motorcycle at the time of the third occurrence, which is here, is right there.

I lost my graphical symbolism a little, and that is right there, and at the time of the last segment labeled No. 4, which at this time we would estimate it to be halfway between those two right there, and that is there, 120 feet behind the limousine at the time of the head shot, if in fact these impulses represent the sound of the head shot.

There is the possibility of labeling one of these four threshold crossings as a potential false alarm because it involves firing from this place at this target at the time that the limousine was here.

That is almost 180° out. It is inconceivable that anyone would do that, and on that basis one of these can be judged a false alarm.

The fact that some of those are thought to be correct detections was illustrated by all of the order in the data, as I explained earlier.

Mr. CORNWELL. Dr. Barger, does that conclude your description of the analysis that you performed?

Dr. BARGER. Yes, it does.

Mr. CORNWELL. Let me then ask you in sum, is it fair and accurate to state that after all of the analysis there is evidence of four shots on the Dallas Police Department tape, and that the acoustical sounds that may represent those shots are spaced as follows: between the first and second approximately 1.6 seconds, between the second and third approximately 5.9 seconds, and between the third and fourth approximately 0.5 of a second?

Dr. BARGER. Yes, that is a possible conclusion.

Mr. CORNWELL. I have no further questions. Thank you.

Chairman STOKES. Thank you very much.

Doctor, I would just like to say you are a fascinating teacher. I am just glad I don't have to take a test on what you have taught us here, today.

May I consult with the committee for just a moment regarding recessing at this time.

At this time the committee will recess until 1:30 p.m. this afternoon.

[Whereupon, at 12:15 p.m., the committee recessed, to reconvene at 1:30 p.m., the same day.]

AFTERNOON SESSION

Chairman STOKES. The committee will come to order.

The procedure this afternoon will be for the Chair to, first, recognize the gentleman from Indiana, Mr. Fithian, who will be permitted to consume such time as he may need in order to fully and extensively question the witness. After that, the Chair will operate under the 5-minute rule as to other members of the committee.

The Chair at this time recognizes the gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman.

Dr. Barger, we want to thank you for your excellent, very technical, and very complete testimony this morning. And as you must be

aware, this poses as very serious evidence for us in that it does not corroborate some other evidence that we have.

And I want to go back now, so that I am clear and others in the room are clear, as to just what it was that you set out to ascertain by the tests that you ran in Dallas when you went back and sort of recreated the shot pattern.

What was it that you were specifically trying to do?

TESTIMONY OF JAMES E. BARGER—Resumed

Dr. BARGER. Congressman Fithian, the first thing that we sought to do was to determine if there were any sounds of gunfire in Dealey Plaza that were recorded on that tape. In other words, we were seeking to determine if the motorcycle, whose stuck transmitter was transmitting sound, was in fact in Dealey Plaza.

Mr. FITHIAN. So you are trying to actually locate the motorcycle itself?

Dr. BARGER. It became necessary, first, to determine if the motorcycle was in Dealey Plaza, and then to locate it therein.

Mr. FITHIAN. And as to its location, correct me if I am wrong, you set your microphones 18 feet apart?

Dr. BARGER. That is correct.

Mr. FITHIAN. And you did this from the beginning of the turn on to Houston, down Houston to the turn on Elm Street, and down Elm Street, at least as far as where the Zapruder film showed, the head shot to the President?

Dr. BARGER. That is correct.

Mr. FITHIAN. Now does this mean, to those of us who are laymen, that once you locate a match of echo patterns, you have physically located the motorcycle to somewhere within that 18-foot stretch?

Dr. BARGER. That is correct. The echo patterns depend for their structure on the location of the microphone that receives the sound. We sought matches of the echo patterns that were sufficiently precise to represent a motorcycle microphone located within approximately 9 feet of each of the microphones.

Mr. FITHIAN. And then you presumed that the motorcycle was moving at the speed of the motorcade, or roughly that?

Dr. BARGER. We presumed nothing about the location of the motorcycle or its speed or even direction of motion. The matches were made without any presumption whatsoever about the position of the motorcycle, in fact, of course, without any knowledge that the motorcycle was even there.

After having made the matches, however, the position, I should say, the location of the microphones through which we found matches did in fact progress down the motorcade route at the times that the four subsequent periods on the tape showed matches. And as I indicated previously, the locations of the microphones where the matches were found at the four different times were moving down the motorcade route at approximately 11 miles an hour.

Mr. FITHIAN. And the number of microphones you used was determined by what? By the uncertainty of where or if the motorcycle was there?

Dr. BARGER. We started out with no assumption about where the motorcycle was, other than the fact that it was presumed to be on the street along the motorcade route. Therefore, we wished to put

microphones all along the route in Dealey Plaza. It was very difficult for us to record through more than 12 microphones at one time, and so in fact we did record through only 12 microphones at one time. It was rather time consuming to conduct the full round of test shots considering the need for observing safety precautions and the like. And so in order to conduct the entire test within a morning, we calculated that about 36 microphone locations could be accommodated and this indicated an 18-foot spacing.

The 18-foot spacing was judged adequate because it would place the motorcycle no more than 9 feet from the nearest microphone. That dimension is about half the width of the street. So if we put the microphone in the center of the street, even though the motorcycle was at the curb, we would be within that 9 feet.

The time it takes sound to travel 9 feet is 9 milliseconds. That is a fairly short period of time. We judged that small uncertainty, 9 milliseconds, to be adequately small compared with the total time over which the echoes would arrive, that being almost a thousand milliseconds or 1 second. That is the way that we decided upon the 18-foot spacing, the desire to have a small enough error, possible error, due to uncertainty of the true motorcycle location and the desire not to conduct the test all day long.

Mr. FITHIAN. Then are you satisfied that the fixes, if we can use that term, of the motorcycle that you came up with, are within 8 to 10 feet, or something not much greater than half the distance between one microphone and another?

Dr. BARGER. Yes, yes, I am satisfied that the 18-foot spacing was not too coarse.

Mr. FITHIAN. Now to the layman, it would seem that if you are going to recreate a test, that you might have wanted to use instead of the most modern microphone equipment, you might have wanted to use, as nearly as you could find, microphones and transmitters identical to those which you believed to have been on the original motorcycle. And I would like some explanation as to why you chose not to use the motorcycle microphone, which you have indicated at one point in your testimony you had indeed used, from the Massachusetts police. Evidently that kind of a microphone or transmitter is available.

Why then did you use a more sophisticated system of microphones?

Dr. BARGER. A more sophisticated system?

Mr. FITHIAN. Yes, more sophisticated than obviously was on the stuck transmitter.

Dr. BARGER. Why did we use the more sophisticated?

Mr. FITHIAN. Why did you?

Dr. BARGER. There are two reasons. In the first place, as I showed, the radio distorts and limits the amplitude of loud sounds. Each radio does that in detail in a different way. We weren't seeking to look at the waveform of each sound echo, only the time at which it occurred. The radio does not distort the time at which it occurs, nor does the more sophisticated equipment that we used.

The more sophisticated equipment that we used is known to be reliable and not to fail in times of stress in the middle of a sensitive test. Old motorcycle radios from those earlier days are known not to be very reliable, nor are they to be found in the

quantities that we required. Therefore we selected a system that would give us equivalent data but more reliably.

Mr. FITHIAN. So that I understand now, the data that you were really looking for was not dependent upon the amplitude or the height of the blip, or whatever you want to call it, greater than a certain amount which would help you identify it. Rather you were trying to locate it along the time line?

Dr. BARGER. Correct. That is absolutely correct.

Mr. FITHIAN. As I understand it, Mr. Chairman, this committee employed two other specialists that Mr. Cornwell referred to this morning, Mark Weiss and Ernest Aschkenasy, and you went over the plan of the test with them; is that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. Did they concur in the layout of the array of microphones, the type of microphones? In other words, did they concur in your proposed test plan?

Dr. BARGER. They did.

Mr. FITHIAN. Tell me then something about the difference in the status of the science of acoutics from 1964, when presumably this tape was in existence and could have been analyzed and 1978 when you analyzed it, 1977–78 when you analyzed it, not in great specificity. But what are the grand changes that have taken place in that 14-year period?

Dr. BARGER. Well, there are two. First, the adaptive filter that we used to reduce the level of the motorcycle noise on the tape was a procedure that was not then, had not then, been worked out. It was not known.

Second, the method we used to detect for the possibility, to search for the possibility of sounds, is generally called a matched filter or a matched detector. The theory of that device, that method of seeking the presence of suspected signals in loud noise, was developed principally I believe by the radar community during World War II. It was therefore known in 1963 to people who study the process of detecting expected signals imbedded in loud noise.

The community that shared that knowledge in 1963 was not as wide as it is now. I don't believe I knew about it then.

Mr. FITHIAN. But the filtering process that you used came in, I think you said this morning, in 1968 to 1970; is that correct?

Dr. BARGER. Well, probably more like 1966 to 1968, but, that is correct.

Mr. FITHIAN. Now some of the terms you used this morning I am sure must be every day terms to you, but I am not sure all of us followed those.

One of the key terms seemed to be "impulsive events" or "sequence of impulsive events" or something to that effect.

What does that term mean, to those of us who don't get along very well with this science?

Dr. BARGER. I used the term "impulsive event" to describe the brief, loud bursts of noise that appeared on the Dallas police tape.

Now when I listened to the tape, you hear spits and stutters and pops. Those would all be descriptors of impulsive acoustical events. When you look at the waveform as presented on the oscillographic records that I showed, then the transient events are characterized

by short intervals of time in which the loudness of a sound is intense, so it looks like blips or peaks in the amplitude record.

Mr. FITHIAN. And another term that was used, I think, as you took that concept and tried to transfer it to the visual, was spectrographic analysis of this transient event. I take it that is that chart that you put up on the wall this morning?

Dr. BARGER. Yes, I did put—we did have an exhibit that was a spectrographic analysis of a segment of the tape recording; that is correct.

Would you like me to discuss that briefly?

Mr. FITHIAN. I just wanted to make sure my understanding was correct, and, that is, that the spectrographic analysis is a sort of a visual playout of this grassy looking material that is blips and depressions.

Dr. BARGER. Yes; the spectrogram itself is a visual description of the tonal content, frequency content, pitch content of sound as a function of time. In other words, if a person was raising his voice like that, you would see a diagonal line on the spectrogram, indicating as time progressed, the pitch of the sound was rising.

Mr. FITHIAN. And now the adaptive filtering you used, do I understand that correctly, that this is the process of filtering out noises and things that you don't want to measure?

Dr. BARGER. The adaptive filtering process, which I characterized as a Widrow-type adaptive filter was used because it is effective in reducing repetitive noises, not impulsive noises, but repetitive ones. If you listen to a motorcycle, basically you hear the sounds of the cylinders firing, and they fire at idle for that motorcycle about once every 140 milliseconds. So, therefore, the noise as generated by that motor cycle has a tendency to resemble itself every 140 milliseconds later.

The adaptive filter studies that noise, determines what is expected to occur in the future, subtracts that out from the data that is just coming in, and leaves you with the absence of that repetitive noise. But if you are looking for transient events or impulses about which the filter could have no prior knowledge, because they only occur once, then that fiter leaves you with those transients more clearly observable. The noises, in other words, the repetitive noise that was masking those transients is thus reduced.

Mr. FITHIAN. And one final sort of terminology question.

You used the term "match filter technique," "matching filter techniques"——

Dr. BARGER. Yes.

Mr. FITHIAN [continuing]. And that means what?

