

MUXH ADO ABOUT NOTHING?

Mantik and the others are serious but this is essentially both silly and impossible. That amount of alteration takes an enormous amount of time and I cannot see how it could be done without being visible on physical examination of the original film and by projecting the copies, lines would show. Then the magnification, as in my study of the slides, from about a quarter of an inch in width to five feet, anything like that would be quite visible. Besides which there is no mention of who did or could have done it, where, how, with the required possession of all copies, or with what knowledge of what was to be hidden. It is also like all other flat-world studies, without regard to all else. Mantik, for example, make no reference to the best of possible proofs of a second shot to the head and of the use of other than military ammo, which is in Post Mortem. He makes no reference to that work or to any of my books other than the first two, yet they and often they alone hold the evidentiary proofs that any alteration of the film would have had to have been designed to eliminate. And could not from any source of them other than the film.

The amount of alteration this postulates is incredible, as is the amount of time that it would have taken. When there was no such time. And when if it had happened it had to have happened after three copies had been made, at the least, and the identical alterations had to be made in them. Not possible!

The amount of time and effort this silliness represents is astounding, yet in the end Mantik does not say what he thinks was accomplished or how it could have been without control of the other relevant evidence. like the medical evidence.

8/22/97

When then did not yet exist.

Or the eye-witness testimony not yet taken.

Or the physical evidence.

AKS

Harold -
Thought you'd like to see an advance copy.
I've to be published in October. Please keep
private fill them! My home phone is 619-340-1964.
D.W. Mantik

SPECIAL EFFECTS IN THE ZAPRUDER FILM

by David W Mantik, M.D., Ph.D.

"When you have eliminated the impossible, whatever remains, however improbable, must be the truth."
--Sir Arthur Conan Doyle, *The Sign of Four*

Introduction

On November 22, 1963, I was working toward a Ph.D. at the Biophysics Laboratory at the University of Wisconsin in Madison. Several of my fellow graduate students and I had just finished our lunches and were listening to a noon radio program. Suddenly, a bulletin came through from Dallas, Texas--the President had been shot! Then a few minutes later all of our worst fears were confirmed. Although that event is sculpted into my memory, it is a bit odd that I cannot recall my first viewing of the Zapruder film. Most likely it was the fall of 1975, when I attended a lecture at Los Alamos, New Mexico. By then I had started a new career and was rotating through the University of New Mexico as a medical student. The speaker was the Nobel Prize winning physicist, Luis Alvarez, who presented his personal analysis of the Zapruder film. What I do know is that I did not leave that lecture with a firm belief that JFK's head snap was proof of a conspiracy.

When Oliver Stone's movie appeared in 1991, my interest in the assassination was rekindled. I recalled that, after all those years and many personal moves, I had still retained the preprint (*American Journal of Physics* (1976) 44:428) from the Alvarez lecture. I now began to review it. Alvarez had concluded that only an external force could produce such a head snap. For this force, he offered a simple explanation from physics--namely that a jet effect of forward going biological tissue had pushed the head backward. But now, as I read this, and as I read the eyewitness reports, I realized that the head snap was a paradox. So I began to wonder: was Alvarez wrong--or was his idea merely irrelevant? I began to realize that I had underestimated the seriousness of the problem. I decided that it was time to find out who was right.

Now, several years later, I have come to a surprising conclusion--no explanation offered so far is either correct or relevant. I do not believe that a frontal shot, with any reasonable sized rifle or bullet, could produce the observed head snap--too much energy is required. Alvarez's explanation, also, is inadequate and irrelevant. By taking both of these positions, I risk losing any friends that I might have on either side of this issue!

In this essay I present new information regarding the authenticity of the Zapruder film. I also review old evidence, some well known (but perhaps misunderstood) and some overlooked, but chiefly I attempt to integrate a wide variety and quantity of evidence that bears on this question. It is only recently that this issue has come to the fore. There is an unusual diversity and amount of evidence that points toward alteration--too much, in fact to be ignored:

- there should not be so many witnesses who disagree with the film (none of them agree with it!), but who also agree so consistently with each other;
- there ought not to be witnesses who saw an earlier version of the film that contained scenes not in the present film;
- the film itself should not contain a cornucopia of mysterious and paradoxical features, some of which have come to light only recently. Finally, I describe my own

recent visits to the National Archives where I examined what are described as first generation copies of the Zapruder film and a reenactment film taken with Zapruder's camera. (I have not had an opportunity to see the so-called original film; that opportunity may yet come.)

Some readers may be surprised that none of this evidence rules out alteration, and they should be surprised. Much of it, in fact, points toward alteration. For example, it is striking that two investigators, working independently of one another, have each identified his own (independent) set of strange features on the same frame of the film. Furthermore, for each of these two cases, film alteration is the most sensible explanation--perhaps even the only possible explanation. That surely would not have been expected, but it has happened. Along the way, I also seek to explain some heretofore enigmatic items--ugly ducklings, so to speak. When one explanation for all of these strange puzzles--that extensive film alteration was deliberately carried out--has such enormous explanatory power, and when the quantity of evidence from so many different directions is all so suspicious, then surely this hypothesis deserves a fair hearing. Those who desire to preserve the alleged "authenticity" of the film now are beginning to appear more and more like the Ptolemaic astronomers who added epicycle upon epicycle in their futile attempts to preserve a geocentric paradigm.

The Centrality of the Zapruder Film in the Assassination

[Editor's note: Many photographic images are discussed here but none are shown. Most are easily accessible elsewhere. Serious students should obtain copies of Robert Groden's The Killing of a President (1993) and Richard Trask's Pictures of the Pain (1994). Black and white reproductions of the individual Zapruder frames from 171 to 334 may be found in The Hearings of the Warren Commission, Volume 18. The 35 mm slides are available for public for viewing at the College Park facility of the National Archives. Noel Twyman's Bloody Treason (forthcoming), will contain 26 color reprints of different frames. Excellent color images were printed in the LIFE magazine issues of 29 November 1963; early December 1963 (Memorial Edition); 2 October 1964; 25 November 1966; and December 1991. For a brief history of the film (and its visit to the CIA), see Mike Pincher and Roy Schaeffer, chapter 8.]

If there had been a trial for Lee Harvey Oswald, or anyone else for that matter, would the Zapruder film have been accepted into evidence by the court? David Wrone ("The Zapruder Film. A Brief History with Comments," 1997), Professor of History at the University of Wisconsin-Stevens Point, has emphasized that there was no chain of possession, nor even an effort to maintain one. If anything, Wrone notes, Warren Commission (WC) staff members Samuel Stern, Wesley Liebeler, and Arlen Specter (now Senator from Pennsylvania) carefully avoided that whole area. No records were obtained from *LIFE*, no official statement collected regarding the damaged areas at the several splices, no record of who had the film, or where it had journeyed for the several months before it was presented to the WC. (Many years ago, Weisberg had made the same point (*Whitewash II* 1996, p. 210.))

For photographic information to be accepted as evidence in court, the images must be vouched for, and their whereabouts ascertained at all times (*McCormick on Evidence*, 3rd edition, 1984). Particularly today, with our enormous capability for altering images, that is critical. But even then, that requirement would have been essential. The legal principle is that eyewitness testimony has priority over photographs. This principle was turned upside down by the battalions of lawyers who worked for the House Select Committee on Assassinations (HSCA) and for the WC. For them, against all legal

precedent, the assumption was always the reverse: witnesses were assumed to be in error or even lying, while the photographs (and the X-rays, too) were assumed to be immutable monuments to truth. In a real trial, no competent judge would have permitted this illegal approach. In view of the astonishing absence of elementary record keeping for possession of the film, it is likely that no data obtained from the film could have been used in a trial. The paradoxes of the first two reenactments (see below) raise tangible concerns about the validity of the Zapruder film as evidence (timing issues, specifically). An attorney for either side could have emphasized that point in addition to the lack of custody if he (or she) wanted to keep the film out of court.

Furthermore, the WC's marked inattention to details of the Zapruder film was shown all too clearly by staff member Wesley Liebler's gross ignorance of the most obvious splice in the film at Z-212 (David Lifton, *Best Evidence*, 1980, pp. 24-27). Another example of incompetence (some cynics regard this as deliberate deception) is the reversal of the critical frames Z-314 and Z-315, at the moment of the first head shot (Lifton 1980, p. 7)--first discovered by a private citizen, Raymond J. Marcus.

It is also somewhat incredible, especially for official investigations of this magnitude, that neither the WC nor the HSCA provided any detailed summaries of the sequence of events in the motorcade (Wrone, in particular, has made this point). Especially for the WC, with its singular lack of interest in the Zapruder film, it would have been expected that such an eyewitness summary of the motorcade events (especially a compilation from multiple witnesses) would have been indispensable to its investigation. At the least, such a summary could have been compared to the Zapruder film to assist in validating the film. Nonetheless, that, too, was not done. So not only is the chain of custody absent, but a coherent compilation of eyewitness accounts is also missing. It is a major task of this essay to complete just such a summary from the eyewitness accounts and then to compare this to the events seen in the film. These two scenarios do not agree at all. Regarding the disinterest in the film shown by the WC, Weisberg notes (*Whitewash II*, 1966, p. 213) that Robert Bahmer, the U.S. Archivist advised him that "There is no print of the Zapruder film among the records of the Commission that is identified as having been received from *LIFE* magazine."

Despite these significant points, however, the centrality of the film in understanding the assassination has been assumed by most investigators--almost without question. The highly respected private investigator and former professor of philosophy, Josiah Thompson (*Six Seconds in Dallas*, 1967, p. 6) stated: "Yet if it is studied with the utmost care and under optimum conditions, it can yield answers to enormous questions. Where did the shots come from and when were they fired?" On the next page he states, "Quite obviously, the Zapruder film contained the nearest thing to the absolute truth about the sequence of events in Dealey Plaza."

Robert Groden (*The Killing of a President*, 1993, p. 19) has also clearly staked out his belief in the authenticity of the film: "The Zapruder film offers the most accurate reflection of the assassination."

And Alvarez (p. 440) added his own endorsement: "That is why I find the photographic record so interesting; it doesn't have the normal human failings." (It is the purpose of this paper to illustrate the enormous irony of this statement.)

In the late 1970s, the HSCA utilized the film extensively--particularly via the work of the Itek Corporation. But no official investigating body has ever questioned--let alone explored--questions of authenticity.

Several histories of the film have been written, either exclusively, or as part of a larger work. These authors include Philip Melanson, Harrison Livingstone, Noel Twyman, Richard Trask, David Wrone, and Martin Shackelford. Of these, the first two doubt the authenticity of the film, while Twyman, also dubious, explores some of the technical issues in his new book, *Bloody Treason*, (1997). Trask (*Pictures of the Pain*, 1994), on the other hand, accepts authenticity almost without comment; even in his very large and well documented work, the word "authenticity" is absent from his index. In a personal conversation (telephone call of 28 July 1997), Wrone also advised me that he believes in authenticity. And Martin Shackelford, a committed student of this case, has also retained a strong vocal commitment to authenticity.

The Availability of the Film.

The film was shown repeatedly during that initial weekend. Zapruder's partner, Erwin Schwartz, has recalled for Twyman that he saw it about 15 times. Dan Rather saw it once and has been vigorously pilloried for describing JFK's head as going rapidly forward (as opposed to rapidly backward--as seen in the extant version). Both of these men describe events in the film that are no longer seen; this is discussed in more detail below. After that weekend and the immediately succeeding days, except for a viewing by the National Photographic and Interpretation Center (Melanson, "Hidden Exposure," *Third Decade*, November 1984) there is no record of another viewing until January 27, 1964 (over two months later), when a second generation copy was shown by FBI Agent Lyndal Shaneyfelt to a small WC audience (Trask, p. 100). In a letter from Secret Service Chief James Rowley (1-27-64) to *LIFE's* Washington Bureau chief Henry Suydam, he confirms that the film was not shown to anyone outside the Secret Service staff (Martin Shackelford, "A Chronological History of the Zapruder Film," 1995, unpublished). This relatively long hiatus--and the fact that the audiences were different--may have provided a sufficient time interval for film alteration. The original film was shown at a joint meeting with WC staff on February 25 (5H138); for fear of damage to the film, however, it was not stopped to project individual frames. A copy of the film was later examined in slow motion and frame by frame though (Trask, p. 100). Also see Weisberg's *Whitewash II* (pp. 211-213) for events during this time period.

In early 1969, the film was subpoenaed (and released) from *TIME*, Inc., for the Garrison trial. While there, many copies were made and bootleg copies proliferated, especially on college campuses. Even slides of individual frames became available to the public. Public interest in the film accelerated when the backward head snap became widely known. This snap was widely touted by critics of the WC as being obvious evidence of a shot from the front--and therefore evidence of conspiracy.

In early 1975, Groden screened his copy of the film for the Rockefeller Commission (Shackelford, 1975). The film was first shown on public television by Robert Groden on NBC's *Good Night America* with Geraldo Rivera on 6 March 1975. Groden showed his enhanced version, which was a great improvement over previously available copies. A viewing of Groden's version by Congressman Thomas N. Downing (Virginia) and staff in April 1975 helped to trigger the formation of the House Select Committee on Assassinations (HSCA). By concluding that at least two gunman had probably fired in Dealey Plaza, this most recent government investigation contradicted the WC--they rejected the lone gunman theory. By doing so, the HSCA thus turned the JFK assassination into an *officially* recognized conspiracy.

Early Critics of the Film

If not the earliest critic of the film, Harold Weisberg was surely its most vocal, particularly in *Whitewash II* (1966). He cites a particularly curious testimony (p. 180) in which Lyndal Shaneyfelt reports that the FBI reenactment took only 3.5 seconds (at 11 mph between Z-222 and Z-313), as opposed to the expected 5 seconds found in the Zapruder film (*Whitewash II*, p. 180). This discrepancy was not resolved in Weisberg's discussion, nor has any subsequent investigation put this issue to rest. If the reenactment was accurate, then the limousine's average speed in this interval must have been distinctly greater than 11 mph (a time of 3.5 seconds would yield a speed of 15.7 mph, assuming that 11 mph is indeed correct). This issue recurs later when the question of a limousine stop is discussed; if such a stop did occur then the time to transit the required interval during the actual motorcade would be longer--and perhaps consistent with the official time of 5 seconds. Another possibility is that the FBI report for Zapruder's camera speed is incorrect. These issues are all addressed below.

In a manuscript never published but informally circulated (*Murder from Within*, Fred Newcomb and Perry Adams, 1974) questions of authenticity were raised and the authors pointed out several inconsistencies in the film. These included:

1. that Dan Rather reported seeing evidence of a successful shot on Connally's shirt front--a witness is even cited who saw the same event (Bill Newman);
2. that numerous witnesses said that the limousine stopped after shots had been fired;
3. that, between frames Z-280 and Z300, JFK and Connally virtually disappear;
4. and that, from frame to frame, the limousine displays a variety of irregular movements, including traveling only 10 feet within 21 frames between Z-197 and Z-218 (this is only about one half of the expected distance).

Because they also suggested that William Greer, the driver of the presidential limousine, had fired the fatal shot, their work was ignored or ridiculed by a large percentage of those (few) readers who did have access to the manuscript. In retrospect, the quality of the images available to them was quite inferior to those widely available today and probably led to an error with respect to Greer.

Recent Critics of the Film.

Although these writers had raised serious questions, their effort was largely ignored for many years. It was mainly with the publication of Harrison Livingstone's *Killing Kennedy* (1995) that these questions began to be discussed among a wider audience. In his book, the chief contributor to this effort was Daryll Weatherly, a graduate student in mathematics, who offered several original and penetrating observations that are discussed below.

Then in November 1996, several individuals met in Dallas, Texas, under the umbrella of the JFK Lancer (headed by Debra Conway) to discuss the film. The chairman for this panel was Prof. James H. Fetzer, McKnight Professor of Philosophy from the University of Minnesota-Duluth. A closed session was held on November 21. This format permitted free and open discussion in a small group setting. Then, in a formal program extending over five hours on November 22, six speakers listed numerous arguments against authenticity of the film. Besides Fetzer, this panel included Jack White (photo analyst), Noel Twyman, Chuck Marler, David Lifton (*Best Evidence*, 1980) and me. In the ensuing several months, particularly by e-mail, discussions raged pro and con as others passionately joined in the arguments over authenticity.

Arguments Favoring Authenticity

The arguments against authenticity may be better understood after first reviewing (and responding to) those arguments that favor authenticity. Most of these have been summarized by the National Archives in "Technical review of the 'Zapruder' film from NARA's courtesy storage holdings," by Charles W. Mayn 21 December 1995). Although this report is available to the public, it has remained little known. Despite discussing several important issues, it left unaddressed several questions that currently occupy students of the film. These arguments are listed first, after which item by item responses (indicated in italics) are offered. Items 1 to 6 are included in the NARA report. Items 7 to 10 have been suggested by others.

1. The film has two different segments of identification leader spliced to its head with identifying information handwritten on the leader. This is typical of film that has been processed, with the leader being added later. *This is necessary, but not sufficient evidence. It would have been possible to imitate this.*

2. Intersprocket images are present. This is characteristic of most regular 8 mm cameras. *This is probably a necessary requirement; if intersprocket images can be copied, however, it is not sufficient.*

3. A splice exists at a point known to have been damaged historically. *This does not preclude alteration elsewhere in the film.*

4. Another splice occurs where a tree trunk lies to the right of the sign; this is historically consistent. *These are necessary requirements, but the film could have been altered before--or even after--his damage occurred.*

5. There are no images from a prior generation--i.e., no edge prints (manufacturer's ID symbols), no images of splices, no images of sprocket holes, and no images of prior damage. *This is a strong requirement. It is addressed in great detail below.*

6. The color is consistent with Kodachrome film exposed in daylight as opposed to the color "cast" often seen in duplicate films. *This is also necessary, but not sufficient. Jack White [Editor's note: see Jack White.] states, from his extensive experience in still photography, that it is often impossible to distinguish an original from a copy. I put this same question to Bruce Jamieson (telephone conversation, 24 July 1997), who produced the first generation copies of the Zapruder film on 22 November 1963 in Dallas. He said that although out-of-camera Kodachrome is film distinctive, a good copy could be difficult to distinguish--unless compared side by side with the original. But that is a catch-22 in this case--it is the original that is in doubt.*

7. The emulsion side faces away from the viewer. *That would be expected for a camera original--or for every alternate generation after that. Within the camera, the emulsion faces forward (to minimize loss of image). Therefore, in order to view the image correctly, it is necessary to look through the film from the opposite (shiny) side--so that light enters the eye in the same manner that it enters the camera. It would be possible to make a first generation copy with the emulsion side facing away; there are no particular constraints on how this is done. (This observation was offered to me by the author of the NARA report.) This condition is necessary but not sufficient.*

8. There was not enough time for the task. This argument is the most difficult for me to address since it presupposes an expert's understanding of the time required for specific tasks, such as excision of frames and editing within frames. I have already noted above that there were over two months between the assassination and the first known WC viewing. A lengthy editing period would also seem to be required since the editors could not know what other films or photographs might later appear and contradict their edited version. In fact, the FBI collected many movie films (e.g., Nix and Muchmore) and photographs in the following weeks. It should also be remembered, however, that films that were collected too late could still have undergone alteration. Finally, viewers of the film from that first weekend report seeing events not present in the current version; so it is not likely that all the film editing was completed during the first night. Having said all of this, however, I am still impressed at some of the images in the 29 November 1963 issue of LIFE. Furthermore, Shackelford notes that this issue was on the newsstands by the following Tuesday (November 26). This issue included frames with the Stemmons freeway sign, the street lamp (in which Connally begins to vanish off the bottom of the film), several frames from the Z-320s in which JFK is near the bottom edge and a portion of his head is grossly missing, and multiple frames after this in which the limousine moves abruptly upward in the field of view. In light of the discussion below (in which I conclude that the bottom of frames before and after Z-313 have been deliberately cropped), at least some editing within frames must have been completed within the first few days. Whether that is too fast or, instead, is quite feasible, will naturally depend on the facilities and personnel available; but about this, nothing at all seems known at this time. During all of this discussion, however, one important point should not be lost--no intersprocket image was reproduced for the public until November 1996 (LIFE). It is in this region especially that work was required by the editors; this same region is the focus of much discussion below.

9. No optical printers existed for copying film to include the intersprocket scenes. (Robert Groden has even recalled an unsuccessful offer of a reward to anyone who could provide such a machine.) It is known that a copy of the "home movie" portion of the film does include intersprocket images. (I have seen these.) Whether the motorcade sequence would also be copied into the intersprocket area seems to be in some doubt. See the discussion of printers below, especially with respect to contact printers and visualizing edge prints. Also note comments below by Bruce Jamieson. Optical printers are extremely useful for copying huge numbers of frames and long lengths of film. However, when the length of film to be copied is only slightly over 6 feet long and contains fewer than 500 frames, it may be sufficient to construct a custom copier (perhaps operated manually) so that the intersprocket images could be incorporated into the new version. There would almost certainly not be any technical barrier to assembling such a device. The main challenge, as usual, would be resources and time. [Editor's note: see Pincher and Schaeffer for a possible system for copying the film.]

10. No film editor inclined to a lone gunman scenario would have left the head snap in. Although no final answer can be given to this objection from common sense, several responses may be offered. The first was actually noted by WC Assistant Counsel, Wesley Liebler, who admitted that the WC never paid much attention to the head snap--at least not until the critics seized upon it (KTTV, Los Angeles, February 1967). It was, in addition, shown to the WC and that seemed not to cause any concern. And, as I noted above, I do not recall being convinced by it in 1975 either. A second response is that the film's editors worked only with still photographs; they did not concurrently view their work as a movie film. When they did view their final product (as a movie), they may have recognized some problem areas but were unwilling (or unable, given the time constraints) to embark on another round of alterations.

