

Standards Committee, and adviser to the U.S. delegation to the International Organization for Standardization Committee on Photography.

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. He serves on the editorial review boards of several technical journals and he has authored numerous papers on photography, color printing and other aspects of chemistry and physics.

It would be appropriate now, Mr. Chairman, to call Mr. McCamy. Chairman STOKES. The committee calls Mr. McCamy.

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

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

Mr. McCAMY. I do.

Chairman STOKES. Thank you.

You may be seated.

The Chair recognizes counsel for the committee, Mr. Michael Goldsmith.

Mr. GOLDSMITH. Thank you, Mr. Chairman.

Mr. McCamy, for what purposes were the photographic evidence panel and contractors asked to review the Zapruder film at its most recent conference?

TESTIMONY OF CALVIN McCAMY

Mr. McCAMY. Our first purpose was to ascertain from the photographic evidence, if possible, the first signs that the President or Governor Connally were in distress. The second objective was to ascertain from the photographic evidence, if possible, whether or not the President and the Governor were in positions in the limousine that would be consistent with the single bullet theory.

Mr. GOLDSMITH. How many panel members actually participated in the review of the Zapruder film, Mr. McCamy?

Mr. McCAMY. There were about 20 people altogether. The films were viewed many times in many sessions. They were not all present at all times. When we voted on specific issues, about 15 people voted.

Mr. GOLDSMITH. And did you view any particular version of the Zapruder film?

Mr. McCAMY. Yes; we had a copy, a direct copy, of the Zapruder film. We also had special films that were prepared by Mr. Groden.

These were rotoscoped, which means that they were slightly enlarged and stabilized.

Mr. GOLDSMITH. Does a rotoSCOPE version of the Zapruder film facilitate analysis?

Mr. McCAMY. Yes, it gives you a closer view, and as I said, it is stabilized, so, it seems to be more stable on the screen.

Mr. GOLDSMITH. Now how many times was this film viewed by the panel?

Mr. McCAMY. That is very hard to say, because we would look at a scene and attempt to determine what was happening, go back, look at it again, and then again and again. We have looked at it for

days. I would estimate somewhere in the neighborhood of 100 times.

Mr. GOLDSMITH. As you know, Mr. McCamy, the original Zapruder film is missing four frames between frames 208 and 211. Those four frames were spliced out when Time-Life had possession of the film.

Was the panel given an opportunity to see the four frames 208-211, showing the President as he went behind the sign when the panel reviewed the Zapruder film?

Mr. McCAMY. Yes. Mr. Groden had obtained the Secret Service film that had those frames. He had copied them on 35-mm film. These were still slides, and at that point in the viewing, we went to a 35 mm projector and looked at the slides that represented those frames.

Mr. GOLDSMITH. And that Secret Service film I take it was made available to Mr. Groden by the committee staff?

Mr. McCAMY. Yes, that is correct.

Mr. GOLDSMITH. Would you state at this time, Mr. McCamy, what the panel's conclusion was about when President Kennedy first showed a reaction to some severe external stimulus?

Mr. McCAMY. Yes. The panel generally tended to agree that there was some sign of distress before frame 207. We took a vote on that, and the vote was 12 to 5 that there was photographic evidence of some distress by that time.

Mr. GOLDSMITH. Would you indicate at this point whether frame 207 is before or after the President goes behind the sign? By "sign" I am referring to the sign that obstructed Abraham Zapruder's line of sight.

Mr. McCAMY. The President's head is partially obscured by the sign at that time, so this is just as he is going behind the sign.

Mr. GOLDSMITH. And what was the panel's conclusion about when Governor Connally first appeared to be showing a reaction to some severe external stimulus?

Mr. McCAMY. The vote was 11 to 3 that there was some sign of distress by frame 226, which is just immediately after he comes out from behind the sign.

