Mr. SPECTER. And how do the two major fragments in 857 compare, then, with the fragments heretofore identified as 567 and 569?

Dr. OLIVIER. They are quite similar.

Mr. SPECTER. Do you have an opinion as to whether the wound on the Governor's wrist could have been caused by a fragment of a bullet coming off of the President's head?

Dr. OLIVIER. I don't believe so. Frankly, I don't know, but I don't believe so, because it expended so much energy in blowing the head apart and took a lot of energy that I doubt if they could have fractured the radius. The radius is a very strong, hard bone and I don't believe they could have done that much damage. I believe they could have caused a superficial laceration on someone or a mark on the windshield, but I don't believe they could have done that damage to the wrist.

Mr. DULLES. And it couldn't have then gone through the wrist into the thigh?

Dr. OLIVIER. I don't believe so.

Mr. SPECTER. Have you had an opportunity to examine a fragment identified as Commission Exhibit 842 which is the fragment taken from Governor Connally's wrist?

Dr. OLIVIER. Yes, I have.

Mr. SPECTER. Could that fragment have come from the bullet designated as Commission Exhibit 399?

Dr. OLIVIER. Yes, I believe it would have, I will add further I believe it could have because the core of the bullet extrudes through the back and would allow part of it to break off very readily.

Mr. SPECTER. Do you have an opinion as to whether, in fact, bullet 399 did cause the wound on the Governor's wrist, assuming if you will that it was the missile found on the Governor's stretcher at Parkland Hospital?

Dr. OLIVIER. I believe that it was. That is my feeling.

Mr. SPECTER. To be certain that the record is complete on the skull tests, would you again state the distance at which those tests were performed?

Dr. OLIVIER. Yes, the skulls—it was fired at the skulls at a range of 90 yards.

Mr. SPECTER. With what gun?

Dr. OLIVIER. The 6.5 mm. Carcano which was marked Commission Exhibit 139 and using Western ammunition lot 6,000, again the 6.5 mm. Mannlicher-Carcano.

Mr. SPECTER. Going to the results of the test on the cadavers, what was the average exit velocity?

Dr. OLIVIER. The average exit velocity on the wrist was 1,776 feet per second.

Mr. SPECTER. Had Governor Connally's wrist been struck with a pristine bullet and the bullet exited at that speed, what damage would have been inflicted had it then struck the area of the thigh which was struck on the Governor according to the Parkland Hospital records which you have said you have examined?

Dr. OLIVIER. It would have made a very severe wound.

Mr. SPECTER. Would it have been more severe than the one which was inflicted?

Dr. OLIVIER. Much more so.

Mr. SPECTER. Do you have anything to add, Dr. Olivier, which you think would be helpful to the Commission in any way?

Dr. OLIVIER. No; I don't believe so.

Mr. DULLES. I have no further questions.

Mr. SPECTER. That completes my questions, Mr. Dulles.

Mr. DULLES. Thank you very much. We appreciate very much your coming.

(Discussion off the record.)

TESTIMONY OF DR. ARTHUR J. DZIEMIAN

Mr. SPECTER. Dr. Dziemian.

Mr. DULLES. Doctor, will you raise your right hand, please? Do you solemnly swear the testimony you give in this proceeding is the truth, the whole truth, and nothing but the truth, so help you God?

Dr. DZIEMIAN. Yes, sir.

Mr. SPECTER. Dr. Dziemian, as you know, the purpose of the proceeding is to question you concerning the experiments which were performed at Edgewood Arsenal which may shed light on the assassination of President Kennedy. With that brief statement of purpose, will you state your full name for the record, please?

Dr. DZIEMIAN. Arthur J. Dziemian.

Mr. SPECTER. What is your profession or occupation, sir?

Dr. DZIEMIAN. I am a physiologist at the U.S. Army Chemical Research and Development Laboratories, and am chief of the Biophysics Division.

Mr. SPECTER. Would you outline your educational background briefly, please?

Dr. DZIEMIAN. Yes; A.B. and Ph. D. from Princeton, Ph. D. in 1939. I was national research fellow at the University of Pennsylvania in the physiology department of the medical school and fellow in anatomy at Johns Hopkins University Medical School.

Mr. SPECTER. In a general way, what have your professional activities been since 1939?

