putting it into a cocked position, so that now all that has to be done is pressure applied to the trigger causing the hammer to be released and move forward striking the primer area of the cartridge. This can be repeated by cocking it each time, each time rotating the cylinder and firing the revolver in that manner. That would be single action, and a lighter mode of fire, 3½ pounds approximately, I believe.

The second mode is simply having the revolver loaded, the hammer now all the way forward, and applying pressure to the trigger, and pulling the trigger, at the same time mechanically cocking the hammer by the pressure being applied to the trigger, causing the hammer to be moved to the rear, to that point where it is released, and then again falls and can be fired. [Demonstrating.]

As often as the trigger is pulled and there is ammunition in the chamber.

Mr. EDGAR. Thank you.

Regarding CE-143, Oswald's revolver, do your test-fired bullets match, microscopically, with CE-602, 603, 604, and 605?

Mr. LUTZ. Are these the bullets that were recovered from Officer Tippit?

Mr. EDGAR. These were the bullets that were recovered from the body of Officer Tippit.

Mr. LUTZ. Our microscopic examination and comparison of these bullets failed to positively identify this revolver as the one that fired those bullets. We did find the class characteristics that were present, the number of lands and grooves, the width of those lands and grooves, to be the same. However, the individual characteristics were not present in sufficient quantities that we could say that that revolver and no other revolver fired them.

Mr. EDGAR. Can you describe whether this is a traditional problem and why?

Mr. LUTZ. It is not an uncommon problem. The problems being in this case we are dealing with a revolver that has been fired numerous times, by all reports that we have received, the condition of the revolver itself is not new, and there is all indications of considerable wear involving the rifling, the chambers of the cylinder have been bored out to accept the longer .38 special cartridge as opposed to the shorter but larger diameter .38 S&W cartridges. So that these in conjunction with the gas erosion, the firing of the lead bullets, not picking up and not retaining enough striations and as a result of going through or into a body and obliterating some of those markings that we could not identify them positively.

Mr. EDGAR. Didn't you say earlier that the firing pin impressions on your test-fired cartridge cases matched the ones recovered at the scene of the murder?

Mr. LUTZ. Yes, sir; we did.

Mr. EDGAR. In the Warren Commission testimony, Ronald Simons, Chief, Infantry Weapons Evaluation Branch, Ballistic Research Laboratory, Department of the Army, stated that a 6.5 millimeter caliber Mannlicher-Carcano trigger was two staged and unusual. Is the two-stage trigger unusual for a military weapon? Second, does a two-stage trigger affect the accuracy of a weapon?

Mr. LUTZ. The answer to the first question is that the two-stage trigger is not uncommon in a military firearm or especially rifles. They are designed with a two-stage trigger, that two-stage trigger being defined as a mechanism or a type of firing system that allows for some slack or a distance of travel for that trigger before it engages into the sear mechanism and then pressure being applied and allowing the rifle or firearm to fire.

So, military rifles are designed with a two-stage trigger. The only ones that I have encountered that did not have the two-stage capability were those that had been worked over for marksmanship shooting, that two-stage feature being intentionally eliminated. As issued, the military rifle many times has that two-stage capability.

Mr. EDGAR. Thank you.

Mr. Champagne, I think it was during your testimony that there was some reference made to extractor markings on CE-543, one of the three cartridges found on the 6th floor of the Texas school book depository. Since Lee Harvey Oswald did not have any live rounds on him at the time of his apprehension, nor did officials find any at either of his residences, did you find any multiple extractor markings which would indicate that cartridge had been loaded in or extracted from CE-139 on more than one occasion?

Mr. CHAMPAGNE. No, sir; we did not.

Mr. EDGAR. What about CE-141, the live cartridge found in the chamber of CE-139?

Mr. CHAMPAGNE. No, sir.

Mr. EDGAR. Would such markings deteriorate over a period of time?

Mr. CHAMPAGNE. That is a possibility but it is unlikely because of the nature of the cartridge case, unless you had some extreme handling of the cartridges.

Mr. EDGAR. When we were demonstrating the action of it we discovered that you could fairly quickly use the bolt action of that particular rifle. Would it be safe to say, in other words, that this bolt action would not prohibit Lee Harvey Oswald from firing the shots in the required time limit that has been estimated were the time between the first and the last shot?

Mr. CHAMPAGNE. No, sir.

Mr. EDGAR. The Warren Commission cited firearms expert Robert Fraser as weighing the three 6.5 millimeter caliber bullets and found them to weigh 160.85, 161.5 and 161.1 grams respectively.

Is it possible that CE-399, that is, the so-called pristine bullet, weighing 158.6 grains, did not have any weight loss?

Mr. BATES. Yes, it is possible. All bullet weights are approximate due to manufacturing tolerances. There are variations, because of plus or minus factors. It is not possible for us to determine what the weight loss was, if any, without knowing the actual weight of the bullet prior to the time that it was fired.

Mr. EDGAR. Thank you. Let me just ask each of you as panel members: Is there anything related to the rifle or either of the two revolvers relating to any of the testimony that has been given today that you would like to comment on or make any extra explanation of?

Mr. CHAMPAGNE. No, sir.

Mr. EDGAR. Let me ask you one final question, then. In your expert opinion, did the FBI do an adequate job in their ballistics test after the death of President Kennedy and for the Warren Commission?

Mr. CHAMPAGNE. I would say, considering the pressures at the time, the FBI did a very good job.

Mr. EDGAR. Are there any tests that you would have done at the time that were not done?

Mr. CHAMPAGNE. No, sir.

Mr. EDGAR. Thank you. Mr. Chairman, I have no further questions.

Chairman STOKES. The time of the gentleman has expired. The Chair recognizes the gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman. I wonder if the panel, any one of all of you, would comment on what has been one of the widely written about and discussed features of the actual shooting. As I understand it, the distance from the window where Oswald was supposed to have been located to the President was 165 feet. With that weapon which you now have inspected and test fired, how difficult a shot is it with the scope or without the scope, sort of from left to right?

Mr. LUTZ. The answer I would give, I believe, would be that it would not appear to be a difficult shot with either device with reasonable training or a reasonable capability of a firer that was familiar with that firearm.

I personally feel that the iron sights would have provided a better capability because of the problems of sighting through the other device, through the telescopic sight, but I feel that it could have very easily been accomplished from that distance with that rifle.

Mr. FITHIAN. And with the car moving at the estimated speed?

Mr. LUTZ. From the data I have about the movement of the vehicle and the speeds involved, I still feel that it would not have been a difficult target at that distance.

Mr. FITHIAN. Is there any other member of the panel who believes that it would be somehow an exceptional feat to have hit the target from that range?

Mr. BATES. I don't believe so, no.

Mr. CHAMPAGNE. No, sir.

Mr. FITHIAN. Mr. Newquist stated, I believe, that the panel could not match their own test-fired bullets with either the FBI's tests from 1963—maybe I misunderstood this—or the so-called pristine bullet that has been so much talked about and the bullet fragments removed from the limousine?

One of the reasons theorized that a match could not be made was that the rifle had been fired too often, somehow destroying or altering the land-and-groove markings. Does anyone on the panel know how many times the weapon was fired by the FBI?

Mr. BATES. No; I do not.

Mr. CHAMPAGNE. Are you referring just to the FBI firing it or the number of times it was actually fired?

Mr. FITHIAN. I was just going in the order I thought it was fired once it was acquired by the FBI and then by the committee panel and by anybody else. I was trying to get at how much actual wear and alteration there has been.

Let me rephrase the question. I am informed by our counsel that the weapon has been fired over 100 times. Is that sufficient wear that it would significantly alter the markings and the identifications?

Mr. CHAMPAGNE. Yes; I think with this type of weapon and the type of bullets involved, that it is. I think that probably the weapon has been fired more than 100 times.

Mr. FITHIAN. Mr. Chairman, I have no other questions of this panel.

Chairman STOKES. The time of the gentleman has expired.

Gentlemen, any witnesses appearing before this committee are entitled, after they have concluded their testimony, to 5 additional minutes in which to explain, amplify, or in any manner expand upon their testimony. On behalf of the committee I at this time extend to you 5 minutes in which any of you may make any comments you so desire.

Mr. LUTZ. I don't believe there is any further expanding on the examinations that we have conducted. I think we feel that they have been as thorough as could have possibly been done. We have been given the opportunity to examine every piece of evidence that we asked for. We didn't have any restrictions. We weren't bound to come up with a particular finding. So I think in that respect we have been very fortunate to conduct an objective examination.

I also would like to express on behalf of the entire panel the thanks to our own employers, the State of Wisconsin, the State of Florida, the State of Iowa, the State of New York, and the Metropolitan Police Department of the District of Columbia for allowing us to participate in this panel. I would like further to extend on behalf of the entire panel our appreciation to the staff of the committee, for the assistance they have given us and especially to thank the committee itself for the privilege and the honor of appearing before it.

Chairman STOKES. We certainly deem ourselves fortunate to have had such a distinguished panel of experts lend their services to this cause. We appreciate all the time that you have expended on behalf of the report that you have brought to the committee and the testimony you have given us here today. We express at this time our very deep appreciation to each of you for the services that you have rendered. Thank you.

The Chair recognizes Professor Blakey.

**NARRATION BY G. ROBERT BLAKEY, CHIEF COUNSEL AND  
STAFF DIRECTOR**

Mr. BLAKEY. Thank you, Mr. Chairman. Mr. Chairman, there have been several prior attempts to analyze missiles and fragments recovered from the assassination from the standpoint of their me-

tallic makeup to determine, for one possibility, if they have a common origin.

In November and December 1963 the FBI applied to the evidence samples a technique called emission spectography. It is a process in which the samples are subjected to intense heat and their metallic composition is determined by the color of the gas that is then emitted. Emission spectography, however, is not highly sensitive and the tests were deemed by the FBI inconclusive.

In May 1964 the FBI also performed neutron activation analysis on some of the samples. That is a nuclear method to determine the elements present. An analysis of trace elements found in the sample of similar materials—for example, bullet lead—enables a highly trained scientist to come to a conclusion as to the probability of the samples having a common origin.

Nevertheless, "inconclusive" was also the term used by the FBI to describe its neutron activation analysis. The report it submitted to the Warren Commission stated that the tests would not, quote, "permit positively differentiating among the larger bullet fragments and thus positively determining from which of the larger bullet fragments any given small lead fragment may have come," unquote.

The Warren Commission did not divulge that the neutron activation analysis had taken place in its final report. Indeed the fact did not become public until the early 1970's.

Hopeful that new tests might succeed where old efforts had failed, the committee engaged as a consultant Dr. Vincent P. Guinn, professor of chemistry at the University of California at Irvine. Dr. Guinn had no relation to the Warren Commission. Dr. Guinn analyzed the assassination evidence samples as well as the bullet allegedly fired at General Walker.

In his experiments, Dr. Guinn used a high resolution lithium-drifted germanium detector, a device that is far more sensitive, and hopefully accurate, than the one used for the FBI test in 1964.

Dr. Guinn received an A.B. and an M.S. degree in chemistry from the University of Southern California in 1939 and 1941 and a Ph. D. in physical chemistry from Harvard University in 1949. Dr. Guinn studied radioisotopes at the Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn., in 1952. He is a fellow of the American Nuclear Society, the American Academy of Forensic Scientists, and he is a member of the American Chemical Society.

Dr. Guinn has published numerous scientific articles in the area of activation analysis and forensic chemistry. He has served as an adviser to such agencies as the Atomic Energy Commission and he has made a training film on neutron activation analysis which is in wide use today.

It would be appropriate, Mr. Chairman, at this time to call Dr. Guinn.

Chairman STOKES. The committee calls Dr. Guinn.

Sir, would you please stand and raise your right hand and be sworn.

Do you solemnly swear the testimony you will give before this committee is the truth, the whole truth and nothing but the truth, so help you God?

Dr. GUINN. Yes, I do.

Chairman STOKES. Thank you. You may be seated.  
The Chair recognizes committee counsel Jim Wolf.

TESTIMONY OF DR. VINCENT P. GUINN

Mr. WOLF. For the record, could you please state your full name?

Dr. GUINN. Vincent P. Guinn.

Mr. WOLF. Where are you currently employed?

Dr. GUINN. As a professor of chemistry, University of California, Irvine campus.

Mr. WOLF. Are you familiar with the technique of analysis of evidence samples known as neutron activation analysis?

Dr. GUINN. Yes; I have been involved in such work for over 20 years.

Mr. WOLF. When did you first personally perform this technique?

Dr. GUINN. About 1956.

Mr. WOLF. Have you testified in legal proceedings before on the applicability of neutron activation analysis to evidence samples?

Dr. GUINN. Yes, on many occasions.

Mr. WOLF. Did you testify in the capacity as an expert witness?

Dr. GUINN. Yes.

Mr. WOLF. In your capacity as an expert witness did you both testify as to samples you had analyzed and performed the analysis on as well as an evaluation of analyses that other people had done?

Dr. GUINN. Yes, both of them.

Mr. WOLF. Approximately how many times have you testified in your capacity as an expert witness?

Dr. GUINN. I would say approximately 50 times.

Mr. WOLF. Generally, Dr. Guinn, why would one subject an evidence sample to neutron activation analysis?

Dr. GUINN. It depends on the kind of evidence sample, but for many kinds the purpose is to detect various elements in the samples and compare specimens to see if they are sufficiently similar in composition that it indicates a high probability of common origin or, if they differ widely, a definite probability of noncommon origin.

Mr. WOLF. So it may be possible, by neutron activation analysis, to determine if two or more unknown evidence specimens are from the same batch or item, is that correct?

Dr. GUINN. That is correct.

Mr. WOLF. To use an example, if a crime had been committed and the victim hit over the head with an ax, and metal fragments were found in the skull of the victim, might you be able to analyze the metal fragments found in the skull to see if they matched the type of ax that was found in a particular person's house who is accused of that crime?

Dr. GUINN. Yes; if one found the same elements at approximately the same concentrations in both, you could establish that there was a good probability that it came from the same type of ax. It wouldn't identify that particular ax because there might have been a hundred or so made of the same batch of metal but it would establish that particular brand and production lot perhaps.

Mr. WOLF. Is it easier for you to state your conclusion that two objects are alike or is it easier to establish the conclusion the two items are not alike?

Dr. GUINN. It is much easier to exclude; if you find two samples that differ markedly, it is easy to say definitively they did not have a common origin. If they look similar in composition, then your first statement is: "They may have a common origin," and you have to look more carefully and look at background data that you have obtained on such materials to try to even estimate a probability that they really do have a common origin.

Mr. WOLF. Briefly, Dr. Guinn, I would like to ask you a few general questions about procedures one would employ to do a neutron activation analysis. If, for example, you had a metal specimen to test, what would you do to that metal specimen to prepare it for testing?

Dr. GUINN. On many kinds of samples it is necessary to remove, as best you can, any external contamination, dust, moisture, or salt from handling and perspiration. You may have to wash them, then dry them, and so on, just to get rid of external, extraneous contamination that would otherwise change the measured composition from what the real material was. That is quite common.

Mr. WOLF. After preparing the sample, you would then insert that sample in a nuclear reactor, is that correct?

Dr. GUINN. You normally place the individual samples in small plastic (polyethylene) vials as a container and, of course, you put that into the nuclear reactor.

Mr. WOLF. And the sample would be made radioactive after it was placed in the nuclear reactor, is that correct?

Dr. GUINN. Yes; in the reactor the purpose is to bombard the sample with neutrons. The neutrons—some of them get captured by the nuclei of the different kinds of atoms in the sample, and that makes some of these radioactive. So when the sample comes out—particularly metal samples—there is no change in weight that you can measure, there is no change in appearance, but the sample is now radioactive and you can then test it with suitable counting equipment.

Mr. WOLF. Now, radioactive materials decay, is that correct?

Dr. GUINN. Yes. Different radioisotopes have different rates of decay.

Mr. WOLF. Can you explain in layman's terms what "radioactive decay" means?

Dr. GUINN. "Radioactive decay" means that an event occurs in the nucleus of an atom resulting in it releasing energy and penetrating radiation and/or a particle such as a beta particle, which is a high-energy electron. In the process, it changes normally to a stable isotope, of the next element in the case of beta-minus emission. The process of that decay is called "radioactivity" or "radioactive decay."

Some elements have a number of different radioisotopes that have been made in the reactor with neutrons. Some of them will only form one radioisotope; some will form two or three. The radioisotopes of different elements are characterized by the energies of the radiations that they emit in the process of decaying and also by their half-lives, which is a measure of how rapidly they decay away.

Mr. WOLF. You are telling us different elements have different radioactive half-lives and, by detecting the radioactive decay of the



unknown sample, you would be able to identify the elements present in that sample, is that correct?

Dr. GUINN. Yes, particularly, in practice, by looking at the energies of the gamma rays that are emitted by the sample, rather than actually measuring the half-life. We make use of the half-life but we don't usually actually measure it.

Mr. WOLF. What are some of the different types of materials you have tested by neutron activation analysis for the purpose of comparison?

Dr. GUINN. Well, almost all the kinds of materials you can think of that may get involved in some kind of criminal case—gunshot residues, bullet lead, glass, paint, paper, cloth, oil, greases, and so on and on and on.