Mr. GOLDSMITH. Finally, would you indicate now what the panel's opinion was about whether the relative alinement of the two men in the vehicle was consistent with the single bullet theory?

Mr. McCAMY. Yes. The positions of the men were examined on these films just prior to the time that the limousine went behind the sign, and it was agreed 15 to 1 that the men were in positions that were consistent with the single bullet theory.

Mr. GOLDSMITH. Mr. Chairman, I might state now that we are about to review the Zapruder film. The film that we are about to see contains all of the frames that had previously been spliced out. We have a special projector here which is capable of running the film at a reduced speed. The normal speed I believe is 18 frames per second, and we will be viewing it today at a somewhat reduced speed.

Mr. McCamy, would you at this point review the film with us for the purpose of describing the actions of the limousine occupants and to summarize generally the basis for the panel's conclusions?

Mr. McCAMY. Yes.

Let me state first the film is taken by Mr. Zapruder, an amateur photographer, using an amateur 8 mm motion picture camera. He had positioned himself on top of a masonry structure where he could see almost the entire path of the parade through Dealey Plaza on Elm Street. For a brief time, view is obscured by a traffic sign indicating the way to the Stemmons freeway.

We are going to see a 16 mm copy of the Zapruder film incorporating all frames. We will first see the entire sequence photographed by Zapruder. We will see it at two-thirds of its normal speed. Then we will go back and make some observations bearing on Governor Connally's testimony that he heard a shot, turned and looked over his right shoulder. Then we will go to a rotoscope version which we will use to study the movements of the President. Then we will again see a rotoscope view in which we will look at the positions of the two men as shown in the Zapruder film and the motions of Connally.

Mr. GOLDSMITH. Could we have the lights out, please?

Mr. McCAMY. At this point, Governor Connally is looking slightly to his left. He continues to look in that direction in the next frame. Here Governor Connally is looking slightly to his left. He continues to look slightly to his left.

In the next frame we see him having turned quite sharply toward the front, and in the next frame even more so. He is now continuing to turn to the right. And here we see him looking to the right and upward, confirming his testimony that he heard a shot and turned and looked over his right shoulder.

We now go to a rotoscope version where we will be seeing it in very slow motion in order that we may observe the actions of the President.

His hand is moving downward. He was waving to the audience. Notice that there are some frames in which there is very considerable blur. This was part of our analysis, as you will recall.

The President continuing to wave to the audience, and apparently smiling on these frames. In this view we can see the President and Governor Connally. The President's shoulders can be seen. Governor Connally is seen turned quite sharply to his right, his entire torso having been twisted somewhat as he looks that way.

Between the two men we see the black upholstery, shiny black upholstery, on the seat behind President Kennedy. The two bright areas you see at the top of that upholstery are reflections of sunlight. So we see a considerable amount of the rear seat of the limousine between the President and Governor Connally.

There is a chrome strip that runs along the side of the limousine. The President's arm is on or over that chrome strip, which means that he is well to the right side of the limousine. Governor Connally, on the other hand, can be seen to be well inside the limousine. These facts were of course confirmed by other photographs as well, but I think they are clearly seen here.

There is considerable blurring at this point. The President's arm is up in a waving position. His head is still toward the right. At this point there is considerable blur, and by here, it appears as though his head is beginning to turn quite rapidly to the left. His

head is now to the left. That is only one-eighteenth of a second from one frame to the next.

He continues to look toward the left. One barely sees his right ear toward the camera. It is quite clear he is here now looking directly at his wife. He and his wife can be seen looking at one another in this sequence.

He now goes behind the sign, and only a fraction of a second later we see his hands moving upward. He has a gasping expression. His hands are in a classic position of a person who has been startled.

He now begins to raise his arms into what I would call a defensive position. He may be clutching at the throat wound. He maintains this attitude, turning again sharply to his wife, who clearly recognizes the situation by now. He moves toward his wife. His wife notices Connally. The President is now moving toward his wife, turning his head toward her, leaning forward, and leaning to the left. His head is quite a ways down, as you can see. His wife apparently inspects the wound or the damage to his clothing at least. That is the head shot.