Dr. DZIEMIAN. Since 1939?

Well, these fellowships that I had. Then I went to Edgewood Arsenal, was there for a few months and then went into the Army, was in the Army for 3 years, in the sanitary corps, officer in the sanitary corps, and then I returned to Edgewood Arsenal in 1947 and in 1947 I went into wound ballistics work and have been in it since 1947.

Mr. SPECTER. And how long have you been chief of the Biophysics Division?

Dr. DZIEMIAN. Since November of 1959.

Mr. DULLES. Where is this Biophysics Division?

Dr. DZIEMIAN. U.S. Army Chemical Research and Development Laboratories, Edgewood Arsenal, Md.

Mr. SPECTER. Would you describe in a general way the tests which are performed at the Edgewood Arsenal, please?

Dr. DZIEMIAN. Yes; well, our mission, the division's mission is to study the antipersonnel effects of munitions, including kinetic energy munitions, incendiary, and some chemical munitions.

Mr. SPECTER. Is it the regular function of your unit then to test the effects of bullet wounds on various parts of the human body?

Dr. DZIEMIAN. Yes; it is.

Mr. SPECTER. And does Dr. Olivier function under your direction in his capacity as chief of the Wounds Ballistics Branch?

Dr. DZIEMIAN. Yes; his branch is one of the branches of the Biophysics Division.

Mr. SPECTER. Have you been present today to hear the full testimony of Dr. Olivier?

Dr. DZIEMIAN. Yes; I have.

Mr. SPECTER. Were the tests which he described, performed under your general supervision and direction as his superior?

Dr. DZIEMIAN. Yes; they were.

Mr. SPECTER. As to the underlying facts which those tests disclosed, do you have any details to add as to results which you think would be helpful or significant for the Commission to know?

Dr. DZIEMIAN. Well, I think that Dr. Olivier described them pretty well on the whole, got all the details in.

Mr. SPECTER. Do you agree with the recitation of the detailed findings, then, as described by Dr. Olivier?

Dr. DZIEMIAN. I do, yes.

Mr. SPECTER. Then moving to the general topic of reconstructing the events in terms of what professional opinion you may have as to what actually occurred at Dallas, permit me to ask you some questions in terms of the known medical facts, and in the light of the results of this series of tests which you have performed. First of all, have you had access to the autopsy report on President Kennedy?

Dr. DZIEMIAN. Yes, I have.

Mr. SPECTER. And have you had access to the same general information described by Dr. Olivier on the wounds inflicted on Governor Connally?

Dr. DZIEMIAN. Yes, I have. I did not speak to the surgeons. I was not here at that time. My information on Dr. Connally's wounds——

Mr. DULLES. Governor Connally.

Dr. DZIEMIAN. Governor Connally, are from the reports and from discussions with Dr. Light or Dr. Olivier.

Mr. SPECTER. So that all of the information available to Dr. Light and Dr. Olivier obtained through consultations with Governor Connally's doctors, Dr. Shaw and Dr. Gregory, have been passed on to you? In addition, you have had access to the records of Parkland Hospital on Governor Connally's treatment there?

Dr. DZIEMIAN. That is right.

Mr. SPECTER. And have you had an opportunity to observe certain films known as the Zapruder films showing the assassination?

Dr. DZIEMIAN. No; I did not see those.

Mr. SPECTER. Have you had, then, brought to your attention the approximate distances involved from the situation here, to wit; that the shots were fired from a 6th floor window at a distance of approximately 160 to 250 feet at a moving vehicle, striking the Governor and the President at angles estimated from 25 to 45 degrees, the angle of impact on President Kennedy being given by the autopsy surgeon as a 45-degree angle of declination, and the angle on Governor Connally being described as 25 to 27 degrees?

Dr. DZIEMIAN. Yes, I did——

Mr. DULLES. You are speaking now of the first two wounds, aren't you?

Mr. SPECTER. Yes.

Mr. DULLES. You are not speaking now of the brain wound at all, are you?

Mr. SPECTER. Correct, Mr. Dulles. The wound that I am referring to on the President is the wound which entered the back of his neck and exited from the front part of his neck in accordance with the prior testimony of the doctors in the case.