It is likely that removal of the head snap would have been technically feasible. The more pertinent question, though, is: at what cost of time and effort? Editing within a fair number of additional frames (a labor intensive task) would most likely have been required. A complete excision of the head snap would have left JFK leaning forward in his slumped position for an exceptionally long time, including many frames before Z-313 and for many afterwards, too. Such an image may have conflicted too much with eyewitnesses who saw something quite different: some saw JFK moving to an erect posture, while others saw JFK hit while sitting erect.

Finally, it should be recalled that this film was never intended for wide viewing--nor did that actually occur until 1975, twelve years later, and then only by private efforts, mainly by Robert Groden. By then, whoever had issued the orders for film alteration had no doubt achieved his (or her) purpose--the ballgame was already over. The cover-up did not need to be perfect; it needed only to succeed for a limited time interval--and that was achieved. In addition, an imperfect cover-up does not surprise many critics who see evidence for such human imperfections in other (attempted) cover-ups in this case.

Arguments Against Authenticity

These arguments are divided into several categories for ease of discussion. They are presented in the following sequence.

- I. Disagreements between eyewitnesses and the film.
- II. Disagreements between early viewers of the film (November 1963) and what is currently seen.
- III. Disagreements between the film and other photographs or movies.
- IV. Disagreements between the film and the first two reenactments
- V. Internal inconsistencies in the film.

I. Disagreements between eyewitnesses and the film.

Did the Limousine Stop? Arguments Pro

In UPI's *Four Days* (1964, p. 17) the author notes: "In the right hand picture [a frame from the Muchmore movie film], the driver slams on the brakes and the police escort pulls up." And Merriman Smith (p. 32) states: "The President's car, possibly as much as 150 to 200 yards ahead, seemed to falter briefly." This book became available in early 1964, only a few months after the assassination. *Newsweek* (2 December 1963, p. 2) wrote: "For a chaotic moment, the motorcade ground to an uncertain halt." And *Time* (29 November 1963, p. 23) asserted: "There was a shocking momentary stillness, a frozen tableau."

Even Trask (*Pictures of the Pain*, 1994, p. 209), who does not raise questions of authenticity, quotes Bobby Hargis, the motorcycle man on the right rear, as saying, "...I felt blood hit me in the face, and the Presidential car stopped immediately after that and stayed stopped for about half a second, then took off at a high rate of speed." (6H294; i.e., volume 6 of the Warren Commission Hearings, p. 294.) How Trask reconciles this statement with the film he does not say. To my knowledge, Hargis is the only witness who states a specific time interval for the limousine stop. Hargis, as a motorcycle officer on the left rear, was positioned perfectly to recognize whether or not such a stop had actually occurred.

Even Gerald Posner, an ardent supporter of the WC, and surely a supporter of film authenticity, does his cause no good at all when he writes (*Case Closed*, 1993, p. 24):

"Incredibly, Greer, sensing that something was wrong in the back of the car, slowed the vehicle to almost a standstill." It would be interesting to ask Posner to point to this moment in the film.

All of these comments are in obvious conflict with the film. No abrupt slowing of the limousine is seen and it certainly does not stop. Furthermore, new observers of the film almost never comment on such a marked deceleration. In a detailed frame by frame analysis, Alvarez did identify a sudden deceleration from about 12 to 8 mph, centered at about Z-300 and extending over about 0.5 seconds (nine frames); this would begin at about Z-295, only a few frames before the head snap begins. This slowing, however, is subtle and is not usually noticed by viewers of the film. It is peculiar that this modest, almost imperceptible, deceleration--lasting only one half of a second(!)--should be what prompted several dozen eyewitnesses to describe this as a marked slowing, or even a possible stop. If this event made such an impression in Dealey Plaza, why do observers of the film not respond in similar fashion today? Vince Palamara ("47 Witnesses: Delay on Elm Street," *Third Decade*, January/March 1992) has since updated his original article to now include at least 48 witnesses who described a limousine stop on Elm Street. Also see "Questioning the Limousine's Speed on Elm Street," by Chuck Marler (*The Fourth Decade*, May 1994, p. 19). A partial list of such eyewitnesses has been assembled specifically for this essay by Milicent Cranor, as follows.

A Partial List of Witnesses to a Limousine Pause (Cranor)

<u>WITNESS</u>	<u>STATEMENT</u>
1. Marrion Baker	"...the car stopped completely, pulled to the left and stopped... Several officers said it stopped completely." (3H266) [Motorcycle officer, several cars behind the limousine.]
2. Charles Brehm	"...between the first and third shots the President's car only seemed to move some 10 or 12 feet...almost came to a halt after the first shot..." (22H837) [To left rear of limousine, near curb.]
3. Earle Brown	"...when the shots were fired, it [the car] stopped." (6H233) [Police officer on overpass.]
4. James Chaney	"...after the first shot rang out, the car stopped completely." (3H221) [Motorcycle officer at right rear of limousine.]
5. J.W. Foster	"...immediately after [JFK] was struck...the car...pulled to the curb." (Commission Document 897, pp. 20-21) [Police officer on overpass.]
6. Bobby Hargis	"The [limo] stopped immediately after that and stayed stopped for about half a second, then took off..." (6H294) [Motorcycle officer at left rear of limousine.]
7. Harry D. Holmes	He noticed the car pull to a halt, and Holmes thought: "They are dodging something being thrown." (Jim Bishop, <i>The Day Kennedy was Shot</i> , 1967, p. 176; 7H291) [Postal inspector, Post Office, one block away.]

8. Douglas Jackson "...the car just all but stopped...just a moment." (Newcomb and Adams 1974, p. 71) [Motorcycle officer, right rear of limousine.]
9. Robert MacNeill "The President's driver slammed on the brakes--after the third shot..." (*The Way We Were, 1963. The Year Kennedy was Shot*, 1967, p. 193) [Press car in motorcade.]
10. Billy Joe Martin He saw the limousine stop for "just a moment." (Newcomb and Adams 1974, p. 71) [Motorcycle officer, left rear of limousine.]
11. Mary Moorman She recalls that the car was moving at the time she took her photo, and when she heard the shots, and has the impression that the car either stopped or slowed before accelerating. (19H487) [Immediately left of limousine near curb.]
12. Bill Newman "I believe Kennedy's car came to a full stop after the final shot." (Bill Sloan, *JFK: Breaking the Silence*, 1993, p.169) [Immediately right of limousine near curb.]
13. Alan Smith "The car was ten feet from me when a bullet hit the President in the forehead...the car went about five feet and stopped." (*Chicago Tribune*, 11/23/63, p. 9; Newcomb and Adams 1974, p. 71) [Unknown location.]
14. Roy Truly "I saw the President's car swerve to the left and stop somewhere down in this area." (3H221) [In front of Texas School Book Depository.]
15. Major Phil Willis "The party had come to a temporary halt before proceeding on to the underpass." (7H497) [Across street from Texas School Book Depository.]

Notice an extraordinary concordance here: all four motorcycle men who were closest to the limousine recalled a stop! Surely if anyone would recall this event correctly, they would. As is discussed below, the probability for eyewitnesses being wrong on a simple fact like this is surprisingly low--but here we have all four recalling the same event in the same way. In addition, Moorman and Newman were extremely close witnesses, one on each side of the limousine.

It is also odd that a list of individuals who said that the motorcade never stopped or slowed has never been assembled. (An essential requirement, of course, would be that they be uninfluenced by subsequent viewing of the film.)

Did the Limousine Stop? Arguments Con

Several arguments against a stopped (or noticeably slowed) limousine have been advanced. An inevitable one is psychological--at moments of high drama, events seem to slow down. This phenomenon certainly occurs; many of us are doubtless familiar with it. Regarding the events in Dealey Plaza, however, it can be replied that many of these eyewitnesses simply did not know what was happening--or even that it was important. Many did not immediately recognize that they were witnessing an assassination--or

anything else of historical importance. Some thought that firecrackers were going off (see 50 such witnesses in Newcomb and Adams 1974, p. 86), while others thought they had heard the backfire of a motorcycle (see 19 such witnesses in Newcomb and Adams 1974, p. 86). In either of these cases, strong psychological reasons for perceiving time as slowed down are absent. Despite this, however, a large number do recall a notable change in the limousine speed. To give added support to the accuracy of their memories, the probable reliability of eyewitnesses for recalling such a fact is addressed below.

Another objection to a limousine stop is that those vehicles farther back in the motorcade may have stopped but the presidential limousine continued without delay, so that reports of stopping were misapplied to the limousine. Indeed, it is likely that followup vehicles did slow, but that cannot be the entire explanation. Some of the closest eyewitnesses such as B.W. Hargis and Mary Moorman also recall a dramatic deceleration. In addition, Secret Service (SS) agents in the followup car describe the same event. (See the Appendix in *Mortal Error* (1992), by Bonar Menninger, for their statements, which provide powerful support for the conclusions drawn here.) Surely none of these individuals was observing the followup vehicles. On the contrary, they had every reason to be intently observing the limousine--it was directly in front of them during the fatal head shots and it was the specific duty of the SS to do so.

Can these Eyewitnesses be Trusted?

It has long been standard practice to impugn the reliability of eyewitnesses in general, but particularly so in the two official investigations of the Kennedy assassination. Whenever conflicts arose between their desired conclusions and the eyewitness reports, both the Warren Commission (WC) and the HSCA persistently either ignored the eyewitnesses (several in the best locations--Bill Newman, Marie Muchmore, Orville Nix--were not even asked to testify) or it was claimed that they had to be mistaken. Even John Connally, a participant and very close eyewitness was not believed. Both he and his wife were thoroughly convinced that he had been hit by a different shot from the one that hit JFK. But to concede this would have been to admit one too many shots--and so his testimony had to be ignored. Seth Kantor, a Scripps-Howard newspaperman is another example. When he described seeing Jack Ruby at Parkland Hospital, he was ignored by the WC. No reasonable explanation was offered by the WC for why Kantor (who had known Ruby personally) would be mistaken on such a simple observation or why he would have lied. Kantor later wrote a book about his own experiences and always insisted that he really had seen Ruby. Later, the HSCA also agreed with him.

Robert Blakey, the General Counsel for the HSCA, in his conspicuous and self-proclaimed public passion for objective data, seemed almost to run a vendetta against eyewitnesses. Rather than rely on eyewitnesses, he chose instead to emphasize data that he could label as scientific. The chief example of this was the acoustic data on which the HSCA based its conclusion of conspiracy. And this Blakey, in turn, pinned on the Mafia who were his own special area of interest. A subsequent review, by a panel from the National Academy of Sciences, refuted those acoustic conclusions, thus detonating the main pillar of Blakey's case--his purported passion for scientific data thereby exploding in his face. The acoustic data is still discussed occasionally--it is possible that the issue is not totally settled, but it was not settled by Blakey's staff and experts. (Also see Thomas Canning's comments below on Blakey's modus operandi.) On another occasion, Blakey's comments showed that he failed to understand even the rudimentary basis of the scientific method and the conclusions reached thereby. When interviewed by Bob Beckel about the neutron activation analysis work on the bullet fragments, he said, "The single bullet

theory is proven beyond reasonable doubt for anyone who has reasonable technical competence and will study the physical and other evidence." (*Larry King Live*, CNN, 21 May 1992).

What Blakey had failed to understand is that scientific truth is not partisan and cannot forever be bent in the direction of personal biases. Although the arena of the expert witness appears to pit one expert against another, observers of such a battlefield might not know that one witness is an eccentric dinosaur while his opponent represents the viewpoint of an entire specialty. The ability of defense attorneys seriously to distort scientific evidence has recently been put on public exhibition in the OJ Simpson trial. It is useful to recall that both the WC and the HSCA were not only led by attorneys but almost entirely staffed by attorneys. The WC sought only minimal expert opinion. Although the HSCA employed many experts, including scientific and medical consultants, its final conclusions were almost always formulated by attorneys--over whom the experts could exercise no veto power whatsoever. [Editor's note: see Ronald F. White, Postscript.] The expert asked to analyze bullet trajectories for the HSCA, Thomas Canning, stated his frustration to Chief Blakey in a letter of 5 January 1978 (HSCA Agency File #014258). "The compartmentalization which you either fostered or permitted to develop in the technical investigations made it nearly impossible to do good work in reasonable time and at reasonable cost....The most frustrating problem for me was to get quantitative data--and even consistent descriptions--from the forensic pathologists.... Much of this rather negative reaction to the hearings themselves stems from my being strongly persuaded to rush through a difficult analysis at the last minute, abandon my regular pursuits for two days, try to boil down forty-five minutes of testimony to thirty, and then listen and watch while two hours excellent testimony is allowed to dribble out over most of a day."

And so Blakey's attempt to prove a conspiracy, by ignoring the eyewitnesses, failed. By ignoring them, however, he overlooked a small mountain of clues. There is no question but that eyewitnesses are notoriously unreliable for identifying faces of strangers only briefly glimpsed. They also do poorly at recalling the specific details of a complex sequence of events. However, when the degree of complexity is lower, and particularly for observations that are considered important, an altogether different conclusion results.

At the University of Michigan, an experiment with an unexpected result was performed in 1971 (by sheer coincidence, I was Assistant Professor of Physics at Michigan at that time). Elizabeth Loftus summarizes this work in *Eyewitness Testimony* (1996). Her book won the National Media Award for Distinguished Contribution from the American Psychological Foundation. The book jacket says what you would expect it to say--it implies that eyewitness testimony is unreliable. However Table 3.1 on page 27 tells quite another story. The data cited are from J. Marshall, et al., *Harvard Law Review* 84: 1620-1643. A total of 151 observers were shown a two minute movie in color and sound--with a fairly complex set of actions. The researchers identified about 900 items present in the film that could have been mentioned. The observers were interviewed immediately after the viewing; they were urged to recount, in all possible detail, what they had seen. The researchers then assessed these responses based on accuracy, completeness, and saliency. Accuracy and completeness were determined by what was actually seen in the film. Saliency, however, was determined, not by the researchers, but rather was defined internally--i.e., by the responses of the observers themselves. Specifically, if an item was described by over 50% of the observers it was considered highly salient.

Marshall, et al. then graphed the accuracy and completeness of the responses vs. saliency, as follows.

<u>Saliency</u>	<u>Accuracy</u>	<u>Completeness</u>
0	61	64
1-12	78	81
13-25	81	82
26-50	83	92
51-100	98	98

In view of all that has been said about eyewitness *unreliability*, these data are quite astonishing--if over 50% of the witnesses considered an item to be salient, then they were 98% accurate and 98% complete! Did the HSCA consider this? It is noteworthy that this study was published in 1971, years before the HSCA even came into existence. It is doubtful that Blakey had taken time to search for evidence of this nature on eyewitness reliability.

Therefore, when many dozens of witnesses all recall an event, such as the slowing of the limousine at a critical moment--this Michigan data strongly suggests that they are recalling the event correctly. As a not entirely hypothetical example, if a single witness has only a 2% chance of being wrong (as in the table above), and if 10 witnesses report the same event, what is the probability that they are all wrong? This subatomic number is $(0.02)^{10} = 10^{-17} = 0.000000000000000001!$ Actually, these witnesses might even claim a higher level of accuracy than the Michigan film viewers; this is because the events in the Zapruder film lasted for only a few seconds, while the Michigan film lasted for two minutes. And if many of these witnesses recall in a consistent manner--as they do--that the limousine slowed or that JFK's head moved in a particular sequence, then this Michigan experiment stands as a serious warning to all of us that such testimony cannot be jettisoned out of hand, as Blakey was only too eager to do.

Did JFK's head move backward abruptly?

Another major disagreement between the film and the eyewitnesses is the backward head snap. This is so dramatic and has been so popular among WC critics that it has been accepted for decades as evidence of a frontal shot. In fact, when Alvarez asked for the best evidence of a conspiracy, the head snap was offered to him. Unfortunately for his view, however, although a weak jet effect may sometimes occur under optimal conditions, there is now much evidence against the jet effect as an adequate explanation for the head snap.

It should first be noted that the jet effect in the Alvarez experiments resulted from soft nosed bullets. When he used full metal jacketed bullets (like those purportedly fired by Oswald), the jet effect was greatly reduced. John Lattimer's shooting experiments were claimed by him to provide strong evidence for the jet effect. He filled 12 real human skulls with fresh brain tissue and white paint, shot them with full 6.5 mm metal jacketed bullets and filmed the entire sequences. In all 12 cases he claimed that brain tissue exited explosively and the skulls moved toward the shooter every time (*Kennedy and Lincoln*, 1980, p. 251). The only other experiment to use human skulls was reported by the Edgewood Army Arsenal. These results were reported in 1978 (1 HSCA 404). In 10 successive skulls filled with gelatin, all 10 skulls went *forward*, in the direction of the bullet! *None* went backward:

Also, you will see that as the skull goes forward, some of the material of the skull and the contents were blown out toward us. Consequently, the opposing momentum carries the skull away from us.... In fact, all 10 of the skulls that we

shot did essentially the same thing.... they also lost material toward us, that is, toward its right and therefore rotated toward its left. (1 HSCA 404.)

In this last phrase, "toward us" refers to the viewers who are to the right of the skulls. Therefore, material blown out to the right sent the skull to the left, i.e., a jet effect! Unfortunately, the jet effect seen here is in the wrong direction for Alvarez--and for Lattimer, too! These results therefore stand in dramatic contrast to Lattimer's. To date, Lattimer is the only individual to claim a useful jet effect with full metal jacketed bullets.

As a personal footnote, I heard Lattimer present his data at a Chicago conference in spring 1993. To this date, as we shall soon see, his results remain unconfirmed. Several critics of his work have noted that he unnecessarily added a new interacting mass--the ladder upon which he placed his skulls. That the ladder definitely moves--thereby taking up energy and complicating the experiment--is obvious from his photographs (Lattimer, p. 257). Recently, based on two new sets of shooting experiments, Lattimer's apparent results with full metal jacketed bullets have been called into serious question. This work has been done independently by Doug DeSalles, M.D., a physician from Sacramento, California, and by Art Snyder, Ph.D., a physicist at the Stanford University Linear Accelerator. Like Alvarez, both experimenters used melons. In repeated attempts, their experiments showed either no jet effect at all, or, at most, only a minimal wavering in the backward direction.

Millicent Cranor points out that Alvarez also ignored a major interaction--the one that occurs at the point where the bullet breaks up on striking the posterior skull. According to the WC, this bullet fragmented into very tiny pieces (they were trying to explain the skull X-rays). This interaction, however, would have expended a great deal of the bullet's energy, thus leaving that much less available for the jet effect. Although Alvarez implies that he has taken into account all of the pertinent interactions, this one is never addressed.

To make matters noticeably worse for the jet effect, Snyder also noted that Alvarez's calculations had assumed that the bullet actually stopped within the melon--Alvarez had used the classical model of the ballistic pendulum. That was, of course, far from the case, since the bullets had actually exited at very high speeds from the opposite side of the melons. And this was especially true for those with full metal jackets. For the jet effect to be successful, a great deal of energy must be deposited within the melon--and the only source for this energy is the bullet. So when the bullet traverses the target nearly unimpeded, very little energy can be left behind, and that, in turn, greatly reduces the jet effect. This observation alone--to say nothing of the actual results of the shooting experiments--casts serious doubt on the jet effect as a relevant explanation for the head snap. It is therefore most likely that the correct explanation for the head snap must be sought elsewhere.

The other traditional explanation for the head snap has been the "neuromuscular reaction." This was first proposed to the HSCA not by any neuroscience specialist, but by a wound ballistics expert based on his viewing old films of goats being shot in the head. To date no official testimony has been obtained from appropriate specialists (the neuroscientists) on this question. At the very least, interspecies differences in neurophysiology would leave this conclusion open at least to some doubt. In addition, the usual reaction to such brain trauma is not the highly directed movement observed in the Zapruder film but rather random muscular activity. Even Alvarez concluded that the highly directional recoil seen in the Zapruder film required the application of an *external* force. Yet another objection to the decerebrate rigidity invoked by the HSCA is the time of onset; even the HSCA admitted that this would develop only after several *minutes*. I have been unable to find any literature

references that even hint that this reaction could occur within milliseconds in human subjects--as is required for the head snap as seen in the film. Furthermore, in a large collaborative study (*Cerebral Death.*, A.E. Walker, 1981, p. 33) with over 500 patients who experienced cerebral death, 70% were limp when observed just before death and an additional 10% became limp at about the time of death. At the very least, therefore, based on all of these considerations, the attempt by the HSCA to implicate a neuromuscular reaction is open to serious doubt. Moreover, the minimum requirement has never been met--the appropriate experts have never been officially consulted.

An additional argument against a neuromuscular reaction is that the observed reaction in the film is much too fast to fit with such a reflex. By the analysis of more than one study, within the space of one Zapruder frame interval (55 msec), the head clearly moves backward. Typical human reflex times are 1/4 to 1/2 second (250 to 500 msec). This is an extraordinary discrepancy--a factor of 5 to 10, which, all by itself, makes this scenario quite unlikely.

Alvarez described ejection of 10% of the melon mass. For a 5 kg head (based on my personal measurements and calculations) this corresponds to an ejection of 500 gm of brain and skull. The combined mass of the bone fragments brought to the autopsy plus the Harper bone fragment (found later) would yield about 80 gm (assuming a density of 1.65 gm/cc, a total area of 67 square cm, and a skull thickness of 3/4 cm), thus requiring an additional loss of at least 400 gm of brain tissue. The autopsied brain, however, was a remarkably large 1500 gm, which implies little or no loss of brain tissue. Unless there was a major loss of brain tissue therefore, the jet effect becomes insignificant for this particular case. Alvarez never commented on any of these issues. [The above figure of 1500 grams for the autopsied brain is disputed by many critics, including Robert B. Livingston, M.D., a greatly respected neuroscientist. (Editors note: see "Statement of 18 November 1993.") I have also performed many point by point optical density measurements of the skull X-rays. These are radically inconsistent with the 1500 gram figure. The above illustration uses this number merely because it is given in the Supplemental Autopsy Report.]