Dr. BARGER. That means that you have in your—you expect to receive one of many kinds of signals. By "many kinds," I mean a signal in this case that has a series of impulses that occur in a definite sequence, like, let's say, the first one occurs at a particular time, the second one perhaps 3 milliseconds later, the third one maybe 15, the fourth one 27, the fifth one 12½ after that, and so on, a definite sequence of impulses.

We went to Dallas to find out what the sequence of impulses would be that would be generated by Dealey Plaza if a gun was fired.

Having found out what that sequence of impulses is, you then go through the tape in question and look for sequences of impulses that match it. When you find one that matches it, you say aha, at that time something occurred that generated a pattern of transient events that just matches what we did in Dealey Plaza, and when that occurs, you judge that you have made a detection. You have identified a similar source of noise. The word "matched filter" is a technically correct or often used form, and the use of the word "match" is fairly self-evident, I believe.

Mr. FITHIAN. Now I am sure there must have been a reason for your lengthy analysis of this bell tone. I am not sure that—I guess my question is why did you look for and analyze and worry about the bell tone, since we were looking for some kind of rifle shots or pistol shots or whatever?

Dr. BARGER. There are two reasons. First, we wanted to see if in fact there were any sounds on the tape that were caused by acoustical signals such as a bell would generate. We found that the sound that resembled a bell was a bell.

Second, we hoped to establish, we hoped to learn, where that bell really was and had thought if we could find it, we would then know where at least one microphone was that was transmitting on channel 1 at that time.

Mr. FITHIAN. So, you were trying to verify that there were transmittals on that tape?

Dr. BARGER. That there were acoustical events as opposed to what might be called microphonics. In other words, as you take a radio transmitter and just kick it around and shake it, as a motorcycle might do, particularly if the radio were broken, then it would transmit signals that wouldn't have any bearing due to sounds. We just wanted to see if there were sounds on there.

Mr. FITHIAN. Now, I am not sure, counsel, what the exhibit numbers are, but I am interested in the way you went about locating the targets; that is, physically locating the targets that you were going to fire at.

I understand why you selected the two points from which you fired, but could you put up the three or four photographs of Dealey Plaza, F-367 and F-377?

Mr. CORNWELL. F-337 and F-344, I believe.

Mr. FITHIAN. While they are doing that, let me ask you sort of the central question.

Is it your conclusion that you proved that there were four shots?

Dr. BARGER. No.

Mr. FITHIAN. With regard to the groupings of shots, what do you prove then?

Dr. BARGER. As regards the grouping of the shots, we demonstrated with high confidence that if there are four shots, we demonstrated the times at which they occurred, and the intervals between them were described by Mr. Cornwell, 1.6 seconds, was it 5.9, and 0.5.

Mr. FITHIAN. Would you repeat that again, please?

Dr. BARGER. Yes.

Mr. FITHIAN. The distance, the time frame between the first and the second shot is what?

Dr. BARGER. 1.6 seconds.

Mr. FITHIAN. And between the second and what you perceived to be a possible third shot?

Dr. BARGER. 5.9.

Mr. FITHIAN. And between the possible third and the possible fourth shot?

Dr. BARGER. 0.5.

Mr. FITHIAN. 0.5?

Dr. BARGER. 0.5, one-half second.

Mr. FITHIAN. One-half second. So what you are saying, Doctor, is that if there were four shots fired, they came at those intervals?

Dr. BARGER. Yes.

Mr. FITHIAN. And let's hypothesize for a minute. If there were only three shots fired, how do you account for the disturbance that you find at I guess it would be 5.9 after the first shot—after the second shot, I am sorry.

Dr. BARGER. I don't have the best exhibit in front of me to answer that, but let me do it without, the first time. Of the 15 detections that our matching process achieved, 10 of them cannot be discounted as false alarms.

It would be necessary for at least three of those to be correct detections, to have established the coherence in the data that led to our conclusion that the microphone was in fact in Dealey Plaza.

It is therefore likely that somewhere between 3 and 6 of the remaining 10 are also false alarms. Therefore, anyone——

Mr. FITHIAN. May I interrupt just a moment?

Dr. BARGER. Yes, of course.

Mr. FITHIAN. I think the staff was putting up the right pictures. I wanted the big pictures of Dealey Plaza. I think there are three or four of them altogether. You had three of them out just a moment ago. Go ahead, Doctor.

Dr. BARGER. Therefore, it would not be unreasonable to expect that approximately 5 of the remaining 10 correlations were also false alarms.

That would indicate that about one-half of the detections that I did not previously indicate to be false alarms, about one-half the remaining 10, are false alarms. This would indicate that the probability that each one is a correct detection is about one-half.

Mr. FITHIAN. I am going to return to this a little bit later. I am going to put those microphone images up there and we are going to go through that time frame because it is very important to me, but right now I want to try to establish the location of the targets.

Now, I am not at all interested in the charts right at the moment. I just want the pictures, the two pictures you have plus another one that shows some interstate signs with targets behind them. That is the particular one I want.

[Exhibits F-339, F-340, F-341, and F-342 were displayed.]

Dr. BARGER. Well, it is there.

Mr. FITHIAN. Yes, OK. Set it up on the upper easel if you will. Thank you.

Now, could you put on your Lavalier microphone, Doctor, and I would like for you to locate for us again the locations of the targets that they fired at.

Dr. BARGER. Yes; the target that was illustrated as target location No. 1 is this pile of sandbags right here.

Mr. FITHIAN. And let me just make sure my optical illusion isn't getting away from me. That is between the Texas School Book Depository window on the left and the interstate signs overhead, is that correct?

Dr. BARGER. This picture is taken from the window adjacent to the window from which Oswald is thought to have fired, so it is taken from the depository.

Mr. FITHIAN. So that one you are pointing at is up the hill, if you will. It is located in the road prior—if you are going toward the underpass—prior to arriving at the interstate signs, the first target that you just had pointed at down here, just right there.

Dr. BARGER. Yes.

Mr. FITHIAN. That is physically before you get to the interstate signs.

Dr. BARGER. These signs?

Mr. FITHIAN. Yes.

Dr. BARGER. Well, it is physically just before them, that is correct.

Mr. FITHIAN. And the second target is where?

Dr. BARGER. The second target is hiding behind the trees right at that point.

Mr. FITHIAN. The third target is the one down the road?

Dr. BARGER. That is the third target.

Mr. FITHIAN. Now, in the location of targets, are those, as nearly as you can compute from the Zapruder film or otherwise, the exact location of the President and Governor Connally in the limousine?

Dr. BARGER. No; with regard to target No. 3, which was positioned to be at the same place as the limousine in frame 313, it was put in that place as well as we could determine it.

Mr. FITHIAN. And is target No. 1 in the same location that you presumed the first shot was fired?

Dr. BARGER. Of course, I don't know exactly where the limousine was when the first shot was fired.

Mr. FITHIAN. I guess basically I am asking you why did you locate the target there?

Dr. BARGER. As I recall, we sought to place the first target at about the position of the limousine, at about frame 158–160. The reason for that was that the preliminary screening that I described earlier of the impulses on the tape, indicated that if the first pattern of impulses that could be seen occurred prior to frame 313 by enough time to place it back at about frame 158. That is why we tried to position the target at that place.

Mr. FITHIAN. Is target No. 2—which doesn't really show up from here, but you pointed to it—is that at as nearly an accurate location as possible?

Dr. BARGER. May I ask Mr. Cornwell a question?

Mr. FITHIAN. Yes.

Dr. BARGER. I forget right now which Zapruder frame we tried to position target No. 2 at.

Mr. CORNWELL. We initially attempted to place it in the vicinity of 190, which would have been slightly further down the street from where it ultimately ended up, but the tree size is different today than it was in 1963, and the signs over the street which are in that area were of course not there in 1963, so we had to simply

find the shortest point from the 190 frame that we could still shoot at sandbags. It was moved, as I recall——

Dr. BARGER. We were striving for the location of the target at the position of the limousine in frame 190, which was obscured by the new growth of the tree, and so we moved it to that position to make it——

Mr. FITHIAN. Doctor, the reason that I am going into this is that in studying the data last night from your research, and going over what you find as possible matches and then eliminating those which you believe to be false signals, there seemed a dirth of any matches with the second target in your data.

The question is whether or not there is anything—we have already eliminated the new hotel building several blocks away as having been in any way altering the echo pattern.

I am curious to know whether or not the location of that target, the interstate signs, the firing direction or anything like that would tend to give us the kind of data that we seem to have on target No. 2.

Dr. BARGER. Three of the matches were achieved for test patterns obtained by firing at target No. 2. I wouldn't describe that as a dirth, that is to say, three out of 15 would represent.

Mr. FITHIAN. But if I may come back to this a little bit later, if you want to remember the point and we will take it up then. If I remember in going through the ones that you eliminate as false alarms, that reduces any match to target No. 2 either to one or to zero, I am not positive, but we will come back to that.

I just was curious to know whether the intrusion of the interstate signs into the whole acoustical pattern does anything to the results you get.

Dr. BARGER. Yes; the target No. 2 was responsible for at least two false alarms. Let me just check this a moment and make sure. Yes, it contributed false alarms in each case. There was a detection made at the second time interval when a shot was fired at target No. 2, and that one was eliminated because it was detected at microphone No. 5 in the third army position, and that was the one that would have required a 55-mile-an-hour speed of the motorcycle to achieve, and so that was labeled as a false alarm.

Target No. 2 contributed a false alarm here, which was one of the three detections made at the third time segment. That too is ruled out because of improbable motorcycle speed required to achieve that position at microphone No. 7 at the time of the third group of matches. And finally, a shot at target location No. 2, contributed a false alarm in the fourth pattern, that one having been identified as a false alarm by the improbable motion of the motorcycle required to achieve it, so that is correct.

The three detections that were achieved from test patterns obtained by shooting at target No. 2 appear to be false alarms.

Mr. FITHIAN. What impact, if any, did the firing of the bullet from the school depository window between the two interstate signs, what impact would that have in altering the data, if any?

Dr. BARGER. The presence of a structure such as this would have been highly irrelevant to the tests had it been over here.

Mr. FITHIAN. You say "highly relevant"?

Dr. BARGER. Irrelevant.

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Mr. FITHIAN. Irrelevant.

Dr. BARGER. Had it been over here. The fact that the trajectory of the bullet missed that sign by only a few feet indicates that, as the shock wave which is radiated from the bullet as it passes, would be in fact scattered by those signs, generating a new source of sound at that point.

Mr. FITHIAN. And so then you really couldn't expect to get a matchup; is that what you are saying?

Dr. BARGER. That would introduce additional echoes in the test pattern that would not have——

Mr. FITHIAN. Let me make sure I am correct.

If you introduce additional echoes, or if you get additional echoes anywhere that don't match up, that reduces the probability, reduces it from eight to seven or seven to six or six to five or whatever.

Dr. BARGER. It reduces the probability of detection and it increases the likelihood of a false alarm.

Mr. FITHIAN. Thank you.

Now I also looked at the pattern of shooting and noticed that you did not have as many shots from the grassy knoll toward No. 2 as at the other targets. I think No. 1 and No. 2, if I am not mistaken.

Were there any reasons why you didn't have a full round of firing?

Dr. BARGER. Yes; I think you are referring to the fact that we did not fire at target No. 1 from the knoll.

Mr. FITHIAN. I am sorry, I said two. I meant one.

Dr. BARGER. Yes.

Mr. FITHIAN. Yes.

Dr. BARGER. That is correct. When we were setting up the locations of the microphones and the rifles and so on, we observed that target No. 1 was directly between the rifle on the knoll and the spectators that had been positioned behind a barricade on Elm Street, and it was judged entirely inappropriate to attempt that shot.