Mr. WOLF. How many different types of bullets have you examined by neutron activation analysis?

Dr. GUINN. Approximately 165 different actual, known brands and known production lots of bullets.

Mr. WOLF. Were these of different calibers as well as manufacturers?

Dr. GUINN. Yes; they covered the full range of calibers as well.

Mr. WOLF. What elements have you found were the most distinct to distinguish among different brands of bullets?

Dr. GUINN. Looking over all of the data that we have obtained and also other people have obtained who have been using the same general approach, we find there are three elements that commonly show up in bullet leads but at widely different concentrations, depending upon which bullet lead it is. These three elements are antimony, silver, and copper.

And I would say that that is about the approximate order of importance—that is, antimony being perhaps the most informative or the most critical element to measure; silver, very close to it; copper, somewhat less, though, mainly because copper wouldn't be so bad in and of itself but, in criminal cases, you very frequently are looking at little bits and pieces of bullets, and the original bullets were copper-jacketed and that means some of the fragments you get may have a little bit of copper imbedded in them physically that you can't see and yet it will show up markedly in the analysis. So the copper numbers can often bounce around.

Mr. WOLF. Are other elements found to be present in bullets when you analyze them, apart from antimony, silver, and copper?

Dr. GUINN. Well, many times in bullets, under the conditions that we normally use, you will just see those three. Very often, unless you very carefully clean them, you will find a little bit of sodium and a little bit of chlorine, coming from salt, which may be from perspiration if anybody has handled the specimens, or salt spray in the air if it is anywhere near the ocean, for example. Often you will find a little trace of manganese, not so much that it is common but we happen to be extremely sensitive for manganese.

The main reason for using the activation analysis method is that it is an extremely sensitive method. It will detect very small concentrations, but it doesn't have the same sensitivity for all elements. Some are far more sensitive than others. So we sometimes see a little manganese, occasionally a little aluminum, once in a while some arsenic or tin.

That about covers all of the elements that we have ever seen in all bullet leads.

Mr. WOLF. Have you analyzed Mannlicher-Carcano bullets produced by the Western Cartridge Co. (WCC)?

Dr. GUINN. Yes, I have.

Mr. WOLF. When did you do these analyses?

Dr. GUINN. A number of years ago. I believe I started doing the first analyses about 1973. A colleague, not at Irvine but at the University of Kansas, Dr. John Nichols, had been interested in the President Kennedy case for quite some time and he contacted me and said he had been able to acquire boxes of Mannlicher-Carcano ammunition from the four production lots that had been produced by the WCC, and he was wondering if I would be interested in doing analyses on them since I had earlier analyzed a lot of other kinds of bullets. I said yes, and I did, and we found some unusual features about WCC Mannlicher-Carcano ammunition that showed it was different from most kinds of bullets.

Mr. WOLF. Prior to getting into those features, did you examine bullets from every lot produced by the Western Cartridge Co.?

Dr. GUINN. Yes. The Western Cartridge Co. reportedly made 1 million rounds of each of 4 production runs, lots 6,000, 6,001, 6,002, and 6,003. They were made at different times in 1954, and reportedly those are the only lots they ever produced, and we had boxes from each of those lots.

Mr. WOLF. Addressing your analyses, did you find WCC Mannlicher-Carcano bullets differed from most other bullets you had analyzed?

Dr. GUINN. Yes; they did.

Mr. WOLF. How did they differ?

Dr. GUINN. Well, as of the time that I first measured them, they had a lower antimony content than I had encountered prior to that in most other bullets, because a very large percentage of bullets you do look at, commercial ones, are hardened lead, where they deliberately add anywhere from half a percent up to perhaps 4 or 5 percent antimony to make the lead much harder. A very large percentage of commercial bullets do have hardened lead. So we have usually found much higher antimony levels than in the WCC Mannlicher-Carcano bullets.

Mr. WOLF. And WCC Mannlicher-Carcano bullets are considered unhardened bullets. Is that correct?

Dr. GUINN. They are definitely unhardened bullets. That puts them down much lower in antimony than most bullets.

Subsequently we—in looking at a lot more brands in the interim—did find some others that were also low, some of them lower yet in antimony, but that was one unusual feature.

The other unusual feature of the WCC Mannlicher-Carcano is that there seems to be no uniformity within a production lot. That is, even when we would take a box of cartridges all from a given production lot, take 1 cartridge out and then another and then another and then another, all out of the same box—boxes of 20, these were—and analyze them, they all in general look different and widely different, particularly in their antimony content.

This is not true of most bullet leads that we have ever looked at before, which are very uniform. In general, if you take most boxes

of ammunition—and we published on this; it is in the literature—take a bunch of them out, you can't tell one from the other. They all look like little carbon copies even to activation analysis, but not so with the Mannlicher-Carcano.

Mr. WOLF. Did any of the 165 known brands and lots of bullets you have previously examined have constituent ranges that were the same as the WCC Mannlicher-Carcano bullets in their antimony and silver characteristics?

Dr. GUINN. Yes; the range of the WCC Mannlicher-Carcanos, especially in the antimony content, is so wide that it does encompass some of the others which are down at that low end; and out of 165, there were 4 different groups, 1 U.S. made and 3 foreign made, that fell somewhere in that range.

Mr. WOLF. Addressing the work you did for this committee, Dr. Guinn, where did you obtain the evidence samples that you examined for this committee?

Dr. GUINN. Well, it was during last year. First of all, we made the arrangements in advance, and then in September of last year Mr. James L. Gear of the National Archives brought the samples out. He flew out with them and brought them down with a couple of Federal guards, down to the laboratory, my laboratory at Irvine.

Mr. WOLF. All the samples you examined for this committee were obtained from the National Archives, is that correct?

Dr. GUINN. Yes.

Mr. WOLF. How many items were brought to you from the National Archives for you to first examine?

Dr. GUINN. There were 10 different specimens that had CE numbers and/or FBI Q numbers attached to them—10 different ones.

Mr. WOLF. Did you test all these 10 different items by neutron activation analysis?

Dr. GUINN. No. The first thing we did was for me to look over the samples to see if they were suitable for analysis—if there was anything left there to analyze for one thing, if an analyzable sample could be obtained. Three of them were not suitable.

Mr. WOLF. Which three items were not suitable for analysis?

Dr. GUINN. Let me just check so I can get the proper numbers for them. One was the so-called Dallas curbing sample.

Mr. WOLF. Is that FBI No. Q-609?

Dr. GUINN. Yes; the FBI number was Q-609. That was a piece of curbing that was cut away in Dealey Plaza because it appeared there was a smear that might be from a grazing bullet, and that was brought out to the laboratory. But after looking at it, it was quite apparent that there would be no way—it was just hardly a visible smudge. To get a sample removed from it, you would have to scrape it and you would end up with a sample that was mostly cement.

You might be able to detect a little antimony or something like that, but you could never relate it to a particular kind of bullet lead. This had been scraped before by FBI to take their samples for emission spectography, and that is why practically nothing was left.

Mr. WOLF. What are the other samples that were not suitable for analysis?

Dr. GUINN. Another one was FBI Q-3, which has a Commission number, CE-569. That was reportedly a fragment recovered from the front seat of the Dallas limousine.

Mr. WOLF. Why was that not suitable for analysis?

Dr. GUINN. That was a sizable fragment, but it was only the jacket material. The lead that had been inside of it was all gone and, since I was trying to analyze bullet lead, not jacket material, there was nothing left in that one to analyze.

Mr. WOLF. The third item that was unsuitable for analysis was what?

Dr. GUINN. FBI Q-15, which also has CE No. 841. That was reportedly some very tiny particles scraped from the inside surface of the windshield of the Dallas limousine. Apparently in the previous FBI emission spectrographic examinations that little bit of material had been completely used up. We opened the container but we could find nothing in there, noting in there at all, even with magnification.

Mr. WOLF. Addressing the items you did analyze for the Committee, could you describe where the two items in what you have characterized as group 2 were found, Commission exhibit 573 and Commission exhibit 141?

Dr. GUINN. Yes; just for convenience of discussion I have grouped the seven specimens that were analyzed—that I did analyze—into these two groups. Group 2 consisted of just two specimens: FBI Q-8, which also has the Commission No. CE-141. That is what has been referred to recently here, too, as the complete, unfired Western Cartridge Co. 6½-millimeter cartridge reportedly found in the chamber of the Mannlicher-Carcano rifle found in the Texas School Depository Building on November 22, 1963.

Mr. WOLF. And Commission exhibit 573?

Dr. GUINN. Yes; Commission exhibit 573 is the other one, which has an FBI number of Q-188 also. It is a mashed bullet still in the jacket, and it is the one that was reportedly fired at Gen. Edwin Walker in April of 1963. I took samples of both of those, of the bullet lead, and analyzed them.

Mr. WOLF. Addressing the five evidence fragments which you examined in which you called group 1, all of which were allegedly found in or near the occupants of the President's limousine, could you give their Commission exhibit numbers and state where they were found, please?

Dr. GUINN. Yes; the first one would be Commission exhibit 399. That is the specimen often referred to as the pristine bullet, reportedly found on the stretcher at Parkland Memorial Hospital in Dallas that afternoon of November 22, 1963.

[Interruption from the floor.]

Chairman STOKES. The gentleman in the rear of the room is requested to remove himself from the room.

Counsel, you may proceed.

Mr. WOLF. Dr. Guinn, if we could again start with the items that we have placed in group 1 of the items, all found in or near the occupants of the President's limousine, and if you could give their Commission exhibit numbers and the location where they were allegedly found.

Dr. GUINN. The first of the five was CE-399. That is the so-called pristine bullet reportedly found on a stretcher at Parkland Memorial Hospital in Dallas. The second was Commission exhibit 567. That was a mashed large bullet fragment still in its jacket reportedly recovered from the front seat of the Dallas limousine.

The third one, CE-843, consisted of one larger fragment and one smaller fragment reportedly recovered from President Kennedy's brain at autopsy. The fourth one was CE-842, one larger fragment and two smaller ones reportedly recovered from Governor Connally's wrist during surgery. And the fifth one was CE-840, fragments reportedly recovered from the rear floor of the Dallas limousine.

Mr. WOLF. Was there any lead on any of the evidence samples in the National Archives on the clothing of Governor Connally or President Kennedy that you could subject to neutron activation analysis?

Dr. GUINN. Not so far as I am aware, and I did not analyze any materials from clothing at all, just these bullets or bullet fragments.

Mr. WOLF. In addition to the evidence samples, you also made radioactive known standards of three elements, is that correct?

Dr. GUINN. Yes, the normal procedure is to not only detect elements in sample; but to measure their concentrations quantitatively. To do this, you need to know, for one thing, the weight of the sample and, second, you have to compare the radioactivities that you observe in the activated samples with those from standard samples of known weights of the elements that you are detecting.

Mr. WOLF. And the three standards you used were ones of copper, antimony, and silver, is that correct?

Dr. GUINN. That is correct.

Mr. WOLF. Mr. Chairman, I would ask at this time to show the witness what has been marked as "JFK exhibit No. F-328," which is a graph of the decay pattern of an antimony standard, and the decay pattern of Commission exhibit 843, reportedly a fragment recovered from President Kennedy's brain during the autopsy, after each had been activated in the nuclear reactor.

Dr. Guinn, did you prepare these graphs?

Dr. GUINN. Yes; I did.

Mr. WOLF. And addressing yourself to the lower of the two graphs, what does that graph illustrate?

Dr. GUINN. What it shows is the peak in the gamma-ray spectrum, the measured gamma-ray spectrum, from radioactive antimony, the radioisotope antimony 122. It has one principal gamma ray with a certain energy, 564,000 electron volts; and that means as we measure it, it should fall in a certain position, horizontally, on the spectrum.

What we see is just an enlarged small portion of the whole spectrum. You may note we have a channel number there and this enlarged portion only ranges from roughly channel Nos. 600 to 700. The entire spectrum goes all the way from channel 1 to channel 4,096. You can see this is just a small part, but any sample that has been activated and counted under these conditions antimony in measurable quantity should show a peak at exactly that location.

Mr. WOLF. And the lower graph, Dr. Guinn, is the graph of the known standard of antimony that was made radioactive, is that correct?

Dr. GUINN. That is correct.

Mr. WOLF. And what does the upper graph illustrate, which is the decay pattern of a fragment reportedly recovered from President Kennedy's brain during the autopsy?

Dr. GUINN. That shows the larger brain sample, which weighed, as it shows there—41.9 milligrams is the sample weight. It was irradiated in the reactor at the same time the standard was, for the same length of time; and then after some time of decay afterward, it was then counted under the same conditions, and you do see you get a peak at the same location—the size of the peak is different because the sample and standard don't have the same amount of antimony, but the location of the peak is the same. That tells us that that sample contains antimony.

Of course, in that spectrum, if you were to look at the entire spectrum, you would see other peaks due to copper and so on as well. But we are just looking at the antimony part of the spectrum here.

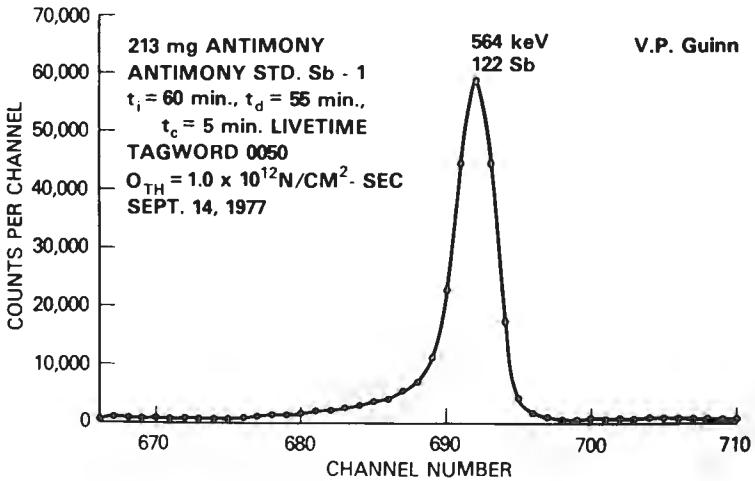
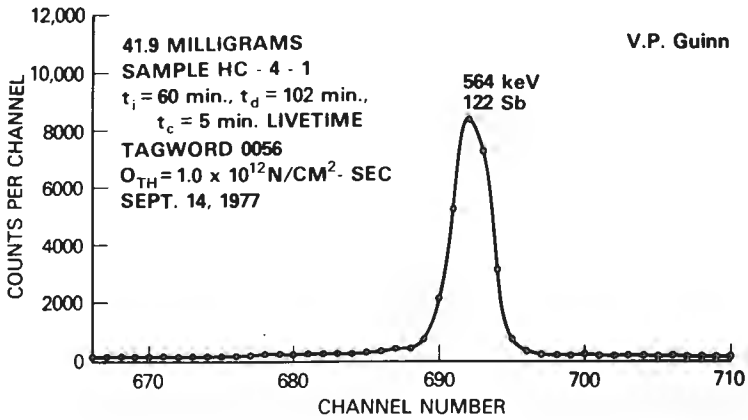
Mr. WOLF. What is the significance of the fact that the peak of the graph above is directly above the peak of the graph below?

Dr. GUINN. Well, falling in the same channel number means the gamma rays you are measuring have the same energy, within plus or minus about 1,000 electron volts, and that is what helps you identify it.

Mr. WOLF. Mr. Chairman, I would like JFK exhibit No. F-328 admitted into evidence at this point.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[JFK exhibit No. F-328 was entered into the record.]



JFK EXHIBIT F-328

Mr. WOLF. Mr. Chairman, I would like to have shown to the witness what has been marked for identification as JFK exhibit 329, which is a photograph depicting the decay pattern of a silver standard and a photograph depicting the decay pattern of a fragment removed from President Kennedy's brain during the autopsy, after each had been activated in the nuclear reactor.

Dr. Guinn, the photograph at the bottom indicates the decay pattern of the known sample of silver, is that correct?

Dr. GUINN. That is correct.

Mr. WOLF. And what does the top graph depict?

Dr. GUINN. It is the same sample that you saw on the previous photograph, the 41.9 milligram sample of material removed from President Kennedy's brain, but activated this time under very different conditions, very rapidly, because we were looking for a very short lived isotope here, namely, the radioactive silver 110, which has a half life of only 24.4 seconds. That means it is rapidly disappearing by decay, dropping in half roughly every 24 seconds. So you must look at it very quickly to see it at all.

Mr. WOLF. How does the antimony on the photo peak on the right, JFK exhibit F-329, differ from the antimony on the photo peak on the upper left?