In fact, the above estimate of 400 gm is very conservative. It assumes that nearly all of the bone and brain fragments went straight forward. If, instead, these fragments had a significant component of vertical (or even backward) momentum, the required mass of ejected brain tissue would be correspondingly larger, perhaps even much larger. It is possible both to calculate and measure speeds of the ejecta from data in the Alvarez paper; the ejecta speeds are 40-50 ft/sec. The distance traveled by the bone fragments in Lattimer's experiments can be shown to be consistent with these speeds. With this information, it is then easy to calculate the ejected masses required to produce the JFK head recoil speed of 1.6 ft/sec. These masses are indeed significant. But there is simply not enough missing brain for this purpose, at least not in the official autopsy report. Alvarez's analysis could not possibly be correct unless, at the very least, the official autopsy report were wrong; but he never did address this issue.

What happens to real human heads when they are shot? In 1992, China executed six prisoners. This was videotaped and shown on *ABC Nightly News!* Michael T. Griffith has viewed this; I have condensed his report here. Each prisoner was shot in the back of the head with what appears to be an SKS or type 56 rifle. The bullet energy is similar to the Mannlicher-Carcano; it is also a full metal jacketed bullet. All men were kneeling and leaning forward at angles similar to JFK's before frame Z-313. None of the heads exploded as seen in Z-313. In all cases the heads were thrust forward and all six fell forward, away from the rifle. The chief difference from Z-313 was that the muzzle was only about one foot from the head. Nonetheless, this videotape is compelling evidence against the explanation that Alvarez has advanced.

A final explanation for the head snap was revisited by Jacob Cohen (*Commentary*, June 1992, p. 32), an arch supporter of the lone gunman theory. He posits a shove from Jackie as the primary mechanism. Even this, however, flies in the face of common sense; it would surely be odd for Jackie to force her husband's head back with such almost inhuman speed, particularly if he was already injured--which she surely suspected by then. That she might have done so at a much slower speed, however, is likely; that evidence will be discussed below. If such a backward movement of the head had been assisted by a sudden acceleration of the limousine, then the head snap might be remotely possible. However, the movement of the other limousine occupants makes that unlikely. Their motions at that moment are not consistent with a dramatic acceleration. In any case, the Itek measurements (see below) placed the final nails into this coffin.

The traditional critics' explanation--a frontal shot--was taken to task by Itek as part of its work for the HSCA. A double pendulum model was used for JFK's head and torso; his upward movement against gravity was also taken into account. This latter, in particular, demands a great deal of energy. Several of the biological values used by Itek seemed unrealistic to me, but even after I corrected for these, I still found their conclusion convincing: no reasonable bullet had enough energy to both lift JFK against gravity and to deliver the observed kinetic energy to his head and torso. Critics have had trouble accepting this conclusion, but the calculations are quite convincing. Unfortunately, they are far too long to print here.

The Itek work offered one more astonishing conclusion (Trask, p. 125)--that has been overlooked by everyone. They noted that Jackie moved forward by an amount similar to JFK at Z-312 to Z-313. Even more astonishing is that she moves backward at Z-313 to Z-314 with even greater magnitude than JFK! This is the moment of the famous head snap! Thompson (pp. 90-93) had earlier described JFK's double movement in these frames (like Raymond Marcus and Harold Weisberg before him) and had correctly noted the enormous magnitude of JFK's acceleration and deceleration in rapid succession--a magnitude of several g's. (As is discussed below, automobile decelerations rarely exceed 0.4 g.) He concluded from this that JFK was hit once in each frame, first from the rear at about Z-312 and then from the front at Z-313. But if the rapid changes in JFK must be attributed to two bullets, then the even greater changes in Jackie require an even more creative hypothesis. (Also note that Jackie's movements in the *same direction* as JFK in this brief interval make it virtually impossible for her to push him back at all--if she did this she should, of course, go in the *opposite* direction.)

In summary, the jet effect really does not apply to this case--nor does the neuromuscular reaction. And a frontal bullet cannot do what is seen in Z-313; too much energy must be expended against gravity. Furthermore, even if any of these might possibly work, an explanation for Jackie's incredible excursions would still be missing! And so, at this surprisingly remote point in history, there is still no explanation for the head snap--an extraordinary state of affairs. It is the purpose of this essay to offer an alternate hypothesis--one that explains not just the head snap but an entire menagerie of curious creatures including a bird. [Editor's note: see the "Postscript" to David Mantik, chapter 6, regarding a pteranodon].

How did JFK's head move after the head shots?

Yet another serious disagreement between the eyewitnesses and the film is the specific path that JFK's head followed in those brief moments after the head shots. This is a new issue, one that has emerged from several independent lines of evidence. As more and more data in favor of film alteration appeared from many sources, I began to realize that it was time to question some deeply rooted impressions. Repeated viewing of the film--with its vivid movements, its brief spray of blood, Jackie's reaction, Clint Hill's rescue attempt, and

the final acceleration--all these had irresistibly left a strong impression on me that I had just seen something real. But now it was time to ask a new question: *if the film had been altered, then what really had occurred and how could we know?* In particular, I wondered now, did the film initially show evidence of two successful head shots? As this new door opened for me (two head shots) a surprising sequence of hitherto vaguely puzzling observations slowly began to make sense. I began to realize that the remarkably vivid image of the single head shot had so transfixed my memory that I had forgotten--or simply overlooked--the eyewitness reports of two different head shots. Even those who disagree with the lone gunman theory often speak of "the head shot." And these individuals actually believe in two head shots--but so strong is the visible image in the film and so persistent is its visual impact that they actually hold two quite different (and inconsistent) scenarios in their heads.

There is a surprisingly wide variety of evidence that favors two successful head shots. For this scenario, the eyewitnesses merely provide the key for unlocking the door. Behind that door, however, lies a small mountain of evidence--much of it indirect, but at the same time remarkably consistent. What had happened to me, however, was the opposite--I had blundered into this room, only later to discover that the eyewitnesses held the key to the door. It was late one night that I finally began to suspect that there might be a pattern to the eyewitness accounts of the head shot sequence, if only I would look for it. And, as I began to review their statements, I was startled at the concordant pattern that emerged. I was astonished that I had not seen it before and I wondered how I had found consistency in their statements before. It seemed most unlikely that the remarkably consistent pattern that emerged would have occurred at random. Although that initial review postponed my bedtime, it was only in the next several days and weeks that I fully realized how well the eyewitness accounts made other data more comprehensible. But this new scenario was quite inconsistent with the movement of JFK's head as seen in the film.

A Reconstruction of the Head Shots

Because my current reconstruction is so different from what is seen in the film, it will be less confusing to the reader simply to summarize it now, after which the evidence for this interpretation will be presented. After an early shot hit JFK in the throat, his head (and torso) slumped forward noticeably with elbows raised, and he stayed forward briefly. While in this position, the limousine began to slow and he was struck by the first head shot (from the rear, the one discovered by the pathologists)--but no head snap followed. He fell forward more--probably into Jackie's lap, as the limousine (probably) continued to brake. Several witnesses describe his head as jerking slightly to the left with this shot; others saw his hair rising up, but there was no bloody spray. Zapruder may have seen him grasp his left chest at the moment of this head shot (7H570). A bloodless bone fragment (probably from the skull vertex) was briefly glimpsed over his right shoulder (by Jackie; also seen in the Moorman photograph), after which it fell into the limousine (where it was later found), but there was no spray of blood. After this, Jackie, now clearly aware that something was wrong, slowly raised JFK's head to an erect position so that she could look into his eyes (this is seen in the film as the head snap). During this time interval, the limousine began to accelerate; it is even possible that Jackie was assisted in raising him by this acceleration. Then, when the second head shot struck while he was sitting mostly erect (entering from the front at his hairline, superior to the lateral border of his right orbit), he went forward for a second time and fell into Jackie's lap for his final rest. This shot occurred much farther down Elm Street (probably 40 feet farther) and produced a bloody halo that was seen by many witnesses. The time interval between these two successful head shots cannot be known with certainty, but multiple lines of evidence (more than eyewitness reports, as we shall see) strongly suggest that it was greater than one second; it may well have been several seconds. By now the limousine had begun to speed up. (It is outside the scope of this essay, but the rising bullet

trail on the lateral skull X-ray is entirely consistent with a second head shot while he was erect--in fact, *only* when the head is erect can such a trail occur for a frontal bullet. Such a trail could never occur for a frontal shot with the head oriented as seen in Z-312--or in Z-313 or Z-314 either, for that matter.)

The evidence for this scenario initially derives from those eyewitnesses closest to the limousine. Included are bystanders on both sides of Elm Street, the motorcyclists, and the Secret Service (SS) agents, mainly those from the first vehicle behind the limousine (nicknamed the Queen Mary). Of about twenty close witnesses who offered an opinion, eight to ten (depending on the criteria being used) describe *another shot* after the first head shot--either by their direct or indirect statements. (The others don't deny it--they simply don't mention it.) At least eight of these describe exactly what happened to JFK with the second head shot--he fell forward! Some witnesses even recall specific events that occurred between these two head shots--thus buttressing the case for two closely spaced, but readily distinguishable, shots. And no one saw a head snap!

This data is assembled in more detail in the attached table, "RECONSTRUCTION OF THE TWO HEAD SHOTS." Milicent Cranor ("The Magic Skull," *The Fourth Decade*, July 1995, p. 32) has compiled additional quotes and citations from the eyewitnesses specifically for this essay. I am much in her debt for this rather large effort. Note that none of these witnesses describe a head snap, although all of them were looking at JFK during the critical interval. And many describe an audible shot after a visible head shot. And the one individual (Altgens) who hears a last shot coincident with a head shot is so far down the street that it cannot correspond to Z-313. Instead, his recollection fits extremely well with the first reconstructions, which are discussed below. Cranor adds at least five more witnesses who saw JFK "slump" either down or forward. Altogether, this is a long list of witnesses who describe slumping.

RECONSTRUCTION OF THE TWO HEAD SHOTS

<u>Frame</u>	<u>Comments</u>	<u>Evidence</u>
250	Kellerman leans forward, begins left turn to rear (complete at Z-270), turns forward by Z-285, speaking into car radio by Z-327.	Z-film
276-290	Shots are fired. Kellerman sees JFK "slumping" into Jackie's lap (before Z-285). Shot may have hit Connally (JBC) here (or earlier).	A,B B C
295	Limousine begins braking. Driver (Greer) still looking forward (but preparing to brake).	D Z-
Film		
302-304	Greer completes rapid right turn to rear. Greer brakes while looking back.	Z-film E
305-315	Greer looks back for entire interval. Greer continues to brake.	Z-film F
	JBC begins falling forward--at least until Z-334. Limousine slows to a stop. Motorcycles begin to overtake limousine.	G H I

300-313	First head shot (to right occiput)-- exact time can only be estimated. JFK's hair "rippled" on the right side. Skull fragment <i>without blood</i> seen by Jackie; also see Moorman photo.	J K L
306-313	No bloody halo was seen with this shot.	M
306-313	JFK grabs his left chest.	N
312-314	Much time and space are missing. JFK's neuromuscular control is gone--he "slumps" into Jackie's lap as the limousine brakes. Jackie screams just after this.	O P
313-315	The limousine goes five feet after the first head shot and stops.	Q
315-317	Greer turns forward--and begins to lift his foot from the brake. More time and space are missing.	R T
317-321	Moorman photo taken; bone fragment seen over JFK's right shoulder. Moorman hears more shots after this. Secret Service men (including John Ready) enter the street.	U V
314-321	JFK's head moves to an erect position as Jackie lifts him upward (slowly) and looks into his face. More time and space are missing. Several witnesses proceed to describe the second head shot. JFK falls forward--for the second time. No head snap is reported by anyone.	W
315-343	Clint Hill begins to run--touches limousine at Z-343. Clint Hill hears a shot <i>after</i> he touches limousine.	X Y
c. 321	Second head shot. Time and space are missing again. The limousine is actually farther down Elm St. The film's editors have moved the limousine--according to the witnesses it should be closer to Z-358. A bullet strikes the right temple/forehead-- the right occiput is blown out. No head snap is seen.	Z
c. 321	A frontal head shot can only produce the metallic X-ray trail when the head is far back, i.e., within several frames of Z-321. The film's editors have moved the limousine at this point though--according to the witnesses it was actually closer to where it is now seen at Z-358). Bloody halo (or explosion) is seen.	AA BB
321+	(Some time after first head shot.) Spectators scatter, fall to the ground, run up the knoll, and then, <i>after all this</i> , another shot is heard.	CC
321+	(Some time after the first head shot.) Chaney drives his motorcycle up to Decker-- and then more shots are heard!	DD
327-337	A new skull defect becomes apparent. JFK falls forward. According to the witnesses, this event must occur	EE FF

just after Z-358 (as seen in the current film). As before, time and space have been lost through the editing process.

343 The limousine finally accelerates.

GG

Evidence

- A. First reenactments: see below. Camera jiggles at Z-290 (Stroscio).
- B. Kellerman (SS): "I turned around to find out what happened when two additional shots rang out and the President slumped into Mrs. Kennedy's lap...I heard Mrs. Kennedy shout, "What are they doing to you?" I yelled at William Greer to "Step on it, we're hit!" and grabbed the mike from the car radio, called to SA Lawson that we were hit...." He added that he was facing forward during the "flurry" (when he was on the car radio), and that he did not look back again until Jackie was on the trunk.
- C. JBC shirt faces Zapruder, Newman, Rather. JBC's movements may have shown a shot.
- D. Alvarez speed analysis.
- E. Common sense; typical time to brake.
- F. Common sense--he is still looking back; also, brake light is on in Muchmore-film (at least for "Z-311 to Z-319").
- G. Z-film; also common sense--brake is still on! This also suggests no limousine acceleration before Z-334, which is confirmed by Clint Hill's testimony below.
- H. See above witness table regarding limousine stop--also see Moorman, Muchmore blur analysis in the discussion below.
- I. All 3 movie films: Nix, Muchmore, Zapruder.
- J. Nix film: Cranor sees a bone fragment seven frames *before* "Z-313."
Brehm: "The President was leaning forward when he stiffened perceptibly; at the same instant...a rifle shot sounded...the President seemed to stiffen and come to a pause when another shot sounded and the President appeared to be badly hit in the head...and then [he] roll[ed] over to his side...." Brehm then heard a third shot.
Cranor: JFK's head made a slight "tic" of a movement to the left.
Jean Hill: "Just as I yelled, 'Hey,' to him, he started to bring his head up...and just as he did the shot rang out...." After the second shot she saw JBC "fall to the floor."
With the third shot, "President Kennedy was hit again and...further buffeted his body and...[she noticed] his hair standing up...it just rippled up like this."
Moorman: She heard a firecracker sound almost simultaneous with her photograph; then she saw JFK "sort of jump," and slump sideways; then Mrs. Kennedy screamed.
Schwartz: JFK's head "kind of twisted" to the left.
- K. Brehm: He saw JFK's hair fly up with a head shot and then he heard a third shot.
J. Hill: "...the hair on the back of his head flew up."
Hickey: "The first shot of the second two seemed as if it missed because the hair on the right side of his head flew forward."
Kinney: The second shot hit JBC, the 3rd hit JFK; with this he saw "hair coming up." He hit the siren; Clint Hill began to run.
- L. Jackie: "I could see a piece of his skull and I remember it was flesh colored...No blood or anything." Also note bone fragment seen in Moorman photograph.
- M. Denied by Hill. Not reported by Moorman, or other nearby spectators. Although Newman did see blood, he has not described a halo. He was in the best position for a close look at the right side of JFK's head, where some blood might be expected.
- N. Zapruder: "Well, as the car came in line almost [i.e., Z-313], I heard the first shot and I saw the President lean over and grab himself like this [holding his left chest

- area]. I heard a 2nd shot [most likely this was the 2nd head shot farther down the street] and saw his head open up...."
- O. Many witnesses (or viewers of an early film version) describe "slumping." Especially note Cranor, Finck, Jackie Kennedy, Lattimer.
- P. Jean Hill, Mr. and Mrs. Bill Newman; see Mary Moorman above.
- Q. Alan Smith: "The car was ten feet from me when a bullet hit the President in the forehead...the car went about five feet and stopped."
- R. Z-film; also, it is common sense to stop braking when looking forward. Note that as the braking stopped, the limousine could still have coasted downhill slowly.
- T. Z-film; Greer's head turn is too fast. For a more realistic turn, see Kellerman's turn between Z-270 and Z-285.
- U. See background objects for the site of the photograph.
- V. Bill Newman: "A car filled with SS men was just behind the President's car, and when it was right beside us, it paused, and I saw several men with what looked like Thompson machine guns get out of the car."
 Marrison Baker: "...and that was when the SS were trying to get in the car."
 John Ready (SS): "At this time the SS car seemed to slow and I heard someone from inside this car say: 'He's shot.' I left the followup car in the direction of the President's car but was recalled by ATSIK Emory Roberts as the cars increased their speeds. I got back on the car and seated myself beside Mr. Roberts on the front seat."
- W. Z-film: Thompson (1967) graph, p. 91. Note that JFK was most posterior at Z-321.
 Schwartz: "What she kind of did was push him back upright...Kind of pushed him like she was looking at him, saying, 'What's wrong?' And then his head goes like that [probably with the second head shot--he has already described the slight leftward rotation with the first head shot that several witnesses saw]...And whew! The whole half of it come off."
 Ault: "Following the first shot...Kennedy appeared to raise up in his seat...and after the second shot the President slumped into his seat."
 Hargis: "I heard the 1st shot...the President bent over...Connally turned around...it looked like the President was bending over to hear what he had to say...[when JFK] straightened back up in the car...his head exploded."
 Hickey (SS): "He was slumped forward and to his left, and was straightening up to an almost erect sitting position....[When] he was almost sitting erect I heard two reports...[The] last shot...made him fall forward and to his left again."
 Kinney (SS): "The first shot was fired...and it appeared that he had been shot because he slumped to the left...Immediately, he sat up again.... At this time Clint Hill jumped off and ran to the President's car....At this time the second shot was fired. With this, simultaneously with the President's car, we stepped on the gas. I released the siren at that time."
 Newman: JFK "went across Jackie's lap, then he went back. He went both ways."
- X. Shaneyfelt testimony, based on Z-film.
- Y. Landis (SS): "When I heard the sound [like a high powered rifle] there was no question in my mind what it was. My first glance was at the President...I did not realize that [he] had been shot....I immediately [looked] over my right shoulder...I saw nothing....Jack Ready said, 'What was it--a firecracker?' So far two or three seconds [had elapsed]. [After checking the crowd, the limousine tires, and thinking about what to do] I glanced toward the President and he appeared to be fairly upright...leaning slightly toward Mrs. Kennedy with his head tilted slightly back. I also remember Clinton Hill attempting to climb onto the...President's car. It was at this moment that I heard a second report and it appeared that the President's head split open with a muffled exploding sound."
 Clint Hill (SS): "The sound came from my right rear and I immediately moved my head in that direction....[As I did so] I saw the President hunch forward and then

- slump to his left. I jumped from the followup car and ran.... I heard a second firecracker noise but it had a different sound--like the sound of shooting a revolver into something hard. I saw the President slump more toward his left."
- Clint Hill: "This is the first sound that I heard; yes, sir. I jumped from the car...[and] ran....Just about as I reached it there was another sound...--it seemed to have some kind of echo. I put my right foot...on the left rear step, and I had a handgrip...when the car lurched forward. I lost my footing and I had to run three or four more steps before I could get back up in the car. Between the time I originally grabbed the handhold and until I was up on the car--the second noise that I heard had removed a portion of the President's head, and he had slumped noticeably to his left."
- Z. Clint Hill: see immediately above. Also note the following exchange.
- Arlen Specter: "Now what is your best estimate on the time span between the first firecracker type noise you heard and the second shot which you have described?"
- C. Hill: "Approximately five seconds."
- Hudson: "...and so the first shot rung out and, of course, I didn't realize it was a shot...I happened to be looking at him when that bullet hit him--the second shot....it looked like it hit him ...a little bit behind the ear and a little above the ear [on the right side]...this young fellow that was standing there with me...he says, 'Lay down, mister, somebody is shooting the President.' ...he kept repeating, 'Lay down,' so he was already laying down one way on the sidewalk, so I just laid down over on the ground when that third shot rung out...."
- Hudson: "He was looking directly at JFK and saw his head slump sideways with the first shot. He heard two more shots in rapid succession. He estimated that he was thirty feet from the car when he heard the shots...." (FBI Report, File #DL-89-43).
- Hudson: "He said that the last shot hit JFK near the steps, just in front of where he was standing. He is also sure the second shot hit JFK in the head. After this second shot he was told to lay down. " (FBI Report #DL 100-10461).
- Hudson: "I don't know if you have ever laid down close to the ground, you know, when you heard the reports coming, but it's a whole lot plainer than it is when you are standing up in the air." [Hudson stood near the top of the stairs.]
- Rather: JFK "...went forward with considerable violence."
- AA. Lateral skull X-rays: the trail rises within the skull, from front to back.
- BB. Altgens: He saw the second bullet just knock JFK straight down. He saw "flesh, blood, and bones fly from the right side of JFK's head...to the left of the limousine." He was also sure that this was the last shot. "At the time JFK got the fatal blow to the back of his head, I was officially fifteen feet from the car--the distance on my camera showed that footage [he was a professional photographer for AP] --a distance for which I had already prefocused."
- Decker: "I distinctly remember hearing 2 shots. As I heard the first, I looked back over my shoulder and saw what appeared...to be a spray of water come out of the rear seat of the President's car."
- Hargis: "I heard the first shot and I saw the President bent over and Governor Connally turned around...When President Kennedy straightened back up in the car...his head exploded."
- Landis (SS): "I heard...the report [first audible shot]...from behind me, over my right shoulder...I heard a second report and...I saw pieces of flesh and blood flying through the air and the President slumped out of sight toward Mrs. Kennedy."
- E. Roberts (SS): [I heard the] "first of three shots fired, at which time I saw the President lean toward Mrs. Kennedy. I do not know if it was the next shot or third shot that hit the President in the head, but I saw what appeared to be a small explosion on the right side of the President's head, saw blood, at which time the President fell further to his left....About this time I saw SA C. Hill trying to get on the...car...." After SA Hill got on the rear step...it appeared that SA John Ready

- was about to follow and go for the right rear step, however, I told him not to jump, as we had picked up speed, and I was afraid he could not make it."
- Mr. Willis: He heard three separate sounds, was sure from his war experience that all three hit their target, and he also saw a red halo.
- Mrs. Willis: She saw the second shot take off JFK's head and produce a red halo.
- Zapruder: "I heard the first shot and I saw the President lean over and grab himself like this (holding his left chest area)...I heard a second shot and then I saw his head open up..."
- CC. Kivett (SS): "As the motorcade was about 1/3 of the way to the underpass...I heard a loud noise....It sounded like an extremely large firecracker. As I was looking...to my right rear I heard another report....I looked toward the Vice Presidential car, and as I did so, I could see spectators, approximately 25-50, scattering--some were falling to the ground, some were running up a small hill, and some were just standing there stunned--here I heard the third shot."
- C. Roberts: "Just seconds after that I heard...backfire....saw a man sprawled over...his daughter...I saw a policeman running across the park...pulling his pistol...I heard a second shot..."
- DD. Chaney: Like Newman, Nix, Muchmore, and other critical placed witnesses, he was not interviewed by the WC!
- Baker: He [Chaney] was on the right rear..."the chief [Curry] he didn't know anything...and he [Chaney] moved up and told him..." and that was when the SS were trying to get in the car."
- Curry: "And then about this time...Chaney rode up beside me and, looking in the mirror, I could see more commotion in the [limousine]..." and there were 2 more shots.
- Hargis: "Chaney...accelerated up to the front to tell them to get...out of the way, that he was coming through, and that is when the limousine took off."
- Campbell: "...a motorcycle...rushed up...immediately, the car rushed away."
- EE. Z-film: note how the light reflection changes over the skull vertex.
- FF. Altgens, Ault, Finck, Kinney, Landis, Rather, and many more.
- GG. C. Hill (SS): He had his hand on the handgrip, heard a shot hit, then lost his grip as the limousine accelerated. Shaneyfelt places his first touch at Z-343.
- Kellerman (SS): The car jumped out of the "goddamned road."