Now, based on the tests which have been performed, and the other factors which I will ask you to assume, since you weren't present; for purposes of expressing an opinion, what is your opinion as to whether all of the wounds on Governor Connally were inflicted by one bullet?

Dr. DZIEMIAN. My opinion is that it is most probably so, that one bullet produced all the wounds on Governor Connally.

Mr. SPECTER. And what is your opinion as to whether the wound through President Kennedy's neck and all of the wounds on Governor Connally were produced by one bullet?

Dr. DZIEMIAN. I think the probability is very good that it is, that all the wounds were caused by one bullet.

Mr. SPECTER. When you say all the wounds, are you excluding from that the head wound on President Kennedy?

Dr. DZIEMIAN. I am excluding the head wound, yes.

Mr. SPECTER. And what is the reasoning behind your conclusion that one bullet caused the neck wound on President Kennedy and all of the other wounds on Governor Connally?

Dr. DZIEMIAN. I am saying that the probability is high that that was so.

Mr. SPECTER. What is the reason for your assessment of that high probability?

Dr. DZIEMIAN. The same reasons that Dr. Olivier gave, based on the same information, that especially the wound to the wrist. That higher velocity strike on the wrist would be caused by the bullet slowing down by going through all this tissue would cause more damage to the wrist and also more damage to the thigh.

Mr. SPECTER. Had the bullet only gone through Governor Connally's chest then, what is your opinion as to whether or not there would have been greater damage to the Governor's wrist?

Dr. DZIEMIAN. I think there would have been greater damage to the Governor's wrist, and also to the thigh from the information, from the experiments obtained by Dr. Olivier's group.

Mr. DULLES. Could I ask a question here? Does that take into account any

evidence as to the angle of fire and the relative positions of the two men, or excluding that?

Dr. DZIEMIAN. Excluding that. I do not know enough details about that to make an opinion on that. This is just on the basis of the velocities of the bullets.

Mr. SPECTER. Would the nature of the wounds on the Governor's wrist and thigh, then, be explained by the hypothesis that the bullet passed through the President first, then went through the Governor's chest before striking the wrist and in turn the thigh?

Dr. DZIEMIAN. I think that could be a good explanation.

Mr. SPECTER. What is your opinion as to whether or not a fragment of a bullet striking the President's head could have caused the wound to Governor Connally's wrist?

Dr. DZIEMIAN. I think it is unlikely.

Mr. SPECTER. What is your opinion as to whether or not Governor Connally's wrist wound could have been caused by a pristine bullet?

Dr. DZIEMIAN. That is unlikely, too. Our results with pristine bullets were very different from the wound that the Governor had.

Mr. SPECTER. Based on the description provided to you of the nature of the wound in the Governor's back, what is your opinion as to whether, or not, that was a pristine bullet or had yaw in it, just on the basis of the nature of the wound on the Governor's back?

Dr. DZIEMIAN. It could very well have yaw in it because of the rather large wound that was produced in the Governor's back. The wound from a nonyawing bullet could be considerably smaller.

Mr. SPECTER. For the record, would you define in lay terms what yaw means?

Dr. DZIEMIAN. It is the procession of the bullet. The bullet is wobbling on its axis, so that as it wobbles, it presents different presented areas to the target or to the air, and this changes the drag coefficient of the bullet. It will slow down the bullet more both in the air and in tissues, in the yawing.

Mr. SPECTER. What is the course of a bullet, then, which is a pristine bullet or the nature of the bullet immediately after coming out of the muzzle of a rifle before it strikes anything?

Dr. DZIEMIAN. A pristine bullet is normally stable. It does not wobble in the air. It presents the same presented area along most of its trajectory until it slows down, so that the drag coefficient in air or in the tissue of this type of bullet is less than the drag coefficient——

Mr. SPECTER. What do you mean by drag coefficient?

Dr. DZIEMIAN. It is a measurement of the resistance of the target material or the air to the bullet. The greater the drag coefficient, the more the resistance to the bullet, the more the bullet slows down within a given time.

Mr. SPECTER. So would a bullet with yaw cause a greater or lesser hole on the surface which it strikes than a bullet without yaw?

Dr. DZIEMIAN. It would normally cause a greater hole. It usually would have more presented area, that is more the surface of the bullet would hit the skin.