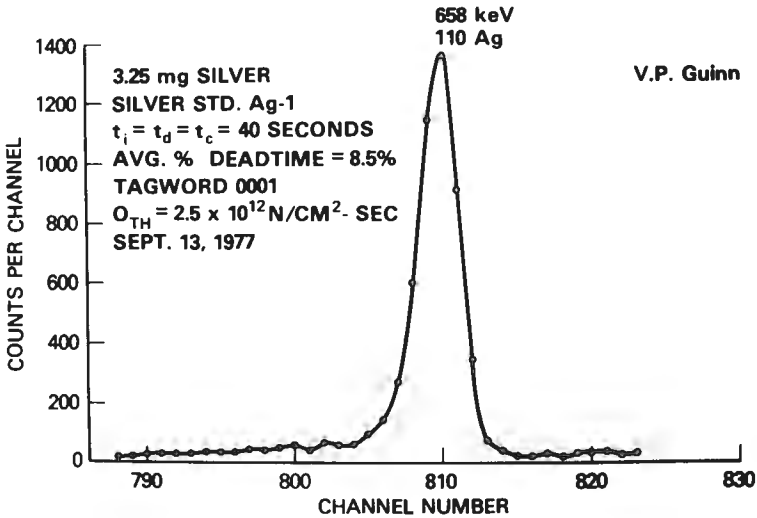
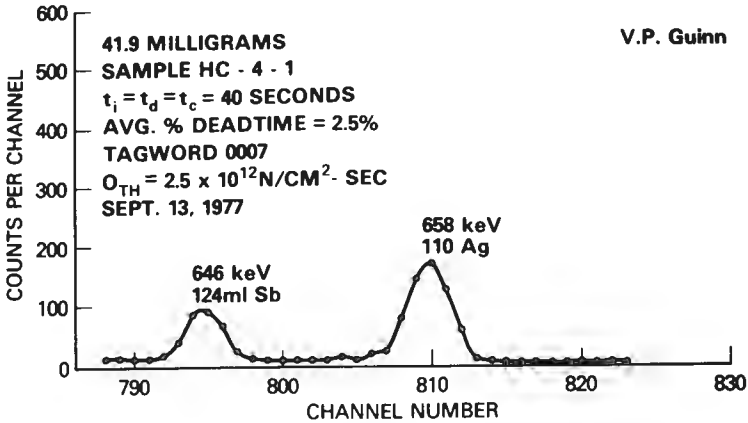
Dr. GUINN. I picked this one particularly to illustrate this point, that even with the high resolution germanium detector you will notice that close to the silver peak of the sample, but not of the silver standard, there is a little peak over to the left, and that is also from radioactive antimony, but it is from a different isotope with a different half life. That is antimony -124 m<sub>1</sub>, which has a gamma-ray energy of 646,000 electronvolts, which brings it close to the 658,000 electron-volt peak of silver -110. Rather than use this smaller antimony -124 m<sub>1</sub> peak, from the short irradiation, to measure the antimony contents quantitatively, I used the much larger peak of antimony -122, from the longer irradiation, to obtain a more precise measurement. With silver there is really only one choice, the short-lived silver -110.

Mr. WOLF. I would move that JFK exhibit F-329 be admitted into evidence.

Chairman STOKES. Without objection, it may be entered into the record.

[The above referred to JFK exhibit F-329 follows:]





JFK EXHIBIT F-329

Mr. WOLF. Dr. Guinn, I would now like to turn to some of the results of the analyses you performed for the committee and some of the conclusions you may have obtained.

Turning to the items in which you characterized as group 2, first, this consisted of the alleged bullet fired at General Walker and the unfired WCC Mannlicher-Carcano cartridge. Was the unfired WCC Mannlicher-Carcano cartridge similar to the previous WCC Mannlicher-Carcano cartridges you had tested?

Dr. GUINN. First of all, I am looking for the table here.

Would you repeat the question, please?

Mr. WOLF. Was the unfired WCC Mannlicher-Carcano cartridge that you tested similar to the previous ones you had tested independent of the work you did for this committee?

Dr. GUINN. Yes, sir; the key elements, the antimony and the silver, were in the same range as the other WCC Mannlicher-Carcano samples. The antimony was definitely down at the lower end and the silver was up at the upper end, but it was in the same general range.

Mr. WOLF. And what was the composition you found in your analysis of the Walker bullet fragment?

Dr. GUINN. About 17 parts per million antimony. Each value has a little uncertainty to it, but just stating the numbers, 17 parts per million antimony, and 20.6 parts per million silver, in the Walker bullet.

Mr. WOLF. Was this similar to the composition of the unfired WCC Mannlicher-Carcano cartridge?

Dr. GUINN. Yes, sir; the unfired WCC Mannlicher-Carcano cartridge which we took apart, took a little sample out of the lead; and put back together again, instead of 17 parts per million antimony it was 15, instead of 20.6 parts per million silver, it was 22.4. These are well within the ranges of slight variation that you get from within such materials.

Mr. WOLF. In your professional opinion, Dr. Guinn, is the fragment removed from General Walker's house a fragment from a WCC Mannlicher-Carcano bullet?

Dr. GUINN. I would say that it is extremely likely that it is, because there are very few, very few other ammunitions that would be in this range. I don't know of any that are specifically this close as these numbers indicate, but somewhere near them there are a few others, but essentially this is in the range that is rather characteristic of WCC Mannlicher-Carcano bullet lead.

Mr. WOLF. Turning to what has already been placed on the exhibit board and labeled at table 1 and marked for identification as JFK exhibit F-330, Dr. Guinn, was this chart prepared by you?

Dr. GUINN. Yes, it was.

Mr. WOLF. Does this chart represent the results you obtained during your tests of the evidence specimens?

Dr. GUINN. Yes, for these five evidence specimens, this chart lists all of the information obtained, even for a few traces of elements for which we find no real significance. But, for the sake of completeness they are all listed. There are some eight elements listed for each sample.

Mr. WOLF. I move that JFK exhibit No. F-330 be admitted into evidence.

Chairman STOKES. Without objection, it may be received.

[The above referred JFK exhibit No. F-330 follows:]

**Table I**  
**RESULTS FROM SEPTEMBER 1977 INAA**  
**OF EVIDENCE SPECIMENS AT U.C. IRVINE**

Sample Number	CE-	FBI Q-	HC-	% Lead	ppm	ppm	ppm	ppm	ppm	ppm	ppm
					Antimony	Silver	Copper	Aluminum <sup>a</sup>	Manganese <sup>a</sup>	Sodium <sup>a</sup>	Chlorine <sup>a</sup>
399	1	1	1	101±4 <sup>b</sup>	833±9	7.9±1.4	58±3	ND <sup>c</sup>	0.09±0.02	5±1	19±12
567	2	2	2	95±2	602±4	8.1±0.6	40±1	1.1±0.4	0.01±0.01	9±1	22±6
843	4,5	4-1	4-1	95±2	621±4	7.9±0.3	40±2	5.5±0.7	0.10±0.01	134±3	59±10
842	9	9-1	104±2	797±7	797±7	9.8±0.5	994±7	8.1±1.4	0.07±0.02	120±4	257±14
840	14	14-1	94±2	638±4	8.6±0.3	44±2	2.7±0.6	2.4±0.5	0.06±0.01	13±1	38±7
			14-2	103±2	647±4	7.9±0.5	42±2		0.05±0.01	19±1	40±8

<sup>a</sup> The absolute values shown for Al, Mn, Na and Cl are approximate values, since standards of these elements were not run, but table values used instead. However, this does not affect their relative values.

<sup>b</sup> The ± values shown for Pb, Sb, Cu, Mn, Na, and Cl represent one standard deviation, based only on the counting statistics. They were calculated in the usual way, taking into account the gross photopeak counts and the counts in the underlying Compton continuum. For a normal distribution, about 68% of the values observed in repetitive measurements should fall within the limits of the mean value ± 1σ. For Ag and Al, which were measured twice on each sample, the ± value shown is 1σ calculated either from the counting statistics or from the spread of the two values, whichever resulted in the larger σ values.

<sup>c</sup> ND means none detected.

#### JFK EXHIBIT F-330

Mr. WOLF. Dr. Guinn, addressing your attention to the column labeled "percentage lead," what does this indicate?

Dr. GUINN. Lead is one of the elements that we can detect with activation analysis, but not with great sensitivity. However, if you have dealings with samples that are mostly lead, you don't need great sensitivity to at least detect it, et cetera, but even here the precision of measurement is not great, and if you look at the numbers you will see percent of lead is shown as plus or minus 2, plus or minus 3, or even plus or minus 4 percent. You will note that they all come out about in the range of 100.

All this really shows is that these metal fragments that we were looking at indeed were lead fragments, they weren't steel fragments, for example, or something else; they were lead.

Mr. WOLF. What does the PPM prior to the listing for each of the other elements indicate?

Dr. GUINN. PPM is just the abbreviation for parts per million by weight. One part per million is only one ten-thousandth of a percent.

Mr. WOLF. Dr. Guinn, based on these results, do you have an opinion as to what type of bullets these fragments were from?

Dr. GUINN. Once again, every one of these samples is in the same range, which is an unusual range, as the background WCC Mannlicher-Carcano samples that we have looked at from all four production lots. These five fall right in the midrange, in fact. They are not the highest; they are not the lowest of the antimony range, and the same is true of the silver.

Mr. WOLF. Is it your opinion then that these all are fragments from WCC Mannlicher-Carcano bullets?

Dr. GUINN. I think that is their most likely origin, yes.

Mr. WOLF. Looking at these results, can you determine how many bullets these evidence specimens came from?

Dr. GUINN. Yes, that is the really interesting part of this. I don't suppose people in back can see, or you up there can see, the numbers on the chart very well, but you have the report to look at. If you look at these five that are listed up here, and you first of all look at the prime or key element, which is antimony, you find of the five samples, that there are two of them that are up somewhere around 800 parts per million, and you find three others that are down just a shade over 600 parts per million.

Now, after each number there is shown a plus or minus. This is only the uncertainty of that particular measurement from what we call the counting statistics. That uncertainty we can measure.

Mr. WOLF. Dr. Guinn. Before we go into a more technical explanation, can you just from looking at the results, state what is the number of bullets that these evidence specimens came from?

Dr. GUINN. Yes, sir, I can.

Mr. WOLF. What is the number of bullets, in your opinion?

Dr. GUINN. These numbers correspond to two bullets. Two of the samples have indistinguishable compositions, indicating that they came from the same bullet, and the other three particles are evidently samples from another bullet.

Mr. WOLF. So it is your opinion that the evidence specimens represent only evidence of two bullets, is that correct?

Dr. GUINN. Yes, sir, there is no evidence for three bullets, four bullets, or anything more than two, but there is clear evidence that there are two.

Mr. WOLF. And which specimens that correspond, respectively, of the two bullets?

Dr. GUINN. Using the CE numbers, the 399 specimen, which is the so-called stretcher or pristine bullet—it has various names—agrees in composition both in its antimony and its silver with CE-842, which are the fragments reportedly recovered from Governor Connally's wrist.

Mr. WOLF. Is it your testimony that CE-399 and CE-842, the so-called pristine bullet, and the fragments removed from Governor Connally's wrist during surgery, both came from the same bullet?

Dr. GUINN. Yes. One, of course, is almost a complete bullet so it means that the 842 fragments came from, in this case, the base of the bullet.

Mr. WOLF. Dr. Guinn, am I correct that technically you cannot today testify to the complete validity of the so-called single bullet theory because there was no lead left in the back wound of the President or around the President's throat that would allow you to examine it and, therefore possibly determine that CE-399 passed through the President?

Dr. GUINN. Yes, reportedly there were no lead fragments found in the back-to-throat wound of the President, and hence no specimens to be analyzed, so I know nothing about that particular wound.

Mr. WOLF. You can, however, today state for the first time scientifically that CE-399 did cause the injuries to Governor Connally's wrist?

Dr. GUINN. Yes sir, those two match so closely that I would say that such was the case.

Mr. WOLF. What is the degree of confidence and certainty with which you can state this conclusion?

Dr. GUINN. I wish that I could put a number on it, as we often can do, that is, calculate a probability, but we really don't have the background information to make a numerical calculation in this case. One can only show what information we do have, and that is that you simply do not find a wide variation in composition within individual WCC Mannlicher-Carcano bullets, but you do find wide composition differences from bullet to bullet for this kind of bullet lead. Thus, when you find two specimens that agree this closely, you can say it looks indeed like they are pieces from the same bullet.

Mr. WOLF. Would you state that your conclusion is more probable than not, highly probable, or what is the degree of certainty of your conclusion?

Dr. GUINN. I would say highly probable, yes. I would not want to say how high, whether it was 99 percent or 90 percent or 99.9 percent. I can't make a calculation like that.

Mr. WOLF. You would state it is highly probable that the injuries to Governor Connally's wrist came from the so-called pristine bullet?

Dr. GUINN. That is correct.

Mr. WOLF. Were you present yesterday during the testimony of Dr. Wecht?

Dr. GUINN. Yes, sir; I was.

Mr. WOLF. Did you hear Dr. Wecht testify, in response to questions from counsel, that in his opinion it was impossible for CE-399 to have caused the injury to Governor Connally's wrist, even if it hit nothing else, because CE-399 would have had to show more deformity?

Dr. GUINN. Yes; I heard him make that statement.

Mr. WOLF. Dr. Guinn, on the basis of your scientific analysis, do you believe Dr. Wecht to have been correct?

Dr. GUINN. Well, I think that is his opinion, but like many opinions and many theories, sometimes they don't agree with the facts.

Mr. WOLF. Dr. Guinn, have you prepared a report for the committee which completely describes your work for the committee and your conclusions?

Dr. GUINN. Yes, sir.

Mr. WOLF. Do you have that report with you?

Dr. GUINN. Yes, sir. It is right here.

Mr. WOLF. Mr. Chairman, I move that Dr. Guinn's report be marked as JFK exhibit No. F-331 and introduced into evidence.

Chairman STOKES. Without objection it may be introduced at this point.

[The above referred to JFK exhibit F-331 follows.]

JFK EXHIBIT F-331

A REPORT TO THE HOUSE OF REPRESENTATIVES

SELECT COMMITTEE ON ASSASSINATIONS

on the subject of

1977 NEUTRON ACTIVATION ANALYSIS MEASUREMENTS

ON BULLET-LEAD SPECIMENS INVOLVED IN THE 1963 ASSASSINATION

OF PRESIDENT JOHN F. KENNEDY

by

Dr. Vincent P. Guinn (Ph.D.)

Professor of Chemistry  
University of California  
Irvine, California

*Vincent P. Guinn*  
*Sept. 8, 1978*

September, 1978

I.

## INTRODUCTION

This report is a presentation of the results obtained and their interpretation, in a September 12-14, 1977 instrumental neutron activation analysis (INAA) study of bullet-lead specimens involved in the November 22, 1963 assassination of President John F. Kennedy in Dallas, and of a specimen from a bullet allegedly fired at General Edwin Walker in April of 1963.

The author has been engaged in neutron activation analysis (NAA) research and applications for the past 20 years -- first, as Head of the Radiochemistry Section of the Shell Development Company, next (1962-1970) as Technical Director of the Activation Analysis Program at General Atomic, and (since early 1970) as Professor of Chemistry at the University of California at Irvine (UCI). The author's first studies of the application of the highly sensitive NAA method to problems in the field of scientific crime investigation commenced in early 1962, have continued steadily since that time, and his forensic activation analysis publications constitute 53 of his 181 publications, to date, in the field of radiochemistry/activation analysis. During the period, 1962-1970, his forensic NAA research was supported first by the U. S. Atomic Energy Commission and later jointly by the AEC and the Law Enforcement Assistance Administration (LEAA) of the U. S. Department of Justice. From this research came the NAA method for detection of gunshot residues that is now used by the FBI and many other law enforcement agencies around the

world, and extensive reports on the use of INAA for the trace-element characterization (as to probability of common origin) of such evidence-type materials as bullet lead, paint, paper, and oil.

NAA is a nuclear method of elemental analysis. It is a nuclear method of analyzing samples of all kinds of materials to determine the elements present in them. The samples to be analyzed are placed in small plastic vials, lowered into or near the core of a research-type nuclear reactor, and then bombarded with a very large number of slow neutrons (typically, about 10 trillion per second) for a selected period of time. When the samples are removed from the reactor, they are essentially unchanged in composition (and in most cases, in appearance), but they are now radioactive, since capture of a neutron by many of the atomic nuclei of many of the elements present in the samples has formed radioactive (unstable) nuclei of these elements. With or without (as needed) some chemical processing of the activated samples before counting, the samples are then counted on a gamma-ray spectrometer -- a sophisticated detector and electronic apparatus that measures the energies and numbers of the gamma rays emitted by each radioactive sample. The gamma-ray energies, observed as peaks in each spectrum, identify the various elements that have been made detectably radioactive, and the measured sizes of the peaks indicate the amounts of the elements present.



The principal advantages of the reactor neutron activation analysis method are (1) it can detect and accurately measure even very tiny amounts (typically, one billionth of a gram) and very low concentrations (e.g., one part per billion) of many elements in a sample, (2) it can utilize sample sizes ranging all the way from a tiny speck up to several grams, (3) it can simultaneously detect a number of elements in a sample, and (4) it can in many instances be carried out nondestructively. The main induced radioactivities are those that have rather short half lives (i.e., they decay away in a matter of seconds, minutes, or hours), and hence the analyzed samples soon become negligibly radioactive and hence can be handled with complete safety.