References for Reconstruction Table

- | | | |
|--|----------------------|-----------------------|
| Ault, C. 24H534 | Altgens, J. 6H517-8 | |
| Altgens, J.; Letter to Doug Mizzer, 21 November 1994. | | |
| Baker, M. 3H266 | Brehm, C. 22H837 | Campbell, O. 22H485 |
| Curry, J. 4H173, 315 | Decker, W. 19H458 | Hargis, B. 6H294 |
| Hickey, G. 18H762 | Hill, C. 18H742 | Hill, C. 2H138-9, 144 |
| Hill, J. 6H214 | Hudson, E. 7H560-561 | |
| Kellerman, R. 2H74, 76, 77, 81, 85 | | |
| Kellerman, R. 18H726 | Kennedy, J. 5H180 | Kinney, S. 18H731-732 |
| Kivett, J. 18H778 | Landis, P. 8H754-755 | |
| Moorman, M. 19H487; 22H838; 24H217 | | |
| Newman, Mr. and Mrs. William; M. Conversations with Cranor (September 1993); also see Bill Sloan, <i>JFK: Breaking the Silence</i> , 1993, pp. 168-174 | | |
| Rather, D.; CBS News, 23 November 1963 | | |
| Ready, J.; Statement of 22 November 1963. Menninger, B; <i>Mortal Error</i> , 1992, p. 289 | | |
| Roberts, C.; MacNeil, R. <i>The Way We Were, 1963. The Year Kennedy was Shot</i> (1967), pp. 192, 197. | | |
| Schwartz, E.; Twyman, N. <i>Bloody Treason</i> (pending); interview of 21 November 1964. | | |
| Shaneyfelt, L. 15H699 | | |

Smith, Alan. (*Chicago Tribune*, 11/23/63, p. 9; Newcomb and Adams 1974, p. 71)
Willis, L. 7H498 Willis, P. 7H497 Zapruder, A. 5H571

[Editor's note: the testimony of the Secret Service agents is summarized in Appendix A of *Mortal Error* (Menninger, 1992). It can also be found in 18H722-784.]

Trask (p.71) quotes a Mike Wallace interview with Clint Hill twelve years after the assassination. Hill believed that if he had been 0.5 to 1.0 seconds faster he could have taken the final bullet himself. Since Hill is seen (Shaneyfelt, 15H699) first reaching the car at Z-343, even one second earlier would have been only at Z-325, still well after the supposed single head shot at Z-313. Hill had not changed his story—it was still grossly at odds with the film.

Jean Hill has denied seeing a red halo. It is striking that the halo was also not reported by her adjacent friend, Mary Moorman. If the red halo was associated with the second head shot, but not the first one, that would explain their experiences. Both Jean and Mary were probably distracted by gunfire that seemed to them to come from directly across the street. Most likely they stopped tracking JFK at that point and therefore did not observe the halo, which was associated only with the second head shot. That such a spray should be seen only with the second shot is quite understandable. The available blood during the first shot is only the amount pumped through a lacerated blood vessel per frame exposure time. However, for the second shot, the situation would be quite different. In this case, blood could actually accumulate within the intracranial cavity for many, many exposure times; the time interval between shots was probably at least one second and may have been longer. Even in a one second interval, however, the amount of pooled blood available would have been greater by a factor of at least ten—perhaps even much greater, thus making a spray of visible blood quite likely.

James Altgens, the AP photographer, was strategically located, far down Elm Street, to see the second head shot. He had just finished another photograph (later correlated with Z-255). Since he was busy preparing for his next shot, he did not see the first head shot but saw only the second, which was much closer to him. In his letter to Doug Mizzer (21 November 1994), he writes as follows.

As for my position of being alongside the limo at the time the fatal shot was fired, I believe we are dealing in inches [meaning that was just about right]. Realizing that the limo was constantly moving, with airborne fragments coming my way, I still maintain that those fragments landed at my feet. And, the reflex of JFK's head--back then forward--as claimed in the Zapruder film, I did not see the backward movement. When first told about it I figured that it was an optical illusion....At the time JFK got the fatal blow to the back of his head, I was officially fifteen feet from the car--the scale on my camera showed that footage--a distance for which I had already prefocused.

It is noteworthy that, unlike the witnesses above, he does not hear any more shots after this head shot. That is because it was the *second* head shot. His observation of airborne debris is also consistent with other witnesses who saw this with the second head shot. Finally, his report of being 15 feet away must be taken seriously. Altgens was a professional photographer for AP (his photograph at Z-255 was one of the most widely published) and it was his business to know distances, not just in order to focus his manual lens, but also in order to set the manual flashes that he would have used in the 1950's and earlier. If he is right about being only 15 feet from JFK at the time of the second head shot--and he is certainly emphatic about this--then this shot must have occurred well after Z-313. In fact, it matches

the last shot in the first reenactments very well (see below). This is about 40 feet further down Elm Street than Z-313.

These witnesses do not all report the same specific details. They are in different locations so they hear and see different parts of the whole scene. They also pay attention to different aspects of the live scene unfolding before them. This is all quite different from the Michigan experiment, in which all viewers had the *same* perspective (they all watched the same film). Within those constraints, however, the consistency of all these witnesses with one another is really quite striking. It seems unlikely that, randomly, they would all devise such compatible stories. Most of all, though, their concordant *disagreement* with the WC is quite overwhelming--*none* of them report what the WC concluded!

Was tissue debris visible in the air after the head shots?

Several eyewitnesses reported debris in the air after the head shots. The left motorcycle officer Bobby Hargis, for example, testified: "It seemed like his head exploded, and I was splattered with blood and brain, and kind of a bloody water" (6H294). The day afterwards he reported, "I thought at first I might have been hit" (*The New York Daily News*, 24 November 1963, p.100). This has generally been assumed to mean that he thought a bullet had struck him--he knew, after all, that something had hit him.

Vince Palamara (*The Third Alternative*, 1993, handwritten appendix, p. 1) reports that the driver of the follow-up car, Samuel Kinney, said that he saw the right rear of the President's skull blown out by the fatal shot, and that the left windshield of the follow-up car and Kinney's left arm had been splattered by blood and brain matter.

SS agent Paul Landis' and James Altgens' (see above comments) both saw pieces of flesh and blood flying through the air. Mrs. Eva Grant (Jack Ruby's sister) reported that Tom Howard, Ruby's attorney, was trying to sell a photograph that showed half of JFK's skull in the air (14 H 479).

Mary Moorman's famous Polaroid photograph (Grodin 1993, p. 34 or Trask 1994, pp. 235, 247) may show a skull fragment. JFK's right shoulder, especially on the clearest available copies, is topped by an Alpine mountain. This object is never seen in the Zapruder film. Oddly enough, though, it may be described by William Manchester (*The Death of a President*, 1967, p. 160): "...and one fragment, larger than the rest, rises over Kennedy's falling shoulders and seems to hang there and then drift toward the rear." This was presumably based on Manchester's reported viewing of the film on 75 occasions (John Corry, *The Manchester Affair*, 1967, p. 45). This is also consistent with Jackie's comments, regarding a flesh colored (and bloodless) skull fragment that she saw.

Trask reports that the time interval between Z-313 and this Moorman Polaroid is about 0.2 seconds. This interval may also be estimated from elementary physics. Assuming that the vertical distance from the top of JFK's head to his right shoulder in this photograph is about eight inches (it would be more if he were erect), and that the skull fragment traveled no appreciable distance above the skull vertex, the time of flight may be calculated to be a minimum of about 0.20 seconds. It could have been longer--even a good deal longer if the fragment had first ascended. This time interval would correspond to 3.7 frames. Therefore this fragment should be seen at about Z-316, or sometime thereafter in the Zapruder film. If it is present it is not easy to see.

Charles Brehm told Mark Lane, "That which appeared to be a portion of the President's skull went flying slightly to the rear of the President's car and directly to it left. It

did fly over toward the curb to the left and to the rear." (This quote is cited by Thompson, 1967, p. 99.)

The only suggestion in the film for flying objects are the two *forward* going streaks seen in Z-313 and, to a lesser degree, in Z-314. For many reasons, however, these are inconsistent with the eyewitness reports of debris in the air. First, the speed of these streaks can be calculated to be extraordinarily high. The distance traveled by the upper streak within the exposure time of an 18.3 fps camera (1/36 sec) is about 7-8 feet. This yields a minimum speed of 135 ft/sec. It could well be higher if the flying object had started its flight anytime after the shutter opened. Elementary physics then yields a maximum ascent of 252 feet (neglecting air resistance) and a total flight time of 8 seconds. These are both quite incredible. To make matters even worse, the horizontal displacement for the lower streak would be 424 feet, well beyond any reasonable distance reported by the observers. Interestingly enough, it is also well beyond the distances of 20 to 40 feet that Lattimer reported in his own experiments (Lattimer 1980, p. 251). Furthermore, even if these streaks did represent such tissue, then by conservation of linear momentum JFK's head should go *downward* and backward, not *upward* and backward, as is seen. (See Milicent Cranor's "The Joker in the Jet Effect," *The Fourth Decade*, January 1996, p. 28.) Therefore, based on all of these arguments, whatever these two streaks represent, they cannot represent biological tissue from JFK's head. Furthermore, if there is no forward going debris, there is no jet effect.

How fast was the limousine moving?

Regarding the speed of the Presidential limousine during the assassination, SS agent Samuel Kinney observed that at the time of the first shot, the speed of the motorcade was "3 to 5 miles an hour." (HSCA Document # 180-10078-10493). For comparison, Alvarez described it as 12 mph. But Alvarez is required to assume a camera speed of 18.3 fps. This is called into question below. The reenactment time of 3.5 seconds (see *Whitewash II*, as discussed above) is also inconsistent with Alvarez's speed.

HSCA Document # 180-10099-10491 is an eight page summary report of an interview with SS agent William Greer, the driver of the limousine. He reports motorcade speeds which ranged from ten to thirty miles an hour, although when he made the turn into Elm Street from Houston his speed was slowed to about three to five miles per hour. "We were almost stopped," Greer said.

Note also the comments of Roy Truly (above): he describes the limousine as almost striking an abutment and nearly stopping as a result of this.

Did all witnesses hear the same 3 shots?

Although the WC was at great pains to limit the total number of shots to three, they spent little time trying to decide if the ear witnesses were all consistent with one another on the sequence of three shots. In fact, many witnesses who heard three shots often heard different sets of three. That has already been seen above. (This subject has been developed in greater detail by Milicent Cranor.) There are frequent reports of two closely spaced shots, often heard as the final shots. A review of Thompson's long and detailed list of witnesses (1967, pp. 254-271) is excellent for this purpose. This list shows that many, if not most, witnesses (of those who report) did not hear three equally spaced shots. Any two closely spaced shots are incompatible with a single gunman firing a Mannlicher-Carcano. Milicent Cranor has also developed the following table to illustrate how so many witnesses heard shots in very rapid succession. If *only one* of them is correct, the Warren Report is wrong.

Some Witnesses Who Heard Very Closely Spaced Shots

<u>WITNESS</u>	<u>STATEMENT</u>
C. Ault	"close enough to be from an automatic rifle" (24H534)
J. Bell	"in quick succession" (<i>NY Times</i> , 11/23/63, p. 5)
G. Bennett	"a second shot followed immediately (18H760)
L. Bowers	He rapped his knuckles on a table to demonstrate.
J. Connally	"The thought immediately passed through my mind that there were either two or three people involved...or someone was shooting with an automatic rifle...because of the rapidity of these two." (4H133-4, 138, 147; 1 HSCA 42, 52-53)
W. Greer	"simultaneously (2H118)
G. Hickey	"in such rapid succession...no time element in between" (18H762)
T. Henderson	"in rapid succession" (22H524)
C. Hill	"The second shot had "an echo...double sound." (18H742, 2H138-144)
J. Jarman	"third shot was fired right behind the second" (3H204)
(Mrs.) L. Johnson	"in rapid succession" (Robert MacNeill, <i>The Way We Were</i> , 1963. <i>The Year Kennedy was Shot</i> , 1967, p. 192)
R. Kellerman	"flurry...plane breaking the sound barrier...bang, bang" (2H76) [After turning forward at Z-285, he spoke into the car phone by at least Z-327; he heard the flurry while he was on the phone; Jim Marrs, <i>Crossfire</i> , 1989, p. 12.]
K. O'Donnell	"almost simultaneously" (7H448)
W. Taylor	"In the instant that my left foot touched the ground, I heard two more bangs." (Commission Exhibit 1024, p. 783)
C. Walther	"almost at the same time" (Commission Exhibit 2086)
L. Willis	"two real fast bullets together" (7H498)
M. Woodward	"The second two shots were immediate...as if one were the echo of the other...." (Nigel Turner, <i>The Men Who Killed Kennedy</i> , 1988)
S. Weitzman	"simultaneous" (7H106)
R. Youngblood	"in rapid succession" (MacNeill 1967, p. 193)

Did JFK raise his hand to his head just before he collapsed?

Thompson (p. 16) claims, that among Manchester's many errors, one is particularly substantial and especially difficult to understand, because Manchester claimed to have memorized every movement (*Look*, 4 April 1967). Manchester (1967, p. 158) states: "Now, in a gesture of infinite grace, he raised his right hand, as though to brush back his tousled chestnut hair. But the motion faltered. The hand fell back limply. He had been reaching for the top of his head. But it wasn't there anymore." Thompson adds, "We know from the Zapruder film that no such gesture ever occurred."

But what are we to think when Jackie says nearly the same thing? In her WC testimony she states: "I could see a piece of his skull and I remember it was flesh colored. I remember thinking he just looked as if he had a slight headache...No blood or anything. And then he sort of did this (indicating), *put his hand to his forehead* (emphasis added) and fell in my lap." (5 H 180). Is it likely that she is making this up--and that it simply happens to coincide so closely with Manchester's account of the film? (This disagreement is reminiscent of another similar one that Milicent Cranor discovered in speaking to Bill Newman. He had tried to tell Garrison that JFK fell downward and leftward as if struck by a baseball bat. But Garrison would not believe him--because it was not in the film.)

When did Zapruder begin filming?

Zapruder told *CBS News* that he began filming as soon as the limousine turned onto Elm Street from Houston Street (*CBS News*, 23 November 1963; see also Commission Document No. 7, p. 12). [Editor's note: see Mike Pincher and Roy Schaeffer for FBI interview with Zapruder.] But the film shows a long gap between the earlier motorcycles and the limousine's first appearance at Z-133. Several questions naturally arise at this point. Why would Zapruder expend valuable film footage on the motorcyclists but not take all possible footage of JFK? He had been extremely frugal in using only 17 frames to film his acquaintances at Dealey Plaza—actually less than one second at 18.3 fps! He had also made a trip home during the day to retrieve his camera for this special occasion. And he had just switched his film to the second side so that he would have the entire track available. Furthermore, he had enough space on the film to catch this event—the motorcade occupies only 6 feet 3 inches of film length, whereas a standard track has at least 25 feet. Even if he had filmed in slow motion (48 fps), he still would have used only about 16 feet (assuming the limousine speed calculated by Alvarez). So it is quite puzzling that he waited so long to begin filming. Or did he really begin filming when the limousine was at the top of Elm Street, as he said he did?

II. Disagreements between early viewers of the film (November 1963) and what is currently seen.

Erwin Schwartz was Zapruder's business partner and during that weekend he was often at Zapruder's side. He was recently interviewed by Noel Twyman and Richard Bartholomew (*Bloody Treason*). Schwartz recalls viewing the film about 15 times during that initial weekend. He saw tissue debris flying to the rear—an event not seen on the current film. He does not report a head snap, but does recall Jackie lifting JFK's head upward and backward (presumably in order to see his face better). He also describes JFK's head as twisting to the left with a head shot, something also suggested by comments of Mary Moorman and Jean Hill. Experts had also previously noted that such head rotation could occur with head shots (7 HSCA 171).

Manchester watched the film, perhaps as many as 75, or even a 100 times. He recalls seeing JFK sitting upright, waving, and then slumping. "A fine spray of blood and pieces of skull are thrown into the air in one quick upheaval." (Corry 1967, p. 45.) Also notable here is the absence of a head snap—and JFK's upright posture at the time of the (second) head shot.

Chester Breneman [Editor's note: Jack White.] wrote a three page personal letter to his nephew on 9 April 1973, describing his experiences. He, along with Robert West, had been a surveyor for the *LIFE* magazine and Secret Service reenactments of November and December 1963. For this task, he had been provided with enlargements of frames from the Zapruder film—to assist him in determining locations and distances. On page three, he states, "On three frames after a *frontal* (emphasis added) entry shot, we saw blobs leaving the *back* (emphasis added) of the President's head and disappearing on the fourth frame."

An interview with Breneman by Jim Marrs also appeared in the *Fort Worth Star-Telegram* (14 April 1978), in which he made the same point. In fact he made it even more forcefully—he described the blobs of backward flying debris as *large* (emphasis added)! What Breneman had seen led him to say, "The only thing I know for sure is that shots came from two different directions." Elementary physics also suggests that such debris should be seen on multiple frames (see below). Breneman added one other curious

comment. He reports that one of the *LIFE* investigators said that his own life (no pun intended) was not worth a plugged nickel and Breneman recalls, "Then he pulled back his shirt and showed me his bullet proof vest. I thought that was a little odd."

The experiments of Alvarez and Lattimer also support this conclusion. Debris remains visible for many frames in each of their films. So why isn't it (easily) visible for multiple frames in the Zapruder film?

Dan Rather (CBS News, 23 November 1963) offered his own description of what is currently not seen in the film: "...Governor Connally, whose coat button was open, turned in such a way to extend his right hand out towards the president....And as he turned he exposed his entire shirt front and chest because his coat was unbuttoned--at that moment a shot very clearly hit that part of the Governor."