Mr. FITHIAN. Now there is one other question I need to ask about what is up on the board there on the easel.

When we visited Dallas, when the committee visited Dallas, and we inspected the Texas School Book Depository, we were told that, at the time that they picked up the shells, the empty cartridges on the sixth floor near the corner, I believe it would be about where the gentleman is standing or in that area, that the area was physically cased in by boxes, not quite entirely, but nearly so, and that some writers have described this as the sniper's nest, et cetera.

But in any event, to get to the acoustics of it, would those stack of boxes in the depository right around where allegedly the shots were fired have any significant impact on the echo pattern that you could expect to get outside?

Dr. BARGER. They would not have a significant impact on the matches performed with the echo patterns. The reason is they would introduce into the echo patterns additional signals which are reflected from the boxes you describe that occur at a time later than the muzzle blast. By the time it takes the sound to go from the muzzle to those boxes and back out the window, that amount of

time would be less than 12 milliseconds, if those boxes were within 6 feet of the rifle. And we have, as I described, broadened the width in time of each impulse on the motorcycle tape by 12 milliseconds to accommodate the uncertainty of microphone position relative to the motorcycle. And the broadening of the acceptance time for each impulse in the motorcycle tape solves the uncertainty caused by the lack of precise microphone location, since we didn't know where the motorcycle was. It also solves the problem that you just described.

Mr. FITHIAN. Let me see if I understand that now.

What you are saying is because the little elliptical bins that you put over these blips—I don't use very scientific language here—but that you put over these blips in the spectrograph because they accommodated up to, what did you say, 6 feet on either side?

Dr. BARGER. Yes, 12 in total.

Mr. FITHIAN. Twelve feet total, that the boxes in order to have been in any way effective would have had to have been closer? In other words, your accommodation, your allowance, took in any allowance for the boxes being there or not being there?

Dr. BARGER. Yes, providing those boxes were within 6 feet of the muzzle. If they were significantly farther than that, then the echo coming from them and trying to get back out of the window and thereby becoming relevant to the test pattern would be so weakened so that it wouldn't have had any significance either.

Mr. FITHIAN. For practical matters, you are saying it doesn't make any difference whether you stack up boxes when you do the test firing or not?

Dr. BARGER. Absolutely.

Mr. FITHIAN. Thank you.

Let the record show that the question pertained to JFK exhibit F-342, the picture of the marksman.

Now one thing that has been bothering me this morning is the possibility that since more than one radio could be transmitting on that channel 1 that the stuck microphone was on, that indeed we might have been picking up some sounds from somewhere out of Dealey Plaza or somewhere else by some microphone other than the stuck microphone, since I believe you said that the bell tone was off outside. The bell tone did not come in over this particular microphone——

Dr. BARGER. That is right.

Mr. FITHIAN [continuing]. To any way that we could locate.Then why couldn't we hypothesize that perhaps the third or the fourth shot or the first or the second shot or some other shot might indeed have been picked up, that kind of a sound might indeed have been picked up by some other radio transmitter being keyed somewhere else other than Dealey Plaza?

Dr. BARGER. Yes; we did establish, particularly with the spectrograms, that other microphones were keying in particularly at the times, the later two times, according to time three in green and four in black on that exhibit. And so during the time when those other radios were transmitting, sounds from their microphones would be expected to also appear in the tape recording, and, therefore, if a pattern of impulses was generated by some mechanism at

the location of the other microphone, then that pattern too would appear on the recorded sound.

However, these patterns were quite complex. They contained no fewer than 10 echoes, as I recall, spread over total times no less than about half a minute—let me see now, half a second—and the interval of time between each of these 10 echoes over this whole period of time, half a second or more, is a very intricate pattern. The likelihood that some other mechanism that would generate a similar pattern that would match with the test patterns is extremely remote.

Mr. FITHIAN. And if one of the other microphones were on one of the other motorcycles in Dealey Plaza, what then?

Dr. BARGER. If another motorcycle in Dealey Plaza keyed in at that time, you would have a test pattern, if you will, that is to say, you would have the sound of gunfire on that one too. If it was sufficiently noise free that our detection process caught it, it would have shown a high value of correlation in the match and would have been marked as a detection.

Mr. FITHIAN. But it would have come the same time frame, though, if it were a shot in Dealey Plaza; is that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. And so the only thing that would be somehow altered would be the location of the motorcycle.

Dr. BARGER. That is correct.

Mr. FITHIAN. So what you are saying is that the only way you could have gotten the pattern that matched is if over some other transmitter that was not in Dealey Plaza, to get those 10 or 15 or however many echo patterns matched up, there would have had to be a configuration somewhere else very much like Dealey Plaza. The transmitter would have had to have been keyed at exactly the right time, and then you would have had this——

Dr. BARGER. That is correct.

Mr. FITHIAN. How would you classify that; very unlikely, impossible, remote?

Dr. BARGER. Extremely unlikely.

Mr. FITHIAN. When you went to Dealey Plaza, you expected a certain approximation or a certain number of impulses. In general now, not referring to anything specific, but your general conclusion, did you get the approximate number of impulses that you anticipated?

Dr. BARGER. Yes.

Mr. FITHIAN. I want to ask this question again, and that deals with the term you used, "correlation coefficient," when you got those.

Would the correlation coefficient be altered if the motorcycle is not at the exact location of the test microphone? In other words, you talked about a correlation coefficient of 0.8 or 0.7, 0.75, 0.6.

Would that have been altered if the location of the microphone were 8 or 9 feet away from where the motorcycle actually was when the Dallas Police Department tape was made?

Dr. BARGER. I am glad you asked that because I don't think I made this point very clear the last time. The purpose for accepting as a match an impulse that occurred within plus or minus 6 milliseconds of an echo was to try to overcome the problem of a low

correlation occurring if you by chance did not have the microphone in exactly the right place. If you insisted that those impulses line up with those echoes precisely, you would have to have the motorcycle just where the microphone was. We didn't have that many microphones or that much time, and so we used, as I said, the 18-foot spacing of microphones.

In order to prevent a loss, a significant loss of correlation, because of the uncertainty with respect to the location of the motocycle and the microphone, we accepted anything that came within 6 milliseconds as a match.

Now let me explain where 6 milliseconds came from. I was trying to guard against low values of correlation, and therefore loss of information, just because I happened to miss the location of the motorcycle, but I couldn't accept as a match echoes and impulses that were half a second apart because then I would accept everything, so it is necessary to find a medium ground.

Now here is how that was done. In the case where the microphone and the reflector that is causing the echo and the source are all in one line, then the 9-foot uncertainty that I had with the 18-foot spacing, plus or minus 9 feet, would generate a plus or minus 9-millisecond uncertainty in the location of the echo.

Now it is also true that if the sound that generates the echo that I am interested in is arriving perpendicularly to the line connecting the microphone and the possible place of the motorcycle, then that uncertainty is of no consequence because it would arrive at both of the two places at the same time. So the error caused by this phenomenon varies between zero and 9 millionseconds. So mathematically we said the arrival of these echo sounds from each direction is equally likely, and we determined an average of the error that would be introduced by a 9-foot uncertainty, and it was 6 milliseconds.

This is not a linear average. That would have given 4½, but there is a cosine involved in this, and so the 6-millisecond uncertainty was arrived at in that way, and it was designed to minimize the loss of correlation due to uncertainty in the microphone location.

However, it won't work perfectly because in those cases where the error is actually 9 milliseconds, when the echo happens to be coming in in the same direction as the line connecting the motorcycle and microphone, then it will cause a lack, a loss of correlation.

So the answer to your question is there is a slight loss in correlation but it is not as large as it would have been if we had not used the plus or minus 6-millisecond window.

Mr. FITHIAN. Staying with the loss of correlation, because some of us are bothered when you match up a shot pattern that we know happened, and you can't match up all the 12 blips or the 15 blips or whatever, here and there, what you have just said is that some of them might be attributable to the fact that the motorcycle was outside by 3 feet or whatever. In other words, you might get a reduction in the correlation coefficient because the motorcycle is just beyond your tolerance level.

Second——

Dr. BARGER. That is right.

Mr. FITHIAN. Would you get a reduction in the correlation coefficient if induced onto the tape by a second transmitter somewhere there were noises that exceeded the threshold level that you established?

Dr. BARGER. Absolutely. The presence of impulses in the motorcycle tape that we counted, because we observed them to be there, that are caused by nonacoustical effects, give us therefore the impossibility of achieving a match because they were caused by some entirely different phenomenon. And the way of computing the cross correlation coefficient or the correlation coefficient that accommodates that, in other words, in the denominator is the square root of the number of impulses. If there is a lot of noise in the tape, as there is a good deal, and many of those impulses are caused by that, they can't be matched, and they will reduce the level of the correlation coefficient just mechanically, because there are numbers in the denominator. So if there are lots of noise pulses, that will reduce the correlation coefficient, exactly.

Mr. FITHIAN. So you would not expect to get a one, or I think you used the term "unity."

Dr. BARGER. The motorcycle tape is so noisy, not only with the sound of the motorcycle, but also keying transients and the like from other transmitters that it would be extremely unlikely that you would have a segment of the tape so noise free that a perfect correlation would be achieved, and in fact none were.

Mr. FITHIAN. From what you know about the echo pattern of the Mannlicher-Carcano rifle, what insight, if any, can you offer into Governor Connally's testimony, if you heard it or read it?

Let me try to reconstruct.

Do we have the transcript of Governor Connally?

On September 6, Governor Connally testified and said that—let me back up here a little ways. Let me take his last part of his testimony first.

He says, "I heard another shot. I heard it hit. It hit with a very pronounced impact," and at that point the Governor slapped his hands together to demonstrate the sound that he heard. "Almost like that." He said "It made a very, very strong sound."

Then he says:

> 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 he goes on.

Now, as I interpret what the Governor said, after he had been hit, and Mrs. Connally had pulled him down into her lap, he was still conscious, and he heard what sounded like a shot, and then heard what sounded like the bullet striking the President's head.

Now, No. 1, if in fact the speed of the bullet is supersonic, you could not hear it in that sequence; am I correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. In other words, he would have had to have heard the bullet striking the skull first, and then the muzzle blast would come at some fraction of time after that?

Dr. BARGER. That is correct.

Mr. FITHIAN. Well, then, obviously there has to be some other interpretation of those sounds, if in fact the Governor heard the sounds correctly.

Can you shed any light on this at all?

Dr. BARGER. Yes; the findings, as I have described them, are that if there are four shots, they have the sequences that we described, and in fact, if you could uncover that back chart, please, you will see that the time segment marked in green occurs a half a second before the time segment marked in black. Therefore, if there are four shots, the times that they occur are shown there on that chart, the last two being a half a second apart.

Now, as I indicated, there are false alarms in this detection experiment or test that I have conducted, and so, therefore, it is the purpose of other evidence to compare to these findings to see which—if you can determine which of these findings are, in fact, corroborated or are discredited by other evidence. In that sense, the comment that former Governor Connally made is of some relevance because a statement that two loud sounds were heard, that are separated only by a small period of time—I don't remember exactly what word he used—"shortly thereafter," as I recall—would indicate that he heard two loud impulsive sounds at the time of the third shot. I can't put any significance in the fact that he may have inverted the two times. That was a traumatic period, obviously, for him. But it is interesting that he did, in fact, characterize as the sound of impact what must have been the sound of a rifle, because it would seem possible, then, that his testimony indicated there were two briefly separated impulsive sounds that might both have been shots.