In previous extensive INAA studies of bullet-lead specimens (of many different calibers, manufacturers, and production lots), it was found that three key elements were almost always detectably present, but at widely different concentrations, depending upon the source of the bullet lead: antimony (Sb), silver (Ag), and copper (Cu). Antimony concentrations in the range of about 1 to 10 parts per million by weight (1 ppm = 0.0001%) are usually found in unhardened bullet lead, made with virgin lead, whereas levels in the range of about 0.4% to 4% Sb are found in commercial bullet leads that have been hardened by alloying Sb with the lead. Intermediate Sb levels (i.e., between about 10 ppm and perhaps

1500 ppm) are encountered in unhardened bullet lead in which some recycled lead is used, along with virgin lead, but in which no Sb has been deliberately added for hardening. Silver concentrations are usually found to lie in the range from about 0.5 ppm to 100 ppm, and the Ag appears to come in mainly as a natural impurity in the lead supply. Copper concentrations are usually found to lie in the range of about 5 ppm to 400 ppm, and the Cu also appears to come in mainly as a natural impurity in the lead supply. Of these three key elements, Cu is the one of least usefulness for comparisons, due to frequent occlusion of tiny bits of copper in the bullet lead coming from the copper jacket of jacketed bullets in the sampling, and from the brass cartridge or brass primer cap in the firing of the cartridge - producing occasional spuriously high Cu values.

Occasionally, the INAA of bullet-lead specimens also shows the presence of traces of certain other elements, such as aluminum, arsenic, manganese, tin, sodium, and chlorine. These elements, where detected, have generally not proved to be consistent enough to be useful for the characterization of bullet lead as to its origin. Sodium and chlorine, the constituents of common salt, appear to occur primarily as the result of external contamination.

In earlier INAA studies of bullet leads from many different manufacturers (See, references 4 and 5 in Appendix H), it was found that bullets from a given manufacturer and

production lot were generally quite uniform in their Sb and Ag concentrations, both within a given bullet and amongst bullets from the same box or production lot. Thus, for such typical ammunition it is generally not possible to distinguish amongst bullets, or bullet fragments, from the same box of cartridges.

However, when the author analyzed (See, Appendix C) quite a number of Western Cartridge Company Mannlicher-Carcano 6.5 mm bullets, from their production lots 6000, 6001, 6002, and 6003 (the only four lots they produced of this type), this ammunition was found to differ sharply from typical bullet leads. Although individual bullets were found to be fairly homogeneous in their Sb and Ag concentrations, they differed greatly from bullet to bullet amongst samples taken from the same box. For example, the Ag levels in bullets from lot 6003 ranged from 7.9 ppm to 15.9 ppm, the Sb levels from 80 to 730 ppm (and the Cu levels from 17 to 62 ppm). This great variation from bullet to bullet from the same box thus indicated that, for this unusual kind of ammunition, it would be possible to distinguish one bullet (or bullet fragment) from another, even though they both came from the same box of Mannlicher-Carcano cartridges.

## II. PREPARATION OF THE SAMPLES FOR ANALYSIS

The analyses that are the subject of this report were conducted at the University of California at Irvine (UCI) during the period of September 12-14, 1977. In these measurements, eight elements were determined quantitatively, by the method of instrumental neutron activation analysis (INAA), using the thermal-neutron flux of the UCI research-type nuclear reactor for the activation of the samples, and the 38 cm<sup>3</sup> Ge(Li)/4096-channel gamma-ray spectrometer at UCI for the counting of the activated samples. The eight elements measured in the samples were the following:

lead	aluminum
silver	manganese
antimony	sodium
copper	chlorine

The evidence specimens to be tested were removed from the U. S. National Archives, in Washington, D. C. by Mr. James L. Gear of the Archives staff.<sup>1/</sup> The evidence

1. The specimens were brought to California in secure containers by commercial airline. Except during the day-time periods of September 12, 13, and 14, 1977, when they were in the process of being sampled and analyzed, they were kept locked up at the Laguna Niguel, California, branch of the National Archives. During all of the operations on the evidence specimens carried out at UCI during the September 12-14, 1977 period, the specimens were accompanied by Mr. James Gear, of the National Archives, and by two Federal guards from Los Angeles. At the end of the day on September 14, 1977 all of the activated samples were returned to Mr. Gear.

specimens which are the subject of this report may be put in two groups. The first group are those reportedly found located in or near the occupants of the President's limousine, the limousine, or the area immediately surrounding it. The second group consists of a sample taken from the unfired cartridge reportedly found in the Texas School Book Depository Building on November 22, 1963, and a sample taken from the mashed bullet reportedly found in the home of General Edwin Walker, after he was reportedly fired upon in April of 1963. The evidence specimens consisted of the following:<sup>2/</sup>

- Group I:
- (1) FBI no. Q609. Reportedly piece of curb from Dealey Plaza.
  - (2) FBI no. Q3 (CE-569). Reportedly a fragment recovered from the front seat of the Dallas limousine.
  - (3) FBI no. Q15 (CE-841). Reportedly particles scraped from the inside surface of the windshield of the Dallas limousine.
  - (4) FBI no. Q1 (CE-399). Whole bullet, still in its jacket, reportedly found on a stretcher at the Parkland Memorial Hospital in Dallas, on the afternoon of November 22, 1963.
  - (5) FBI no. Q2 (CE-567). Mashed large bullet

<sup>2.</sup> The CE-number is the number assigned by the Warren Commission as its exhibit numbers; the FBI Q number is the identification number assigned by the FBI Laboratory.

fragment, still in its jacket, reportedly recovered from the front seat of the Dallas limousine.

- (6) FBI nos. Q4, 5 (CE-843). One larger fragment, and one smaller fragment, reportedly recovered from President Kennedy's brain at autopsy.
- (7) FBI no. Q9 (CE-842). One larger fragment, and two smaller ones, reportedly recovered from Governor Connally's wrist during surgery.
- (8) FBI no. Q14 (CE-840). Fragments reportedly recovered from the rear floor of the Dallas limousine.

- Group II:
- (9) FBI no. Q8 (CE-141). Complete unfired Western Cartridge Company 6.5 mm cartridge, reportedly found in the chamber of a Mannlicher-Carcano rifle found in the Texas School Book Depository Building (TSBD) on November 22, 1963.
  - (10) FBI no. 188 (CE-573). Mashed bullet, still in jacket, reportedly fired at General Walker in April, 1963.

The evidence specimens from the National Archives were inspected on September 12, 1977. Each specimen was examined to determine if it was suitable for INAA analysis. For a specimen to be suitable for analysis, it must contain in excess of one milligram of uncontaminated bullet lead. During the first inspection, it was determined that the

Dallas curbing sample (FBI no. Q609) was not suitable for INAA analysis. The slight gray smear on it had previously been scraped by the FBI Laboratory, and the scrapings analyzed by emission spectography, in 1964. The amount of remaining metal (?) in the smear was too small for proper INAA measurements, and, further, any material scraped from the curbing would be too contaminated by cement material to yield any meaningful INAA results.

On September 13, 1977, the remaining evidence specimens were examined, one at a time, more closely, under magnification, to decide which ones were suitable for bullet-lead analysis by INAA. Two additional specimens were found to be unsuitable for analysis:

FBI no. Q3 (CE-569). Fragment reportedly recovered from the front seat of the Dallas limousine. This specimen consisted of only the copper bullet jacket, with no lead inside.

FBI no. Q15 (CE-841). Particles reportedly scraped from the inside surface of the windshield of the Dallas limousine. No particles were left in the specimen container received from the Archives. The particles probably were entirely consumed in the emission spectrographic analyses performed by the FBI Laboratory in 1963/1964.

The remaining evidence specimens were deemed suitable for INAA measurements, and were prepared for analysis on September 13, 1977, except for the CE-141, Q8 sample, which was prepared on September 14, 1977.

Samples of the suitable evidence specimens were then taken and prepared for analysis. Each sample was placed in a cleaned, labeled, weighed half-dram polyethylene vial, then weighed again to obtain the sample weight. For security reasons, each vial was labeled "HC-1", "HC-9", etc. the HC standing for "House Committee" and the number being the FBI Q number (except for the Walker bullet sample, which was labeled according to its CE number). Each sample, taken in its entirety, or a portion of a larger specimen cut off or drilled out, when necessary to obtain only bullet lead, was washed three times, alternately, with distilled/deionized water and Reagent Grade acetone, then air-dried before analysis. Deionized water was used to remove water-soluble salts; acetone was used to remove oil. Once the sample was placed in its polyethylene vial, the hinged vial cap was snapped tightly shut. Cutting, where necessary, was performed with a cleaned surgical scalpel. Drilling, where necessary, was performed from the center of the bullet base with a tiny (approximately 0.5 mm diameter) cleaned carbon-steel drill in a pin vise holder. Care was taken to avoid contamination of the bullet-lead sample by jacket material, and each sample was examined under magnification, to be sure that no visible jacket material was ad-



hering to the lead sample. In some instances, when more than one suitable sample could be obtained from the same specimen, two samples were taken for analysis from a given specimen (HC-4, 5; HC-8; HC-9 and HC-14). The two separate samples of a given specimen were then given an additional number, to distinguish them from one another (e.g., HC-9-1 and HC-9-2).

The samples taken for analysis are summarized below:

<u>CE No.</u>	<u>FBI No.</u>	<u>UCI No.</u>	<u>Sample Wt. (mg)</u>	<u>Remarks</u>
399	Q1	HC-1	10.7	Drillings from bullet.
567	Q2	HC-2	50.5	Piece cut from large fragment.
843	Q4, 5	HC-4-1	41.9	Single larger specimen.
		HC-4-2	5.4	Single smaller specimen.
842	Q9	HC-9-1	16.4	Single larger specimen.
		HC-9-2	1.3	Two tiny specimens.
840	Q14	HC-14-1	33.4	One single specimen.
		HC-14-2	33.8	Second single specimen.
573	Q188	HC-573	16.3	Drillings from specimen.
141 <sup>2/</sup>	Q8	HC-8-1	24.3	Drillings from bullet.
		HC-8-2	6.3	Drillings from bullet.

3. Regarding the CE-141 (FBI Q8) sampling, a special die for 6.5 mm cartridges was purchased and then used on September 14, 1977, along with the UCI reloading equipment, to disassemble and later reassemble the CE-141 cartridge. The cartridge was first examined visually, with the following observations made: (1) the cartridge base was stamped "WCC 6.5 mm", (2) the entire cartridge case, and the bullet

As well as preparing the evidence samples, four sample standards, each, of silver, antimony, and copper were prepared on September 8 and 9, 1977 to be used in this test. Standard samples of the elements to be measured are necessary in order to convert the measured gamma-ray peaks quantitatively to micrograms of element present in a sample -- this is the usual comparator method. Samples and standards are activated and counted exactly the same way. Each silver standard contained 3.25 micrograms ( $\mu\text{g}$ ) of silver, each antimony standard contained 213 micrograms of antimony, and each copper standard contained 192 micrograms of copper. Each standard consisted of  $0.100 \text{ cm}^3$  of a freshly prepared aqueous solution, gently dried in the bottom of a half-dram polyethylene vial, and cemented down with a few drops of a 10% paraffin solution in carbon disulfide (allowed to dry at room temperature).

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jacket, were rather dark in color -- indicating external oxidation/sulfiding, (3) there was no firing-pin impression at the base, where the primer cup is located, indicating that the cartridge had never undergone even an attempted (abortive) firing. Upon disassembly, the bullet (projectile) part was found to be the same in shape, dimensions, weight, and single cannellure as other Western Cartridge Company 6.5 mm Mannlicher-Carcano bullets from their production lots 6000, 6001, 6002, and 6003. The pristine jacketed bullet, before sampling, was found to weigh 10.4082 grams (160.62 grains). This compares closely with the nominal bullet weight of 161 grains quoted by the Western Cartridge Company. The gunpowder from the cartridge was also weighed, and found to be 2.8294 grams (43.66 grains), which agrees closely with the manufacturer's nominal value of 44 grains. After the two drilling samples were taken from the bullet (24.3 mg and 6.3 mg), the bullet was reweighed, and found to now weigh 10.3774 grams (160.15 grains). The cartridge was then reassembled, with the gunpowder and sampled bullet back in place.

## III. THE ANALYSES OF THE SAMPLES AT UCI

On September 13, 1977<sup>4/</sup> each sample (except for samples HC-8-1 and HC-8-2) was activated twice and counted twice, under conditions optimized for the generation and detection of short-lived induced radioactive species.<sup>5/</sup> With the UCI TRIGA Mark I nuclear reactor running steadily at full power (250 kilowatts), each sample, in its closed 1.3 cm<sup>3</sup> polyethylene vial, was irradiated for 40 seconds in the pneumatic-tube reactor core position (where the thermal-neutron flux is  $2.5 \times 10^{12}$  n/cm<sup>2</sup> - sec), allowed to decay for 40 seconds (during which the activated sample was transferred to a fresh, labeled vial), and then counted for 40 seconds clocktime on top of a one-centimeter thick plastic beta-particle absorber on top of a 38 cubic-centimeter high-resolution coaxial lithium-drifted germanium (Ge(Li)) semiconductor gamma-ray detector, coupled to a 4096-channel pulse-height analyzer. During the counting of a sample,

4. Present during these tests were Dr. Guinn; Michael Purcell, a laboratory assistant; Archivist James Gear; and two Federal guards.
5. Optimized conditions vary for each element. For element radioisotopes with a short half-life, a short irradiation time, a short decay time, and a short counting time provide optimized INAA detection conditions. For element radioisotopes with a long half-life, optimal conditions are a long irradiation time, a long decay time, and a long counting time.

the analyzer percentage deadtime was read from the deadtime meter at the beginning and at the end of the counting period.<sup>6/</sup> As soon as the counting of the sample was completed, its complete pulse-height spectrum was transferred twice to a fresh magnetic tape, identified by its tagword. The samples, and the standards of antimony, silver, and copper, were processed identically in this fashion, in succession, one at a time. Each sample and standard was then activated and counted a second time, under the same conditions.

On the following day (September 14, 1977) the samples and the standards of antimony and copper, and sample HC-8-1, were activated in the reactor again -- this time for one hour and all at the same time, each sample, in its 1.3 cm<sup>3</sup> polyethylene vial, in a separate tube of the 40-tube rotary specimen rack of the reactor. At full power (250 kilowatts),

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6. While the pulse-height analyzer is measuring the size of one electrical pulse from the Ge(Li) detector, to determine in which of the 4096 channels it should be stored as a count, the analyzer cannot accept another input pulse. This period is called "deadtime". In the analyzer circuiting, the percentage of the total clocktime that is deadtime is continuously monitored and displayed on a percent deadtime meter. The counts obtained during a given clocktime period are then corrected for this deadtime loss of counts by dividing the observed counts by (1 minus the average fractional deadtime) during the counting period. In order to avoid spectrum distortion, it is not advisable to use the counting data for really quantitative calculations if the deadtime during the counting period is greater than about 10%.

each sample in the rotary specimen rack is exposed to an average thermal-neutron flux of  $1.0 \times 10^{12}$  n/cm<sup>2</sup> - sec. During the first part of this one-hour irradiation, sample HC-8-2 and one each of the antimony, silver, and copper standards were activated in the pneumatic-tube reactor position (at a thermal-neutron flux of  $2.5 \times 10^{12}$  n/cm<sup>2</sup> - sec) and counted as in the measurements on the previous day: at irradiation, decay and counting times of 40 seconds each. The HC-8-2 sample was activated and counted twice. After the end of the one-hour irradiation, each sample and standard was removed from the rotary specimen rack, each sample transferred to a fresh labeled polyethylene vial, and then each counted for 300 seconds livetime on the Ge(Li)/4096-channel gamma-ray spectrometer as before. As before, also, each pulse-height spectrum was recorded twice on the magnetic tape, along with its identifying tagword. The time of day at which each count was started was noted -- for use in subsequent decay corrections.

At the beginning of the counting on each day, the energy scale was calibrated by means of the 661.6 keV gamma ray of cesium - 137 and the 1332.4 keV gamma ray of cobalt - 60. The energy calibration pulse-height spectra were also stored on the magnetic tape. The energy range covered was from 15 keV (channel 2) to 3277 keV (channel 4096).

On subsequent days, each recorded pulse-height spectrum was read back off the magnetic tape. Each spectrum

was scanned carefully on the expanded oscilloscope display, and the energy of each significant photopeak observed was calculated and printed out on the Teletypewriter, using the built-in PDP-8 computer. Each selected photopeak of quantitative interest<sup>7/</sup> was printed out, channel by channel, including the regions on each side of the peak. In the spectra from the pneumatic-tube measurements, the principal photopeaks observed were the following:

1. the 658 keV peak of 24.4-second silver - 110.
2. the 498, 603, and 646 keV peaks of 93-second antimony - 124m<sub>1</sub>.
3. the 1039 keV peak of 5.10-minute copper - 66.

Smaller peaks due to 2.31-minute aluminum - 28 (at 1779 keV) and due to 66.9-minute lead - 204m (at 375, 899, and 912 keV) were also observed and printed out. The 564 keV peak of 2.80-day antimony - 122 and the 511 keV peak of 12.80-hour copper - 64 were observed, but not printed out.