Milicent Cranor has advised me in personal conversations and correspondence that in 1992 she saw an unusual version of the film at an NBC studio. "It showed that while the car was stopped, Kennedy was knocked flat across Jackie's lap--after which he went backward. She then adds: I recently realized that an early description of the film--by John Lattimer of all people--fits my own impression of this version. Lattimer, in describing Z-313 to Z-320, stated that "...the President's body, which had already tilted to his left, with his head hanging downward and forward, moved slightly forward at the moment of impact, but then stiffened and lurched completely over to his left, onto the rear seat of the automobile, from which Mrs. Kennedy then rose and pivoted, to allow him to lie down on the seat" (*Resident and Staff Physician*, May 1972, p. 60). He later changed his story to match the public version of the film (*Kennedy and Lincoln*, 1980, p. 248). Is it pure chance that Dr. Pierre Finck, one of the autopsy pathologists, actually agrees with Lattimer's first description? In his "Personal notes on the Assassination of President Kennedy" (1 February 1965) written to his superior, Brig. Gen. J. M. Blumberg, he states: "On 16 March 1964 I also had the opportunity to examine COLOR PRINTS, approximately 10 x 20 cm, stamped 'US Secret Service, Washington, DC' on the back and made from the only color film taken at the time of the Assassination of Kennedy....[These] clearly show how Kennedy slumped forward from a sitting position....This sequence of photographs is compatible with a bullet hitting Kennedy in the back and with another bullet hitting him in the head, both from behind." This document was released only in the past several years from the Otis Historical Archives at the National Museum of Health and Medicine, Armed Forces Institute of Pathology. His description is, of course, quite at odds with the current public version of the film, which displays a grossly obvious backward head snap--an event that neither Lattimer nor Finck (nor Cranor) saw in an apparently different version of the film. These seemingly fantastic intimations of multiple versions of the film even surfaced in *LIFE* magazine (2 October 1964). Frame Z-323 had a caption that described JFK's head "...as snapping to one side." Another version of the same date has this picture replaced by Z-313 and a caption saying that JFK's head went "forward," consistent with a shot from the rear! Paul Hoch and Vincent Salandria (Newcomb and Adams, p. 143) together discovered six different versions of *LIFE* for this same date! Cranor adds one last comment regarding her own experiences: the studio now denies that she was ever there or that they ever had such a film.

Dan Rather (*The Camera Never Blinks*, 1977, p. 127) of CBS reports that security at *LIFE* for the film was extremely poor and that any major executive could order his own version of the film. Is it possible that some of these (possibly) unaltered films have persisted through the years? Did Cranor see one of these?

III. Disagreements between the film and other photographic evidence.

In prior discussions, I have listed the Moorman photograph as possible evidence for a limousine stop, mostly because the foreground motorcycles are blurred while the limousine seems as well defined as the background. That analysis is, however, complicated by issues of proximity and perspective. I shall therefore turn instead to another film taken during the shooting on Elm Street--Marie Muchmore's 8 mm movie film. Thompson's map (p. 253) places her (witness #104) on the grass of Dealey Plaza, just in front of the wall (*Archives*, CD 735, I, p. 8). But Trask disagrees (inside front cover)--he places her on the other side of the wall, closer to Main Street! The grass in front of the wall is easily seen in the Zapruder film, but she is not there. However, her unattached shadow may be there (see discussion below)! Her location is also discussed by Milicent Cranor ("The Magic Skull," *The Fourth Decade*, July 1995, p. 36). Cranor notes one other anomalous feature: even though Muchmore was closer to the book depository than Zapruder, the spastic camera motions in Zapruder's film (that have been attributed to his reaction to Oswald's gunshots) are not seen in Muchmore's film at the supposed time of the Z-313 head shot!

Muchmore's view was across Elm Street toward Zapruder; she was noticeably farther away from the limousine than Zapruder at Z-313. Because of her distance, the resolution of her film is not as good as the Zapruder film. Her camera, however, ran at 18.5 frames per second (fps). (Trask, p. 206). This nearly one to one correspondence with the (FBI determined) Zapruder camera rate should make intercomparison of frames straightforward. Close inspection of the limousine in the Muchmore film shows that the right taillight is on (only the brake would cause this--the blinkers controlled only the front lights) for nine successive frames; these correspond to about Z-311 to Z-319 (Groden 1993, pp. 33 and 37, shows two of these frames; see also the back of the dust cover). Before and after these frames, the taillight is not visible. Therefore the brake was on for at least nine frames (about half a second), or perhaps even longer; that cannot be determined from this film. If the brakes were applied just before the head shots, then the limousine would probably have slowed. If a shot occurred around Z-276 (see first reenactments below), then the braking that begins around Z-295 (per Alvarez) may be a reaction to this shot. The time interval of about 20 frames would be long enough for a braking response to occur--even using the official camera speed of 18.3 fps.

The Muchmore film may provide better evidence of limousine slowing than the Moorman photograph: there are more images, but even more importantly, it does not suffer the drawbacks of proximity and perspective that are evident in the Moorman photograph. By examining the Muchmore frame shortly before Z-313, as printed in Groden (p. 33) the reader may draw his own conclusions. Note the reflected highlights on the rear of the near motorcycle: they are distinctly blurred. So is the image of the tire and the rear fender. For comparison, look at the limousine. On the rear tire, the whitewall trim seems quite well defined--as compared to the motorcycle tire. Also examine the limousine right rear taillight and immediately adjacent fender. Again, this seems better defined than the motorcycle fender. Also compare the clarity of the limousine hand grip (seen against the background grass) to the rim of the motorcycle windshield. All of this is consistent with a very slow limousine speed. Also note that the foreground characters are seen quite clearly, implying that the camera tracking is quite slow at this time. Even the closest female figure on the far right is not blurred due to her proximity to the camera. Since the limousine image is clearer than the motorcycle, we know that the camera is preferentially tracking the limousine. And, since the bystanders are well seen, the logical conclusion is that the limousine speed is much closer to the bystanders (zero) than to the motorcycles. I have also viewed all of the adjacent frames in the Muchmore film with a

loupe and cannot avoid the same conclusion there—the limousine is hardly moving. This deceleration appears to begin shortly after Z-300, just as Alvarez said. Simply from qualitative appearances, however, this deceleration appears to be much larger than he suggested, with a final speed much less than his 8 mph.

There are other photographic clues to the slowing of the limousine. In the Zapruder film, the two motorcycles on the left rear begin to overtake the limousine after about Z-305. That would be consistent with limousine slowing. The timing of this event is particularly compelling since the other evidence (especially the eyewitnesses) also suggests that the limousine slowed at precisely this time.

The Nix film, however, shows a near uniform speed through Dealey Plaza. Twyman has calculated this after Z-300 to be 9.2 mph. The film was shot at 18.5 fps (Trask, p. 190). It would also be most useful to measure the speed before the frame that corresponds to Z-300, so that a comparison to the Zapruder film can be made. A distinct head snap is also visible in the Nix film.

Supporters of Zapruder film authenticity have argued, quite naturally, that alterations of the Zapruder film are unlikely because appropriate alterations of both the Nix and Muchmore films would also have been required. Although, at first glance this inevitable argument from common sense seems compelling, some reasonable responses can be offered. It should first be noted that the FBI made extensive efforts to capture all possibly relevant photographic evidence. Nix turned his original film over on December 1 (Trask, p. 183). The Muchmore film was sold to UPI and was featured in *Four Days* which was published in early 1964 (Trask, p. 205). The FBI received a copy by about mid-February 1964.

After requesting and receiving a copy of his film from the FBI, "He [Nix] stated that the copy...does not appear as clear as his usual pictures." (Trask 1994, p.190). Some years later, Nix's granddaughter, Gayle Nix Jackson, said that the government kept the original film and still refuses to make it available to her. She added that her grandfather believed that the government altered the film and the copy returned to him, though she simply doesn't know the truth (Trask 1994, p. 197). In a conversation with Milicent Cranor (May 1993), she said that her grandfather believed that frames had been removed from his film. In a technical report (21 December 1995) on the Nix film at the National Archives, Charles Mayn states that their copy is not an out-of-camera film. Groden reports (1993, p. 32) that after Nix's film was returned to UPI in 1978 by the HSCA it was never located again.

These films actually may not agree with one another as well as is widely believed. Doug Mizzer (Livingstone 1995, p. 138) has pointed out an apparent discrepancy between the Zapruder and Nix films. Clint Hill testified that he grabbed Jackie and put her back into her seat (2H138-139). In the Nix film, Hill gets both feet onto the limousine and puts one hand on each of Jackie's shoulders. He even seems to be hugging her head and shoulders as he pushes her back into the seat. But the Zapruder film shows that he did not reach her until she was already back in the seat.

Although Shaneyfelt (15H699) testified that Clint Hill did not touch the limousine until Z-343, my review of individual frames of the Muchmore film shows him there by (the equivalent of) Z-332; even if that is disputed, he is certainly there well before Z-343.

In the Nix film, there is no sign of motorcycle officer Chaney passing the limousine before the final head shot. His purpose was to inform his police chief, Curry (see RECONSTRUCTION TABLE). This action is attested to by multiple police officers.

Nor are there any spectators running up the knoll before the final head shot in this film (see RECONSTRUCTION TABLE again), as several witnesses reported seeing before the final shot was heard. And Emmett Hudson recalled actually being *on the ground* during the last shot (5H560-561), but he is not in this position anywhere in the Nix film. Furthermore, he also described his young companion on the ground *before* him. That is not seen either.

I have been struck by how difficult it is to see the acceleration of the limousine after the head shots--in all three movie films. This dramatic acceleration caused Clint Hill to lose his grip after his first contact with the limousine. Its magnitude is typified by Glenn Bennett (SS) who said, "The President's car immediately kicked into high gear" (18H 722-784). This nearly uniform speed, especially for the Nix film, seemed all too apparent in the frame by frame, slow speed, and normal speed modes available on the Medio Multimedia's *JFK Assassination: a Visual Investigation* (1995). Twyman has confirmed this visual impression by measuring the limousine speed for frames on the Nix film that correspond to Z-301 to about Z-480. This graph should show a marked acceleration of the limousine at about the time that Clint Hill climbed onto the back of the limousine--i.e., at about Z-343, according to Shaneyfelt, the FBI expert on the Zapruder film. (It was Shaneyfelt who numbered all the frames (5H139).) Not only is there no marked acceleration--in fact, no acceleration at all is seen! The graph of position versus frame number is a beautiful straight line, consistent with a speed of 9.2 mph (assuming 18 fps). Twyman's analysis was done quite independently of my own qualitative impressions of the film. This result will be published in his book but has not yet been presented publicly. Short of an explanation of another crew of film editors for the Nix film, this result of a uniform speed throughout the period of marked limousine acceleration will be extraordinarily difficult to explain.

Insofar as the Muchmore film is concerned, Groden (1993, p. 37) notes that while UPI had the original film, it "...was cut or mutilated at the frame that showed the moment of the head shot." The original copy has never been located. In a technical report (21 December 1995) on the Muchmore film at the National Archives, Charles Mayn states that their copy is not an out-of-camera film. It is therefore not possible simply to say about either of these films that the original film agrees (or disagrees) with the Zapruder film. The originals are gone.

If the Zapruder film has been edited, then it should also be possible to alter both of these films. It is even likely that less effort would have been required for these two films. For that reason, it seems more pertinent to focus on specific Zapruder film issues. If the authenticity of the Zapruder film can be resolved, then the hurdles posed by these other two films should also be surmountable. It should also be recalled that we have only the FBI statement for the film speeds. (Is it possible, for example, that either the Muchmore or Nix camera was running at 48 fps or some other speed? In fact, once this question is asked, it is astonishing to recall that Nix originally told the FBI that he had filmed at 40 fps! (24H 539; CE 2109.)) In fact, if the Zapruder film can be proved to be altered (and there are specific identifiable ways in which this might be shown), then these two other films, of necessity, must also have been modified. On the other hand, if the Zapruder film survives all attacks, then the issue is moot.

Pincher and Schaeffer [**Editor's note:** see Mike Pincher and Roy Schaeffer.] have developed an ingenious observation into a compelling conclusion. By comparing the blink pattern on the front of the limousine on Main Street (as seen on the Hughes movie film) to the same pattern on the Zapruder film, a paradox ensues. Since the Hughes camera speed is known, the blinker frequency can be calculated. Then a prediction can be made for the Zapruder film between frames Z-133 and Z-238 when these blinkers are

visible: each blinker should be on for about 7 frames. In fact, between Z-133 and Z-181, the blinkers are consistently on for about 9 frames. Between Z-182 and Z-211 the blinkers are hidden behind the sign and after this an irregular (but also inexplicable) pattern is seen. If the blinker speed was truly constant, the only way for more than 7 frames to appear in sequence is for Zapruder's camera to be running faster than the purported 18.3 frames per second (fps). This is powerful and direct evidence that something is wrong with the film--in particular, the camera speed of 18.3 fps is called into serious question. The observed blinker frequency in the Zapruder film is actually more consistent with 24 fps than with 18 fps. However, that speed (24 fps) was not available on Zapruder's camera. Pincher and Schaeffer therefore propose that Zapruder's camera had actually run at 48 fps and that frames were excised so as to bring the nominal speed down to a range of 12 to 24 fps. Although, at first sight this may seem inconceivable, there is a surprising range of otherwise puzzling data that begins to make sense with this new hypothesis. I shall return to this issue later.

IV. Disagreements between the film and the first two reenactments

Independently of one another, Chuck Marler [Editor's note: see Chuck Marler.] and Darryl Weatherly (*The Investigator*, Winter 94-95, p. 6) completed a superb job of detective work on the first two reenactments. These were done on 26 November and 5 December 1963. Because of the extensive and detailed nature of their work, only a brief summary of their conclusions can appear here. The chief finding is that the second survey (conducted by the SS) showed "X" marks on Elm Street for the three shots (see photographs and diagrams in *Whitewash II*, pp. 243-248; also Livingstone, 1995, photographs 9-16)--these correspond (approximately) to frames 208, 276, and 358 (the frames had not been numbered yet). This map is accompanied by supporting data (CE 585). It is tantalizing that the first of these shots occurs within the small number of frames supposedly damaged at *LIFE* magazine (a very unusual event, according to Marler, who has worked extensively with such film); these frames were missing for several years until 1967, when they were printed in *Six Seconds in Dallas*. The other odd feature, of course, is that the limousine and its occupants are almost completely hidden behind the freeway sign at this point! One naturally wonders how a successful shot could have been identified at that point, but that is where these early reenactments consistently place it.

To further compound the mystery of these (supposedly) accidentally damaged frames, it should be duly noted that one of the reenactment frames (from 24 May 1964) was a missing frame, Z-210! Although this frame was not published with the other frames in volume 18 of the Hearings, it was printed (intact) in CE 893 along with the corresponding photograph of the reenactment! The intersprocket image does appear to be absent, however, just as it was later when printed in *Six Seconds in Dallas* (1967).

Some investigators have proposed that the Stemmons sign was deliberately elevated by the editors in order to hide JFK when he was struck by the bullet at this time. (A related issue, that the sign was moved very soon after the assassination, was raised on 16 December 1963 by WC member John J. McCloy (Newcomb and Adams 1974, p. 131): "You see this sign here (pointing to a Z-frame); someone suggested that this sign has now been removed.") At first such an editing change seemed likely to me, but as I analyzed all the pertinent photographs, I became convinced that the superior and far edge of the sign had not been altered. The left portion of the sign was stretched out, however, as the magnification studies showed. This latter conclusion also derived support, in my view, by careful comparison of the relative position of the left post to the reflected highlights on the small tree above and just to the right of the post. The horizontal separation between these two objects actually increases over successive frames; this also

not so.

This not
orig in ef

Silly!

was evidence for a composite image. Nonetheless, it seemed most unlikely to me that the sign was elevated in order to obscure JFK. But that still left a problem: why did the reenactments place a shot where JFK was invisible?

The enigma of how the first reenactments could have identified a shot while JFK was hidden behind the sign was addressed by Livingstone (1995, p. 61-63). Weatherly had discovered an astonishing document (CD 298, p. 11) that described the location of Nix in a wholly impossible manner. In this document, he is placed precisely--with distances specified--where the well known "Babushka Lady" was standing, on the grass on the far side of the limousine! Nix, of course, was actually located near the corner of Houston and Elm, nearly a block away! The images on this film are even summarized:

Nix...⁷photographed the motorcade as it approached the triple underpass. Nix photographed the left side of the Presidential car with Mrs. Kennedy in the foreground waving when the President's head suddenly snaps to the left and the car picks up speed as a man jumps on the left handhold. The Nix film runs about 8 seconds.

Livingstone adds that this is clearly not the Nix film--that film is only about 6.5 seconds long (Trask 1994, p.185). The extant Nix film does show a backward head snap, but this film describes only a sharp leftward movement, consistent with the second head shot as I have described it above. As further confirmation that this leftward movement coincides with the second head shot, note that Clint Hill climbs onto the limousine--and the limousine accelerates--only well after the first head shot; therefore, what is being described can only fit with the second head shot. This supposed film of Nix, of course, is missing. That this film was of some interest to the investigation is confirmed by an interview that was actually conducted with the photographer (Commission Document No. 2, p. 31)! By now the question should be obvious: since JFK was obscured in the Zapruder film at the site of the first shot in the first reenactments (Z-208), was the film of the "Babushka Lady" used to identify this first shot?

There is a surprising amount of unexpected additional support for a final shot at about Z-358 (such a shot is, of course, no longer seen on the extant film). It should first be noted that the data table places this shot at 294 feet from the depository window, quite near the bottom of the steps below Emmett Hudson. This is well beyond the 265 feet cited in the Warren Report for the last shot (frame Z-313). A second WC exhibit (CE 875) actually displays a photograph of Elm Street in which this last shot is identified as being nearly 40 feet past frame Z-313. Finally, there is CE-2111, a SS report which describes the manhole cover as located almost opposite the limousine site at this last shot. This manhole cover is actually 70 feet beyond Z-313--hardly opposite the official last shot at Z-313. Marler also quotes the testimony of Hudson (cited above); Hudson describes the last shot as about even with the steps and he also describes his actions *between* the two head shots. The statement of James Altgens, a professional photographer (cited above) also supports this whole scenario--he was only 15 feet from JFK, with his camera pre-focused, when the final shot hit. This indubitably places the last shot far after Z-313. (Altgens can be seen in Z-349, far west of Hill and Moorman.) Marler adds the coup de grace by noting that a data table (CE-884) has actually been altered. This is known both from close inspection of the shape of the numbers (the altered digits have a different shape from other digits of the same number) and from comparison to surveyor Robert West's still existing field notes. For further details the reader is strongly encouraged to read Marler's and Weatherly's reports on these extraordinary findings.

If everything were simple and straightforward, none of the above anomalies should exist. Not only do they exist, but all of the available points of disagreement are

did not
negotiate
with at
Navy.

consistent with one another--a ^{nonsense!} truly astonishing state of affairs. But there is even more. Michael Stroschio, a physicist associated with Duke University, has recently published a short article ("More Physical Insight into the Assassination of President Kennedy," *Physics and Society*, October 1996, p. 7) in which he identifies more camera jiggles than the three conceded by Alvarez. (Editor's note: See enclosure by Stroschio.) One of these occurs shortly after Z-285 and it is not a small one. Alvarez was aware of this but chose to ignore it based on his speculation that a siren had gone off just before this. (There was--and still is--no evidence for a siren at this time. Regarding the siren, see above comments by Kinney.) The concordance between the large jiggle seen just before Z-290 and the first reenactment is truly intriguing. In case there is any concern about the apparently imperfect match between Z-290 and the second shot in the first reenactments (at Z-276), several items should be kept in mind: (1) there is a time delay for impulses to show up on the jiggle analysis, (2) at the first reenactment, the frames had not yet been numbered--only the approximate site on the street was identified, and (3) if film editing has occurred, then the frames with the jiggles could have been moved by a modest distance, consistent with the natural resolution within the frames. This site on the street could have been misidentified (or even deliberately moved) by virtue of the natural uncertainty of position within the frames. (See comments below from Salamanowicz for the HSCA on this issue.)

To close this section, it might be asked what the shot at Z-276 (or thereabouts) represented--surprisingly enough, the reenactments do not clarify this! Initially, I had thought that it was the first head shot, but that does not fit. The strongest argument against this is the Moorman photograph. The background images in this photograph clearly place this photograph after Z-313. Furthermore, a skull fragment is seen over JFK's right shoulder and the limousine is seen on Elm Street downhill of Z-313. If the shot at Z-276 had been the first head shot, then elementary physics tells us that this skull fragment must have sailed over 150 feet vertically before coming down to its position on the Moorman photograph! If, however, its maximum elevation had been only three feet (it could have been less, of course), then it should have been airborne for only about 8 frames (less than half a second) and it should appear about where it does in the Moorman photograph--assuming a first head shot at Z-313. I had to conclude, therefore, that the shot at Z-276 was not a head shot. Nonetheless, something about it had been obvious--or it would not have been identified as it was. It seems most likely that it was the shot that hit Connally. This moment may have been identified in one of the original films by his movements or perhaps by the appearance of blood on his shirt.

V. Internal inconsistencies in the film.

Many of these issues are summarized by Jack White [Editor's note: see Jack White.] and also by Pincher and Schaeffer [Editor's note: see Pincher and Schaeffer.] These items include the white object at JFK's right temple, the spray of blood, Greer's head turn, Connally's invisible left turn, apparently superhuman movements by multiple individuals, as well as other items. Not all of these items are discussed here.

The rapid head turns of the limousine driver, William Greer, between about Z-302 and Z-304 and again at Z-315 to Z-317 seem impossibly fast to many observers. I have looked at these frames many times myself, in the slides at the Archives, on high quality copies made from the Lifton movie version and on 8 mm film rented from the Zapruder attorney. These all appear the same to me and the angular displacement per frame interval does seem unnaturally large, just as reported independently by each of Twyman, Schaeffer, and Marler. I found this rapid turn especially convincing on a CD-ROM titled *JFK Assassination: A Visual Investigation* produced by Medio Multimedia (1995). In this

format, it is possible to move quickly between frames (in either direction) so that the rapid turn is readily visible. Experiments with athletic subjects by each of Twyman and Marler have been unable to reproduce this angular speed.