Mr. GOLDSMITH. Mr. McCamy?

Mr. McCAMY. Yes, sir.

Mr. GOLDSMITH. As we are about to view the rotscope version a second time, could you state the specific basis of the panel's conclusion that the President was hit before he went behind the sign when we view that film a second time?

Mr. McCAMY. We will largely be studying the motions of Governor Connally here.

Here is where he is looking to the right sharply, while the President still waves to the crowd. Here is the view in which you can see fairly well the positions of the men. That is a fairly clear view right there. Governor Connally seems to be looking left (as seen from the viewer's perspective) as the car goes behind the sign.

Now President Kennedy made this very sharp sudden turn to the left, turning about 180 degrees in something like a sixth of a second. This was a very sharp turn. It would be whipping one's head around.

As Connally comes out from behind the sign, he has a distressed look on his face. He is concerned. He is looking upward. His body is in a rather taut attitude. He winces. His facial expression changes radically. His head position changes rapidly from moment to moment. He grimaces. He begins to turn sharply. His cheeks are puffed. He apparently is screaming or saying something, very clearly in distress. He turns, looks back at the President, as he said he did, recognizes that the President has been shot, recovers only enough now to lie back down at the time of the head shot which he described.

Mr. GOLDSMITH. Mr. McCamy, I would ask you to run the rotscope version one more time, and at this time specifically indicate the panel's basis for concluding that Governor Connally is showing a reaction almost immediately after emerging from behind the sign.

Mr. McCAMY. Here he is seen first. He is looking upward. His body is thrown back. He seems to be frowning. His facial expression changed very suddenly there. We can compare those two

frames. That is an one-eighteenth of a second from that to this. Another one-eighteenth of a second later his facial expression has changed radically, and now his head moves very quickly in one-eighteenth of a second.

Now facing straight forward. There was a turn something like 60 degrees in about one-ninth of a second. His facial expression seems to change from frame to frame, and now he begins to turn. His cheeks are puffed here. He opens his mouth, turning back to look at the President.

Mr. GOLDSMITH. Mr. McCamy, at this point, rather than continue with the end of this particular section of the rotoscope film, I would ask you to move the film back to where the two men are behind the sign and indicate the specific basis for the panel's concluding that the men were sitting a position consistent with the single bullet theory.

Mr. McCAMY. This is one of the clearer frames taken in a small fraction of a second before the limousine went behind the sign. The President's arm is on the edge of the limousine. He is seated far to the right in his seat. Governor Connally, on the other hand, is looking to the right, and his body is twisted toward the right. His shoulders can be seen here, and as I indicated earlier, a considerable expanse of the rear seat of the limousine can be seen between the two men at this angle.

This indicates, of course, that Connally was well inside the automobile, and therefore a projectile coming from the right side of the automobile could have penetrated Kennedy's back, come out through his neck, and then gone downward through Connally's torso, his right wrist, which was just above his thigh, and then be buried in his thigh.

Mr. GOLDSMITH. Does this correspond approximately with frame 193 of the Zapruder film?

Mr. McCAMY. Yes, that is approximately right.

Mr. GOLDSMITH. Very well. I would ask you now to finish showing the film at regular speed, and we will proceed with your testimony. Thank you.

Can we have the lights now?

Mr. McCamy, I noticed several times in your testimony that you made references to changes in the movements of the occupants of the limousine within an one-eighteenth of a second.

To what extent was the panel's knowledge and understanding that the Zapruder film runs at approximately 18.3 frames per second important in its analysis? By that I mean, to what extent did the panel attempt to quantify its analysis?

