

## Notes on the CBS-Alvarez Analysis of the Zapruder Film

(Based on Dr. Alvarez' notes; and on an (inaccurate) article in "The Magnet," which is "published for the employees and families of the Lawrence Radiation Laboratory, University of California," July, 1967. Familiarity with the transcript of the CBS Television program of June 25-28, 1967 is assumed.)

Dr. Alvarez became interested in the Zapruder film around Thanksgiving, 1966. On the basis of his analysis of the frames in Life and Vol. 18, he wrote to Edwin Huddleson, a lawyer with CBS contacts, who communicated the results to Frank Stanton of CBS (a longtime acquaintance of Alvarez). On Jan. 19, Alvarez studied the film at the Archives with CBS officials and E.G.&G. experts. (E.G. &G. is described as "the firm that also does much technical-photography analysis in connection with LRL-Livermore field activities.")

The analysis of the motion of Zapruder's camera is considerably more subtle than was indicated by Dr. Wyckoff on CBS. Alvarez' procedure was to look at various points in each frame, especially highlights on the car frame or windshield which would be dots if the panning motion were perfect. The effect of a shot is to set the camera into oscillations, which turn the dots into streaks. (Either the shock wave of the bullet, or Zapruder's reaction to a sound, etc., could have started the oscillations.) From the lengths and directions of the streaks in many consecutive frames, one can deduce the rate of oscillation. One finds a frequency of about 3 cycles per second (cps); the oscillations are visible with decreasing amplitude over several cycles. Since the camera was following the moving car, and was rotated by the reaction to the shots, the background blurring is different from that of objects in the car, and gives further information about the direction of the jitter.

In a sense, this analysis is an extension of the observation (Whitewash, p. 47) that the film is blurred at about frame 190. However, I know of no previous attempt to compare quantitatively that blurring with the less obvious reaction by Zapruder to the other 2 known shots. I think this is pretty solid proof that Zapruder was startled at about frame 186. I am not convinced, however, that this analysis proves (or could prove) that 3 and only 3 shots were fired.

Although the FBI perhaps should have thought of this, one can easily see how they missed it. Shaneyfelt testified (5H142) that the FBI looked for reactions to the shots by Kennedy and Connally, and by the spectators visible in the film, but he did not mention reaction by Zapruder. It happened, however, that Dr. Alvarez had formerly studied two problems related to this analysis - measurement of shock waves, and the "jitter" of hand-held binoculars and cameras.

Dr. Alvarez also observed that, contrary to the implications of Shaneyfelt's testimony (5H161), one can do better than just determining the average speed of the car, 11.2 mph. There are sufficient features in the background of the Zapruder film to allow a fairly precise determination of the position of the car at all times. It appears that it did in fact slow down between the second and third shots! (I think that Itek has already claimed to have located the car at the time of the fatal shot more accurately than the Commission did.)

In connection with the question of the speed at which the Zapruder camera

was operating, Dr. Alvarez noted that the film contains a kind of internal "clock." One can measure the frequency of the clapping of the man visible in frames 276-297. It is about  $3\frac{1}{2}$  cycles in 18 frames. (I haven't taken the time to do this carefully.) If the camera was running at 18.3 frames per second (fps), this is about 3.5 cps, which is a quite natural clapping speed. If the camera were running at 24 fps, the rate would be 4.6 claps per second, which is about as fast as one can clap, spreading one's hands as widely as the man in the film is. To me, a rate of 4.6 cps does not really seem natural.

A clapping rate of 7 cps, with a large handsread, is physically impossible, so the camera could not have been going as fast as 36 fps. It may seem surprising that one cannot clap at 7 cps, since 3.5 cps is quite natural. However, it is easy to show that a "cube law" is involved; e.g., to clap twice as fast, with the same amplitude, one must use 8 ( $8=2^3$ ) times as much power.

This is, I feel, a very ingenious observation by Dr. Alvarez, but I doubt that it can discriminate between 18 and 24 frames per second. In any case, comparison of the Zapruder film with other films of the assassination is probably the first thing that should be done if the figure of 18.3 fps is still questioned.

Paul Hoch  
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(These are rather rough notes  
and should not be quoted in  
print or taken to be exact.)