Immediately related to this issue is the lack of motion blurring during these rotations. Given the angular displacement and the approximate exposure time per frame of 1/36 sec (18.3 seconds divided by 2), blurring must be seen--that is simply unavoidable. Experiments by Twyman and Marler confirm this; Twyman even saw large blurs at 60 fps, for a fit athlete attempting his fastest turn. Rapid movements are seen at other sites such as the movement of Jackie's right arm between Z-327 and Z-328; there is a significant displacement, which seems both too large for the short time interval, as well as too large not to show a blur. Such considerations again raise the question: were frames excised at fairly regular intervals--thus speeding up the action?

That the spray of blood at Z-313 is clearly visible for only one frame initially struck me as incomprehensible, particularly in view of Alvarez's experiments with melons. It also seemed unlikely to me that so many eyewitnesses would distinctly recall such an event if the spray really had lasted for only 1/18 of a second. This was the first objective item to cause me to consider film alteration seriously. These melon frames are printed in the Alvarez article. Melon debris is readily visible in the air, even in these poor quality prints, for at least 5 to 6 frames. Although the camera speed here was faster (24 fps), this is still an enormous discrepancy *visa vis* the Zapruder film. Even simple physics calculations show that an object starting from rest at 52.8 inches elevation (see Marler for the position of JFK's head above Elm Street) will take 0.52 seconds to reach the pavement. That would correspond to 9 or 10 frames in the Zapruder film. Similar results are seen in Lattimer's experiments with human skulls. No experiment has shown near total disappearance of such a spray within one frame, or even in two or three frames.

Schaeffer has noted a remarkably symmetric plus sign in the center at Elm Street at Z-028. This does not exist at the same site in the frames before or after this. Nor have other such symbols been seen in the film, except for one I describe below at Z-308. It is possible, however, that more of these will be discovered when a thorough search is made, especially since my own discovery was accidental. Schaeffer conjectures that this may have been used as a register mark for aligning the film during copying. (I also saw this plus sign in the best SS copy at the Archives--see below.)

The Soaring Bird

Twyman has recently identified a new and extraordinary feature within the intersprocket area. It is seen in both the WC prints and in the Archives slides. This feature is particularly obvious in some frames, e.g., Z-226. (It even appears on the front cover of *LIFE* for 25 November 1966!) For convenience in locating it, however, refer to Z-241. First identify the helmet of the far motorcycle man. Then draw an imaginary line straight up to the bottom of the sprocket hole. At almost the bisector of this line is a small dark spot, slightly smaller than the holes in the retaining wall. Running through this dark spot is a line from 8 o'clock to 2 o'clock; the entire image looks vaguely like a soaring bird at an angle, as it catches an updraft. In Z-226 this dark spot is surrounded by a bright halo. And above the halo (just barely discontinuous from it) is a imperfectly rectangular white area that covers the top of the wall and extends slightly over it. This "Soaring Bird" image repeats very frequently (but not always) throughout the WC images and the Archives' 35 mm slides. It is absent in Z-225 and Z-224, then returns in Z-215 to Z-223. It is present in many (but not all) frames before Z-200, often surrounded by a white halo. The halo seems inconstant in shape, sometimes looking more like a square than a circle.

The dark spot always seems positioned at the same point with respect to the sprocket hole, as if it had been placed there on purpose. The Soaring Bird recurs through multiple frames after Z-241, including many frames in the Z-300s and Z-400s. It is also seen during the head shot sequence. The questions raised by this apparition are, to say the least, consequential. Why does this specter (pun intended) occur only intermittently? Why does it occur at the same place below the sprocket hole? Why does the halo change shape? Is a similar image seen in the "home movie" portion? Is it seen in the first 17 frames of the motorcade track? Was this bird's head used as a register mark for positioning the film? And why does the rectangular shape above the soaring bird in Z-226 (also in Z-227 and possibly in Z-225) appear so rarely? And why have all those prior Zapruder film experts not brought this to our attention? Surely, at the very least, if they noted it, they should have sought to explain it. And then there is Shaneyfelt, the FBI agent who numbered the frames and who was the FBI's primary expert on the film before the WC. With his first hand knowledge of the film, why did he not relate what he knew about this figure? Finally, anyone who believes in film authenticity will certainly want an explanation for this strange entity.

E. Martin Schotz in his "Notes on the Dynamics of Public Denial in the Assassination," (*History Will Not Absolve Us*, 1996, p. 283) points out that there is a kind of black hole at the center of our culture. If anything gets too close to the truth and is sent to an authoritative figure in the bureaucracy, a reply will rarely be received. Like an astronomical black hole, no light can escape. Since the center of this bird-like figure looks like a black hole, I am suggesting that, to reflect Schatz's observations, this object be titled "The Black Hole."

Twyman adds one more peculiarity. In the slides from the Archives (supposedly made directly from the original film), the intersprocket images suddenly vanish in Z-413 and Z-414; the intersprocket area is simply black. Why is this? Were these intersprocket images truly absent from the "original?" And, if not, why was the intersprocket image excluded from these slides? Can anyone find these intersprocket images now on any images at the Archives? Can the "original" 8 mm be checked to see if the intersprocket images are there for these frames?

In the upper one-third (approximately) of the intersprocket area, beginning at about Z-310, a superimposed image appears; this persists through Z-334, the last image printed by the WC. In several frames this is particularly well seen, Z-327 for example. There can be little doubt but that this is the front tire, strut, and fender of a motorcycle on the *right side* of the limousine. This part of a motorcycle on the left side would be blocked from Zapruder's view by the limousine. On several frames, the trunk of the limousine even seems to be visible behind the motorcycle. The reader may judge this conclusion for himself by viewing the motorcycle image as seen in the Muchmore film (see the rear dust cover of Groden's book). The images seem identical to me. This image abruptly vanishes on the first frame after those printed by the WC, as can be seen on the Archives' slides. Even on photocopies that I made from the WC Hearings, I could see this--in fact, that was when I first noticed it. It is even more obvious on the slides in the Archives and in the large, high resolution prints made by Twyman. The appearance of this image is odd since it is never seen in the central (projected) image. The second odd feature is that, uncannily, it begins just before the head shot sequence. The third odd feature is that such superimposed images do not occur elsewhere in the film--only here during the head shot sequence! The fourth odd feature--it is really quite striking--is that this superimposed image appears in the same location that the Soaring Bird and Black Hole appear above! In fact, the Black Hole is usually seen superimposed on the front of the tire, or very close to it. Bruce Jamieson (personal conversation of 26 July 1997) told me that *any* superimposed image in the intersprocket area would be most unlikely. And

he certainly could offer no explanation for the sudden appearance of an image when there had been none before.

Such a superimposed image is also missing from the first track (the "home movie" side). Why such an overlap occurs only during the head shot sequence and nowhere else--unless an artifact of alteration is accepted--is a mystery. In addition, it seems uniquely portentous that it is precisely *in this same area* that the Soaring Bird and Black Hole are visible! Was the faint image of the motorcycle wheel placed here deliberately in order to distract the viewer from its true intention of providing a useful background for inserting the Soaring Bird and Black Hole, so that registration of frames could be keyed to these images during editing?

silly!

If this hypothesis is correct--namely that the motorcycle image has been deliberately superimposed (to assist in frame registration)--then the position of this image might not be entirely consistent from frame to frame. That would be because it was merely placed to assist in registration of frames and not necessarily to appear in a true relationship with other objects in the scene, such as the limousine. So I measured the distance of the top of the fender from the bottom of the sprocket hole and then calculated the fraction of the intersprocket area that this distance occupied. I did this for all frames available to me. I used large color magnifications (about 8 x 11 inches) supplied to me by Noel Twyman. These distances were measured with an EKG caliper; with this precision tool, I have *generously* estimated the measurement error for most frames as about 1%. These results are shown in the following table.

Intersprocket Image: Distance from Motorcycle Fender to Sprocket Hole

<u>Z Frame</u>	<u>Fraction of Frame (%)</u>	<u>Z Frame</u>	<u>Fraction of Frame (%)</u>
312	13.5 ± 0.1	322	(not available)
313	13.5	323	6.3
314	15.2	324	4.4
315	17.9	325	2.2 + 0.07
316	19.8 ± 0.15	326	5.9
308 (sic)	(+)	327	5.1
318	17.6	328	5.2
319	8.95 + 0.07	329	9.1 ± 0.07
320	5.15	330	8.5
321	6.7	331	6.7

The effects of measurement error are selectively displayed above. Between Z-312 and Z-318 the limousine is quite constant with respect to the bottom of the frame. But in this interval the fender moves a huge amount with respect to the sprocket hole. This is easily visible to the eye once it is noticed. It also far outside the measurement error. Furthermore, the frame to frame changes are not monotonic (that would occur if the motorcycle were moving away from or toward the limousine): in particular, notice the position reversal within 55 milliseconds in the sequence of Z-315 through Z-318. After this, the erratic behavior only worsens. None of this would be expected for a real image as initially recorded by the camera. However, for a deliberately superimposed scene, with only slight attention paid to proper placement of the new image, such a random skipping around by the motorcycle would be expected. To make this point even more powerfully, note how precisely the limousine follows the curb from about Z-300 to the last printed frame (Z-334). During this long interval, the driver (Greer) exercises near surveyor's precision--despite gunshots *and* his turn to the rear, and also despite eyewitness testimony

that he swerved to the left and stopped! Perhaps Greer's precision received an assist from the film's editors.

sure?
One frame is shown out of sequence above: Z-308. It actually appears in the National Archives slide carousel at this point--where it has replaced Z-317. This is an old problem--first pointed out decades ago by Harold Weisberg--and still not corrected. What is curious about this frame, though, is that a plus sign similar to the one that Schaeffer first noted on Z-028 reappears! It is seen just below the sprocket hole, close to where the black hole inevitably is located (when it is present); this frame, however has no soaring bird nor a black hole. These were probably not needed here since the plus sign was available. This plus sign is visible on the 35 mm slide in the Archives and also on the large print that Twyman made. I also had the unique advantage, for all of this work, of constantly checking my observations against black and white photographic prints made directly from those printed in the WC Hearings (volume 18). These images are, of course, superior to those printed by the WC. This plus sign was also visible on Z-308 in this set. Shackelford has suggested that these plus symbols are mere random artifacts in the image and are found elsewhere in the film as well. In fact, to date I have not found any others, nor has anyone else to my knowledge. They are quite geometric, not what would be expected from random lines. And if Shackelford knows of any more, he has not publicly identified them. The appearance of the plus sign on a frame with no superimposed motorcycle image (that image seems to begin at Z-310) is also interesting. Quite possibly both register marks were not needed on the same frame.

why? By whom?
There is another bizarre event that supports this conclusion of deliberate superposition of images at this point in the film. In the frames that include the right sided motorcycle, it remains within the intersprocket area while background objects progress regularly across the field of view. The lone pedestrian in the background grass provides a guide to this progress. However, between Z-321 and Z-322 there is almost no change in the relative position of this pedestrian and the motorcycle! It is as though the motorcycle has suddenly stopped within one frame interval, and then restarted within one frame interval! This is all, of course, easily understandable if these images are merely the result of careless film editing.

The image of the right motorcycle wheel, strut, and fender implies another conclusion, one of momentous importance. Recall that this image never appears in the central portion of the frame. The arguments above (and the comments by Jamieson) make it quite certain that this apparition did not originally appear in this intersprocket area--it was added later. But if this is true, then where did the image come from? There can be only one possible answer to this question: it must have been present on the original image (in the main portion of the frame)! It has merely been edited out of the bottom of the frame--possibly in order to exclude the Newmans (and adjacent spectators) from the bottom of the image. If they had been left in and frames had been irregularly excised (e.g., during a limousine stop), then their positions with respect to the limousine would have revealed nonuniform motion of the limousine. In addition, any movement by any of them would have appeared either unnaturally accelerated or simply too erratic.

This deletion of the bottom of the frame has placed JFK, and Connally, too, at nearly the edge of the image. This has often struck viewers as odd, especially since Zapruder was quite confident that he had filmed the entire sequence. In fact, the current images show that he almost missed JFK during the head shot sequence, and Connally appears quite beheaded in some frames. This is most peculiar because Zapruder had no difficulty centering JFK in the frames before or after the head shot sequence. It cannot be argued that he was distracted by the sounds of the head shot, because they had not yet reached him--the supposed jiggles from this are seen in Z-318 and later. And if the

gunshots had caused him to lose his tracking, then such errors should be seen after the head shot. In fact, just the opposite is seen. He regains his tracking skills again--just when he should have lost them!

But this almost fatal (presumed) tracking error was so outrageous that I thought it would be interesting to see how other photographers at Dealey Plaza performed that day during the motorcade procession down Elm Street. So I combed carefully through the photographs in the books by Groden (1993) and Trask (1994). Many of these images are present. I measured the location of JFK's head with respect to the center of each frame (I recognize that it is possible that some of these may have been cropped; nonetheless, particularly flagrant tracking errors would not be correctable). Nearly everyone of these showed JFK within 10% of the frame center. Even in those rare exceptions where he was more eccentric were nowhere near as poor as Z-313. I performed the same measurements for successive Zapruder frames and graphed these; the worst frames were obviously those near the head shot sequence, as though Zapruder knew the head shots were coming and he wanted to miss them. Furthermore, these frames were grossly worse than the rest. This analysis, therefore, provides indirect support (certainly not proof) for the excision of the bottom of the head shot frames.

Weatherly's Streaking Analysis

Weatherly, in an insightful analysis (Livingstone 1995, pp. 371-381), takes Alvarez's work to its logical conclusion and raises new and curious issues related to image streaking. For example, between Z-193 and Z-194 the camera moves to the left. This is easily determined by simply looking at the right edge of the frame--the image shifts with respect to the frame edge, presumably as a result of uneven camera movement (i.e., poor tracking). As Alvarez noted, such a movement should produce streaking--of the background figures, the sign, and the closer bystanders. But none of this is seen--it is all quite paradoxical. Based on this, Weatherly proposes that this is a composite scene. This is a remarkably simple and powerful argument. It is difficult to avoid this conclusion.

Meanwhile, in Z-194 and Z-195 the motorcade occupants appear unchanged, but both the *background and foreground* are very fuzzy in Z-195--quite different from Z-194. If the limousine is being tracked similarly in these two frames, then why should the clarity of the background (and foreground) be so different between these two frames? Weatherly notes that this phenomenon occurs repeatedly throughout the film--one part of a frame changes a great deal while another part (inexplicably) stays the same. This might be expected if these frames were composites; it is extremely difficult to imagine any other explanation. Another example of contradictory information is Z-212. Here the posts on the Stemmons sign are quite blurred, but the holes in the masonry wall in the background are quite well defined. Since neither of these objects is moving (!) their visual definition should be similar--but it is not.

Between Z-198 and Z-199 the camera obviously moves to the left--note the disappearance of the tree trunk at the right edge. As a result of this, some streaking should be seen in Z-199--unless Zapruder knew how to stop moving when the shutter opened! But no streaking is seen--not even on tiny highlights (observe the background for these). Weatherly again concludes that different parts of the frame indicate two incompatible actions for the camera. In both cases, a composite scene is the simplest explanation. Weatherly adds one more significant point--no frames between Z-166 and Z-216 were published by *LIFE* in late November, so none of these composite frames had to be completed by then. Also recall that no images published by *LIFE* contained any intersprocket images until 1966!

Between Z-302 and Z-303 (during Greer's rapid head turn to the rear) the camera moves quite uniformly with the limousine--i.e., it tracks well. The evidence for this is that the bright reflection in front of the windshield appears in the same place (at the right edge of both frames). In Z-302, Jean Hill and Mary Moorman (standing) are very fuzzy, but in Z-303 they are extremely clear. Even if it is conceded that the camera tracked normally immediately before the shutter opened for Z-303, then stopped when the shutter opened, and then tracked well again when the shutter closed, there should be blurring of the motorcade, which is not seen.

Similar comments apply to Z-308 to Z-311 for Moorman and Hill. And more paradoxes occur in Z-313 to Z-315. In Z-315 (one of the most interesting of all of the frames), the background pedestrian suddenly becomes quite clear whereas in the frame before she is quite blurred. And this occurs despite (supposedly) excellent tracking--note the similarity of the image at the right edge of the frame. Also note the double image of the motorcycle windshield within the intersprocket area, even though the limousine image appears single. This is also the frame immediately before Greer's rapid head turn and the frame in which the head snap begins to accelerate. Weatherly interprets this data to mean that frames have been excised from the head shot sequence, possibly to remove evidence of a frontal head shot. Any reader with a logical bent for objective data is advised, in the strongest terms, to review Weatherly's analysis thoughtfully. It is beautifully simple and the conclusions are inescapable.

The above examples are merely several of many that occur throughout the film. The intersprocket area, especially, is home to many of these odd features, particularly image doubling--sometimes of only part of the intersprocket image. Because of the *selective* nature of these double images, vibration of the film edge during exposure cannot be accepted as an explanation.

In frames Z-316 and Z-317 Jackie has no facial features (even on the slides in the Archives), even though other objects seem well defined. Compare this to Z-312 where her facial features are well defined. In Z-327 to Z-330 a large wedge is missing from the top front of JFK's head (Jackie's upper torso and left shoulder are visible where his head should be). All of these events could easily occur in an improperly prepared composite frame.

A particularly obvious and inexplicable event occurs on frame Z-213. (Roy Schaeffer brought this to my attention.) Near the center of the right border are two shadows, apparently from two bystanders off the edge of the film. Their length, shape, and direction are all consistent with shadows of other nearby bystanders. (Curiously, one the shadows does not extend all the way to the right edge!) However, these shadows are absent in the preceding and following frames! In fact, they do not reappear again until Z-217--but here they are in a slightly more superior location (as if both bystanders had moved away from the camera). These shadows are never seen again! And the area in which such bystanders should have stood can clearly be seen in multiple subsequent frames--but no bystanders ever appear! I have noted above that Thompson shows Muchmore in approximately this area on his map. Was one shadow due to Muchmore? If so, how did she and her companion appear and disappear within one frame interval?

Alvarez noted a sudden deceleration from about 12 to 8 mph, centered at about Z-300 and extending over about 0.5 seconds (nine frames); this would begin at about Z-295, only a few frames before the head snap begins. Art Snyder (e-mail, 20 December, 1996) notes that this represents a deceleration of about 0.37 g, which is quite substantial. He adds that he would expect this to toss things about in the car and notes that most cars do

not decelerate more than 0.4 g. However, anyone can examine the frames immediately after this--no apparent effect on the occupants from such a dramatic deceleration is visible. JFK, in particular, should be observed because he no longer had voluntary muscular control and should indeed have been tossed forward by such a huge deceleration. But over many, many frames before and after this he seems quite immobile.

In reality (as opposed to the film) he should have been--and probably was--tossed forward by the deceleration--recall the many witnesses who reported that he slumped (or fell) forward. Also recall several reports of his falling *into Jackie's lap* (see Cranor, Lattimer, and Finck above). Did this occur when the limousine braked? If so, then those frames have been removed. And if the limousine stop was real, but no longer visible in the film, then JFK's slumping would also no longer be seen in the film--both events would have disappeared at once. Furthermore, if this falling into Jackie's lap had occurred, then Jackie would, quite naturally, have lifted his head in order to look into his eyes. *With frames excised, this would have looked like the head snap in the current film.* Is there some other explanation for the multitude of witnesses who describe "slumping", especially in the sequence in which it is often described?

The White Spot in the Grass

Between Z-313 and Z-336, there is a white spot in the grass beyond the limousine. At first I thought that this object had been added to the film (to give the illusion of uniform motion) because it was not visible in the *LIFE* images published on 29 November 1963, and because its behavior was so odd. I was later reminded by Jack White that Bothun photo #4 (Trask, p. 156) does show a white object in the grass--at about the right location. Nonetheless, this object, as seen in the Zapruder film still has peculiar features. I have projected slides of these frames and traced the size, shape, and location of this white object. First I centered each frame from left to right based on the left most light atop the limousine roll bar and from top to bottom by using the curb. The distance of the projector was held constant throughout. On a very long sheet of white paper I traced the white spot from frame to frame, drawing its size and shape as exactly as I could. As a control, I also traced the size and shape of the above noted light on the roll bar.

Next, I measured Zapruder's (supposed) camera tracking errors by measuring (with an EKG caliper) each successive shift of the image at the right edge of the frame. (This is the same principle that was used by Weatherly.) This provided a wealth of data, all of which should be consistent. But it turned out to be far from that. When the image at the right edge of the frame stayed constant or nearly so, it meant that Zapruder was tracking the limousine very well. Therefore, the width of the light should be at its smallest. Although there was a trend in this direction, there were several occasions in which the width was two, or even three times, larger than the smallest width. This makes no sense at all.

On the other hand, when Zapruder's tracking slowed down (the frame image is shifted to the left), then the width of the white spot should be smaller than when he is tracking well (because the camera's relative speed with respect to the white spot is lower.) The pattern seen here was even more erratic than above. The width was seemingly unrelated to Zapruder's (supposed) tracking; on many occasions it was two or more times larger than it should have been. And this was far outside the measurement error during tracing. In fact, once I noticed this, I could simply look at the image and perceive immediately--without even measuring--that it was paradoxical.

Similar paradoxes persisted when the width of the white object was compared to the width of the light. In addition, the frame to frame displacement of the white object was particularly egregious as it passed into the intersprocket area. Between Z-334 and Z-335, the displacement was 180% of normal; for Z-335 to Z-336 it was only 50% of normal. (Abnormalities in magnification within the intersprocket area are discussed below.) In view of all of this, therefore, it is most likely that composite frames are being viewed again. The white spot plays a remarkably effective role--it yields a convincing impression that the limousine is moving uniformly, during a period in which virtually all the eyewitnesses tell quite another story. And, as often seen above, the worst editing again occurs within the intersprocket area, which was probably not intended for public viewing.