Mr. McCAMY. The 18.3 frames per second was used by the panel. The motion picture camera takes a photograph every 18.3—I am sorry, takes a photograph 18.3 times each second. This tells us that the movement between any two frames takes place in about one-eighteenth of a second, and that timing is quite good. We saw no evidence that the camera was running in an unsteady manner or any such thing, so that this makes it a reasonable basis for timing.

Mr. GOLDSMITH. Now at one point early in the film, you made reference to Governor Connally turning sharply from his left to his right within approximately four frames. If you were to quantify

that, would that come out to a turn of something like or something in excess of 720° per second?

Mr. McCAMY. I would describe it in this way: There was first a jerk of about 60 degrees in a one-ninth of a second, and that would be characterized as a jerk. He was looking slightly left. He jerked toward the right, paused momentarily, and then executed another sharp turn to his right, 30° more in one-eighteenth of a second. So, it was essentially two sudden jerks, and then he began to look upward.

Mr. GOLDSMITH. And that was approximately at frame 160 of the Zapruder film?

Mr. McCAMY. This is the first jerk from 162 to 164, and the second one, 166 to 167.

Mr. GOLDSMITH. Thank you. I am going to proceed now to the next area of inquiry, Mr. McCamy.

Are you familiar with the trajectory project that has been conducted by this committee?

Mr. McCAMY. Yes.

Mr. GOLDSMITH. To what extent have you been involved in this project?

Mr. McCAMY. I assisted with some of the photographic interpretation and some of the photogrammetry.

Mr. GOLDSMITH. At this time I would ask that the witness be given an opportunity to look at what has been marked for identification as JFK F-133, a Survey Map.

Mr. Chairman, this is a survey map of the Dealey Plaza area. I move for its admission into the record.

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

[The information follows:]

Mr. GOLDSMITH. Mrs. Downey, may I have your assistance for a moment?

According to this map it indicates the position of the Presidential limousine in frames 193 and 313 of the Zapruder film. Mrs. Downey is pointing to those two positions on the map.

I ask you, Mr. McCamy, do you know what method was used to place the limousine in Dealey Plaza for purposes of the trajectory analysis?

Mr. McCAMY. Yes.

Mr. GOLDSMITH. Who actually carried out this analysis for the committee?

Mr. McCAMY. This was done by the U.S. Geological Survey in Reston, Va.

Mr. GOLDSMITH. Would you describe now what method they used photogrammetrically to place the limousine in Dealey Plaza?

Mr. McCAMY. Yes, a map was made of Dealey Plaza by a survey firm in Dallas, Tex., and that map was provided to the Geological Survey. Enlargements of six frames of the Zapruder film were provided to the Survey.

The position of the cameraman was known from his testimony and confirmed by photographs of him taken by photographers on the other side of the street. The Geological Survey found a number of points on a wall that appeared in these photographs. They located these points precisely on the map, and they could determine the line of sight from the lens to each of these points.

Now these lines made angles at the camera lens. The same angles were described inside the camera when the scene was imaged. They were able to measure the corresponding distances on the film, and knowing the angles and these corresponding distances, they were able to determine the distance from the film to the lens. Once that distance was determined, it was possible to make measurements on photographs, and from those measurements compute angles in space.

They knew the dimensions of the limousine, both from design drawings and from measurements made by the Secret Service. Knowing the dimensions of the limousine, and the angles subtended on the films, it was possible for them to compute the distance from the camera to the limousine.

Then on these photographs they were able to pick out known points in Dealey Plaza and known points on the limousine, and, as I said, they were able then to compute from the measurements on the photograph the angles from these known points to the points on the limousine.

Knowing the distance and knowing the angles, they were able to plot these positions on the map.

Mr. GOLDSMITH. Does this method have any particular name by which it is referred to?

Mr. McCAMY. This is analytical photogrammetry.

Mr. GOLDSMITH. And within what margin of error was the U.S. Geological Survey able to place the limousine in Dealey Plaza?