In the spectra from the rotary-rack measurements,

7. An oscilloscope is employed to visually display the pulse-height spectrum. Generally, the spectrum has the shape of a descending curve, upon which peaks are superimposed. Each element radioisotope shows characteristic peaks of certain energies and of different sizes. A peak size measurement is made by measuring its area. A peak of the tested sample is later compared with the area of the corresponding peak of one of the known standard samples. The relative area of the peak from the tested sample compared to the area of the peak from the known standard indicates the total weight of the element within the tested sample. In some cases, there are overlaps of peaks of similar energies. Accordingly, the photopeak measured for any given element is chosen considering two factors -- a large peak, and one which does not overlap with a peak of another element. Such a peak is a selected photopeak of quantitative interest.

the principal photopeaks observed were the following:

1. the 511 keV peak of 12.80-hour copper - 64.
2. the 564 keV peak of 2.80-day antimony - 122.

Smaller peaks due to 2.576-hour manganese - 56 (primarily at 847 keV), to 60.4-day antimony - 124 (primarily at 603 keV), to 14.96-hour sodium - 24 (at 1368 keV and 2754 keV), to 37.29-minute chlorine - 38 (at 1643 keV and 2168 keV), and to 66.9-minute lead - 204m (at 375, 899, and 912 keV) were also observed and printed out.

For all spectra, the counts in each channel of each selected photopeak, and the counts in several channels on each side of each peak, were printed out. From these read-outs, and those of the antimony, silver, and copper standards and the sample weights, the concentration of each of these three elements of particular interest (and the standard deviation of each, calculated from the counting statistics) was calculated from the pneumatic-tube data for 24.4-second silver - 110, 93-second antimony - 124m<sub>1</sub> (via its 498 keV peak), and 5.10-minute copper - 66. From previous activations of lead standards, the concentration of lead in each sample was calculated from the sum of the photopeak areas of the 375, 899, and 912 keV peaks of 66.9-minute lead - 204m. Using standard table values, the concentration of aluminum in each sample was calculated from the 1779 keV peak of 2.31-

minute aluminum - 28. In the calculations, small corrections were made for the average analyzer fractional deadtime during each counting.

Similarly, from the rotary-rack data, the concentration of antimony in each sample was calculated from the size of the 564 keV peak of 2.80-day antimony - 122, and the concentration of copper in each sample was calculated from the size of the 511 keV positron annihilation peak of 12.80-hour copper - 64. From the previous activation of lead standards, the concentration of lead in each sample was again calculated from the sum of the photopeak areas of the 375, 899, and 912 keV peaks of 66.9-minute lead - 204m (note: lead - 204m is a fast-neutron product of lead, rather than a thermal-neutron ( $n, \gamma$ ) product, formed by the lead - 204 ( $n, n'$ ) lead - 204m reaction). Using standard table values, the concentration of manganese in each sample was calculated from the 847 keV peak of 2.576-hour manganese - 56, of sodium from the 1368 keV peak of 14.96-hour sodium - 24, and of chlorine from the 2168 keV peak of 37.29-minute chlorine - 38. All observed peak areas were, of course, corrected to the same decay time, by means of the radioisotope half-life and the time between the end of the rotary-rack irradiation and the start of the counting period of the sample.



## IV. THE RESULTS OBTAINED IN THIS STUDY (1977)

The results obtained on the tested specimens for Group I are presented in Table I, Appendix B, and those for Group II in Table III, Appendix G. The Tables list the concentration found in weight percent for lead, and in parts-per-million by weight (ppm) for the elements antimony, silver, copper, aluminum, manganese, sodium, and chlorine -- eight elements in all.

The values shown for silver and aluminum were calculated from peak areas of 24.4-second silver - 110 (at 658 keV) and of 2.31-minute aluminum - 28 (at 1779 keV), respectively, in the pulse-height spectra from the 40-second pneumatic-tube activations. As noted earlier, these spectra also showed peaks due to antimony - 124m<sub>1</sub>, copper - 66, and lead - 204m, but these three elements were determinable more exactly from the spectra obtained in the one-hour rotary-rack irradiation, and, hence the Table values for antimony (via the 564 keV peak of 2.80-day antimony - 122), copper (via the 511 keV peak of 12.80-hour copper - 64), and lead (via the three peaks of 66.9-minute lead - 204m) are those obtained from the rotary-rack irradiation. The results shown in the Tables for manganese, sodium, and chlorine are also from the rotary-rack irradiation.

Two of the very small samples analyzed (the 5.4 milligram HC-4-2 sample, and the 1.3 milligram HC-9-2 sample) had results within expected standard deviations to those obtained from the respective larger samples (the 41.9 milligram HC-4-1 sample, and the 16.4 milligram HC-9-1 sample), but the much more exact values obtained from the larger samples, only, are shown in the Tables.

In most cases, the  $\pm$  value shown after each value in the Tables represents the uncertainty of the value (expressed as one standard deviation) computed only from the counting statistics. In general, the overall uncertainty of a given value may be in some cases as much as two or three times the standard deviation calculated just from the counting statistics. For silver and aluminum, which were measured twice on each sample, the  $\pm$  values shown represent one standard deviation calculated from either the counting statistics or the spread of the two values -- whichever was larger.

The ppm values shown in the Tables for antimony, silver, and copper were obtained, as mentioned earlier, by comparison with standard samples of these elements activated and counted along with the various evidence samples, and hence these values should be quite accurate. Similarly, the results for lead should be very reliable since they were based on

previously tested lead standards. For the remaining elements (aluminum, manganese, sodium, and chlorine), whose presence was not known in advance, as mentioned earlier, standards of these elements were thus not prepared at the time of these experiments. Instead, standard table values were used in the calculations for these elements. As a result, the reported ppm values for these four elements present in the evidence sample could be in error by a factor of perhaps two on an absolute scale. However, the use of tabulated standard values does not affect the relative values -- only the absolute values of a given element in the various samples.<sup>8/</sup>

8. For example, if the estimated values for aluminum, based on standard tables, in two samples were  $5.0 \pm 0.5$  ppm and  $2.5 \pm 0.3$  ppm, the ratio of their aluminum concentrations would be  $2.0 (\pm 0.3)$  to 1. If the standard table value for aluminum were 20% high, for example, the true sample aluminum values would be  $6.2 \pm 0.6$  ppm and  $3.1 \pm 0.3$  ppm, respectively, but their ratio would still be  $2.0 (\pm 0.3)$  to 1.

V.

## CONCLUSIONS

A. It is highly probable that the evidence specimens from Group I are all fragments from Mannlicher-Carcano bullets.

As discussed in Appendix C., Mannlicher-Carcano ammunition displays very distinct characteristics when analyzed by neutron activation analysis. The ammunition displays an unusual range of concentrations for the antimony in bullet lead. The concentrations for silver are unusual as well, although not as distinct as those of antimony. Based upon these characteristics, and the results obtained from an analysis of the evidence specimens, it is highly probable that all the evidence specimens are fragments from Mannlicher-Carcano bullets. The antimony content of the evidence fragments is such that it is significantly higher than that found in most unhardened bullet lead examined by the author, and significantly lower than that found in bullet lead of hardened lead bullets examined by the author. Such an intermediate range of antimony concentrations is particularly characteristic of Mannlicher-Carcano ammunition. The values of silver found in the fragments also support the conclusion that the fragments are from Mannlicher-Carcano ammunition, as these values also are within the range characteristic of Mannlicher-Carcano ammunition.

B. It is highly probable that the Walker bullet is a Mannlicher-Carcano bullet.

The bullet fragment recovered from the home of

General Walker is apparently also from Mannlicher-Carcano ammunition. This sample (CE-573, FBI Q188) of a bullet fragment recovered from the home of General Walker in April of 1963 was analyzed by the FBI in late 1963, but only by the rather qualitative method of emission spectrography. They did not analyze it by neutron activation analysis. This sample was analyzed by INAA during the UCI analysis. It was determined that the bullet lead consisted of almost 100% lead, with only 17 ppm antimony and 20.6 ppm silver. (See Appendix G.) Its composition, therefore, is considerably different from any of the Dallas specimens -- which are also almost 100% lead, but contain much more antimony (602 to 833 ppm) and much less silver (7.9 to 9.8 ppm). However, the antimony content of the Walker bullet is close to the range of Sb values found earlier at UCI for Mannlicher-Carcano bullets from the four Western Cartridge Company production lots (24 to 1218 ppm), and also close to the range of Ag values found in such ammunition (6.0 to 15.9 ppm). Furthermore, the composition of the Walker bullet is very close to that of the unfired Mannlicher-Carcano cartridge reportedly recovered from the rifle found in the TSBD.

The unfired MC cartridge (CE-141, FBI Q8) was never before taken apart or analyzed. At UCI it was examined, taken apart, its several components weighed, the bullet lead sampled, the cartridge reassembled, and the two small bullet-lead samples taken from it analyzed by INAA. (See Appendix G.)

Its composition (almost 100% lead, 15 ppm antimony, and 22.4 ppm silver) is extremely close to that of the Walker bullet and, consequently, supports the conclusion that the Walker fragment is from MC ammunition.

C. The results indicate the presence of only two bullets in Group I.

When the recent UCI results were analyzed statistically, taking into account both the overall reproducibility of the measurements on a single sample and the variability due to counting statistics of the individual measurements, evidence for the presence of only two bullets is found. Whereas, for most brands of ammunition it is not possible to distinguish between two bullets from cartridges from the same box/production lot, earlier studies by the author on Western Cartridge Company Mannlicher-Carcano 6.5 mm bullets have shown that this brand (lots 6000, 6001, 6002, 6003) exhibits widely different antimony values, even amongst bullets from a given lot, so that individual bullets of this brand can usually be distinguished from one another. (See Appendix C.)

The presence of only two bullets is indicated as follows:

- Q1 (Stretcher bullet) and Q9 (fragments from Connally's wrist) match one another within one standard deviation in both antimony and silver.
- Q4, 5 (Fragments from President Kennedy's brain), Q2 (large fragment found in car), and Q14

(smaller fragments found in car) match one another within one standard deviation in both antimony and silver.

Q1, although similar in silver content, is markedly different in antimony content from Q2, Q4, 5, and Q14.

Q9 differs considerably from Q2, Q4, 5, and Q14 in both antimony and silver.

These results therefore indicate the presence of only two bullets: (Q1 and Q9 one bullet) and (Q2, Q4, 5, and Q14 a second bullet). There is no evidence of a third bullet.<sup>9/</sup>

The analyses not only resulted in values for silver and antimony in the various samples, but also in values for six additional elements: lead, copper, aluminum, manganese, sodium and chlorine. The values for these additional six elements do not appear to contribute much useful information -- except to confirm, quantitatively, that all the samples are approximately 100% lead. With the exception of Q9, all the

9. Independent research conducted by the author (See, Reference Number 10 in Appendix H.) indicates that a careful analysis of the data obtained by the FBI during the INAA tests conducted by the FBI in 1964 (using a scintillation detector rather than the higher-resolution modern Ge(Li) detector) would reach this same conclusion. The FBI reported the results of its tests as inconclusive due to the wide variety of absolute values obtained each time a sample was tested. These results, however, were under differing test conditions. It is necessary to compare the results obtained under a given set of conditions, rather than a comparison of all the values under all conditions, to reach the conclusion that only two bullets were present.

copper values were approximately the same -- in the range of 40 to 58 ppm. The very high copper value of the Q9 sample (994 ppm) is most likely due to contamination from the copper jacket of the bullet. The copper values for samples Q4, 5, Q2, and Q14 average  $42 \pm 2$  ppm -- appreciably different from the Q1 (stretcher bullet) copper value of  $58 \pm 3$  ppm. The aluminum values range from 1.1 to 8.1 ppm and show no systematic trends between the two groups of samples. Similarly, the manganese values range from 0.01 to 0.10 ppm and show no systematic behavior. The sodium values show a wide range, from 5 to 134 ppm, and the chlorine values also show a wide range, from 19 to 257 ppm -- in both cases with no evidence of any trends. Even though all the samples were washed three times with pure water and pure acetone, to free them of any salt (sodium chloride) possibly accumulated on the exteriors of the samples from previous exposures to the air and/or possible handling by fingers (perspiration), it cannot be ruled out that some slight and variable amounts of salt contamination were still present in some of the samples. It might be significant that the two samples that show the highest levels of sodium and chlorine are samples Q4, 5 (President Kennedy's brain) and Q9 (Governor Connally's wrist) -- the only two samples that were recovered from biological tissue. It is barely possible that these samples, in spite of the washing, still contained a small but significant amount of dried body fluid (e.g., blood), which would



increase the levels of sodium and chlorine in the samples. The other samples exhibited much lower levels of sodium (only 5 to 19 ppm) and of chlorine (only 19 to 40 ppm).

Accordingly, neutron activation analysis of the evidence specimens tested indicates the presence of only two bullets in Group I. It is highly probable that the specimen tested from Q1 (the stretcher bullet) and the specimen tested from Q9 (the fragments from Governor Connally's wrist) are from the same bullet. It is highly probable that Q2 (large fragment found in the limousine), Q4 and 5 (fragments from President Kennedy's brain) and Q14 (smaller fragments found in limousine) are all from a second bullet. There is no evidence of a third bullet from any of the evidence specimens tested.<sup>10/</sup>

10. More recent very detailed INAA studies made at UCI (See reference 11 in Appendix H) on 10 samples from each of 16 Mannlicher-Carcano bullets — 4 from each of the 4 production lots — give a more complete picture of the generally high degree of homogeneity of individual bullets and the wide variation from bullet to bullet, regardless of lot number, of the antimony concentration in particular, the appreciable variation of the silver concentration, and the lesser variation of the copper concentration. However, the earlier data and these more recent data do show some Mannlicher-Carcano bullets that cannot be distinguished from one another via only their antimony and silver concentrations. From these data, it appears that if 2 cartridges are removed at random from a box of Mannlicher-Carcano cartridges, although it is highly probable that they would differ significantly in their antimony and silver concentrations, it is at least possible that they might not.

## APPENDIX A

## LIST OF ABBREVIATIONS AND SYMBOLS

UCI	University of California at Irvine, or U.C. Irvine.
FBI	(U.S.) Federal Bureau of Investigation.
MC	Mannlicher-Carcano.
Sb	Chemical symbol for the element, antimony.
Ag	Chemical symbol for the element, silver.
Cu	Chemical symbol for the element, copper.
Pb	Chemical symbol for the element, lead.
Al	Chemical symbol for the element, aluminum.
Mn	Chemical symbol for the element, manganese.
Na	Chemical symbol for the element, sodium
Cl	Chemical symbol for the element, chlorine.
$^{122}_{\text{Sb}}$	Symbol for the antimony radioisotope of mass number 122. (half life of 2.80 days), antimony - 122.
$^{124\text{m}}_{1\text{Sb}}$	Symbol for the metastable antimony radioisotope of mass number 124 (half life of 93 seconds), antimony - $^{124\text{m}}_1$ .
$^{124}_{\text{Sb}}$	Symbol for the antimony radioisotope of mass number 124 (half life of 60.4 days), antimony - 124.
$^{110}_{\text{Ag}}$	Symbol for the silver radioisotope of mass number 110 (half life of 24.4 seconds), silver - 110.

$^{64}\text{Cu}$	Symbol for the copper radioisotope of mass number 64 (half life of 12.80 hours), copper - 64.
$^{66}\text{Cu}$	Symbol for the copper radioisotope of mass number 66 (half life of 5.10 minutes), copper - 66.
$^{204m}\text{Pb}$	Symbol for the metastable lead radioisotope of mass number 204 (half life of 66.9 minutes), lead - 204m.
$^{28}\text{Al}$	Symbol for the aluminum radioisotope of mass number 28 (half life of 2.31 minutes), aluminum - 28.
$^{56}\text{Mn}$	Symbol for the manganese radioisotope of mass number 56 (half life of 2.576 hours), manganese - 56.
$^{24}\text{Na}$	Symbol for the sodium radioisotope of mass number 24 (half life of 14.96 hours), sodium - 24.
$^{38}\text{Cl}$	Symbol for the chlorine radioisotope of mass number 38 (half life of 37.29 minutes), chlorine - 38.
NAA	Neutron activation analysis.
INAA	Instrumental neutron activation analysis.
CE	Abbreviation for (Warren) "Commission Exhibit".

HC	Sample designation abbreviation used at UCI, referring to "House Committee".
cm <sup>3</sup>	Abbreviation for cubic centimeter, a metric unit of volume (one cubic inch equals 16.4 cm <sup>3</sup> ).
Ge(Li)	Abbreviation for a lithium-drifted germanium semiconductor gamma-ray detector.
mm	Abbreviation for millimeter, a metric unit of length (one inch equals 25.4 mm).
mg	Abbreviation for milligram, a metric unit of mass or weight (one gram equals 1000 mg.).
g	Abbreviation for gram, a metric unit of mass or weight (one ounce equals 28.3 g).
µg	Abbreviation for microgram, a metric unit of mass or weight (one gram equals one million µg).
n	Abbreviation for neutron, a fundamental particle that is a constituent of atomic nuclei.
cm <sup>2</sup>	Abbreviation for square centimeter, a metric unit of area (one square inch equals 6.45 cm <sup>2</sup> ).
keV	Abbreviation for one thousand electron volts of energy.
γ	Abbreviation for gamma, as in gamma ray (γ ray).
ppm	Abbreviation for parts-per-million by weight (one ppm equals one µg of constituent per gram of material).