The analysis above was only for the horizontal direction. But tracking can also be examined in the vertical direction. By measuring the distance from the bottom of the frame to the light on the roll bar (the far left one), Zapruder's (supposed) vertical tracking can be determined. At frame Z-332, the limousine suddenly jumps superiorly by a huge amount--meaning that the camera (supposedly) lurches downward. There is a jogger at the top of the frame with his feet widely spread. The frame jump is about the same distance as the separation between his feet (or more). Such an Olympian downward displacement of the camera cannot avoid producing a severely blurred image of everything in the frame. But nothing like that is seen. Surely this frame is displaying a physical impossibility. This event, in all probability, occurred because of defective film editing. It is also telling us that the bottom of Z-331 has been edited out and is therefore no longer seen.

Magnification Anomalies

When I measured the width of an object, or the distinct separation between two stationary objects, from frame to frame, then that interval remain constant--until that interval (or object) crossed the junction between the intersprocket image and the central image. And when that occurred, the measured distance increased progressively, getting larger as the interval progressed into the intersprocket area. An excellent example of this is the measured width between the two posts on the back side of the Stemmons Freeway sign between Z-212 and Z-218. See Figure 1. The prints in the WC volumes were used for this purpose. This measured distance increased by over 12% --for only 6 frame intervals. By contrast, between Z-191 and Z-207, before the first post enters the intersprocket area, this interval remained quite constant. I have found this effect repeated in virtually all frames (measurable objects are required, of course) between Z-212 and Z-313. I have not yet explored other parts of the film.

A simple excuse for this is inevitable--perhaps the camera lens was nonlinear for objects this far off the central axis. Even if this were true, however, it would still be odd for such discontinuous changes to occur so abruptly within the lens--as if the manufacturers had devised the lens to be adequate precisely up to the very edge of the field with no tolerance for error at all and then managed to produce a sudden change at just that point. Besides this oddity, lens aberrations do not typically occur in such a discontinuous fashion.

Unfortunately, the problem is even worse than it appears. If this were a simple matter of lens aberration, then such magnification changes should be uniform through the intersprocket area for all of the frames. But that is not the case. For example, examine what happens between frames Z-173 and Z-189, in which multiple bystanders are seen to the left of the freeway sign. For these frames, the interval measured was between the left sign post and the seventh bystander left of the sign. This particular interval was chosen

because the total length measured (on an individual frame) is very similar to the separation of the two signposts (as was used above). The magnification change over this 16 frame interval is only 1%! This poses a serious paradox: if lens aberration is the explanation, then why should it be 12% for a short interval (6 frames) but only 1% for a longer interval (16 frames)? At the very least, this is an uncommon optical phenomenon!

I close this section with two bizarre scenes. Recently, Marler rented an 8 mm copy of the Zapruder film. At Z-316 in this version of the film, a solitary pedestrian is seen in the background. Her shadow extends well into the intersprocket area--the image is clearly seen in this area. On this particular frame the shadow is grossly discontinuous! I have seen this myself. When I tried to rent this same film, however, I was advised that there were no films with intersprocket images.

Several summers ago, while visiting me in the mountains, David Lifton gave me an 8 mm film in a light blue plastic container with a red and white label. In handwritten black ink it was titled: ZAPRUDER #2 FILM (WITH) "OPTICAL EFFECTS." Lifton does not recall where he got this. After I determined that the sprocket holes would not fit into my father's old 8 mm (silent) projector (I have all of his many old films and still show them) I put it aside for several years. Then, out of curiosity one day, I began to look at it frame by frame. I was stunned! A large number of frames had either obvious double exposures or some other unnatural feature. For example, when Clint Hill tries to climb onto the back of the limousine, the curb can be seen *through* his leg! In at least Z-344 through Z-362 (the last frame I examined), there is a self-luminous (sic) appearance to Clint Hill's image just above the sprocket hole. This is grossly obvious and cannot be explained by sunlight--this area, after all, should be in total shade. It reminded me of the luminous appearance of Clint Hill in this most peculiar film from Lifton. Fielding (*The Technique of Special Effects Cinematography*, 1965/1985, p. 177), while discussing traveling mattes (see below), reports that a typical effect seen in such superposition special effects is the 'phantom' phenomenon, in which background detail can be seen *through* an actor. I have since looked at many of these frames under the microscope and have made slides of them through the microscope. The symbols for the date of manufacture of this strange film are two solid triangles--the same symbols that occur on the Zapruder film. According to information provided by Kodak, films with this symbol were manufactured in 1941, 1961, and 1981. Is it possible that this version may play a role in understanding some of the mysteries of the Zapruder film? Why should such frames exist at all? Who made them? And for what purpose? (Special effects are discussed in greater detail below.)

Personal Observations at the National Archives

In order to settle these many issues, a review of the original film at the National Archives would be ideal. I therefore requested the support of the ARRB for this purpose. Although I received a sympathetic reply from the board, further events were already in place. Within a very short time after my letter, the ARRB officially recommended (24 April 1997) that the film be made public property. Although I could still ask the Zapruder family attorney for permission for such a review, the implications against authenticity might not be cheerfully received, particularly since the purchase price could be adversely impacted. I resolved instead, for the moment, to review only the May 1964 reenactment film and, for a second time, to review the FBI and Secret Service copies of the film, all of which are held by the National Archives. I am grateful to the Archives for permission to view these items. My two visits to the Archives took place in October 1996 and in June 1997 (shortly after my letter).

In an attempt to simulate Zapruder's effort on 22 November 1963, a reenactment film was shot on 24 May 1964, through Zapruder's camera. When I looked at this film, I was immediately surprised--it contained no intersprocket images! The intersprocket area is simply black. This was fairly conclusive proof that this film was not the original, but rather a copy. Staff members assured me that this was the only copy in their possession and that they did not know where the original was, or if it existed at all. Additional evidence that this is a copy is that the emulsion side faces the viewer. Even more evidence is that images appear to be out of sequence (spliced in) yet no physical splices are visible. There are actually two successive reenactments, i.e., the vehicle is filmed twice as it travels down Elm Street. Lyndal Shaneyfelt, the FBI expert confirmed this in his testimony (5H162). A third sequence was also filmed with Zapruder's camera--at stationary points en route--and I viewed this also.

Despite the fact that this film was a copy, the image color and clarity were very good. To my amateur photographer's eye, I could not easily distinguish it from an original. (Such comparisons, of course, are best made with known originals side by side; I did not have that opportunity.) Unlike the film shot by Zapruder, there are no anomalies such as portions of frames alternately going in and out of focus, and there is minimal blurring due to camera or subject movement. Some of this may be explained by the use of a tripod--which Zapruder had not used.

For this reenactment, Shaneyfelt (5H176) stated that the time interval between the sites corresponding to Z-222 and Z-313 was 3.5 seconds--instead of the 5 seconds assumed by the WC. This latter was based solely (there is no other time clock) on an assumed camera speed of 18.3 fps: for the 91 frame intervals between Z-222 and Z-313 then, this time interval is $91 \div 18.3 \text{ fps} = 4.97$ seconds, just as Shaneyfelt said. Using Shaneyfelt's time interval, the speed of the limousine in the reenactment is $11 \text{ mph} \times (5 \div 3.5) = 15.7 \text{ mph}$!

As I was very interested in the camera speed, I counted the number of frame intervals between two fairly well defined points: the first corresponded to Z-222 (the tree in the background identifies this site with very good accuracy--certainly within one frame interval) and the second was where the limousine is exactly opposite the camera (where the roll bar is precisely vertical--this corresponds to Z-316). I counted the number of frame intervals several times and got a consistent number: reenactment frame intervals = 81 ± 2 .

For the physical interval cited by Shaneyfelt (between the sites of Z-222 and Z-313 in the "original" film) the reenactment film shows 78 frame intervals (naturally three less than the above interval). Since the time interval was stated by Shaneyfelt to be 3.5 seconds, the camera speed is simply $78 \div 3.5 = 22.3 \text{ fps}$! This is a serious discrepancy--one to which the WC remained totally oblivious. How could the camera speed have increased from 18.3 fps on 22 November 1963 to 22.3 fps on 24 May 1964? Or was Shaneyfelt grossly in error when he said that the time interval was 3.5 seconds? And, if he was, when else might he also have been grossly mistaken? Was the camera speed really 18.3 fps? For the WC to leave the only quantitative reenactment--the only one shot through the actual camera--in such a state of confusion does nothing to reassure us of their competence unless, of course, it was more than mere incompetence. We have only the FBI's word that Zapruder's camera speed was 18.3 fps. (For the Nix and Muchmore camera speeds of about 18.5 fps, there is also only the word of the FBI, nothing more; as noted above Nix himself disagreed with this speed.) If they were so undeniably incompetent during the reenactment, what assurance can there be that Zapruder's camera speed was correctly measured--or correctly reported? (It is impossible to know at what level this problem lies.) And without reliable data on the camera speed, there is no way of

knowing how fast anything in the film happens, except by indirect inference! Even the interval between shots cannot be estimated with any precision.

There is one other means of determining the limousine speed. From Cutler's widely used map of Dealey Plaza, the physical distance between Z-222 and Z-313 can be measured as about 77 feet (Robert Cutler, *The Umbrella Man*, 1975). Using the time of 5 seconds in the Zapruder film, the speed can be quickly calculated to be 15.4 ft/sec or 10.5 mph. This is consistent with the 11 mph stated above. For the reenactment, the speed would be 22 ft/sec. or 15 mph, also in good agreement with the value calculated above.

There are two FBI copies and two SS copies of the film in the Archives. One SS copy has very good color and clarity. In the second one, the color is faded (I have made this observation of an obvious difference in quality on both of my visits; it was not something I had prejudged in any way. My notes still show my sense of surprise at this obvious difference.) The two FBI copies are likewise of inferior quality, with notable loss of color. These observations by themselves bear some discussion. Recall that three copies of the film were made by Bruce Jamieson on 22 November 1963. Since they were all made at the same time on the same film stock, they should still be of similar quality, unless they have been handled or stored differently. Based on this alone, only one of the above copies would seem to qualify as a first generation copy. The ARRB has indicated (letter to Noel Twyman with a copy to me, 11 July 1997) that a third ("*LIFE* magazine") copy is in private hands, but is in degraded condition. This implies that the Archives considers the poorer quality SS version to be a first generation copy, despite its differences from the better version.

But there is more information on this point. To my great surprise, I immediately noticed that none of these four copies of the motorcade sequence contained any intersprocket images. That area was simply black. Since my long anticipated controls were now missing, I was quite disappointed. Should I have expected to see intersprocket images? In an interview with Bruce Jamieson (who was at the laboratory on 22 November 1963) by Noel Twyman (*Bloody Treason*), he said that a contact print process was used for copying the film. When I spoke to Jamieson (phone conversation, 26 July 1997) he recalled that for 16 mm film only one intersprocket image was copied. The other side was masked out--so that a sound track could be installed there. He also recalled that their contact printer was custom built and was of very high quality, perhaps even superior to Bell and Howell's version. But if Jamieson's memory is correct, and he did not seem uncertain about this, then the absence of intersprocket images in the first generation copies of the motorcade made by him should not have been a surprise to me.

LIFE magazine admitted to damaging¹³ frames Z-207 to Z-211 during its initial work (*New York Times*, 30 January 1967, p. 22). Later, however, Time-Life released these missing frames (Thompson 1967, p. 216). These replacement frames contain no intersprocket images. Had intersprocket images been present, they would have provided overwhelming evidence that these images were present on first generation copies. Their absence, however, is consistent with Jamieson's memory. (My own subsequent analysis of these frames proved interesting. Using the analysis of streaks as described above, at least some of these frames appear to be composites, thus suggesting that they also are not from the original film.)

The remainder of these copies at the Archives revealed no more surprises. I did, however, search for--and find--the purported register mark on Z-028 that was discovered by Roy Schaeffer near the center of Elm Street. I did not make a thorough search for other similar marks, as that would have been extremely time consuming and lay well beyond the scope of my goals for those visits.

According to Zapruder (SH571ff.), he had shot the first side of the film earlier and had then reversed the film in the camera so that he would be ready to shoot the second side. The first few frames on the second side were taken in Dealey Plaza, before the motorcade arrived; the remainder of this side contains the motorcade sequence. The first side (the "home movie" side), however, is present in the Archives and is full of images. To my delight, the intersprocket areas were all intact--these do include the adjacent (left) portion of the scene in the main image area. So, at last, some controls were available.

On this first track, I noted that there were two sets of edge prints (Kodak ID symbols) within the intersprocket area. One set was printed upside down and reversed, so that there could be no question about this conclusion. Furthermore, the phrase, "Processed by Kodak D Nov 63," appeared more than once across this area. So this was evidence that the first generation copies had shown an image in the home movie portion, i.e., this sequence on the first track was obviously a copy (it had two sets of edge prints) and yet it did contain intersprocket images of scenes. Therefore, the first generation copy must have included intersprocket images. Furthermore, the copy that I saw was made shortly after the original--the copying date was explicitly stated to be "Nov 63." What could still not be determined directly from this, however, was whether the first copy of the *motorcade sequence* (the opposite side of the film) had included the intersprocket area. At this point there is only Jamieson's recollection for this, plus the apparent absence of images in this area on all of the available films.

I also noticed that the quality of the intersprocket scenes (especially near the center of this small area) was similar to that of the projected (central) image. In fact, for the large majority of these frames, the color, clarity, contrast, and shading of the intersprocket image seemed indistinguishable from the adjacent central image. This seemed true over the entire 32-33 feet (including leaders and splices without images) of film, for both indoor and outdoor sequences. This similarity of image in the intersprocket area and the central image of the "home movie" portion is quite different from the motorcade in either the WC prints or in the slides housed in the National Archives--particularly after about Z-235. In both of these latter cases, the intersprocket areas are distinctly darker than the central image. (I am grateful to David Lifton for first bringing this issue to my attention.) On the other hand, I am told by someone who has seen the "original" that the intersprocket area shows *less* color intensity and seems more washed out. It was not clear to me, however, that this description was meant to apply to frames after Z-235.

I looked for anomalies in the intersprocket area (as discussed above for the motorcade sequence) of the "home movie" sequence--these also were not evident: no frame to frame alteration in resolution was seen, no missing portions of images, no blurring due to a hand held camera, no single and double images in the same area.

The Kodak edge prints within the intersprocket area, as printed in the WC Hearings, contain two solid triangles. According to Noel Twyman, who discussed this with the Zapruder attorney, this identifies the film as produced in 1961 in Toronto. All of the other symbols, both on the reenactment film and on all copies in the Archives, contain the symbol of a solid triangle and a solid circle. Again, according to information from Twyman, these films are thereby dated to 1963. I was subsequently able to confirm these years from an *Eastman Kodak Film Edge Guide*, in which the symbols repeat at 20 year intervals.

To my great surprise there were no symbols that would permit dating the "home movie" portion--none anywhere! If symbols appear on the motorcade track, why would

they be absent from the "home movie" portion? I discussed this with Jamieson. To my surprise, he reported that dating symbols should appear only on one track of a 16 mm film!

One other point can be made. In the reply I received from the ARRB, it was explicitly stated that the original copy of the first track (the "home movie" portion) has not been located, nor, apparently, is there any information about its whereabouts. This is quite significant. If such a copy were still available, it might be possible to analyze in some great detail (by chemical and physical techniques) the composition of the emulsion. This analysis could then be compared to the "original" film now in the National Archives. It seems likely now, though, that that can never happen. Not only is this original "home movie" portion missing, but there is apparently no documentation of any kind as to where it has gone. (This is reminiscent of another critical missing piece of evidence in the case--the brain of JFK.)

To summarize all of this data, the following table may be useful.

SUMMARY OF FILMS

<u>Film</u>	<u>Expected</u>	<u>Actual</u>
Re-enactment	original version	copy
SS copies A	first generation	first generation (?)
B	first generation	later generation
C	first generation	privately held
Z film, "home movie" track	original	later generation
	dark intersprocket images	normal images
	partial image overlap	no overlap
Archives slides: Z -413, Z-414	intersprocket image	none
Muchmore	original	copy
Nix	original	copy
"Nix"	somewhere	nowhere
Nix camera speed	40 fps (per Nix)	18.5 fps (per FBI)

In this table, the SS copies A, B, and C, refer to the three that were made by Jamieson on November 22. The better SS copy could be an original, if, indeed, the first generation contained no intersprocket images. (A claim that this is truly a first generation copy is, however, no stronger than the claim that the "original" is authentic; and since there is no way to distinguish a first generation from a later one, that ambiguity still persists.) The partial image overlap refers to the intersprocket area. The expected images on the first track are those that would be expected based on what is seen in the motorcade track. The

film referred to as "Nix" is the one improperly attributed to Nix (see above discussion), and which was filmed from the position of the "Babushka Lady."

Synthesis

It is time to draw all of these threads together. Although every thread of the tapestry will never be seen, a faint view of the landscape may now be possible. It has proved surprisingly difficult to rule out film alteration. In fact, there are simply too many threads out of place, too many scenes (and whole film copies) missing, and too many peculiar features. Precisely what was done to the original film--which frames were excised and which frames were retained (but altered)--may never be completely clear. What follows is a current best guess, subject to revision based on new evidence. What is proposed, however, does explain a wide array of bizarre features.

Frames were excised, particularly those that showed tissue debris going backward. Backward going debris would have been overwhelming evidence of a frontal shot (or shots) and would have posed too serious a threat to the official story of only posterior shots. But the original edge prints also presented an ominous hazard; if any of these symbols remained in the final version of the altered film, their very presence would have tipped off even a casual viewer that something was wrong--an original cannot contain two sets of edge prints (or even part of a second set). Frames showing the limousine stop were removed. Whether these latter frames were coincidentally the same as ones as for the airborne debris is impossible to say with certainty--it is conceivable that some of them were. Whether any independent reason demanded removal of frames of a stopped (or slowed) limousine is debatable. The Secret Service, of course, may have wished such action (or lack of action) removed simply because it was potentially embarrassing. And, of course, if the limousine did stop, or slow a great deal, then a block of frames could have been excised during that interval. Portions of these could then have been available for insertions into other scenes, as needed.

A large block of frames were probably excised from the top of Elm Street to the first limousine frame at Z-133. Zapruder's comments are consistent with this interpretation, as discussed above. The goal of this excision may have been to eliminate an embarrassing limousine turn (almost hitting the curb--see Roy Truly's statement above), or simply to minimize the overall task of editing the film, or both.

The original film was probably shot at 48 fps. A 25 foot track of film would contain about 2100 frames (7 frames/inch), or about 44 seconds of action at 48 fps. This would have been sufficiently long to film the entire motorcade, long enough even to encompass a limousine stop and an initial speed as low as 3 to 4 mph. Especially if Zapruder knew this about the film and the camera, he may have filmed at 48 fps, hoping later to rerun all the action in slow motion.

There are several direct arguments for 48 fps. It is also possible, now that this issue has come to the fore, that further direct arguments for 48 fps may still be discovered; this is a rather new area of exploration. The major one is the blinker light cycle time. The other significant one is the absence of significant blurring during rapid motions, such as the two Greer head turns and Jackie's hand movement. Alvarez described the hand clapping cycle of Charles Brehm in Z-278 to Z-296 as 3.7 cycles per second (about five frames per cycle). Alvarez found that he could clap comfortably at this rate, but that a rate even 30% higher (i.e., a camera speed of 24 fps) felt unnatural. He therefore concluded that the camera speed was closer to 18 fps than to 48 fps (the only other speed on the camera). If, however, the original film had been shot at 48 fps and two

of every three frames had been removed from this part of the film, then Brehm's clapping cycle would appear about as it does in the current film and the clapping analysis would be unable to detect this loss of frames.

There are also powerful indirect arguments for 48 fps—in fact, many of them. A film shot originally at 18 fps would make frame excision quite difficult (perhaps impossible)—without being overtly obvious. Such an abbreviated film, made from an 18 fps original, would yield too much jerkiness—or, if this were corrected (if possible at all) by fabrication of new frames, then an extraordinary effort would be required for many such frames. Furthermore, the 18 fps scenario would still leave unexplained the lack of blurring during rapid movements—where some blurring would be expected (the exposure time would be shorter at the faster camera speeds).

Weatherly discusses (Livingstone 1995, p. 377) the use of double images in cinematography to serve as filler frames. For this purpose, images before and after the required frame are combined in a double exposure. In a movie film, such a filler frame would restore the visual impression of a continuous image. Roy Schaeffer has noted that many of the double images seen in the Zapruder film represent about four inches of separation in real space. Since each frame represents a displacement of about one foot (at 12 mph and 18.3 fps), the four inches would correspond to one-third of a frame interval (in the WC scenario). But if the film had actually been shot at 48 fps, the displacement from frame to frame would be only about four inches. So the question becomes obvious: have these double image frames been deliberately created from original (and sequential) frames shot at 48 fps (which no longer exist)?