Mr. McCAMY. They made estimates of the error. Some of the frames given to them were better photographically than others, and on the three best frames, they estimated their positions to be

within one-half meter. For the other frames that were not as clear, they estimated their maximum error to be about 2 meters.

Mr. GOLDSMITH. In your opinion, Mr. McCamy, do you regard these estimates as being conservative?

Mr. McCAMY. They have said that these are conservative estimates, and, yes, they sound like quite conservative estimates to me.

Mr. GOLDSMITH. Why do they sound conservative to you, sir?

Mr. McCAMY. Because the methods of photogrammetry are very precise. We have lines of sight, and we have quite precise methods of computation, so I would think that these are conservative values.

Mr. GOLDSMITH. Thank you very much.

I have no further questions.

Chairman STOKES. The Chair will at this time yield to the gentleman from Michigan, Mr. Sawyer, after which the committee will observe the 5-minute rule.

The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Yes. Thank you, Mr. Chairman.

When you were making these studies on trajectory, did you make any assumptions with regard to the positions of the people in the limousine?

Mr. McCAMY. The positions of the people in the limousine were determined by a study of a large number of photographs.

Incidentally, some of these photographs have just come to be known, so that there is some new evidence. At least one recent photograph is a very clear photograph of the side of the limousine taken by a man standing right on the curb. So we do have quite a bit of information about the positions.

On that photograph that I just mentioned, I went back to the design data for the limousine and to the measurements that were taken by the Secret Service on the various parts of the limousine, and these gave quite accurate scaling, and then it was possible to make measurements of the people. Not all of the people were visible. There were times when there were areas that were simply in shadow so that you could not see everything. The determinations are not perfect, of course, but we were able to position them quite well, I think.

Mr. SAWYER. I noticed, or as I recall it, you said that Governor Connally executed this rapid turn to his right, as I recall it, 90 degrees in one-eighteenth of a second, and then looked upward.

Now this was before, that was 166 to 167 frames, whereas you said the panel agreed on a vote that about frame 207 was the first indication that the President was in distress.

Mr. McCAMY. Yes.

Mr. SAWYER. So that I presume from listening to you, that it would be an indication at least that there had been a shot that didn't hit anybody at that time, at about 166 to 167?

Mr. McCAMY. This would explain the observed facts, yes.

Mr. SAWYER. And then if I follow more by inference than specifically what you said, it would have been a second shot that hit the President for the first time.

Mr. McCAMY. Yes.

Mr. SAWYER. And that would have been the shot that presumably then hit Governor Connally also.

Mr. McCAMY. Yes.

Mr. SAWYER. Thank you.

I have no further questions, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

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

Mr. DODD. Mr. Chairman, I will defer any questions I have at this time.

Chairman STOKES. The gentleman from Ohio, Mr. Devine.

Mr. DEVINE. I have no questions, Mr. Chairman.

Chairman STOKES. Any other members seeking recognition?

The gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Mr. Chairman, I wonder if at some time this morning I might see the photo that was taken by the man on the curb. Is that evidence available?

Mr. GOLDSMITH. I am not sure which photograph you are referring to.

Mr. FITHIAN. The one that Mr. McCamy just referred to. He said it was a very clear photo taken perpendicular to the limousine; is that correct?

Mr. McCAMY. Part of the limousine, yes. This is the Croft photo.

Mr. GOLDSMITH. Yes, Mr. Fithian, that will be made available.

Mr. FITHIAN. The only problem I have with the testimony is the location, the relative location, of Governor Connally and the President.

As I perceive it, the Zapruder angle in relationship to the side of the limousine is about what?

Mr. McCAMY. That is a rather sharp angle at that time. I would estimate something like 20°. I have not calculated that.

Mr. FITHIAN. From your expertise, the photo shot, the picture taken at that angle, what does this do in terms of spreading the perceived distance between the two men?

Mr. McCAMY. It would appear as though the two men are very perceptibly separated left and right, that is, that Kennedy is right against the edge of the limousine and—

Mr. FITHIAN. I understood your testimony. Let me rephrase my question.