Std.  
dev.      Abbreviation for standard deviation, a statistical  
            measure of precision (also abbreviated as  $\sigma$  or  $s$ ).

cm         Abbreviation for centimeter, a metric unit of  
            length (one inch equals 2.54 cm; one cm equals  
            10 mm).

APPENDIX B  
 TABLE I  
 RESULTS FROM SEPTEMBER 1977 INAA OF EVIDENCE SPECIMENS AT U.C. IRVINE

Sample Number	FBI O- HC-	% Lead	ppm Antimony	ppm Silver	ppm Copper	ppm Aluminum <sup>a</sup>	ppm Manganese	ppm Sodium	ppm Chlorine <sup>a</sup>
399	1	101±4 <sup>b</sup>	833±9	7.9±1.4	58±3	ND <sup>c</sup>	0.09±0.02	5±1	19±12
567	2	95±2	602±4	8.1±0.6	40±1	1.1±0.4	0.01±0.01	9±1	22±6
843	4,5	4-1 95±2	621±4	7.9±0.3	40±2	5.5±0.7	0.10±0.01	134±3	59±10
842	9	9-1 104±2	797±7	9.8±0.5	994±7	8.1±1.4	0.07±0.02	120±4	257±14
840	14	14-1 94±2	638±4	8.6±0.3	44±2	2.7±0.6	0.06±0.01	13±1	38±7
		14-2 103±2	647±4	7.9±0.5	42±2	2.4±0.5	0.05±0.01	19±1	40±8

<sup>a</sup> The absolute values shown for Al, Mn, Na and Cl are approximate values, since standards of these elements were not run, but table values used instead. However, this does not affect their relative values.

<sup>b</sup> The  $\pm$  values shown for Pb, Sb, Cu, Mn, Na, and Cl represent one standard deviation, based only on the counting statistics. They were calculated in the usual way, taking into account the gross photopeak counts and the counts in the underlying Compton continuum. For a normal distribution, about 68% of the values observed in repetitive measurements should fall within the limits of the mean value  $\pm 1\sigma$ . For Ag and Al, which were measured twice on each sample, the  $\pm$  value shown is  $1\sigma$  calculated either from the counting statistics or from the spread of the two values, whichever resulted in the larger  $\sigma$  values.

<sup>c</sup> ND means none detected.

APPENDIX C  
BACKGROUND DATA ON MANNLICHER-CARCANO  
AMMUNITION

During 1964, Dr. John Nichols obtained boxes of Western Cartridge Company Mannlicher-Carcano 6.5 mm cartridges from the four different production lots of this ammunition that they produced: Lots 6000, 6001, 6002, and 6003. According to the Western Cartridge Company, these production lots of this ammunition were of one million rounds each, all produced in 1954 for the U. S. Army. Each cartridge contained an average of 44 grains (2.85 grams) of a special blend of Western Ball Powder. The lead cores of the bullets weighed 110 grains (7.13 grams), had a diameter of 5.33 mm and a length of 26.2 mm, and consisted of #0 soft lead (99.85% pure). The bullet jacket weighed 51 grains (3.3 grams), had a side wall thickness of 0.66 mm, and consisted of CDA No. 220 Commercial Bronze (90% copper, 10% zinc). The primer cup was made of CDA alloy no. 260 cartridge brass (70% copper, 30% zinc), and its main components were 37% lead styphnate, 32% barium nitrate, 15% antimony sulfide, 7% aluminum powder, 5% PETN, and 4% tetracene. Dr. Nichols used some of this ammunition in various test firings

that he conducted with a Mannlicher-Carcano rifle of the same make as that reportedly used by Lee Harvey Oswald. Late in 1972, Dr. Nichols contacted the author, offering to supply bullet-lead samples from the four production lots, for NAA examination by the author. The author accepted the offer, and Dr. Nichols shortly sent him two bullets from Lot 6000 and four each from Lots 6001, 6002, and 6003. The author commenced analysis of these in late 1973 with most of the work carried out during 1974 and a few final measurements early in 1975.

Samples ranging in weight from 44 to 58 milligrams (each weighed to within  $\pm 0.1$  milligram) were drilled out from the open base end of each bullet with a cleaned small steel drill, after first scraping the surface of the bullet face free of oxidized layer with a clean stainless-steel scalpel. Each drilled sample was washed with high-purity toluene, to remove any oil or grease possibly present.

In the first analyses, all 14 samples, along with a standard of antimony, were activated for 2 hours in the rotary-specimen rack of the UCI TRIGA Mark I reactor, at a thermal-neutron flux of  $1.0 \times 10^{12}$  n/cm<sup>2</sup>-sec. After



a decay period of approximately 24 hours, each activated sample was counted for 200 seconds livetime on top of a 38 cm<sup>3</sup> Ge(Li) detector (with a 1 cm beta-particle absorber), coupled to a 4096-channel pulse-height analyzer. The only photopeaks observed were those of 12.80-hour <sup>64</sup>Cu, 2.80-day <sup>122</sup>Sb, 60.4-day <sup>124</sup>Sb, and 14.96-hour <sup>24</sup>Na. The counts in the 511 keV peak of <sup>64</sup>Cu, in the 564 keV peak of <sup>122</sup>Sb, and in the 1368 keV peak of <sup>24</sup>Na were printed out. After correcting all of the data to the same decay time, the number of micrograms of copper (Cu), antimony (Sb), and sodium (Na) in each sample was calculated, along with its standard deviation -- calculated from the counting statistics. Dividing each µg value by the sample weight, in grams, then gave the ppm concentrations. The Cu and Na values were calculated from tabulated standard values. These are tabulated in Table II-A.

Later, after the previously-induced activities had decayed down to negligible levels, the 14 samples were activated and counted again, under different conditions. This time, the samples were activated and counted in sequence, one at a time. Each sample was activated for 40 seconds in the pneumatic-tube position of the reactor, at a thermal-neutron flux of  $2.5 \times 10^{12}$  n/cm<sup>2</sup>-sec. After a

decay period of 40 seconds (during which the activated sample was transferred to a fresh vial), each sample was counted for 40 seconds clocktime under the same counting conditions used in the previous measurements. In the subsequent calculations, a small correction was made for the average analyzer deadtime during each counting. The principal induced activities observed in the pulse-height spectra were those of 24.4-second  $^{110}\text{Ag}$  (658 keV $\gamma$ ), 5.10-minute  $^{66}\text{Cu}$  (1039 keV $\gamma$ ), and 93-second  $^{124\text{m}}\text{Sb}$  (498, 603, and 646 keV $\gamma$ 's), although the 12.80 hour  $^{64}\text{Cu}$  (511 keV $\gamma$ ) and 2.80-day  $^{122}\text{Sb}$  (564 keV $\gamma$ ) activities were also observed, as well as very small peaks due to 66.9-minute  $^{204\text{m}}\text{Pb}$  (375, 899, and 912 keV's). Standards of silver, antimony, and copper were then activated and counted under the same conditions, but at a thermal-neutron flux only 1/100 as large. Microgram and ppm values for Ag, Sb, and Cu were then calculated for each sample (along with its standard deviation, based upon the counting statistics) from the sizes of the 658 keV peak of 24.4-second  $^{110}\text{Ag}$ , the 498 keV peak of 93-second  $^{124\text{m}}\text{Sb}$ , and the 1039 keV peak of 5.10-minute  $^{66}\text{Cu}$ . The silver results are also included in Table II-A

The new antimony results (from  $^{124}\text{mSb}$ ) and the new copper results (from  $^{66}\text{Cu}$ ) in all cases compared well with the results for these two elements obtained in the previous longer irradiation (with measurement, instead, of  $^{122}\text{Sb}$  and  $^{64}\text{Cu}$ ). However, the counting statistics (precisions) of the  $^{122}\text{Sb}$  and  $^{64}\text{Cu}$  results from the longer irradiation were much better than those of the  $^{124}\text{mSb}$  and  $^{64}\text{Cu}$  results from the 40-second irradiations, so only the  $^{122}\text{Sb}$  and  $^{64}\text{Cu}$  results are given in Table II-A.

The antimony results obtained, shown in Table II-A, were surprising. In all earlier studies of commercial bullet leads, individual bullets were found to be quite homogeneous in their antimony concentrations, and bullets from the same box of cartridges were found to be closely similar to one another in their antimony concentrations. In sharp contrast, the bullet-to-bullet variation in antimony content amongst bullets from the same box of Mannlicher-Carcano cartridges is seen to be tremendous: the four samples of lot 6001 bullet lead ranged all the way from 158 ppm to 1218 ppm Sb; those of lot 6002 bullet lead all the way from 24 to 949 ppm Sb; and those of lot 6003 all the way from 80 to 730 ppm Sb. In general, such antimony values indicate that (1) the bullets were indeed a soft

lead, since bullet lead deliberately hardened by alloying the lead with antimony requires the addition of anywhere from about 0.4% (4000 ppm) Sb up to several percent, (2) no effort was made by the manufacturer to control the antimony content of the bullet lead, so long as it was much less than 4000 ppm, and (3) the high degree of Sb variability during a production run indicates that the lead supply was of mixed sources, apparently containing an appreciable amount of scrap lead (some of which is antimony-hardened lead), since virgin lead seldom contains more than 10-20 ppm Sb.

From a great deal of earlier work on the INAA of bullet-lead samples for Ag, Sb, and Cu, it had been established that the method itself was highly reproducible, approximately to within the limits imposed by the counting statistics, for any individual sample. To prove this point, however, two individual specimens (6001 B and 6002 B) were each analyzed four times, for Ag, Sb, and Cu, under the pneumatic-tube conditions. As can be seen from the results, shown in Table II-B, the reproducibility for a given sample is indeed quite satisfactory. After each ppm value is shown its standard deviation, based upon its counting statistics. The  $\pm$  value shown after each

mean value, however, is the standard deviation of the set of four values, calculated from the deviations of the values from the mean value. It can be seen that the standard deviation shown with the mean value is generally fairly close to the counting-statistics standard deviation of an individual measurement.

To study the degree of homogeneity of individual Mannlicher-Carcano bullets, four samples of bullet lead were analyzed from each of three individual bullets (bullets 6001 C, 6002 A, and 6003 A). The larger drillings obtained from each of these three bullets (which were made approximately down the longitudinal axis of each bullet) were cut into four pieces -- one of which was the specimen analyzed earlier. These samples were then analyzed for Ag, Sb, and Cu under the same pneumatic-tube conditions used before. The results are shown in Table II-C. As can be seen, of the three bullets sampled, one (6001 C) is fairly homogeneous in all three elements; one (6002 A) is fairly homogeneous in Ag and Cu, but not so homogeneous in Sb; and one (6003 A) is fairly homogeneous in Cu, but not homogeneous in Sb or Ag. However, comparison of Table II-C with Table II-A indicates that, in general, the

heterogeneity within an individual Mannlicher-Carcano bullet is much less than the heterogeneity from one bullet to another. One of the primary conclusions, therefore, of the results of the UCI background study of MC bullet lead indicates a wide range of Sb values, from bullet to bullet, but reasonable homogeneity within an individual bullet.

## APPENDIX D

TABLE II-A

THE TRACE-ELEMENT COMPOSITION OF MANNLICHER-CARCANO 6.5 mm BULLET  
LEADS FROM LOTS 6000, 6001, 6002, AND 6003

(INAA results obtained by V.P. Guinn during 1973-1975)

ppm Element Found, and Standard Deviation in ppm\*

<u>Lot No.</u>	<u>Bullet Sample No.</u>	<u>Wt. (mg)</u>	<u>Silver</u>	<u>Antimony</u>	<u>Copper</u>	<u>Sodium</u>
6000	A	51.2	11.8 $\pm$ 0.4	173 $\pm$ 3	372 $\pm$ 6	13 $\pm$ 1
	B	45.6	13.5 $\pm$ 0.5	261 $\pm$ 3	167 $\pm$ 4	15 $\pm$ 1
6001	A	47.8	12.2 $\pm$ 0.6	158 $\pm$ 3	(2766 $\pm$ 16)**	13 $\pm$ 1
	B	57.9	15.3 $\pm$ 0.5	732 $\pm$ 5	23 $\pm$ 2	13 $\pm$ 1
	C	58.5	8.5 $\pm$ 0.4	1218 $\pm$ 7	48 $\pm$ 2	15 $\pm$ 1
	D	47.2	11.6 $\pm$ 0.4	161 $\pm$ 3	147 $\pm$ 4	17 $\pm$ 1
6002	A	51.8	9.1 $\pm$ 0.4	385 $\pm$ 4	30 $\pm$ 2	12 $\pm$ 1
	B	52.8	9.7 $\pm$ 0.4	949 $\pm$ 6	25 $\pm$ 2	12 $\pm$ 1
	C	55.3	6.0 $\pm$ 0.3	24 $\pm$ 1	120 $\pm$ 3	15 $\pm$ 1
	D	51.3	8.3 $\pm$ 0.6	121 $\pm$ 2	(4516 $\pm$ 21)**	13 $\pm$ 1
6003	A	54.3	15.9 $\pm$ 0.5	730 $\pm$ 5	21 $\pm$ 2	12 $\pm$ 1
	B	44.6	7.9 $\pm$ 0.4	80 $\pm$ 2	62 $\pm$ 2	20 $\pm$ 2
	C	44.7	8.8 $\pm$ 0.4	464 $\pm$ 5	36 $\pm$ 2	17 $\pm$ 1
	D	44.0	8.7 $\pm$ 0.4	240 $\pm$ 3	17 $\pm$ 2	15 $\pm$ 1

\* One standard deviation, based only upon the counting-statistics standard deviation of a single measurement.

\*\* These two copper values are extremely high. It may be that these two samples were contaminated with jacket material during the drilling out of the sample.

## APPENDIX E

TABLE II-B

REPRODUCIBILITY MEASUREMENTS ON TWO INDIVIDUAL SPECIMENS OF MANNLICHER-CARCANO BULLET LEAD (MADE BY V.P. GUINN, PNEUMATIC-TUBE CONDITIONS).

<u>Specimen</u>	<u>Measurement No.</u>	<u>ppm Element Found + One Standard Deviation*</u>		
		<u>antimony</u>	<u>silver</u>	<u>copper</u>
6001B (57.9mg)	1	621+56	15.3+0.5	19+10
	2	646+55	16.6+0.4	19+4
	3	646+55	13.9+0.4	18+5
	4	791+55	15.0+0.4	20+5
mean:		676+78	15.2+1.1	18.5+1.3
6002B (52.8mg)	1	990+60	9.7+0.4	16+10
	2	1007+56	10.1+0.4	10+5
	3	942+56	9.8+0.4	24+5
	4	946+56	10.7+0.4	24+5
mean:		971+32	10.1+0.5	18.5+6.8

\* Standard deviation of individual measurements based upon counting statistics only. Standard deviation shown with mean values based upon the spread of the four individual measurements.



## APPENDIX F

TABLE II-C

HOMOGENEITY MEASUREMENTS ON FOUR SPECIMENS FROM EACH OF THREE INDIVIDUAL MANNLICHER-CARCANO BULLETS (MADE BY V.P. GUINN, PNEUMATIC-TUBE CONDITIONS)

<u>Production Lot</u>	<u>Specimen</u>	<u>ppm Element Found +</u>		<u>One Standard Deviation*</u>
		<u>Antimony</u>	<u>Silver</u>	<u>Copper</u>
6001	6001C	1139+60	8.5+0.4	67+11
	6001C1	1062+60	9.5+0.4	(391+17)**
	6001C2	1235+93	10.1+0.6	20+7
	6001C3	1156+90	9.2+0.5	23+10
	mean:	1148+71	9.3+0.7	37+26
6002	6002A	358+47	9.1+0.4	45+11
	6002A1	983+51	10.3+0.3	34+5
	6002A2	869+47	9.9+0.3	58+6
	6002A3	882+81	10.2+0.5	30+8
	mean:	773+281	9.9+0.5	42+13
6003	6003A	667+58	15.9+0.5	27+10
	6003A1	395+54	9.6+0.4	28+6
	6003A2	363+39	8.3+0.3	(257+12)**
	6003A3	441+51	9.8+0.4	16+5
	mean:	466+137	10.9+3.4	24+7

\* Standard deviation of individual measurements based upon counting statistics only. Standard deviation shown with mean values based upon the spread of the four (or three) individual measurements.

\*\* These two copper values excluded from the means as probably due to contamination from the bullet jackets.