Mr. FITHIAN. I agree with you obviously that it was a very traumatic and almost impossible-to-imagine state of mind. But, I recall the Governor saying very clearly, early on, that he had done enough hunting that he recognized rifle shots when he heard them, et cetera, and that is what caused him to turn his head at the beginning way back, I don't know, frame 170 or 180, or whatever, and he did characterize or if there are only three shots and the last one is the one that hit the President in the head, then he had to confuse what would have been a bullet wound in the skull with a rifle shot.

Dr. BARGER. That is correct.

Mr. FITHIAN. As an expert in acoustics, can you just help me out in trying to distinguish what the differences in characteristics would have been?

Going back to my original premise of the question, the first thing he heard after being in Mrs. Connally's lap could not have been a rifle shot if there is only one shot fired.

Dr. BARGER. That is right.

Mr. FITHIAN. The first sounded to him—if you x out our fourth one or third one you have come out with as a possibility, prior to the head shot, then that first noise the Governor heard could not have been a rifle shot.

Dr. BARGER. If he could have heard the sound of the impact at all, as he thought he did, then it could not have been the second sound that he heard; it would have had to have been the first—what he described as an impact.

Mr. FITHIAN. My question was basically if you could help me describe acoustically or otherwise what the human ear would hear in the difference between a rifle shot from the Texas School Book Depository and a bullet striking the head of the President 6 feet away or 5 feet away or whatever.

Dr. BARGER. I have heard the former, and, of course, I have no concept of the impact sound, I really have no opinion on that.

Mr. FITHIAN. I want to return to that troublesome shot from the grassy knoll, the third one that comes just ahead of the obvious head shot. If we are to stay with three bullets being fired as our final interpretation, then we have to somehow or other rationalize a way or do away with or accept as other phenomena the third impulse that you have on your charts, is that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. What might the third impulse be, then, if it isn't a shot?

Dr. BARGER. If it is a false alarm, which I described as the alternative to being a correct detection, by the very nature of a false alarm, it cannot be very easily explained. The only reliable procedure I can conceive of for identifying it as a false alarm is by comparing the time that it had to have occurred with all other testimony that has come and will follow about the possibility of that having occurred.

Mr. FITHIAN. Random statistical errors? Would that have done it?

Dr. BARGER. As I indicated just before, I think there is an even chance that about half of those remaining detections are, in fact, false alarms. Each one has an even probability of being one, including the one you just cited. I guess there is a chance of random error that that correlation occurred.

Mr. FITHIAN. I would like to recall, Mr. Chairman, JFK exhibit F-370. Doctor, if you would proceed over there, I want to make sure before I turn you loose here that I understand that vital chart.

Now, starting from the lower left-hand corner, where originally on the chart you had four possible verifications, and you eliminated one, you are fairly certain that that is the first shot, and you are fairly certain of the location of the motorcycle within 10 feet; is that correct?

Dr. BARGER. The origin of this chart represents the estimate that the motorcycle was half-way between microphones 5 and 6 at that time; that is correct.

Mr. FITHIAN. Now, you use the term "false alarm." Perhaps we should put up JFK F-367 there for you to refer to. I notice in some of those that you rule out as false alarms they are really the same shot except that one is with the muzzle at the plane of the window and the other is at the muzzle 2 feet inside. Isn't that correct?

Dr. BARGER. There were these two which you must be referring to.

Mr. FITHIAN. Take No. 1, for example.

Dr. BARGER. This one?

Mr. FITHIAN. Yes; which one have you eliminated—one of them you have eliminated. But is it meant that the first shot heard would have been from the grassy knoll and it would have been aimed at the target clear down by the underpass; is that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. So you eliminated that just because it wasn't very probable that the first shot would have been it was 75° away from where the limousine was, or whatever?

Dr. BARGER. That is correct. I used that as an example of the lack of any evidence to corroborate that someone would have done that.

Mr. FITHIAN. That leaves three other matches or verifications you came up with right in that time frame?

Dr. BARGER. Yes.

Mr. FITHIAN. As I read this chart, two of those are shots which were fired with everything exactly the same except that the rifle muzzle was withdrawn 2 feet from the plane of the window.

Dr. BARGER. That is correct.

Mr. FITHIAN. And so, in fact, all three of those matches come from the microphone being in the same place and everything else being in the same place with the exception that you fired one, which is shot No. 3, which has an 0.8 correlation coefficient, with the muzzle at the window plane, and you fired the other two, having 0.8 and 0.7 correlation coefficients, with the muzzle of the Mannlicher-Carcano withdrawn inside the window 2 feet. That is the only difference, isn't it?

Dr. BARGER. That is correct, apart from the fact that——

Mr. FITHIAN. I am trying to account for all these extra dots, because to the average person looking at that, it looks like there are 15 different shots and obviously that is not the case. We are trying to match up signals from repeated tests, and your verifications come up with four of those being possibly correct, and you eliminate one as being highly improbable.

Dr. BARGER. Yes.

Mr. FITHIAN. But the other three are all from a Mannlicher-Carcano shot from the window into the target.

Dr. BARGER. Yes.

Mr. FITHIAN. As you move on over about 1½ seconds we see another group of shots which you have marked with a red circle.

Dr. BARGER. That is correct. These are marked here and listed in this table.

Mr. FITHIAN. As I take it, there are possibly four matches in that area. You have ruled out the one from the knoll at the target No. 2. The remaining four, again, are fired from the same place, the only difference being that two of them are with the muzzle withdrawn and two of them are with the muzzle at the plane of the window.

Dr. BARGER. That is correct.

Mr. FITHIAN. So, again, then we are not really talking about a different variety of shot impulses on the original tape. These are shot impulses you put on the test tape because you fired several times, isn't that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. And the reason they show up at that time frame match would be because on the original tape that is when the second shot was fired. Is that correct?

Dr. BARGER. That is very close to correct. These indicate where on the original tape is the pattern of impulses that looks like the test shots.

Mr. FITHIAN. Now you are aware that the FBI test firing by the expert indicated you couldn't fire the Mannlicher-Carcano more rapidly than 2.25 or 2.30 seconds. That much time had to separate shots. You are aware of that testimony in the Warren Commission.

Dr. BARGER. As it turns out—I am aware of that and was. However, I had no reason to put high reliability on that, and I could not allow that to influence the interpretation of the results.

Mr. FITHIAN. You are saying—with your careful scientific analysis of this tape—saying the first two shots are 1.6 seconds apart; is that correct?

Dr. BARGER. Yes; I felt confident in ruling this one out, because I was certain there was no motorcycle going 55 miles an hour. On the other hand, the fact that all of these correlations came up 1.6 seconds later is the way the test developed, and that is the result that was obtained.

Mr. FITHIAN. I want to make sure I also understand, when you look down in that lower left-hand corner, near the red circle, you have two dots below and two dots roughly above the imagined track of the motorcycle, but, again, during the same time frame—from here it looks like that might not be the case—with the upper right-hand matchup in that group of four; is that correct?

Dr. BARGER. Would you repeat that again?

Mr. FITHIAN. In the vicinity of the red circle for shot No. 2——

Dr. BARGER. Yes.

Mr. FITHIAN [continuing]. Two shots just below represent the same time frame.

Dr. BARGER. Exactly.

Mr. FITHIAN. You had to space it that way.

Dr. BARGER. That was artistic license; that is right.

Mr. FITHIAN. Now, if my eyes do not deceive me, the one immediately above that is also on exactly the same time frame, that 1.6.

Dr. BARGER. That is correct.

Mr. FITHIAN. The fourth shot up and to the right, does that not represent a different time frame?

Dr. BARGER. This is the fourth detection, not the fourth shot.

Mr. FITHIAN. I am sorry. The fourth detection.

Dr. BARGER. Of the four we have discussed so far.

Yes. That one is this one. In other words, four of the matches in this segment of the tape which I have listed here as occurring at this time, were one, two, three, four, those all match at exactly the same place in the tape.

Mr. FITHIAN. And you eliminated the highest, the one clear up at the top next to the limousine, because that would make the motorcycle going 100 miles an hour?

Dr. BARGER. Yes. For a reason wholly unrelated to the evaluation of the test.

I don't know whether there is another question remaining.

Mr. FITHIAN. I am wondering if any of the rest of those four down there are clearly false alarms.

Dr. BARGER. I don't have any good indication that any of them are.

Mr. FITHIAN. If I am not mistaken, the upper right-hand one of those four is beyond the 2-second time limit on your linear scale at the bottom; is that correct?

Dr. BARGER. That is correct. This particular match occurred at a different time than the other four. This one occurred at a slightly later time. It achieved a rather high value above the threshold of the cross-correlation coefficient, but it did it in a way that was unlike any of the other 14.

The early echoes in that particular pattern didn't match with anything. It was all the later ones that matched. Therefore, the first match that was actually achieved in the echo pattern did not correspond with the leading edge of the echo pattern. In a sense, it is conceivable the leading that edge of the echo pattern could have been obliterated at that time by transmission from another motorcycle, or whatever. That would explain why its leading edge was off and its timing was bad. I included it in the results of the tests because objectively it had, in fact, exceeded the threshold of 0.6.

Mr. FITHIAN. Now, move to the third, which would be your green shot, or green matchup. That is the one that is 5.9 seconds later, or whatever the time is Mr. Cornwell.

Now, am I not correct in visualizing that all three of those matchups are exactly on the same time frame?

Dr. BARGER. That is correct. All three of those occur at the same time, 145.15 seconds after the microphone button is stuck.

Mr. FITHIAN. So am I correct in assuming that if we are to discard that shot altogether or that echo pattern altogether, we have to discard all three of those despite the fact that you have three matchups on exactly the same time frame?

Dr. BARGER. I am not sure I understood that.

Mr. FITHIAN. Vertically. In the third verticle.

Dr. BARGER. These three?

Mr. FITHIAN. Yes. Those matchups occur from some kind of an impulse that goes at exactly that time; is that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. So if we are to return to the three-shot theory, which has been existing for 15 years, we must reject all three of those as being false alarms of some sort; is that correct?

Dr. BARGER. No; that is not correct. Or if it is true, I don't know why.

Mr. FITHIAN. If there are only three shot impulses on that tape you got from the Dallas police force, and we all agree one of them is down in that blue circle and that caused all those matchups as No. 1, and we agree there are three matchups that are very close to the red circle for No. 2, that accounts for two shots.

Dr. BARGER. Yes.

Mr. FITHIAN. Then if we are going to accept the final series as the head shot—that is the one you have in black clear up the linear scale—if we are to reject an intervening shot, whatever the number is, we have to say that all of the matchups on that time line are false alarms.

Dr. BARGER. Yes, that is correct. If that were to be rejected for any reason, then all of those at that time would have been false alarms, that is correct.

Mr. FITHIAN. You said you didn't prove we had four shots and I was trying to eliminate one. There are four time line groupings that indicate four shots, so we have to do something to eliminate one of the sets of impulses which are line up on that vertical. Am I on the right line?

Dr. BARGER. If there were in fact three, it would be necessary to identify either this one or both of these, or four of these, or three of those as false alarms. There are other possibilities. Because of sound we have found no evidence of more than four, but we have found there may be four and if there are they occurred with this time sequence.

Mr. FITHIAN. Congressman Edgar calls my attention to the fact that in the third sequence, the one we just referred to now, the green sequence, that one of those is from a shot fired at target No. 2.

Dr. BARGER. Yes, that is correct.

Mr. FITHIAN. If we match up the Zapruder film, it seems rather unlikely since the limousine is on down the way a little further than that.

Dr. BARGER. The target location is one target location removed, but that is not a very large difference.