If Zapruder had been looking directly at Connally's nose from the front, then the alinement of Connally and Kennedy could be readily and clearly measured as to which one was at forward ships, so to speak.

The question is, as you swing around at an angle, where you finally get in the angle that would include Zapruder, what does that do in the perception of the two people? Presumably, if you get around at 90°, there would be no way of telling, except by distance measurements, which of the gentlemen was closer or further from you. But what does it do at the Zapruder angle? That is my question.

Mr. McCAMY. At the Zapruder angle, the apparent displacement is reduced, so that the displacement is actually greater than you would compute it simply looking from that angle.

Mr. FITHIAN. So it appears that those two bright, shiny spots and so forth, it actually appears that they are further apart, that is, in alinement within the vehicle, than they are by some certain percentage.

Mr. McCAMY. Yes; I see what you are getting at.

Connally is, of course, definitely well in front of Kennedy, and we are seeing part of that angle as well. But as you perceive, if we were to look from the side of the vehicle, we would not get any indication at all of the shift of Connally to the left. We would see that vector at a maximum, if we look right straight from the front of the vehicle. That vector is reduced slightly by moving through this 20°.

The positioning of the man, however, as I have pointed out before, was obtained from a number of photographs, not just this one. There were other motion pictures, as well as other still photographs, and with reference to the apparent shift with angle, the eye is a pretty good judge, so that when you look at that and you get an impression of how far they are, you can trust that impression pretty well.

Mr. FITHIAN. I take it then that you are satisfied that there is room, though this jump seat is very small for Connally, a large man, to make these what seemed to me to be almost violent gyrations or at least very quick movements.

Mr. McCAMY. He made rather quick movements. I think the small size of the jump seat would facilitate these movements actually.

Mr. FITHIAN. And, finally, Mr. Chairman, a last question.

It is your testimony that at frame 162 to 167 or thereabouts, both men make rather sharp movements, but they are not hit. That is your conclusion?

Mr. McCAMY. No, sir, that was merely with reference to Mr. Connally. At that time President Kennedy is happily waving to the people in the crowd.

Mr. FITHIAN. So Connally makes a sharp movement.

Mr. McCAMY. Yes.

Mr. FITHIAN. You are presuming because he heard something or he reacted to something.

Mr. McCAMY. Yes; he testified to this effect, and this would seem to be consistent with what he testified.

Mr. FITHIAN. And then that the single bullet that hit them both is just as they enter behind the sign or one frame or two ahead of that; is that correct?

Mr. McCAMY. Yes.

Mr. FITHIAN. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. Yes.

If we were to assume or determine as the panel did and as I think we could see, that the reaction to the noise apparently by Governor Connally occurred in, say, frame 166, and the visible first reaction of any distress on the part of the President was at about 207, and considering that the reaction times of both men probably are a wash, there would be about 2.3 seconds between the presumptive first shot that missed and the shot that hit the President, about 2.3 seconds?

Mr. McCAMY. Yes, something like that, right.

Mr. SAWYER. Thank you.

That is all.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Connecticut, Mr. Dodd.

Mr. DODD. Thank you, Mr. Chairman.

Just very briefly, you indicated that the distances between Governor Connally and the President in one clear frame is approximately 1 meter, I think you said, and a blurrier frame, 2 meters, and you said you were being conservative.

Then you indicated this was an exact science.

Mr. McCAMY. When we were speaking of those errors, we were talking about the ability of the Geological Survey to place the limousine on the street in a precise position. They feel as though their errors are within a half meter in placing it geographically for the better frames and within 2 meters for the poorer frames, but it was not the distance between the President and the Governor. That was surely known with much better precision than that.