APPENDIX G  
TABLE III

RESULTS FROM SEPTEMBER 1977 INAA OF ANALYSIS OF WALKER BULLET FRAGMENT AND UNFIRED

MC CARTRIDGE AT U. C. IRVINE

<u>Sample Number</u>											
<u>CE-</u>	<u>FBI</u>	<u>Q-</u>	<u>HC-</u>	<u>%Lead</u>	<u>Antimony</u>	<u>Silver</u>	<u>Copper</u>	<u>Aluminum</u>	<u>Manganese</u>	<u>Sodium</u>	<u>Chlorine</u>
					ppm	ppm	ppm	ppm	ppm	ppm	ppm
Walker Bullet Fragment	573	188	573	100+2	17+2	20.6+0.6	100+3	32+3	0.24+0.02	39+3	102+11
Unfired MC Cartridge	141	8	8-1	107+2	15+1	--	22+1	--	0.01+0.01	3+1	15+6
			8-2	--	--	22.4+1.0	--	ND	--	--	--

(The t values shown represent one standard deviation, based only on the counting statistics.)

## APPENDIX H

## REFERENCES ON THE INAA OF BULLET LEAD

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  10. V. P. Guinn and J. Nichols, "Neutron Activation Analysis of Bullet-Lead Specimens: The President Kennedy Assassination", Trans. Amer. Nucl. Soc., 28 (1978) 92-93.
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Mr. WOLF. Mr. Chairman, I have no further questions of Dr. Guinn.

Chairman STOKES. The Chair now recognizes the gentleman from Indiana, Mr. Fithian, for such time as he may consume.

Mr. FITHIAN. Thank you, Mr. Chairman.

Dr. Guinn, we are happy to have your expertise assisting the panel. I am holding in my hand a lead pencil, and I have now broken the point from this lead pencil. Would you tell me is this enough for you to analyze by your process?

Dr. GUINN. Well, that is a different kind of material.

Mr. FITHIAN. I know.

Dr. GUINN. It is called pencil lead; but it is actually graphite—not lead.

Mr. FITHIAN. Sizewise?

Dr. GUINN. Sizewise, that is plenty. For materials such a bullet lead, to be specific, any sample that weighs anywhere between 1 and 50 milligrams is sufficient or plenty. Such an amount represents a rather tiny sample of lead, but it is all we need.

Mr. FITHIAN. Now, if this were not graphite, and if it were bullet lead, and it contained a variety of these elements that you have described here today, antimony, silver, and so forth, would your neutron activation analysis sort out the count sufficiently accurately to tell us which elements are in that particle?

Dr. GUINN. It won't tell you all the elements that may be in them, but it will usually give you numerical results for a number of elements that will become detectably radioactive and readily identified; yes.

Mr. FITHIAN. As I understand it, this is from one pass through the equipment, simultaneously you read out several different elements?

Dr. GUINN. That is true. Usually when you activate a sample for a certain length of time in the reactor, wait a while, and then count the sample, you see peaks from a number of radioactive elements. Then if you take the same sample, if you wish, and do it over again, but this time irradiate longer and wait longer, then all of the isotopes you saw before you won't see this time because you have waited long enough that they are all gone, and now you will see some longerlived isotopes that were not there detectably before but now they are.

So you don't usually just do an activation and a count once, but you usually do it two or three times, if you are trying to look for a large number of elements.

Mr. FITHIAN. You used the term counting equipment. Could you explain that for those of us who are laymen in this?

Dr. GUINN. There are many kinds of radioactive detection devices which are usually loosely called counters. The most common one most people know about is a Geiger counter. If these same samples, after activating them, had been held near a Geiger counter, you would hear the Geiger counter ticking away. Unfortunately, the Geiger counter is, No. 1, not very sensitive for gamma radiation, and, No. 2, it can't tell one gamma ray from another. You have to go to a more elaborate detector. The kind, for example, that was used by the FBI in 1964, which was the only useful kind that was available then, was a scintillation detector. That is a

solid detector, it absorbs gamma rays better, so it is more efficient, and also the size of the output pulse from the detector is proportional to the gamma ray energy it has absorbed.

So with such a detector one has the possibility of using what we call a multichannel analyzer to look at the output pulses, sort them into their sizes, and get a spectrum with peaks.

Mr. FITHIAN. The current equipment is generations removed from the 1964 equipment?

Dr. GUINN. Yes, sir. The old scintillation detectors are still useful for some purposes, but the difficulty is that in a spectrum obtained from it, each of the peaks is typically about 20 times wider than the peaks from a modern germanium detector. We say that means that the older scintillation detector has very poor energy resolution.

In the chart example that shows the silver—110 peak, with a little antimony—124m, peak next to it, for example, with a scintillation detector all you would see would be one broad peak that included both of them, and you wouldn't know that you really were looking at two gamma rays, of two different energies.

The germanium detector, the more modern type, which wasn't available generally in 1964, is a high-resolution detector, it is of a new generation of detectors, and that was really one of the primary reasons for wanting to reanalyze these samples, but now with much more modern equipment.

Mr. FITHIAN. Just for the record, before I ask the additional questions, in your answer to counsel Wolf's question you used the phrase that the WCC Mannlicher-Carcano bullets were made of unhardened lead. You were referring only to the lead core and not to the hardened copper jacket?

Dr. GUINN. That is correct. The specifications for those bullets were that they were to be made of No. 0 soft lead, unhardened, that was at least 99.85 percent lead.

Mr. FITHIAN. One of the most serious questions facing the panel is the identification of the "pristine" bullet with the fragment taken from Governor Connally, in the wrist wound area. I realize the importance of your conclusion that the fragments removed during the surgery from Governor Connally's wrist were from the "pristine" bullet, and I realize the difficulty of saying you are absolutely certain to the exclusion of all other possibilities, but I am wondering if you could go any further than you have, in terms of certainty of the comparison of those two specimens?

Dr. GUINN. I don't think that I can in the sense of putting a percent probability or something like that. All I can say is that those two specimens, CE-399 and 842, agree so closely in their antimony concentration and their silver concentrations that I could not distinguish one from the other. However, I can clearly distinguish those two from the other three specimens. They are different. They are still WCC Mannlicher-Carcanos; but they represent a different WCC Mannlicher-Carcano bullet.

Mr. FITHIAN. And so it is your testimony that it is very unlikely that these were fragments from two different bullets?

Dr. GUINN. It would be extremely unlikely. You can imagine that certainly there are some WCC Mannlicher-Carcano bullets that are of essentially the same composition, and hence that the pristine

bullet might be one bullet that just happened to have the same composition as a different bullet that fractured the wrist, for example, but it is very, very unlikely.

Mr. FITHIAN. But the scientific term that you used, is it extremely unlikely?

Dr. GUINN. Extremely unlikely, or very improbable, however you prefer.

Mr. FITHIAN. To your knowledge, has any other scientist to date linked the so-called pristine bullet to the injuries?

Dr. GUINN. Not that I am aware of; no.

Mr. FITHIAN. Equally important, as your conclusions concerning Governor Connally's wrist injuries and the "pristine" bullet, is the second conclusion you make, and that is that there is no evidence of a third, fourth, or fifth bullet represented in any of the fragments that you tested?

Dr. GUINN. That is correct.

Mr. FITHIAN. And therefore, it is highly likely—is that the term you used to Mr. Wolf—that all fragments tested match up with two bullets and two bullets only?

Dr. GUINN. Yes, sir. The other three samples that we have been referring to—one being the fragments recovered from President Kennedy's brain, and then two different groups of particles found on the floor of the limousine—those three specimens are indistinguishable from one another, but markedly different from CE-399 and 842. So there is only evidence for the presence of two different bullets.

Mr. FITHIAN. I understand that the Warren Commission did emission spectrography tests on many of the same items you have tested with neutron activation analysis. How does the neutron activation analysis process, just in brief layman's terms, differ, and what are the advantages or disadvantages of the two methods of testing?

Dr. GUINN. Well, they have some similarities and they have some differences. They are both methods of elemental analysis. They will both detect down into what we call the trace element range, approaching parts per million, let's say, and they will both detect a number of elements more or less simultaneously in the specimens.

Now, where they differ is that for most elements, at least, we can detect much lower concentrations by activation analysis. In other words, activation analysis is more sensitive for most elements.

What is perhaps even more important, though, is that activation analysis, when it measures something, measures it very quantitatively. Emission spectrography does not.

I have a copy of all of the FBI raw data from those measurements, and they list things like magnesium, a trace; chromium, a very slight trace; and things like that. No numbers. So you can't make any kind of quantitative comparisons by looking at information of that sort. And the remaining difference is that the emission spectrographic method is destructive. You normally would like to have about 10 milligrams of samples, which isn't a great deal, but that 10 milligrams is totally consumed, it is vaporized and it is gone, whereas the way we analyze bullet-lead samples, at least, and

many other kinds, by activation analysis, the method is nondestructive.

These same samples I analyzed, if somebody didn't agree with the numbers, they could come back and do them all over again on the same specimens.

Mr. FITHIAN. Your results then could be verified by others?

Dr. GUINN. Yes, sir, all the samples I activated and analyzed were turned right back over to the Archives, and they are right back there, and they could be reanalyzed.

Mr. FITHIAN. Dr. Guinn, this is not meant to be an embarrassing question, but I think I must ask it. Mr. Chairman, a recent article in the New Times magazine stated that you had worked for the Warren Commission and, therefore, your conclusions for this committee would be implicitly biased.

Did you even work for the Warren Commission or work for the FBI in connection with the analysis of these evidence samples?

Dr. GUINN. Neither one. I think Mr. Wolf called my attention to the existence of this article, which I haven't seen, and I don't know where they got their misinformation, but I never did anything for the Warren Commission, and although I know people in the FBI, I have never done any work for them.

Mr. FITHIAN. But it is correct, isn't it, that the Warren Commission had the FBI perform neutron activation analysis measurements on the bullet-lead specimens in 1964?

Dr. GUINN. Yes, sir.

Mr. FITHIAN. How did you find this out?

Dr. GUINN. Well, it was rather interesting because both Dr. John Nichols and I felt that activation analysis of the bullet-lead specimens in the President Kennedy case should be done, and he in particular was trying to persuade J. Edgar Hoover, first, and later Clarence Kelley, that these things should be done. He made no progress with them, and then quite accidentally there turned up in the Archives a letter from J. Edgar Hoover to J. Lee Rankin, in July 1964, stating that indeed the FBI had made activation analysis measurements on these samples. Until then, this fact was totally unknown to us, so, therefore, after that we requested the results, because, the letter didn't give any numerical results; it just said that the analyses had been done and the results were generally inconclusive. This again took quite some time, and it was only finally, under the amended Freedom of Information Act, that Dr. Nichols was able to obtain the some 70 pages of raw data copied out of the FBI records, from the FBI. I then took all of those data and recalculated them from scratch.

Mr. FITHIAN. I want to come back to that data in just a moment; because I think it is very, very, important for us to explore that with you, but let me ask, prior to doing that, do you know why the existence of these tests was never divulged until recently?

Dr. GUINN. No; I certainly don't know why. I can just speculate. The letter states that—if I may just read this one last little short sentence in it—this is from J. Edgar Hoover to the Warren Commission. It states:

While minor variations in composition were found by this method, these were not considered sufficient to permit positively differentiating among the larger bullet



fragments and thus positively determining from which of the larger bullet fragments any given small lead fragment may have come.

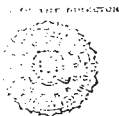
I believe probably that the FBI and the Warren Commission both felt that this didn't prove anything, in their opinion, and, therefore, didn't need to be noted.

Since we had been asking them for quite sometime to perform such analyses, we rather thought it would have been nice if they had told us, instead of our eventually finding out accidentally.

Mr. FITHIAN. Mr. Chairman, I would like the record to show that the witness, Dr. Guinn, was reading the last paragraph of a letter from J. Edgar Hoover to J. Lee Rankin, the General Counsel to the President's Commission, the so-called Warren Commission, dated July 8, 1964, and delivered by courier service. I would ask that the entire letter be made a part of this exhibit as JFK exhibit No. F-332.

Chairman STOKES. Without objection, it may be entered into the record.

[The above referred to JFK exhibit No. F-332 follows.]



UNITED STATES DEPARTMENT OF JUSTICE  
FEDERAL BUREAU OF INVESTIGATION

WASHINGTON 25, D.C.

July 8, 1964

By Courier Service

Honorable J. Lee Rankin  
General Counsel  
The President's Commission  
200 Maryland Avenue, Northeast  
Washington, D. C.

FORWARDED  
JOHN NICHOLS  
NOV 31 11 32 AM '73  
PATHOLOGICAL ANTHROPOLOGY  
UNIVERSITY OF KANSAS MED. CENTER

Dear Mr. Rankin:

As previously reported to the Commission, certain small lead metal fragments uncovered in connection with this matter were analyzed spectrographically to determine whether they could be associated with one or more of the lead bullet fragments and no significant differences were found within the sensitivity of the spectrographic method.

Because of the higher sensitivity of the neutron activation analysis, certain of the small lead fragments were then subjected to neutron activation analyses and comparisons with the larger bullet fragments. The items analyzed included the following: C1 - bullet from stretcher; C2 - fragment from front seat cushion; C4 and C5 - metal fragments from President Kennedy's head; C9 - metal fragment from the arm of Governor Connally; C16 - metal fragments from rear floor board carpet of the car.

*We did not examine the copper zinc jackets and fragments.*

While minor variations in composition were found by this method, these were not considered sufficient to permit positively differentiating among the larger bullet fragments and thus positively determining from which of the larger bullet fragments any given small lead fragment may have come.

Sincerely yours,

*J. Edgar Hoover*

JFK EXHIBIT F-332

Dr. GUINN. May I comment—I will give you this copy of the letter—but it does have stamped on it, which of course wasn't there originally, John Nichols stamp when he received it, in November 1973, and he also wrote in himself one little handwritten line. Those were not in original, but otherwise it is a copy of the original letter.

Mr. FITHIAN. So, for the record, then, the handwritten notation between paragraphs two and three, which read "He did not examine the copper, zinc jackets and fragments," was written by Prof. John Nichols and were not a part of the original letter when we received it?

Dr. GUINN. I guess that was John Nichols little note from him to me that he put in there.

Mr. FITHIAN. With regard to that important paragraph that says, "These are inconclusive," I would like now to ask you, Dr. Guinn, if you could tell us what your findings were when you looked at the same 70 pages of raw data, and prior to that, are you aware or do you know who and how this neutron activation analysis work was done and whether this was a common practice of the FBI or just how this came about?

Dr. GUINN. Yes, I have subsequently found out most of the details of it. The FBI work was done in May 1964, at which time the FBI laboratory had not done any prior activation analysis work, so far as I am aware. But in the same elemental analysis group, where such work would normally fall, they asked Mr. Jack Gallagher (John F. Gallagher) of their staff, whom I know, to take these bullet lead specimens down to the Oak Ridge National Laboratory.

Mr. FITHIAN. To where?

Dr. GUINN. To the Oak Ridge National Laboratory, in Oak Ridge, Tenn., where they have all the nuclear facilities, and so on, they are quite good, and they do a lot of activation analysis work, although not usually connected with crime investigation, but for other purposes. He took the samples down there.

Two of the people down there, who were highly conversant in activation analysis, but not in forensic work, and Mr. Gallagher, who was highly conversant in forensic work but not in activation analysis work, worked together. He actually did all of the measurements, but with the two Oak Ridge people showing him how to do it and how to calculate the results, et cetera, since this really was his first experience in this field.

Mr. FITHIAN. Are you saying this was the first neutron activation analysis work done by the FBI?

Dr. GUINN. So far as I am aware, it was; yes.

Mr. FITHIAN. This is the first that they had ever done?

Dr. GUINN. Two years later, in 1966, they set up a regular activation analysis group in the FBI laboratory, which it still operates. But at that time, it was their first, direct contact with the method, I believe.

At any rate, Jack Gallagher, in a period of some days there, did go ahead and analyze the samples, and he calculated the results, and he obtained a lot of numerical results.

When I obtained all of these data and went through the calculations, my initial reaction was pretty much the same as theirs, or his.

Mr. FITHIAN. That is, it was inconclusive?

Dr. GUINN. The numbers appeared to bounce everywhere. Any one sample just didn't seem to be consistent. To just pick an example here, for one particular specimen, one time he measured it, and found it to be 977 parts per million antimony. Another time he measured it, but the result was only 676. The numbers just bounced around.

He measured each sample a number of times under somewhat different conditions, but this shouldn't make any difference, you should get essentially the same number every time, merely somewhat different with uncertainties. My initial reaction was thus, exactly the same as his. At that time I just went through all of the data quickly and initially could not make any sense of it. I concluded they had done careful work, in general, but it somehow didn't make sense.

Then I did my own analyses here and found very definitely that the samples fell into the two groups, two bullets, so then I asked my self, as far as I know, even though they had more antiquated equipment at that time, these analyses were done well, why can't you get the same results out of their data, and I went back through a second time, and in a very detailed way, and I tried a little bit different approach, and I think I figured out finally what was wrong with their original work, which they were not aware of and I wasn't initially either.

If you take the numbers that they obtained on the whole group of samples and you only look at them under one set of measurement conditions, that is, you don't look at all the conditions for the moment, but just look at one set of conditions, lo and behold, it is exactly the same result.

Mr. FITHIAN. The same result as what?

Dr. GUINN. As what I found in my own measurements.

Mr. FITHIAN. How do you mean?