Mr. FITHIAN. I think that is all the questions I have on that particular chart.

Did you and your team reconstruct for the committee the sound of the gunshots as they would have been heard if in fact we are to accept this final chart with four impulses? Do we have a sound re-creation of that?

Dr. BARGER. Mr. Robinson has prepared a tape spliced up of the four test shots that were representative of the four possible locations where there might have been shots and I believe he is prepared to play that.

Mr. FITHIAN. If the Chair would permit, I would like to have it played.

Chairman STOKES. You may proceed.

Mr. CORNWELL. Mr. Chairman, we might identify it for the record as a tape recording, JFK exhibit F-353 and we would like to have it admitted into evidence.

Chairman STOKES. It will be so identified and so ordered.

[Tape recording played for the committee.]

[JFK exhibit F-353 is retained in committee files.]

Dr. BARGER. I think it would be appropriate for me to tell you where those sounds are recorded.

That was microphone 5. If we can see the exhibit that has the map of Dealey Plaza——

Mr. FITHIAN. I believe it is JFK exhibit F-337. I have one last question on that any way.

Dr. BARGER. What you just heard were the sounds picked up at this microphone of shots fired from here, the first two; one shot then fired from here, followed half a second later by one shot from there.

Mr. FITHIAN. Could you point to the place on the street where the motorcycle would have been located when the third of those impulses or shots were recorded?

Dr. BARGER. Yes. The estimate of the motorcycle position that we achieved by this test placed it 120 feet behind the Presidential limousine. Given that the Presidential limousine was just short of frame 313 at the time of the fourth shot, the position of the motorcycle was then 120 feet behind it at this position.

In fact that green dot represented the estimated position of the motorcycle at the time of that third impulse that we detected that might be the knoll shot, in fact. The black dot here represents the position of the motorcycle where it would have been at the time of the fourth impulse that we identified as a possible shot.

Mr. FITHIAN. Thank you. I have one last question having to do with the authenticity of the tape itself that you worked with. I am sure that many will want to know whether or not there is internal evidence or otherwise that can attest to the fact that the tape which you were working with—that is, the original tape you were working with—was indeed a tape of the shootings in Dealey Plaza on November 22, 1963. What information can you shed as to your best judgment as to which tape you were working with?

Dr. BARGER. In the first place, the tapes that we received from the committee staff were represented as being that. However, at a different time we received a Dictabelt, which is a plastic continuous blue colored belt that was marked as "Being recorded from Channel 1" in a white marking pencil.

Channel 1 of the Dallas police tape on November 22, 1963. We obtained a rebuilt Dictabelt recorder, newly rebuilt, and we played that Dictabelt and made our own magnetic recording of the Dictabelt. We then analyzed this middle segment around 12:30 of that recording that we had made from the Dictabelt on the same computer and in the same way that we had the first one and had it print out a record, a wave form record. We compared the two and found them to be identical in virtually every detail.

Mr. FITHIAN. And, the appearance of the Dictabelt, was there anything there that would indicate anything to you?

Dr. BARGER. It had the appearance of having been played a great deal and being quite old. The margins of the belt were cracked and it was necessary to tape them together to prevent further deterioration in the plane.

Mr. FITHIAN. Are you satisfied from a scientific analysis and in fact the way you have described it carefully this morning, that this particular recording passed all of your six screening tests; that you were indeed working with a recording of Dealey Plaza, November 22, 1963?

Dr. BARGER. Yes. The likelihood that the shape of the patterns that we achieved correlations on having come from some other place, seems extremely remote to us.

Mr. FITHIAN. I would ask staff counsel Cornwell whether or not we have additional information on the chain of custody.

Mr. CORNWELL. We do have additional information, Congressman. We had obtained the tape recording and Dictabelt originally from Mr. Paul McCaghren, who is now a retired member of the Dallas Police Department. We know the details of the story that we received at the time we got the tape from Mr. McCarran. He is here today. I can either summarize for you the information he has

provided, or he is available and if the committee so desires, he could testify as to those facts himself, at your convenience.

Mr. FITHIAN. Mr. Chairman, I would not want to interrupt the committee's questioning of the witness now on the stand, but I would ask that immediately upon conclusion of this we bring the witness forward who can attest and I think probably very briefly, but certainly as to the chain of custody. I think it is very important that we do this.

Chairman STOKES. The Chair will be glad to entertain that.

Mr. FITHIAN. Mr. Barger, I certainly want to thank you for your answers and your insight and I would appreciate your final collective judgment as to whether there are three or four impulses on that tape that could represent gunshots?

Dr. BARGER. We have endeavored, Mr. Fithian, to make as powerful a detection test as we could devise and to lower the acceptance threshold of those matches that passed the threshold so that all likely correct detections would emerge. In so doing, we found that the process had sufficient noise in it that some of the detections that passed our threshold are false alarms.

We believe that the chances are very high that we have in fact located the motorcycle and, of course, that was done by matching sounds of gunfire. Therefore, to believe the probability that there were at least two shots is very high because it would take at least two to establish that pattern on the chart. You can't draw a straight line through one point.

The indication is that there are probably somewhere between three, maybe six additional false alarms that we cannot on our own information correctly identify as false alarms. Therefore, we think each of the detections that we have made is about equally likely to be a false alarm.

As there is only one detection remaining for the third shot—I don't remember what color it was, but it was the knoll shot, it is about equally likely that it is a false alarm. Therefore, it is about equally likely that there were three shots. However, there is an equal likelihood that there were four, and if there were, we have determined the time at which they occurred and, we also believe, the location from which they came.

Mr. FITHIAN. If there were four locations from which they had come, it would have been where?

Dr. BARGER. They would have been those indicated in the chart that was up there a little while ago.

At the first time, all of the detections that were not clearly false alarms were fired from the Book Depository. At the second time, 1.6 seconds later, likewise those that have not been identified as clearly false alarms are from the depository.

At the third time, the one that is not disqualified by inappropriate motion of the motorcycle is from the knoll. At the last time, half a second later, those two nondisqualified detections are both from the Book Depository.

Mr. FITHIAN. Thank you. Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The committee will now proceed on the 5-minute rule.

Doctor, I am going to ask that you replay the tape that you played a few moments ago. Prior to playing the tape, I am going to

ask you to tell us what we ought to listen for and ask you further to tell us precisely what we should conclude from what we have heard.

Dr. BARGER. I wouldn't presume, Chairman Stokes, to tell you what you should conclude from anything.

Chairman STOKES. What do you conclude from what you hear as an acoustical expert and as a scientist?

Dr. BARGER. You are asking me my opinion of the sound of those shots now before they are played a second time?

Chairman STOKES. Yes.

Dr. BARGER. I just heard them for the first time in that order. Of course, I heard them singly several Sundays ago in Dallas.

I really think my opinion about them is of no particular value. Professor Green, who will follow me, is an expert on how sounds affect people.

I am more expert in how sounds affect microphones. I must say, when I just heard them it sounded like test shots that I heard several Sundays ago. Why don't we hear them again?

Chairman STOKES. May we have the tape played again, please?

[Tape replayed.]

Dr. BARGER. Let me add all of the hissing noise you hear is necessary to make the impulsive sounds sufficiently audible because they are so brief that they have to be loud in order to be clearly heard.

Chairman STOKES. Now, you are in a better position to respond to my original question.

Dr. BARGER. I understand the question is, what do I think those sound like, is that correct?

Chairman STOKES. In order to help me, when I listen to that tape can I come to a conclusion from what I appear to be hearing?

Dr. BARGER. I think not. The microphone is a device that accepts sounds from all directions with equal facility, whereas the human ear is not. The human can make a judgment about the directions from which the sounds arrive and this was not a stereo recording so we haven't been able to replicate the directionality of the sounds and echoes, and therefore I just don't believe I can reach a meaningful conclusion about how those sounds should be interpreted.

Chairman STOKES. I am rather concerned about the 9-foot uncertainty which you ascribe to the location of the motorcycle. I believe that is your testimony, is that right?

Dr. BARGER. That is correct.

Chairman STOKES. In order to reduce or lessen the uncertainty with reference to the placement of the motorcycles, can you tell me to what degree you have studied the Zapruder film or any other films or to what degree you have studied photographs in order to try and reduce the uncertainty?

Dr. BARGER. I think the only way that photographs would be helpful would be to show where the motorcycle in fact was. I know of no such photographs at the time of the shooting.

Chairman STOKES. What I have in mind, Doctor, is with reference to the placement of the motorcycle because that is where the uncertainty comes. That is precisely where the motorcycle was in Dealey Plaza at the time each of the shots were fired, is that correct, and that is where the uncertainty comes in?

Dr. BARGER. That is where some of the uncertainty comes from.

Chairman STOKES. You make an allowance of something like 9 feet in terms of the uncertainty, is that right?

Dr. BARGER. We made an allowance in the correlation procedure to accept some uncertainty in the microphone location.

Chairman STOKES. All I am attempting to ascertain from you is something to reduce or lessen that uncertainty as much as is scientifically possible.

To what degree did you study any available photographs or films in order to try and make a more accurate placement of the motorcycle?

Dr. BARGER. Well, before we conducted the detection experiment, we had absolutely no idea which motorcycle it was. We could look at motorcycles a lot and it wouldn't tell us anything.

After we did the detection experiment and then had the position of the motorcycle revealed to us, we found, in fact, that it appeared to be about 120 feet behind the limousine. We looked at the photographs available to us, to see if there were any photographs taken at the time of the shooting of that part of the motorcade about 120 feet back, and we found none. We have seen some photographs taken less than 1 minute before the shooting, and there are motorcycles back there, but there is so much time elapsed between those pictures and the time of the shooting, it wouldn't help us within 9 feet.

Chairman STOKES. My time has expired. The Chair recognizes the gentleman from Ohio, Mr. Devine.

Mr. DEVINE. Thank you, Mr. Chairman, and thank you, Doctor. I think you are a very patient man to go through all of this in the methodical detail as you have.

I have a couple questions as a nonscience layman. I would like to know what is your definition of a false alarm.

Dr. BARGER. A false alarm is the correct description in detection theory for an indication from your test that an event occurred when in fact it did not occur. Our test, which was a correlation detection test was set up to give an indication that an event occurred whenever the correlation coefficient exceeded 0.6. Every time that happens, there are two possible outcomes. One is, we have got the indication of the gunfire event when, in fact, there was a gunfire event at that time—let's call it a detection. The other possible outcome is there was not, in fact, a gunfire event at that time. That is called a false alarm. In other words, it is an error, a mistake.

Mr. DEVINE. Well, it either happened or it didn't happen, I suspect, when we are talking about either sound waves or whatever detection you are talking about. I was under the impression it might be a convenient way to eliminate the unexplainable.

Dr. BARGER. Unfortunately, there is no way to eliminate the unexplainable that I can explain. False alarms don't have to be hard to find. Some of our identifications of false alarm are easy, in that they would require the motorcycle to fly all over the place. On the other hand, a false alarm can mimic a correct detection, and if it mimics it well, it is hard to identify as a false alarm. In fact, I present the results of our test in this way, with the hope that it will simplify the job, in the face of uncertainty, of the committee to

consider other testimony that potentially verifies or refutes these findings.