Mr. DODD. One of the areas that has drawn a lot of attention over the past few days that we have been here, in terms of the photographic evidence and the timing of the shots, has to do with Governor Connally's hat. Congressman Sawyer has I think very eloquently pointed out how difficult it would be for him to understand—and I think many of us, who are not as expert as he is in that area, also have difficulty understanding—how someone could hold on to a hat and be hit, as the allegations have it, hit through the wrist.

What does your photographic evidence show with regard to Governor Connally's Texan Stetson hat in the photographs as you saw them in the Zapruder film?

Mr. McCAMY. It can be seen that he has his hat in his hand or lying somewhere in front of him. The pictures are not quite clear enough to be able to tell you exactly what he does with the hat, but he does seem to have the hat in his hand. The medical evidence certainly shows that the radius was broken, but that is well up on the wrist, and it seems conceivable that he could have continued to clutch the hat. It is quite well known that one of the startled reactions is to clench the fists, and it just may be that he clenched it very tightly.

Mr. DODD. But as a matter of photographic evidence, I am not trying to get you to comment on the medical aspects. As a matter of photographic evidence, he is holding, your evidence shows or your examination of these photographs shows, that he is holding that hat after he has been hit.

Mr. McCAMY. Yes, it seems to be the case because the hat moves, and I would think this is because it was in his hand being moved.

Mr. DODD. Could you give me an indication? You moved your head a couple of times trying to demonstrate how Governor Connally moved.

How fast do you move your head in one-eighteenth of a second? What does it look like?

Mr. McCAMY. I visualize Connally in that first sequence we were talking about moving this way and then this way.

Mr. DODD. That quickly?

Mr. McCAMY. Yes, that quickly.

Mr. DODD. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

Mr. McCamy, at the conclusion of a witness' testimony before this committee, he is entitled to 5 minutes in which to explain or in any way expand upon the testimony he has given this committee. I, at this time, extend to you 5 minutes, if you so desire.

Mr. McCAMY. I have no comments.

Chairman STOKES. All right.

We thank you very much for your testimony here this morning, and you are excused, sir.

Mr. GOLDSMITH. Thank you, Mr. McCamy.

Chairman STOKES. Mr. Blakey.

Mr. BLAKEY. Thank you, Mr. Chairman.

The photographic analysis was, of course, only an underlying fact from which the trajectory analysis could proceed. The trajectory analysis itself was a joint effort between the committee and the National Aeronautics and Space Administration. An engineer with NASA's Space Project Division, Tom Canning, constructed the final product from information provided by the committee from its various panels.

Mr. Canning received a B.S., cum laude, in mechanical engineering and an M.S. in aeronautics from Stanford University. Since joining NASA in 1943 as an aeronautical research scientist, he has been the Branch Chief of the Hypersonic Free-Flight Branch, Group Leader of the Probes System Group of Pioneer-Venus Mission, and currently he is Staff Engineer of the Space Projects Division.

Mr. Canning received the NASA Medal for Exceptional Scientific Achievement for his work in atmosphere entry body research for Mercury, Gemini, and Apollo. During his 23 years of work with the Hypersonic Free-flight Branch he has conducted and supervised research in the flight trajectory and stability of high speed projectiles and missiles. He has published numerous papers in that field.

Mr. Chairman, it would be appropriate now to call Mr. Canning.

Chairman STOKES. The committee calls Mr. Canning.

Sir, would you please stand and raise your right hand to be sworn?

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

Mr. CANNING. I do, yes.

Chairman STOKES. Thank you.

You may be seated.

Mr. Goldsmith?

Mr. GOLDSMITH. Thank you, Mr. Chairman.

If I may have a moment.

For the record, sir, would you please state your name and occupation?

TESTIMONY OF THOMAS CANNING

Mr. CANNING. I am Tom Canning. I am Staff Engineer for the Space Projects Division of NASA Ames Research Center.

Mr. GOLDSMITH. Mr. Canning, I would like to ask you to move the mike somewhat closer to you and to speak directly into it. Thank you.