Mr. SPECTER. And would a bullet with yaw decrease in velocity to a greater, lesser, or the same extent as a bullet without yaw?

Dr. DZIEMIAN. It would decrease in velocity to a greater extent.

Mr. SPECTER. Whether it passed through air or——

Dr. DZIEMIAN. Or through tissue, and the important thing in tissue is that it transfers more energy to the target than would a nonyawing bullet.

Mr. SPECTER. Dr. Dziemian, Governor Connally testified that he experienced the sensation of a striking blow on his back which he described as being similar to a hard punch received from a doubled-up fist. Do you have an opinion as to whether that sensation would necessarily occur immediately upon impact of a wound such as that received by Governor Connally, or could there be a delayed reaction in sensing that feeling?

Dr. DZIEMIAN. I don't have too much of an opinion on that. All I can say is that some people are struck by bullets and do not even know they are hit. This happens in wartime. But I don't know about that.

Mr. SPECTER. So that it is possible in some situations there is some delay in reaction?

Dr. DZIEMIAN. I couldn't say.

Mr. SPECTER. Is it a highly individual matter as to the reaction of an individual on that subject?

Dr. DZIEMIAN. I don't know.

Mr. DULLES. But take a wound like the wrist wound of Governor Connally. He couldn't get that without knowing it, could he?

Dr. DZIEMIAN. I think he said that he didn't know he had a wrist wound until much later.

(Discussion off the record.)

Mr. SPECTER. I have no further questions of Dr. Dziemian, Commissioner Dulles.

Mr. DULLES. Thank you very much.

TESTIMONY OF DR. FREDERICK W. LIGHT, JR.

Mr. DULLES. Doctor, would you give your full name?

Dr. LIGHT. Frederick W. Light, Jr.

Mr. DULLES. Would you raise your right hand? Do you swear that the testimony that you will give before this Commission is the truth, the whole truth, so help you God?

Dr. LIGHT. I do.

Mr. SPECTER. Dr. Light, the purpose of asking you to appear today is to question you concerning the results of tests taken at the Edgewood Arsenal. With that brief statement of purpose, I will ask you to state your full name for the record, please.

Dr. LIGHT. Frederick W. Light, Jr.

Mr. SPECTER. What is your business or profession, sir?

Dr. LIGHT. I am a physician specializing in pathology.

Mr. SPECTER. What is your educational background?

Dr. LIGHT. I have an A.B. from Lafayette in 1926, M.D. from Johns Hopkins Medical School in 1930, and Ph. D. from Hopkins in 1948.

Mr. SPECTER. Would you outline your experience since 1933 in a very general way, please?

Dr. LIGHT. Well, in 1933 I was still at the Reading Hospital, resident in pathology. Betwen then and 1940 I was pathologist in Clarksburg, W. Va., and later in Springfield, Ill. In 1940 I returned to Johns Hopkins University to study mathematics for awhile.

Mr. DULLES. To study mathematics?

Dr. LIGHT. Yes. And then in 1952, or 1951, excuse me, I began working at Edgewood Arsenal where I am at the present time.

Mr. SPECTER. What have your duties consisted of while working at Edgewood Arsenal?

Dr. LIGHT. Primarily the study of pathology of wounding.

Mr. SPECTER. What is your formal title there now, Dr. Light?

Dr. LIGHT. I am chief of the Wound Assessment Branch and assistant chief of the Biophysics Division.

Mr. SPECTER. And what is your relationship to Dr. Olivier and Dr. Dziemian?

Dr. LIGHT. Dr. Dziemian is the chief of the division. Dr. Olivier is chief of one of the branches, and I am chief of one of the other branches.

Mr. SPECTER. Have you been present here today to hear the full testimony of Dr. Olivier?

Dr. LIGHT. Yes.

Mr. SPECTER. And were the tests which he described conducted under your joint supervision with Dr. Olivier?

Dr. LIGHT. Only a very general way. I wouldn't want to say I supervised him at all. We discussed what he was going to do.

Mr. SPECTER. Would it be more accurate to state that you coordinated with him in the tests which were under his general supervision?

Dr. LIGHT. Yes; that might be stretching it a bit even.

Mr. SPECTER. How would you characterize your participation?

Dr. LIGHT. Largely—originally Dr. Dziemian, as I recall, was ill, and by the