Mr. DEVINE. I believe you said in your summary by your tests you have located at least two shots that were fired that were not false, and that there was an equal likelihood that there was a third or fourth shot. I mean it is likely that there was or wasn't a third and or fourth shot. Now, in listening to the recording which I have had an opportrnity like all others here to have heard just twice it seemed to me as one who was in the past a fire-arms expert, having spent a lot of time on the range and recognizing rifle fire, my personal interpretation based on that tape that I heard that the first, the second and the fourth noises sounded to me quite a bit like a rifle shot, the third noise that immediately preceded the fourth sounding like possibly something else. I am not that sure, and I haven't had enough time to listen and study, but it brings me back to what you said earlier—I think it was brought out in Mr. Fithian's questioning that Secretary Connally couldn't possibly have heard the shot that hit JFK's head before the sound of impact when the bullet hit the head. To the contrary, he may have heard the head explosion before he heard the shot that did it. Isn't that likely due to his immediate proximity to the President, and the distance from which the shot was fired, the muzzle velocity, and so forth. Isn't it possible that he could have heard that head explosion prior to the sound of the shot that caused it?

Dr. BARGER. If he heard the impact on the head, he would have had to hear it first.

Mr. DEVINE. I don't know if you were here when he testified. But, he startled the room by clapping his hands on the sound that he thought was the head hit.

Dr. BARGER. Yes.

Chairman STOKES. The time of the gentleman has expired. The gentleman from North Carolina, Mr. Preyer.

Mr. PREYER. Thank you, Mr. Chairman.

Following up the comment of Mr. Devine about the sound of the shot hitting the President's head, that Mr. Fithian asked you about, one thing I would like to get the record clear on: I think you stated you had no opinion as to how a bullet would sound hitting the President's head, but can you say one way or the other that it would not be nearly as loud a sound as the sound of a rifle shot firing?

Dr. BARGER. I have here the sound of rifle shots. I haven't heard anything approximating that other event, and, therefore, what I am giving you is not an opinion based on scientific evidence; it is an off-the-wall guess.

I would imagine that the sound of an impact of that sort would not be as loud as a rifle shot.

Mr. PREYER. What I am getting at is, the last two patterns on the tape, the possible third and fourth shots could not possibly be (1) the rifle firing, and (2) the head exploding.

Dr. BARGER. Those events did not occur in that order; that is correct.

Mr. PREYER. In other words, nothing on the tape could possibly be an indication of the headshot sound?

Dr. BARGER. You could not interpret those sounds in that way; that is correct.

Mr. PREYER. We might have some confusion on that.

You mentioned at the end of your statement to Mr. Devine that the committee should view this as evidence, as I understood you to say, which potentially requires verification. Something to that effect.

Earlier my notes indicated you said something like this, "Since there are false alarms, we must examine the other evidence to see whether this corroborates it or not."

My question is, did you regard the evidence of your experiments here as what we would call in the law corroborating evidence only or would you consider it as direct primary evidence?

In other words, you seem to be saying that this is not like an X-ray, exactly, where you can see it and know it as a physical reality and a fact. But, that this is subject to errors, and subject to false alarms and that it should be used to corroborate other evidence which should not be used in itself to prove the truth of the statement it makes.

Dr. BARGER. I am not certain of the question, but I think you are observing that I said that the potential of the evidence that we are presenting, the test results that we are presenting, is as a potential corroborating force toward other evidence. It is also, of course, and if I didn't say this, I should have, a potential discrediting force when compared to other evidence. Is that what I didn't say that you think I should have?

Mr. PREYER. Well, I guess I am asking you how far the acoustic science has developed and the strength of the evidence of your test. That is, is it like a fingerprint that if it says one thing we know it is true and we disbelieve any contradictory evidence or is it a state that is still partly art and part science and that we should treat its results cautiously.

Dr. BARGER. The results of the test that I presented are—I have presented as objectively as I can—I indicate that it seems quite important that we can identify here and I have some of these detections that we achieved we can properly identify them as false alarms. I believe that the remaining ten or so are each about equally likely to be false alarms in themselves and I am required to say that by the uncertainty in the results and I am not sure that I am answering any question any more, and would you kindly help me by reminding——

Mr. PREYER. I think you have been conscientiously objective in understating rather than overstating. To put it in laymen terms, are you saying that it is about a 50–50 chance that there was a third and fourth shot?

Dr. BARGER. It comes down to that because the third shot indicated in green is supported by only one detection. Since I don't feel I can put more confidence in any single detection than I have indicated, the possibility of the third impulse pattern actually representing a shot is about even. Therefore, the question of four or three depends on that one detection. It comes down to what you said.

Chairman STOKES. The time of the gentleman has expired. The gentleman from Connecticut, Mr. Dodd.

Mr. DODD. I think you may have just answered my question, Doctor, in your answer to Judge Preyer's last question to you. But, for the purpose of clarity, you have obviously made a judgment here with regard to the probabilities of certain indications on the spectrograph being what would appear to be gunshots.

Could you state for us what the probabilities are as for the first, second, third, and fourth sounds being gunshots?

Dr. BARGER. Yes, I will attempt that. Altogether I said the pattern of the detections that we achieved were tested statistically and found to be such that they would have arisen by chance only 5 percent of the time.

So I think therefore the probability that we have found at least two is very high.

Mr. DODD. What would you mean by very high? What are you talking about?

Dr. BARGER. I think I just said I meant 95 percent.

The necessity that others be accepted——

Mr. DODD. Would you try to speak into the microphone, Doctor?

Dr. BARGER. The requirement that a third one be accepted would be dependent on either of two of the detections standing up in the fourth area or three standing up in the first area, for example. Those are reasonably likely in the first case, less so in the fourth case because it has only two. An estimate on my part to state the probabilities, which you have asked about—and this is hard to do because I don't want to confuse the results of the tests as they stand. The probability that there are two that we have detected is 95 percent. The probability there are three that we have detected correctly is probably somewhere between 60 or 70 percent; the probability that there are four is lower than that, around 50 percent.

Mr. DODD. Thank you.

Could you indicate for me what effect the location of the targets has on the waveforms produced by rifle fire? Looking at JFK F-367, there are target locations that seem to change and I was trying to follow you as you were trying to identify false alarms and what you think may not be false alarms and correlating those to target locations. Is there a significant difference and, if so, in the third area—I guess that is green over there—could you indicate to me what the target location differences would mean there?

Dr. BARGER. I am not sure I understand that question.

Mr. DODD. Let me first of all ask you, does it make a difference?

Dr. BARGER. What target gave the correlation?

Mr. DODD. Target location.

Dr. BARGER. Yes.

Mr. DODD. How about the waveform produced by rifle fire?

Dr. BARGER. Yes. The exact location of the target has a different effect on the echo pattern depending on the location of the rifle, the target and the microphone.

If the rifle is pointing approximately 90° or so away from the direction between the rifle and the microphone, then the location of the target has very little effect because the shock wave radiated by the bullet which is dependent on which way the gun is firing, never reaches the microphone anyway.

However, if the target is in such a location that the shot passes near to the microphone on its way to the target, then a change in the target location is important because in that case the sound of the shockwave is in fact a part of the pattern.

Mr. DODD. Looking at the 145.15 second block—that is the green block——

Dr. BARGER. That is correct. That is green.

Mr. DODD. We have got two separate target locations there. Do you have that before you? Can you see that?

The first one as I can see it is the knoll; the second one is the School Book Depository, and the target location is 2. The third is Texas School Book Depository and that is in the first three, is that correct?

Dr. BARGER. That is correct.

Mr. DODD. Now, which of those did you exclude as a false alarm?

Dr. BARGER. The last two were excluded as a false alarm because they were detections made in microphones 7 and 8, which are about 60 feet away from microphone 4 where the other detection was made. It would have been necessary for the motorcycle to be speeding up in order to achieve that position in the time allowed and the sound of the motorcycle was in fact diminished all throughout that time.

Mr. DODD. I am sorry to ask you to repeat. If you accept the existence of a fourth shot occurring there in the black figures, then the third shot you would have to accept as the rightful location being on the grassy knoll?

Dr. BARGER. Well, under the presumption that you couldn't fire from the same place within a half second, that would be true. I think that is what you mean.

Mr. DODD. Thank you very much.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Connecticut, Mr. McKinney.

Mr. MCKINNEY. As I listen to your reenactment of the tape, there is a distinct difference between the third shot fired—not just a time difference, but a sound difference—between the third shot fired and the first, second and fourth.

Is my impression correct?

Dr. BARGER. It does sound different to me, yes.

Mr. MCKINNEY. It does sound differently to you?

Dr. BARGER. Yes.

Mr. MCKINNEY. Since that shot sounds differently and also is much closer to any other shot in time—at least from the reenactment—how can you be sure that particular shot is not a false alarm?

In other words, you have two shots, at least to my ear—and I know my ear is not very accurate—that sounded alike in the beginning and then you have a third shot followed almost immediately by another one in the reenactment. The third shot sounds quite differently. What is it about that particular shot that had you include it, in other words might have told you that it wasn't a false alarm or something else?

Dr. BARGER. Nothing has told me it is not a false alarm. The features of that shot that caused it to have been detected in the first place was simply that the pattern generated by it at that

microphone matched sufficiently well with the noise on the tape at that time that it was accepted as a possible detection. I don't know whether it is a false alarm or not.

Mr. McKINNEY. So then could I assume that the likelihood that if any of the four shots that we heard were false alarms, that you could presume more strongly that it is third one?

Dr. BARGER. I think you are looking for an indication of the power of the test to find a shot, given that one may be quite different than another, and would the different one be easier to find.

Is that the question, or am I completely off?

Mr. McKINNEY. I guess what I am really saying is that we seem to have three occurrences that are pretty similar—one, two and four.

Dr. BARGER. Yes.

Mr. McKINNEY. And we have a third that looks differently, and sounds differently. I was just questioning as to whether or not that was the one that you could presume was most likely to have perhaps been something else, or perhaps been another occurrence, or backfire, or something.

Dr. BARGER. I don't have the information to answer that. I don't know about other occurrences.

Mr. McKINNEY. Neither do I.

Dr. BARGER. But I do know about test shots fired in Dallas. All I can say is that particular sound on the tape sounded sufficiently like one of the test shots in Dallas to have scored above the threshold.

Mr. McKINNEY. But then if we were to accept that third shot as we heard it in the reproduction as a shot, it would have had to have come from the grassy knoll?

Dr. BARGER. That is correct. If it occurred, that is where it came from.

Mr. McKINNEY. Not to get back into the game of probabilities, which we already played down the line, would you consider—is your probability on the third shot the lowest of the group?

Dr. BARGER. Yes.

Mr. McKINNEY. Thank you very much.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Tennessee, Mr. Ford.

Mr. FORD. Thank you, Mr. Chairman.

Mr. Chairman, let me ask a question to you and to the staff at this point.

Dr. Barger mentioned earlier, when you questioned him, that they conducted an analysis of the police tape, and the tape that was done in Dallas with the experiment. Just which tape did we hear a few minutes ago?

Dr. BARGER. Was that my question?

Mr. FORD. I was asking—maybe the staff. Yes, I will raise the question to you.

Dr. BARGER. What you were hearing were the sounds of four of the test shots recorded in Dallas 3 weeks ago, or whenever.

Mr. FORD. The tape that we heard a few minutes ago——

Dr. BARGER. Yes, was prepared by splicing together four of the shots that were recorded during the reconstruction.

Mr. FORD. So we are not talking about the tape from the police motorcycle.

Dr. BARGER. Well, we were not listening to it; that is correct.

Mr. FORD. I was under the impression that we were listening to the tape from the police motorcycle of 1963, but we were not.

Dr. BARGER. No, sir. If it had been that distinct, we would have followed an entirely different detection scheme that would have been much easier to explain.

Mr. FORD. Let me ask you another question.

From what you said earlier, are you able to distinguish from which directions the shots came? I recall your earlier testimony regarding three shots and a possible fourth shot, and different directions.