Dr. GUINN. CE-399 matches CE-842 in each of the four sets of conditions that he used, and the other three specimens match one another and are different from the other two every time. But if you look at all the numbers at once, everything is varying so much you don't get the picture at all. But once you sort them out this way then the same result comes out as what I obtained—a little fuzzier picture of course, because his detector didn't have the sharp resolution of the modern germanium detector. But, of course, hindsight is much better than foresight. I didn't get this out of his data either until after I had my own data. In a sense it is confirming.

Mr. FITHIAN. Are you testifying then, Dr. Guinn, that a more in-depth reading of the 1964 neutron activation analysis data would have led equally trained scientists to the conclusion that there were in fact fragments from only two bullets that were tested?

Dr. GUINN. Yes; the data were there but they were not interpreted as far as they could have been taken.

Mr. FITHIAN. Using the charts that you provided the committee, and they have been previously admitted into evidence, would you

just briefly summarize for me how the readings of your equipment might be more accurate, more specific, than those of the FBI?

Let me see if I can understand this as a layman. As I understand the process, what you do is you take a particle of something and you put it in some kind of little—

Dr. GUINN. Container.

Mr. FITHIAN [continuing]. Container. And you put that inside the nuclear reactor and you bombard it with trillions of neutrons per second?

Dr. GUINN. Yes, sir.

Mr. FITHIAN. And then you remove it from the reactor, and in some time frame thereafter, the unstable atomic nuclei that have been created, each by the absorption of a neutron, from the extra neutrons that you have bombarded the sample with, undergo radioactive decay, with the emission of gamma rays of characteristic, or identifying energies. Am I roughly correct?

Dr. GUINN. Yes, each radioactive nucleus that undergoes disintegration, which it decides on its own to do, spontaneously, in the typical case emits a beta particle of some energy (which turns out not to be very useful to measure, for detailed reasons), but it also usually emits one or sometimes two or three different gamma rays, gamma rays of different energies. Those we can measure much more easily and exactly, and so those are the ones we look for.

The decay of one nucleus may just give one gamma-ray photon. At best it would give one count on that counter. So what we are looking at, of course, are thousands or millions of these disintegrating nuclei, and we accumulate the results. The detector is capable of distinguishing between gamma rays of different energies, and they show up in our spectra as peaks.

Whether you are looking for it or not, for example, if somebody gave me a sample and I didn't know it had any antimony in it, if I activated it and looked at it under either of those conditions and saw that peak, at 564 keV, I would know that the sample contained antimony.

Mr. FITHIAN. The antimony peak will always come at the same part of the spectrum?

Dr. GUINN. That is right, that is the characteristic; yes.

Mr. FITHIAN. And, therefore, without any knowledge of what is in it, if you see a peak in that frame of numbers, it has to be antimony?

Dr. GUINN. That is right.

Mr. FITHIAN. And then the height of the peak indicates the quantity?

Dr. GUINN. It is proportional to it. We usually measure the area of the peak instead of its height, because the peaks aren't quite symmetrical, but otherwise you are right.

Mr. FITHIAN. You have said this whole process that you go through does not destroy the material, is that correct?

Dr. GUINN. That is correct.

Mr. FITHIAN. Now, then; did you test exactly the same particles that the FBI tested in 1964?

Dr. GUINN. Well, it turns out I did not, for reasons I don't know, because as they did the analysis, they did not destroy the samples either.

Mr. FITHIAN. So?

Dr. GUINN. The particular little pieces that they analyzed, I could just as well have analyzed over again, but the pieces that were brought out from the Archives—which reportedly, according to Mr. Gear, were the only bullet-lead fragments from this case still present in the Archives—did not include any of the specific little pieces that the FBI had analyzed.

Presumably those are in existence somewhere, I am sure nobody threw them out, but where they are, I have no idea.

Mr. FITHIAN. And the 1964 equipment wouldn't have consumed them either?

Dr. GUINN. No.

Mr. FITHIAN. What was the state of the knowledge at that time in terms of storing radioactive materials? Would there have been any prospect that someone not adequately informed, such as perhaps the FBI at that time or law enforcement people, would have been a little leery about keeping radioactive materials in their files?

Dr. GUINN. I wouldn't think so. I am sure by that time they knew enough about the safety aspects that, considering the very small size of samples we are dealing with here, and the very small amount of radioactivity in them, they would have rightly considered them to be perfectly harmless. Also, the little activity in them soon decayed out.

Mr. FITHIAN. So, finally, it is your conclusion that despite what Mr. Hoover said to Mr. Rankin, the FBI data are not really inconclusive, though it appeared to be so to you initially?

Dr. GUINN. That is right, the data really were fundamentally better than they thought, or than I initially thought.

Mr. FITHIAN. The reason I raise that issue, Dr. Guinn, is this. As I understand the critical literature, it falls into two categories with regard to this question. Earlier on, the critics said that the Warren Commission was afraid to do the neutron activation analysis measurements because if they did it, it would show something other than the single bullet theory and thereby would undermine the entire Warren Commission findings. This charge was made in several places in the literature, and I have several examples here to that effect, namely, that the reason for their not doing the neutron activation analysis work at that time was the fear on the part of the Bureau that it would show something other than a single bullet theory, that is, the fragments from Connally's wrist and the "pristine" bullet sample would turn out to be two different bullets.

Dr. GUINN. Yes.

Mr. FITHIAN. In post-1973 literature, after the Freedom of Information Act episode to which you refer, the critics have said that it was done, but with inconclusive results, and since the results were inconclusive, it did not prove that they were from the same bullet, and, therefore, the publication or the publishing of the results were suppressed because it did not support the single bullet theory.

That is the reason I raised the question specifically about the FBI data and about your analysis or interpretation of their data.

Dr. GUINN. I don't know anything about any of the peoples involved motives but what I do know is that indeed in 1964 the FBI did do the analyses and according to this letter that we just intro-

duced into evidence, they did not appear to be able to draw any conclusions from the numbers.

Looking at them many years later, I can see why that would be possibly the case, but as I say, with the advantage of these new results to guide me in the right direction of how to statistically treat the data they had gotten earlier, lo and behold, they very definitely did agree, with my more recent findings from my own measurements, using more powerful equipment.

Mr. FITHIAN. Now, is there any evidence, in either the FBI interpretation of the test results of 1964 or in your own interpretation of the tests for this committee, that would support the speculation that the "pristine" bullet and the one that hit Connally's wrist are two separate bullets? Is there any evidence in either report?

Dr. GUINN. No, there is no evidence either in my work or the previous FBI work of that. You cannot distinguish one specimen from the other, from the analytical results. Both my findings and the earlier FBI findings give this same result.

Mr. FITHIAN. Going from this conclusion, could the FBI have been able to draw the conclusion of only two bullets being present if someone, anyone there, did not have the kind of expertise in WCC Mannlicher-Carcano ammunition that you have testified or that we understand you possess? Would someone not familiar with that kind of ammunition—could they have drawn the right conclusion?

Dr. GUINN. It would have been certainly much more difficult because, as I say, most kinds of ammunition, other kinds that we have looked at over years, have been so uniform that you can't tell—you literally cannot tell one bullet from another out of the same box.

WCC Mannlicher-Carcano bullet lead, however, is different. The concentration range from bullet-to-bullet is tremendous. For example, out of the same box, one bullet may only have 20 parts per million antimony, the next one you take out of the box might be 1,200 parts per million antimony, and each of these values can be measured quite precisely.

Actually, when Jack Gallagher did these measurements, he also analyzed a couple of known WCC Mannlicher-Carcano bullets, just as background samples: One from lot 6,000, one from lot 6,003, but that is all. That is not much of a background to look at; but sure enough, those two, just the two that he looked at were quite different from one another—one was about 90—I have the numbers somewhere here but not handy—one was like 90 parts per million antimony and the other one was something like 700 parts per million.

So even the two samples he happened to pick as background samples immediately showed the same thing regarding which we have much more data.

Mr. FITHIAN. So is it your testimony, then, or is it your estimate that the FBI's failure to correctly interpret the 1964 data, which is so disturbing to so many people—would the FBI have had the knowledge and experience in 1964 to correctly interpret the results?

Dr. GUINN. Well, it is a little hard to say. I think they might have been able to, but I think it might have been more difficult for

them to at that time since they didn't have an extensive background in activation analysis or interpretation of such results, and they didn't have any experience with WCC Mannlicher-Carcano ammunition, either. For that matter, in 1964 I didn't have any experience with this kind of bullet lead either.

Mr. FITHIAN. We must, I think, Mr. Chairman, clarify one thing for the record.

Dr. Guinn, is your interpretation of the FBI data based on the information you obtained through the FBI, as opposed to any secret or otherwise restricted data you obtained through this committee?

Dr. GUINN. No. You are only referring to the FBI data?

Mr. FITHIAN. Yes.

Dr. GUINN. No; the FBI data that I have, copies of all the raw data that Jack Gallagher got, were obtained actually not even by me; they were obtained by Dr. John Nichols from the FBI under the Freedom of Information Act, and then turned over to me; since Dr. Nichols is not an activation analyst. He didn't know what to do with such socialized data—his expertise is in the field of forensic pathology.

Mr. FITHIAN. Therefore any information that has been published either by him or by you no way falls under any restrictions, is that correct?

Dr. GUINN. No, none of this is restricted information.

Mr. FITHIAN. One final line of questioning, Dr. Guinn, and I will subside. Have we done, have you done—as far as your expert knowledge is concerned, have we done all the tests that are possible to ascertain the number of bullets that the fragments came from? Is there anything else that we should do?

Dr. GUINN. One can always think of other analytical methods, et cetera, that might show up some elements that were not detectable by activation analysis, or you can even—using activation analysis go to the destructive form of the method, but then you destroy the samples. I am sure that is not desirable.

I would not recommend any further analytical studies at the present time. I think that the findings that we have are pretty definitive and most other things that one can think of that you could try on the samples might or might not add some additional information. It is questionable. And most of those methods that are really sensitive would destroy or alter the samples or alter their compositions.

Mr. FITHIAN. And I close with this question, then: Since there are no fragments from President Kennedy other than the skull shot, in actual fact, using your scientific methods, you cannot shed any light on whether or not the bullet that passed through Governor Connally also passed through the President; is that a correct statement?

Dr. GUINN. That is correct. These results only show that the CE 399 "pristine" bullet, or so-called stretcher bullet, matches the fragments in his wrist. They give you no information whatsoever about whether that bullet first went through President Kennedy's body, since it left no track of fragment's and, for that matter, it doesn't even say that it went through Governor Connally—through his back, that is—because it left no track of fragments there. At



least I have never see or heard of any recovered lead fragments from either of those wounds.

The results, merely say that the stretcher bullet matches the fragments in the wrist, and that indicates indeed that that particular bullet did fracture the wrist. It unfortunately can't tell you anything else because there were no other bits and pieces along the other wounds.

Mr. FITHIAN. Then your conclusions are what you just stated as far as the back entrance and throat exit wound of President Kennedy, and as far as the close match of the fragments from Connally's wrist with the "pristine" bullet, and the other conclusion you referred to today is that the particles taken from President Kennedy's skull matches other fragments that were in the car?

Dr. GUINN. That is right, they match one another, but they do not match the Connally samples.

Mr. FITHIAN. And that means there were two bullets?

Dr. GUINN. There were definitely two bullets. There is no evidence for the presence of three, or more.

Mr. FITHIAN. Repeating then, there is no evidence for three bullets. Thank you, Dr. Guinn.

I have no further questions, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

Dr. Guinn, I think I just have perhaps maybe one, maybe two questions. Obviously from your testimony here it is evident, as an expert in neutron activation analysis, that we are talking about a field in which there are relatively few experts; aren't we?

Dr. GUINN. I wouldn't say so any more. It might have been true many years back, but every time we have an international conference we have something like 500 people there, all supposedly and most of them really experts in some phase or another of activation analysis. It has grown to be a field where there are probably altogether a few thousand people who are knowledgeable in the field.

Chairman STOKES. And if we go back to the period of time we are talking about, 1963-64, that period of time, what type of field would there have been then of experts?

Dr. GUINN. Smaller numbers, although even in 1964 we had already had one international conference in the field. We had another one the year after that. So it was obviously already getting to be of some size, but obviously not as many people as there are now. It was still considered to be a relatively new method by some people, at least in 1964, although the method itself was first originated in 1937, way back then.

But it couldn't become a really very useful method until the nuclear reactor came along, and that was during World War II, and then it was some years before reactors became very widely available to people; and so it was not until about 1950, you might say, that at least a few places had nuclear reactors and the scintillation detector kind of counting equipment, and then the field began to grow at a pretty good clip.

Chairman STOKES. I have no further questions. At this time, under the rules of our committee, any witness appearing before the committee, at the conclusion of his testimony, is entitled to 5 minutes. During that 5-minute period he may explain, amplify, or

in any way expand upon the testimony he has given to our committee. I would like to extend to you such time at this time if you so desire.

Dr. GUINN. Thank you, Mr. Chairman. I will just make one comment that I thought we might have brought out before, but we didn't quite get around to it. If any of you start looking at these detailed numbers, there needs to be a little further interpretation. First of all, some of the elements listed in my report, in our experience with all kinds of bullet leads often show up and often don't show up, and they don't seem to be characteristic of anything. Some of them are probably the result of external contamination. For the sake of completeness, I have included all of the elements detected, but I don't think that some of them contribute one way or the other to the characterization of source of the specimens.

Also, when you look at the antimony and the silver values to see if these samples match these and these match these, it should be noted that the plus or minus that is shown after each of those numbers is merely the uncertainty of each value calculated from what we call the counting statistics. We can calculate that.

The overall measurement uncertainty of that number on that specific sample is somewhat bigger than that, meaning that if we took that identical little piece and did the same experiment over and over again we would get about the same value, but the variation would be somewhat more than that calculated from the counting statistics—perhaps as much as twice larger. It depends on the value.

And then, if you are trying to match this piece and this piece—which really both came from the same bullet but you don't know it and you are trying to prove it—you have to take into account another factor—how homogeneous is that bullet? Is every piece that you take from a bullet the same? And the answer is: No; they are not. The individual bullets are fairly homogeneous, but there are significant variations within them.

We have a great deal of background data, specifically on WCC Mannlicher-Carcano bullet lead, that isn't in the report, but we use that as the backup which shows that the variation within a bullet is significant.

So when you start to compare numbers, it turns out, for example, on the antimony numbers, roughly speaking, if you take the plus or minus that is shown and multiply it by about 6, that will take care of all of those variabilities within the sample, as well as the small measurement uncertainties.

The variation within that individual bullet is then taken into account, and then you find out that two samples indeed match one another as closely as could be expected. For example, the CE-399 sample gave a measured value of 833 parts per million antimony, whereas the CE-842 sample showed 797. Well, any grammar school boy will tell you 797 is not the same as 833. But when you consider that the 833 is plus or minus about 50 and the 797 is plus or minus about 50, then you see that you can't distinguish one from the other. They are indistinguishable, but, by the same token, the other samples which are only about roughly 620 plus or minus a smaller amount, in that case about 20 or 30—they very clearly not

only match one another, but they also widely differ from this 800 figure.

But some of that is explained in the text of the report. You can't just take the numbers from the table and blindly go ahead; you have to read the fine print as well to see that everything is properly taken into account.

In any event, though, I think the results have come out in a fairly clean-cut fashion. We didn't predict any particular way they would come out; they just fell out this way. And, as I say it led me to reexamine the FBI data more carefully than I had done earlier. I frankly was very surprised to see that even their data, somewhat fuzzier, et cetera, still fell right into the same picture.

So I think the conclusions are well established. Also, as I have stated earlier, fortunately by using this method one does not destroy the samples. The identical samples are still there. They weigh the same; they can be analyzed all over again. All of the radioactivity that we induced in them a year ago has long decayed out, so they could readily be analyzed over again, if desired.

Other than that, I just want to say it has been a real pleasure working with the committee and with the staff of the committee, and I thank you very much for inviting me here.

Chairman STOKES. I guess you raised one additional question in my mind. Assuming that your data were presented to another expert in your field, can we assume with a reasonable degree of certainty that the expert will come to the same conclusions that you have?

Dr. GUINN. I believe so; yes. As I say, if you just handed him the table of measured values, he initially might interpret the plus and minuses as meaning the total uncertainty; and, of course, then he would say: Well, 797 is not the same as 833. However, in the text of the report, it is pointed out that the table plus-minus values do not represent the total uncertainty of a sample; it is larger than that. If he took that into account, he would reach the same conclusions; yes.

Chairman STOKES. The Chair recognizes counsel Jim Wolf.

Mr. WOLF. Mr. Chairman, for the record, I would like to note that Dr. Guinn's report has been submitted to an independent consultant for review and evaluation and he completely agreed with the results achieved and reported by Dr. Guinn.

Chairman STOKES. Dr. Guinn, on behalf of our committee, we thank you very much. You have made a very valuable contribution here today and we certainly appreciate all the time you have expended on our behalf. Thank you.

Dr. GUINN. Thank you.

Chairman STOKES. There being no further business to come before the committee today, this committee meeting is adjourned until 9 a.m. Monday morning.

[Whereupon, at 5:10 p.m. the committee adjourned, to reconvene at 9 a.m. Monday, September 11, 1978.]