Are you able to pinpoint that and, at the same time, unable to determine if there were three or four shots fired?

Dr. BARGER. Well, we can only imply the direction of the shot by the location of the target and the gun for the test shot that matched. In other words, each time we get a match between the noises, the impulsive noises on the Dallas police tape made during the assassination, and each time one of those noises correlates or matches with one of the echo patterns, we can only infer what the direction of the shot was by knowing what it was during that test shot. Otherwise—that is the procedure.

Mr. FORD. All right. I was reading here that the team of scientists headed by you concluded that a reliable and credible conclusion could be determined if they could test and analyze in three crucial areas.

When you appeared before this committee, however, you testified that you could not be sure whether there were three or four shots fired on November 22, 1963.

So, we are not able to pinpoint that at this time; is that correct?

Dr. BARGER. The results of the tests are inconclusive to the degree that I described them, I believe, when I was answering Mr. Dodd's question, or Congressman Preyer—I am not sure whose question it was.

There is uncertainty in the results, as I described it.

Mr. FORD. I don't have any further questions, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

The gentleman from Pennsylvania, Mr. Edgar.

Mr. EDGAR. Thank you, Mr. Chairman.

Mr. Chairman, I have to admit that I am a little bit confused, and I would like to try to clarify some of what I have heard throughout today. Your testimony has been detailed. Let me just ask you this question.

Before you went to Dallas, before you went to Dallas to do the experimental test, you were more sure, I believe, of four impulses which you found on the original tape. That was one of the reasons why you came back to the committee to suggest that the test firings be held.

It seems to me that after the Dallas trip you seemed less certain of the four-shot indications that you received though the computerized acoustics. Why is that?

Dr. BARGER. Because the tests that I had performed at the time that I spoke to the committee previously were the screening tests

that I described today. These are very weak tests. It is not particularly difficult to pass them.

You recall they had to occur at the right time of day, they had to have the total timespan of 5 seconds or more, they had to have the right kind of distorted waveforms. There were six in total.

These were not very stringent tests. There were, in fact, four patterns, or four segments of the tape that had impulses on them that passed these weak, nonstringent tests.

The opinion that I intended to convey at that time was that I could not rule out that the impulsive events in these segments of the tape were in fact gunfire because they had passed those six screening tests.

On the other hand, I said there was no way I could be sure that they were because the data were so noisy and that there was no way I could be sure, unless I could find out what echo patterns were in fact generated by gunfire in Dallas.

I described that as a test that was the best one that we could conceive to determine whether those impulse patterns were in fact shots or not.

Mr. EDGAR. As I remember it, you had a long roll of paper that you rolled out across the table for us.

Dr. BARGER. Yes.

Mr. EDGAR. And you were able to indicate four patterns of blips on your computerized paper that indicated something occurred in those four timeframes.

Dr. BARGER. Yes.

Mr. EDGAR. Do the four timeframes that are on the weak evidence—that is, the pre-Dallas evidence—correspond to the timing, the minutes and seconds timing, that is listed alongside the four possible shots that you indicate in today's testimony?

Dr. BARGER. No. Of the four impulse patterns that I had originally described, the first three proved to give us detections in this matching test that we performed. The fourth did not. However, we got two in the third that I showed you that time.

In other words, my indication of the general areas that might contain matches with gunfire sounds were approximately correct, but not in detail.

Mr. EDGAR. Approximately correct, but not in detail. Was there one of those weak impulse areas that, after going to Dallas, you can discount as being a gunshot?

Dr. BARGER. Well, yes, I think I understand that question. I showed four segments of the tape that had patterns that I thought might be gunfire, because they passed these six screening tests, and the last of those four did not subsequently prove to contain any.

Mr. EDGAR. So that it was the third tentative weak gunshot that has now been divided into two possible gunshots?

Dr. BARGER. That is correct.

Mr. EDGAR. And you say it is a 50–50 chance that the fourth gunshot described up here is just a 50–50 chance; is that correct?

Dr. BARGER. That is correct. I have insufficient evidence to state anything stronger or weaker than that.

Mr. EDGAR. Is there any test that we could make that could reduce the uncertainty?

Dr. BARGER. Congressman, the answer to that literally is yes. Now that the position of the motorcycle has been fixed with some confidence one would not bother with microphones all over other parts of Dealey Plaza, for example.

However, I believe that the advantages to be gained from rectifying that problem are very marginal, and I doubt if they could reasonably be expected to improve the level of uncertainty in the test.

Mr. EDGAR. When I go home to explain what I have heard today to my 11-year-old son, who is in the seventh grade, what do I tell him?

Dr. BARGER. How much time do you have? [Laughter.]

Mr. EDGAR. I have all of the evening dinner to explain to him what I heard. I am just trying to get it into a language that I can communicate with him.

Dr. BARGER. That is a good question. I think the answer would go something like this.

There was, by a considerable measure of chance, a motorcycle in the motorcade with its radio in an operating condition, but with the motorcycle policeman not speaking into it.

The motorcycle was just moving. Over that radio were heard a series of sounds, including the motorcycle, including other radios, and including the possibility of the sounds of the assassination of the President.

What you were observing today was the description of a test that was made on that tape to see if it was statistically likely to have contained the sounds of gunfire.

You found out that it was possible from this test to locate the position of the motorcycle with a good deal of confidence 15 years later. It turned out that the motorcycle was about 10 feet short of the corner, at the approximate time of the first gunfire, when the motorcycle noise in fact was observed then to abate, and the man slowed down.

You found also that motorcycle was in a position, found to be in a position, when the first shot was heard, that corresponded to the limousine being in the position where it was at approximately the time of the first shot.

For these reasons and others that I have described, there is good confidence that the motorcycle has been found. Therefore, good confidence that some of the shots have been correctly detected.

There is less confidence in questions of increasing detail, and I hope he enjoys the story. [Laughter.]

Chairman STOKES. The time of the gentleman has expired.

Mr. EDGAR. Thank you.

Chairman STOKES. The gentleman from Michigan, Mr. Sawyer.

Mr. SAWYER. I have been following the testimony reasonably closely, but I am somewhat perplexed.

You actually caused these shots to be fired in the same environment as the other shots were fired, with the same echoes and refractions and reflections and whatnot. So, you have a known—namely, your own—recording of what you knew were shots.

Now, were you able then, by comparing that to your oscillographic pictures of what was on that tape, to say what was on that tape were or were not shots?

Dr. BARGER. Was able to——

Mr. SAWYER [continuing]. Determine whether what was on that motorcycle tape originally were or were not shots, these disturbances?

Dr. BARGER. We were able to determine that with considerable uncertainty that I have described.

Mr. SAWYER. You were not, then, able to determine at least to the point of forming a scientific opinion that those were shots?

Dr. BARGER. It is my judgment, our judgment, the judgment of the team that did this study, that we have detected with about 95 percent likelihood, at least two of them, and on down the scale that I described for Congressman Dodd or Preyer—I still can't remember which.

Mr. SAWYER. You have described now a number of times these probabilities. But let me ask you this.

I am not an expert, and no one else on this panel to my knowledge is, certainly in this type of thing. You have had a chance now to conduct the test, to examine the tape, to examine the results.

Do you have an opinion yourself, aside from any other evidence, based just on your tests of this tape, do you have an opinion as to whether there were three or four shots fired?

Dr. BARGER. I have gone to some pains to present my opinion. I believe that I have presented the results of this test as clearly as I know how.

Mr. SAWYER. I understand all that, but now you have explained the pros and cons of the test. But laying aside any other evidence, you have now conducted the tests, and you have looked at the oscillograph of this motorcycle tape.

Now, do you as a professional in this area have an opinion as to whether or not there were three or four shots fired?

Dr. BARGER. Congressman, I can't add any information by saying I think there are three or four. I believe the results of the test do not allow me to state with greater certainty than I have, the answer to that question.

Mr. SAWYER. Well, then all I can say is I would hate to civilly sue anybody, let alone prosecute anybody, on this kind of evidence.

Thank you, Mr. Chairman.

Chairman STOKES. The time of the gentleman has expired.

Doctor, let me go back for a moment and try and clarify something.

It appears to me that in answering both Mr. Dodd and Mr. Sawyer, when you make reference to the probabilities, that you group the four shots in terms of the probabilities. When you say that two of the shots, the probabilities are 95 percent; three, the probability is 60 to 70 percent; and that the fourth is approximately 50 percent.

Would you please individualize for us, and tell us which are the two where the probabilities are 95 percent, which is the one which is approximately 60 to 70 percent, and which is the one that is 50 percent.

Dr. BARGER. Congressman Sawyer isn't going to like this answer, but the probabilities that I gave you are based on not distinguishing which three, which two. In other words, the high confidence

that we have is based on the high degree of order in the detections, and that can be established by two, any two.

Mr. SAWYER. Let me say I anticipated the answer, Mr. Chairman.

Dr. BARGER. If I might indicate possible mitigating circumstances for Congressman Sawyer, I do believe that even with this level of uncertainty, it is quite important to know when they occurred, if they did.

I can see that Congressman Sawyer is not convinced of that.

Chairman STOKES. Let me ask you this. I would assume, then, from your former answer, that you are unable to identify what shot or impulses represented the grassy knoll shot or impulse?

Dr. BARGER. I think not. I don't believe that is a correct interpretation of the results. If the shot at that time, 7½ seconds, indicated in green, stands up, then it was from the grassy knoll—it would not have been from the Depository.

Chairman STOKES. Now, I understand from your previous testimony that the shot which you simulated in Dealey Plaza from the grassy knoll was with a .32 revolver, or a .38?

Dr. BARGER. Well, the one with a pistol, yes. There was also a rifle fired from there.

Chairman STOKES. Simultaneously, or separately?

Dr. BARGER. No, separately. The tests included separate and distinct shots from rifles and from pistols, from the knoll.

Chairman STOKES. Well, with reference to the pistol, what caliber was that?

Dr. BARGER. .38.

Chairman STOKES. .38. And that is a subsonic or supersonic type of sound that emanates?

Dr. BARGER. The particular charge in the bullet used made it a subsonic projectile.

Chairman STOKES. The composition of the bullet gave you a supersonic result.

Dr. BARGER. I am sorry. Yes, we were firing a subsonic projectile from that pistol.

Chairman STOKES. All right.

Now, is there a different type of acoustical representation that you will get depending upon whether it is subsonic or supersonic?

Dr. BARGER. Yes, there is. That is why we also fired a rifle from the knoll because it has a supersonic projectile.

Chairman STOKES. I see. So that in terms of the simulation, and in the absence of any real knowledge as to whether a subsonic or supersonic type of firing came from the grassy knoll, you are unable, with any real degree of certainty, of being able to say that is in effect a real simulation, aren't you?

Dr. BARGER. If that one should stand up, that shot from the knoll matched with a rifle shot, and not a pistol shot. The match achieved with the pistol shot was very poor.

Therefore, it is possible with confidence to distinguish on that point, and it would appear that there was not a subsonic projectile fired from the knoll.

Chairman STOKES. I just have one further question.

With reference to attempting to simulate the scene as you did, to what degree did the lack of a crowd such as there existed on that particular day in 1963 affect your simulation?

Dr. BARGER. Well, it affected it very little because the sounds that are scattered from a person are of the sort that I described earlier today, as scattered sounds. This is the weakest form of redirecting the sound from a source and into a receiver.

Our thresholding procedure, which eliminated all of the weak sounds, both in the test pattern and in the police tape, was designed to eliminate the contribution of weak echoes such as those due to the presence of people.

Chairman STOKES. I see.

My time has expired. Other members seeking recognition?

The Chair recognizes counsel, Gary Cornwell.

Mr. CORNWELL. We have to leave you in a few moments, I am sure, Dr. Barger. We want to take away from your presentation whatever we can of a constructive nature.

You made a statement informally to me last evening which I think you mentioned previously in your testimony, but nevertheless, it might merit further explanation for just a moment.

That, as I recall, was to the effect that a scientist such as yourself can basically give us the data, and can to a limited degree provide us some insights about the probabilities of any one aspect of the data occurring by random chance, but that once you present us with the data, it is the committee's problem then to decide how to interpret it in the end.

Is that correct?

Dr. BARGER. That is correct.

Mr. CORNWELL. From your point of view, then, all you can do to help us unscramble the chart is to tell us what a mechanical, numerical calculation of some type, how it comes out, with respect to the random chances of various events occurring.

I take it there is no probability which will tell us how many shots occurred, or which were the real ones and the wrong ones in the end. Is that correct?

Dr. BARGER. None that I know of beyond what I have mentioned.

Mr. CORNWELL. All right. So what we must do, then, is take the data and see what external corroboration or impeachment can be applied to it.

Dr. BARGER. That is my view, yes.

Mr. CORNWELL. Just so that we understand what help you can provide us in that task, I would like very quickly to run through the chart and use it with some hypotheticals out of it. Let's talk about the top line of each of the four time segments.

In the first time segment, the top line is in microphone array 2-5, a shot from a TSBD, down toward target 1.

The second shot, the motorcycle's apparent location is moved from mike 2-5 to 2-6, slightly up the street, another shot from the TSBD, down to the street and the target, somewhere in the motorcade.

The next one, picked up with the microphone again slightly further down the street, a shot from the knoll, out to the motorcade.

Finally, another shot from the TSBD, motorcycle again slightly further down the street, pointed at the motorcade.

With respect to each of those four possible shots, apart from any probabilities, independently, we might say, they each occurred at

the right time of the day, they each were unique in the data overall that you analyzed, they each occurred within a time span which did encompass at least 5 seconds, the shape of each of the impulses was what you would expect, the amplitude was roughly what you would expect, and the number of impulses or echo patterns in each were what you would expect from the geography of Dealey Plaza, is that correct?

Dr. BARGER. That is correct.

Mr. CORNWELL. With respect to each one, the strict probability that that one would have occurred on that tape through some random sound source would be identical, individually viewed; that is .08, .08, .08, and .08. Correct?

Dr. BARGER. Well, the correlation coefficients were all .08, that is a fact.

Mr. CORNWELL. The tape on which each of them appeared is, to the best of your knowledge, a genuine tape made in Dealey Plaza on November 22, or from transmissions from there on that date?

Dr. BARGER. That is correct.

Mr. CORNWELL. Each of those four items appear very close, near to the line which you would expect the motorcycle to be traveling; in other words, the rate that it would travel down the street in the procession at approximately 11 miles per hour.

Dr. BARGER. That is correct.

Mr. CORNWELL. And independently we do know that there were shots fired in Dealey Plaza on the day at about the time that these impulses occurred on your tape.

Dr. BARGER. Correct.

Mr. CORNWELL. Then it would be the committee's job to apply independent evidence for each of those as an equal chance of being a genuine shot, to determine if it is genuine or if it is not.

Dr. BARGER. That is correct.

Mr. CORNWELL. I have no further questions.

Thank you.

Chairman STOKES. Thank you, counsel.

The gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. One question, Mr. Chairman.

Can we say that the shots, as far as time sequence is concerned, that were fired in Dealey Plaza at any time during that stuck microphone, any time during that time frame, had to have occurred at the following relative sequence: The first shot as zero, the second 1.6 seconds later, the third 5.9 seconds later, or at about 7.5 seconds after the zero time frame, and the fourth .05 seconds later, or at just shy of 8 seconds in the time frame?

Dr. BARGER. That is correct.

Mr. FITHIAN. There is no other acoustical disturbance of the tape that could possibly be a gunshot?

Dr. BARGER. We believe that the threshold that we set was low enough to accept all actual occurrences, and there were none other than those you just described, that is correct.

Mr. FITHIAN. If, therefore, there were any shot that did not match this time sequence—well, to put it the other way around, there could not have been definitively, could not have been a shot in this time frame that did not match one of those four interruptions?

Dr. BARGER. That is correct.

Mr. FITHIAN. Thank you.

Chairman STOKES. Dr. Barger, at the conclusion of any witness' testimony before this committee he is entitled to a period of 5 minutes under our rules in which to explain or amplify, any way expand upon his testimony.

I would like on behalf of our committee to extend 5 minutes to you at this time.

Dr. BARGER. Chairman Stokes, I thank you for that. I suspect that everyone has heard quite enough of me today, and I will respectfully decline to speak at any greater length.

Chairman STOKES. You have had quite a lengthy day here with us. It has indeed been a real experience for us, in not only working with you today, but previous occasions we have had to be with you, and to discuss the matter which we assigned to you for your investigation and analysis.

It has indeed been a pleasure to work with you and to have had the benefit of your testimony here today. On behalf of the committee, we thank you for having appeared here with us. You are excused, sir.

Dr. BARGER. Thank you, sir.

Chairman STOKES. At the request of Mr. Fithian, the committee at this time calls Mr. Paul McCaghren.

Mr. BLAKEY. Mr. Chairman, before Mr. McCaghren is interrogated by the committee, it occurred to me that it might be appropriate to clarify the record on one point.

Much of the emphasis of the committee's testimony has focused on the validity of the third shot in an effort to establish whether there were three or four shots. There is a time span between the first and second shot that I believe was identified by Dr. Barger as approximately 1.6 seconds.

The issue that I would like to bring to the committee's attention is that the existence of the expert FBI testimony indicates the minimum time in which a Mannlicher-Carcano could be operated and correctly aimed was stated twice in the Warren Commission's hearings, once by Mr. Fraser, as a minimum of 2.3 seconds. He said that was "as fast as the rifle could be operated."

Mr. Shaneyfield, at a subsequent point in the record, indicated that his study indicated that the minimum the rifle could be fired was 2.25 seconds, "for two successive well-aimed shots."

The committee staff has systematically made an effort to reexamine each of the underlying premises in the investigations that have preceded us, as that seemed to be the proper thing to do.

When the staff learned that the time differential between the first and second shot was 1.6, and thus well below what the FBI testimony had indicated was possible for one person using the rifle, it obviously raised the specter of two gummen. Consequently, preliminary tests were undertaken to evaluate the validity of that FBI conclusion. I would like to report to the committee at this time the preliminary results of those tests. I would emphasize, too, that those tests are an ongoing proposition, and the final results will be given to the committee at a later point in time.

The staff, on a preliminary basis, conducted a series of tests at the Lorton firing range under the supervision of Cecil Kirk, of the Metropolitan Police Department.

We learned that it was possible for a relatively untrained individual to operate a Mannlicher-Carcano in considerably less than the time stated by the FBI.

One test resulted in one hit out of three at 150 feet in average times of 1.65 and 1.75. That is considerably under the estimate by the FBI.

A second test performed by another individual, who informs the staff he has not used a rifle in 25 years, was able to hit three out of three in a human silhouette at 150 feet in 2.125 and 2. Again, considerably under the FBI data.

I bring that information to the attention of the committee in order that an improper inference not be drawn from that aspect of Dr. Barger's testimony that deals with the time span between the first and second shot.

As you indicated in the beginning of this hearing, all of the evidence is not yet in.

Another area where the committee will obviously have to take evidence is on the minimum time required for the operation of a Mannlicher-Carcano.

If I may summarize, it would seem that the prior assumption, the one employed by the FBI as well as the Warren Commission, of a minimum of 2.25 or 2.3 is questionable, and it will have to be reexamined by the committee before a final interpretation can be made of the time span between the first two shots.

Mr. DODD. Mr. Chairman, could I address a question to Mr. Blakey.

That test that we are performing now, is that being done with a Mannlicher-Carcano?

Mr. BLAKEY. Yes. The committee is in the unique position for a congressional committee in that it now owns two Mannlicher-Carcanos.

Mr. DODD. Of the same?

Mr. BLAKEY. Of the same kind and style employed by Lee Harvey Oswald. I might add, Congressman—and I underline again its a preliminary judgment—the sharp difference in time may well be because the FBI experts were firing the rifle using the telescopic sight.

One clear implication of the expert testimony that this committee has received from its firearm experts is that the gun can be accurately fired using the iron sights, and the tests that were performed this last weekend used the iron sights and not the telescopic sights. Consequently, we were able, with very little effort, to sharply improve on the expert performance of the FBI.

Mr. DODD. Can you tell me whether or not the FBI used the alleged Oswald rifle?

Mr. BLAKEY. The FBI did use Oswald's rifle in some of its tests.

Mr. DODD. Is there some particular reason why we cannot use the same rifle?

Mr. BLAKEY. I am told by our expert panel that there is some concern about the use of Oswald's rifle. It has been in the Archives

for a considerable period of time, and it has not been given the kind of attention that a hunter might give to his favorite weapon.

There may be some question as to whether that weapon may be dangerous to employ in simulated tests now.

Mr. SAWYER. Would the gentleman yield?

On the firing—and I didn't examine closely that Mannlicher-Carcano that was here—is that scope so mounted that there is an option of using the iron sights?

Mr. BLAKEY. Yes.

Mr. SAWYER. So you can use either on it?

Mr. BLAKEY. You can use either the iron sights or the telescopic sights. The testimony, if you will recall, Congressman, of our ballistics panel, was that the choice that they would have made would have been to have used the iron sights.

What I might add is that the Dallas Police Department sharpshooters who fired the two weapons in our reconstruction in Dallas in fact used open iron sights, and they were extremely accurate at that time.

Again, Congressman, I emphasize these are preliminary tests and they will have to be perfected at a later point in time. It seemed to us, though, potentially not the best to introduce evidence and to simply allow the acoustics test to be considered without some clarification being made of that time problem between shots one and two.

Chairman STOKES. The committee calls Mr. Paul McCaghren.

Sir, will you raise your right hand and be sworn. You solemnly swear the testimony you give before this committee is the truth, the whole truth, nothing but the truth, so help you God?

Mr. MCCAGHREN. I do.

TESTIMONY OF PAUL McCAGHREN, PAUL McCAGHREN ASSOCIATES, DALLAS, TEX.

Chairman STOKES. Thank you. You may be seated.

Mr. Cornwell?

Mr. CORNWELL. Thank you, Mr. Chairman.

Mr. McCaghren, what is your present occupation?

Mr. MCCAGHREN. I am a private investigator and private security consultant in Dallas, Tex.

Mr. CORNWELL. You have your own firm, is that correct?

Mr. MCCAGHREN. Yes, I do.

Mr. CORNWELL. What is the name of that firm?

Mr. MCCAGHREN. Paul McCaghren Associates.

Mr. CORNWELL. Previously you were a member of the Dallas Police Force?

Mr. MCCAGHREN. Yes, I was.

Mr. CORNWELL. During what period of time?

Mr. MCCAGHREN. From 1953 until 1974.

Mr. CORNWELL. And during that period of time, what was your rank?

Mr. MCCAGHREN. I worked up from patrolman to detective in 1958. I was a lieutenant from 1960 to 1965 or 1966. I was a captain from 1966 to 1968. I was the director of the intelligence division in 1969. I was an assistant chief from 1970 to 1972. In 1972, I began to work my way back down. I was a captain, and I retired in 1974.