Recognizing that Zapruder's camera had only two speeds (18 and 48 fps), the film editors would have recognized that, after frame excision, the film would no longer be realistic at 48 fps. The only other choice (consistent with Zapruder's camera) was 18 fps. As a first step, every other frame could have been excised—at least for much of the film. That would immediately eliminate some undesirable frames and yield a 24 fps film. The work of Pincher and Schaeffer on the emergency blinker rate is compelling evidence that some portions of the film may have been left just like that. The eyewitness accounts of JFK's movements, the airborne debris, and the limousine stop would require excision of more frames. Removal of frames during a limousine deceleration has been explored in some detail by Art Snyder by use of computer modeling. His conclusion was that an original 48 fps film could be cut down to 12 fps and then filled in with extra frames to return the speed to about 18 fps. He concluded that acceptable results could be obtained in this fashion. The chief reason that this approach could work is the limited resolution within each frame—this is so limited that effects of tampering (of the type being discussed here) could be hidden within the existing uncertainty of position within each frame. The uncertainty issue has been explored previously by Paul H. Salamanowicz for the HSCA (HSCA # 180-10102-10425). He concluded that positions from frames Z-151, 173, and 193 could be determined to within 0.5 meters whereas frames Z-272, 313, and 410 were accurate to within 2.0 meters. If the limousine moved at about 1 ft/frame (12 mph, 18.3 fps), then the first inaccuracy above would correspond to about 1.5 frames, but the second to about 6 frames! So there is definite room to substitute and modify within fairly broad limits.

Two head shots have been combined into one. The witnesses saw a bloody spray and tissue debris with the second head shot (near Z-358 in the first reenactments) but apparently no halo and little debris with the first head shot. That such a halo is seen with the second shot, but not with the first one is eminently reasonable. Only after disruption of major intracranial blood vessels and passage of a brief period of time (during which blood could accumulate) would there be enough blood to see a halo.

With out this spinning? impossible!

5 FPS? practical? Ah? Down?

Another persistent puzzle that may be solved by this proposal of two quite separate (rather than two immediately successive) head shots is the intact appearance of JFK's right occiput in Z-313 and immediately afterwards. Most likely the skull was still intact at that moment. What Jackie saw flying through the air at the first head shot was probably a bloodless bone from the skull vertex (one of the bone fragments at the autopsy appeared to fit there). Only with the second head shot did the remainder of the skull explode with a halo of blood and with a blowout of the right occipital area. (The X-rays show that this occipital bone was mostly present, but hanging on a kind of vertical hinge at the side of the head. This is astonishingly consistent with Dr. Robert McClelland's observations at Parkland Hospital (6H33) that the occipital bone was fractured in its lateral half and had sprung outward.) In fact, close inspection of the top of JFK's head at frames in the mid Z-330s shows a distinct change in contour at about this time. Suddenly the light reflection at the skull vertex changes shape, thus implying that a skull defect abruptly appeared at this time. This image of a defect extends far posteriorly, possibly into the upper occipital area. (The hinged occipital bone would lie directly inferior to this level. This lower occipital area might well look intact in the film—even though the bone was fractured and somewhat displaced, but not actually missing—just as described by McClelland.) This (presumed) parietal-occipital defect is seen in multiple frames in a consistent manner. (It must be remembered that, even if this conclusion is accepted, it would not necessarily prove that the second head shot occurred precisely where the limousine now appears on Elm Street in Z-330 to Z-335. This is because the image of JFK's head could have been extracted from original frames near Z-358, where the first reenactment and so many of the witnesses place the second head shot, and then simply imported to where it now appears as a composite image. See discussion below for editing within frames.)

The head snap would then inevitably result from frame removal—the backward *invisibly* action would be accelerated, perhaps by a factor of 2 or 3, or even more. In real time, Jackie probably did (slowly) lift JFK's head so that she could look into his face—she needed to know immediately how badly he was hurt and what better to do this than to look into his eyes? The (inexplicably sudden) forward and backward movements of both JFK and Jackie are probably related to imperfect frame excision—or to poor internal frame editing.

In the film, with the possible exception of the final acceleration (even this is not certain), the limousine advances uniformly for much of this interval between the two last shots of the first reenactments. En bloc removal of frames could not be done (so as to skip entirely over one of the head shots) without causing the limousine suddenly to leap forward. It seems likely, therefore, that frames were left in so that the limousine would appear to be progressing uniformly. However, JFK's positions in the limousine would then require alteration, at least for some of these frames, in order to eliminate the impression of two clearly separate head shots.

This problem could have been solved by transparency retouching [Editor's note: see Jack White.] which was a well developed skill by this time. Jack White notes that he frequently had to rely on this process in his own work and that the results were typically undetectable. Such a process (imprecisely done) could explain the apparent absence of facial features in Jackie in one frame and the inexplicably (and temporarily) missing portion of JFK's head in several frames. An alternate possibility is the use of some portions of already excised frames—or a combination of the these two options. (Transparency retouching can also be used in conjunction with the traveling matte process, which is discussed below.)

In addition, portions of some frames may have been repeated over and over--in order to replace necessarily excised frames. This may have been done for JFK (and possibly for Jackie, too) in that long, apparently stationary, sequence preceding Z-313. Other frames where this may have occurred are those that show the bystanders to the left of the Stemmons Freeway sign, where the magnification is unusually invariable over so many frames. The peculiar *absence* of magnification changes (especially when they are so uniformly seen otherwise) for this intersprocket area has already been noted. Regarding these bystanders to the left of the sign, it is extraordinary that Weatherly, via his analysis of streaks and camera motion, *independently* concluded that these bystanders have been inserted as a composite image. With two such independent lines of evidence--both for these particular frames--a conclusion of composite frames becomes very difficult to avoid.

The intersprocket area has been the location for many of these queer features. There is a specific reason that it may have posed unique problems. The edge prints are located along the film edge in the intersprocket area. In the WC images these edge prints are *KODACHROME II 1. 1: 37 ... SAFETY FILM*. Where the three dots appear here in my description there are actually symbols on the film: a solid (white) vertical bar followed by two identical solid (white) triangles. These latter two triangles date the film to 1961.

unnecessary?

If every other frame had initially been excised (or any other regular pattern of elimination used) then this entire intersprocket pattern of edge prints would have been disrupted. Loss of a portion of any of these edge prints would have been obvious evidence of tampering--absence of known letters (or even parts of letters) would be flagrantly obvious. So a decision had to be made: either to leave the intersprocket area out entirely, or to replace it so that it looked like an original. If the first option had been chosen, it might have worked. We have so little intersprocket information today that we might not have known what to expect. When Zapruder's camera was used to shoot the May 1964 reenactment, the sudden appearance of intersprocket images would have been embarrassing--but only if the FBI had shared such information. Nonetheless, the original reenactment film is not now available--there is only a copy with no intersprocket images. It is possible, however, that copies of individual frames of the authentic original Zapruder film had been made by then. Such copies were made for the surveyors within the first week. (At a 25 February 1964, WC meeting, Herbert Orth of *LIFE* volunteered to make 35 mm slides. Whether such slides existed before that seems unlikely.) If any copies of individual frames included the intersprocket areas, the first option may have been considered too dangerous. (That the 4 x 4 transparencies were made from the original film is strongly suggested by Thompson (p. 17). He cites the testimony of FBI agent Lyndal Shaneyfelt for this likely conclusion.) In any case, there could still have been concern that any subsequent film shot through Zapruder's camera would show an intersprocket image. If so, a question of authenticity would immediately arise--or perhaps even worse, an actual proof of inauthenticity.

It is likely, therefore, that the second option, that of including standard edge prints, had to be chosen. Their first concern then should have been to remove the edge prints from the original film. If these had been left in, the new copy would contain *two sets* of edge prints--and anyone would have concluded that it was a copy. Techniques for removing and for inserting scenes had been available in cinematography for many years. In fact, when I put this question (on how to remove edge prints) to Bruce Jamieson (telephone conversation, 25 July 1997), he mentioned--without any hesitation--the traveling matte technique (Fielding 1985, p. 183).

While on a trip to visit Noel Twyman, I had previously purchased five out-of-print books on cinematography (from the period just after 1963) from Wahrenbrock's Book House in San Diego. From these, I learned that matte shots are used to prepare composite photographs by a double exposure (analogous to what I had already successfully done with X-ray images): one part of the film is blocked out for the first exposure, then the complementary part is blocked out for the second exposure. What results is a composite and complete image, with parts from both originals, side by side in the same frame. Almost any combination of originals can be done. Fielding prints a wonderful still photograph from the nineteenth century (p. 73). He adds that fine composite photographs were being obtained by the 1850s, before the Civil War! He also shows a photograph (p. 74) of a scene from *The Great Train Robbery* (1903), in which a locomotive appears through a window. Such techniques were refined enormously over the ensuing decades. A classic use of the traveling matte appeared in the movie, *Mary Poppins*, in which a similar process was used, frame by frame, to insert animated figures into live action scenes (Fielding 1985, p. 212, shows a studio photograph from this production in which a sodium vapor traveling matte process was used.) It is noteworthy that *Mary Poppins* was produced in 1964, the same year as another well known production--*The Warren Report!*

To prepare a traveling matte (Fielding 1985, p. 183) the image is projected (enlarged) onto a surface where it can be traced. Then the portion that needs to be blocked out is actually painted black. This is done frame by frame for the entire scene, and then a movie film is exposed, frame by frame, of this succession of partially blocked out frames (the matte) onto a high contrast stock film. When this matte film strip is placed directly on top of an original film (label it A) inside an optical printer (the two films actually touch each other and run through the projector together like two Siamese twins), the combined image is exposed onto new film stock (B). The new film (B) will then have a (latent) image only in a selected portion of each frame, with no image appearing in the rest of each frame. (Film B, however, is not developed at this point.)

A negative of the original matte film (the one that was made from the black painting) is next prepared--so that areas that were black before now become white and vice versa. When this (reversed) matte film is run through the optical printer on top of film B (still not developed), a latent image is now imprinted on film C for the area that was blocked off before, thus producing a composite and complete image for each frame on the final version--film C. Fielding describes the use of an out-of-focus lens to produce a soft matte junction between the two joined images. This is usually desirable for blending closely matched detail and tones--so that the junction line is undetectable. Fielding (p. 215) also describes the use of contact printing (as opposed to optical printers) for production of traveling mattes. [The reader is warned that this is a greatly simplified version of an enormously complex undertaking in an area in which I am no expert. The language used here is that of a layman. Please see appropriate references for this purpose. Another source is Leslie Wheeler, *Principles of Cinematography*, 1953/1969, especially chapter 9.]

Such a process could be used, for example, in split frame scenes in which an actor's twin image appears in a scene with him. Or it could be used for superimposing titles and credits over a scene (L. Bernard Happe, *Basic Motion Picture Technology*, 1971, p. 226).

In the Zapruder film, such a process could have been used, first to mask out the edge numbers, and then, in a second step, to copy an image (of a scene) into the masked out area. For this purpose, similar images from nearby frames (those without any overlapping edge prints) could have been superimposed to fill in the area where the

original edge prints had been removed. When developed, this new film would show edge prints only from the new film stock (all film stock has such latent edge prints, according to Jamieson). A traveling matte process could also have been used elsewhere in the Zapruder film, particularly to fill in for excised frames--or to paste in images for portions of frames. Such images could have been borrowed from excised frames that no longer appear in the film, or even borrowed from frames that do appear. It is possible that some of the double images that remain (especially in the intersprocket area) are leftovers from such composite shots for which both images were permitted to print through (the reason for permitting this to occur is not clear, unless the intersprocket image was simply deemed to be unimportant). It should be added that the optics of these printers is quite flexible. Fielding shows a photograph (p. 135) in which the bellows extension lens can be moved to and fro on geared mounts. On some printers it was even possible to view the entire width of the film (Fielding 1985, p. 134), *including the edge numbers*. This view of the edge numbers permitted selection of frames for the aperture. In my conversation with Jamieson, he stated that some printers even used a separate light source in order to reproduce the edge numbers onto the copy film; this was done so that the individual frames could easily be referenced for film production purposes. Fielding adds that such optical printers could also be used to enlarge the film size to 65 mm or to reduce it to 8 mm--the size of Zapruder's film (p. 134). Alterations on the Zapruder film were probably not done in 8 mm format. More likely, these alterations were done in a larger format and then later reduced to 8 mm. See *Bloody Treason* (Exhibit 12-5) for a schematic of possible steps in such a process.

Is there any evidence that such a process was used in the Zapruder film? To address this, let us first assume (in the current absence of any other information) that the existing edge prints and the original edge prints had the same symbol size, position on the film, and interval between occurrences. The current edge prints are black upper case letters on a white background strip (see an example in Trask, p. 65). If these symbols had been erased via a matte, then what would be left behind? What we would expect is either a uniform white strip or a uniform black strip where the symbols had previously appeared. And that is precisely what is seen in Z-194--it is particularly obvious on the black and white prints (donated to me) that were made from the WC originals. Here there is a darkened vertical strip in exactly the same area where the symbols had previously appeared. The width of this dark strip matches the original size of the letters as closely as I can measure it. To make this even more convincing, a very thin strip of the original white background appears to persist (immediately to the right of the dark strip) just where it was located in the unaltered white background. Other frames that show this effect are Z-195 through Z-200. (Of these, Z-198 is the least definite.) It is possible that additional frames also exhibit this appearance but, in the resolution available to me, these were the ones that seemed most certain. A similar effect occurs on the back of the Stemmons freeway sign at Z-218 through Z-222 (this is also entirely within the intersprocket area). Another inexplicable feature occurs in Z-213 (the first intact intersprocket area after the damaged frames) through Z-218: two broad white strips intersect just above the lower sprocket hole. This effect is precisely confined to the intersprocket area and the intersection produces a right angle (on the inside corner of the intersection) where the sign is extremely dark. All of this only raises further questions: was this device also used to erase edge prints here?

Between these two sites of the film lies the region of the damaged frames: my black and white set includes five frames without intersprocket images: Z-208, 209, 210, 211, and 212. If original edge prints had occurred in these frames, they would simply have vanished along with the damaged frames. The current edge print (*KODACHROME II 1. 1: 37 ... SAFETY FILM*) occupies 17 frames. If 2 of 3 frames had been excised at this point from the original film, then each current frame would represent 3 original

frames--i.e., a total of 15 lost intersprocket images. Besides this, however, 1-2 frames would be missing immediately before Z-208 and immediately after Z-212, thus making a total of 17-19 missing frames. It would therefore be possible, by this means, to totally eliminate an entire edge print (since it occupied only 17 frames). Is this why these frames were said to be damaged?

After about Z-222, odd lighting effects appear on the back of the Stemmons Freeway sign in some frames, but the original intent (if any) seems obscure. Then, at about Z-235, another transition occurs--the intersprocket area becomes noticeably darker than the central image (and remains like this at least through Z-412, where my review stopped; Z-413 and 414 contain only black intersprocket areas) and numerous odd features enter the intersprocket scenes. So another question arises: were the original intersprocket images excised after this point in the film, only to be replaced by nearby adjacent scenes? And, if so, why? This device would, of course, have effectively removed any original edge prints--no small accomplishment for the editors. The area removed could then be replaced with nearby (and almost indistinguishable) images that did not contain the troublesome original edge prints. This could have been done in a simple sequential manner, or, in a less obvious fashion, by alternating intersprocket images from different frames. Whether or not this hypothesis is correct will take some effort to explore--I have not yet done that. If this had been done, however, then the intersprocket images over multiple frames would be too similar (or even identical) to match reality. I note only one small example as an illustration for further study: in the four frames including Z-235 through Z-238, the two motorcycle antennae retain exactly the same distance apart for all frames (and the same position with respect to the helmets)--even though these antennae are obviously vibrating and changing position in the frames following this. Is this an example of filling in with the same image? ✓

Artifacts from film alteration may have been left behind: the shadow discontinuity at Z-316 discovered by Marler, the entire 8 mm film loaned to me by Lifton (with so many obvious composite frames), the magnification changes that commonly occur across the intersprocket interface, the double images that are sometimes seen in the intersprocket area (often only in a portion of it), the leaked image into the top third of the succeeding intersprocket image, and the fact that the image is darker in the intersprocket area (especially for frames after about Z-235) than in the central image. (Such intersprocket image darkening is not seen on the "home movie" track and is not apparent in frames before about Z-235 either.) Jamieson was unable to explain why the intersprocket image for the motorcade sequence should appear darker (or different in any way for that matter) from the "home movie" portion; he also could not explain why there was an image overlap in the intersprocket area for the motorcade sequence but not for the "home movie" portion. The plus sign on Z-028 and Z-308, the "Soaring Bird" figure on so many frames, and the irregular white rectangles on Z-226 and Z-227 would all have been invaluable aids in positioning each frame according to the desires of the editors. This is a surprisingly long list of oddities--where none at all should exist. The fact that they can all be explained by the single hypothesis of film alteration is also compelling.

In addition, of course, such editing explains virtually all of the other odd features that have been discussed in this essay. It is ironical that one author (Ernest Walter, *The Technique of the Cutting Room*, 1969, p. 127) uses the "obvious" example of a moving car as an illustration of the traveling matte technique! Frame excision and traveling mattes (for frame alteration) can explain multiple curious features: the absent limousine stop, the altered movement of JFK's head (including the contraction of two head shots into one), the loss of Connally's left turn, the disappearance of obvious blood on Connally's shirt front, the excessively rapid movement of multiple individuals, the

disappearance of tissue debris from the limousine trunk and from the air, the register mark at Z-028 and Z-308, and more.

I would like to offer one final observation. When the original film was copied, it would have been critical to overlap the real sprocket holes of the new version with the sprocket hole images from the original. For this purpose, the Black Hole (and perhaps the plus signs) would have been invaluable. So the question naturally arises: is there any leftover evidence of imperfection from this process of overlapping? Although I do not yet claim that this evidence is definitely incriminating, I do offer the following considerations. Around each current sprocket hole, on almost all frames, is a thin halo—it is like a white reflection of the actual sprocket hole. This effect occurs repeatedly, frame after frame, most often to the right of the sprocket holes. (In Trask 1994, p. 65, this phenomenon can be seen faintly to the right of the upper sprocket hole on even this degraded image.) This halo follows the contours of the current sprocket hole with great precision—it can even be seen at times to round the corner of a hole. A more distinct example of this effect is seen in the reproductions of the Nix frames (18H81-83); here the halo is much larger. In these Nix frames, the intersprocket area is black, so that we can be reasonably certain that these images derive from a later generation copy. Therefore, images of sprocket holes (from previous generations) would not be surprising—that is most likely what the halo represents in the Nix film. In the Zapruder film, however, this effect need not necessarily derive solely from images of the original film. In fact, on very close inspection, a real and continuous image of the scene seems to appear between the halo and the sprocket hole. If this is correct, any explanation that invokes a cutting artifact (during the removal of film from the sprocket holes) will not work. Such an effect, however, might derive from an intermediate film that contained a traveling matte, especially if it had been transparent (or possibly even black) near the sprocket holes. In that case, the Zapruder halo would be a faint image of one of these sprocket hole edges. (The index of refraction through the edge of the sprocket hole is slightly different from unity—i.e., the edge is often visible even on a transparent film.) What is incontestable, however, is that when *LIFE* magazine first printed intersprocket images (25 November 1966), these sprocket holes were all blocked out! So instead of being able to see the sprocket holes, every one of them was simply covered over with a black patch that was shaped a sprocket hole. And this black patch was just large enough to cover the halo effect! It might be argued in reply that this approach was quite innocent since it permitted *LIFE* to print readily visible frame numbers (white) onto this black area; a reasonable response, however, is that black frame numbers on a white background (the real color of a sprocket hole) would show up just as well—and without all the extra work; it would also be more authentic! I can add that such a halo does not occur in my father's old 8 mm films. It is not my purpose in this paragraph, however, to draw a final conclusion about these halos. It is enough for now to know that this observation can be evaluated by a simple act—simply filming through the original Zapruder camera (now under the jurisdiction of the National Archives) should tell us whether the original camera yields such images or whether they are yet another artifact of film editing.

Summary

A strong case can be made for extensive editing of the Zapruder film. In fact, the conclusion seems inescapable—the film was deliberately altered. No other explanation is in the same league, in terms of explanatory power, for the myriad of anomalous characteristics that are seen everywhere in this case. Many frames were excised, some individual frames were extensively altered, others were changed only enough to fill in for missing frames, and others were left alone. Frames that were excised were simply too embarrassing for the official story, or contained troublesome edge prints. What is perhaps

when? when - By whom?
with what knowledge - necessary

last of god

most remarkable, though, is that, even in the past several months, to say nothing of the past several years, yet more evidence has accumulated--all of it pointing toward alteration. One can only wonder what still remains to be discovered.

What can be made of the absurd paradoxes of (supposed) camera tracking errors that are totally inconsistent with what actually appears in the relevant frame? When the frame contents shift by enormous amounts, corresponding blurs *must* be seen. There is no cinematic magic that can avoid such realities. And what can be said about intersprocket magnifications that are grossly different in two frames, particularly when tracking nonsense surfaces in the *same* frame? And now, thanks to Noel Twyman, we have the image of The Soaring Bird and of The Black Hole. These could have provided precisely the kind of reference points for pin registration that would be essential for frame to frame editing. Why else are these images there? They do recur persistently throughout the film. And when they are absent, where do they go--unless someone has deliberately omitted them? And where exactly did the intersprocket image of the right motorcycle come from? And why is it never visible in the central image? Why does the intersprocket image of the motorcycle skip around? Why is the intersprocket image darker after about Z-235? Why do so many odd features occur within the intersprocket area? Why is the intersprocket image missing in frames Z-413 and 414? And so the questions come, one after another, like automatic rifle fire. How much more evidence is required before reason prevails? At the very least, this proposal of film alteration deserves extensive consideration and serious discussion--even among those who are still inclined to be doubters. For these individuals, there is now much to explain. It is time for them to put on their boots and to begin climbing this small mountain of data.

Acknowledgments

It always amazes me to consider how little I would have accomplished by working in isolation. I have tried to credit appropriate individuals in the text. I trust that those who frown where I have forgotten them will understand that no malice was intended. If Lady Fortune smiles there will be a second edition to correct the (certain) undetected errors of the first. I have tried hard to get them out, but, like pulling weeds on my father's farm as a youth, I know that their roots are deep. I alone take credit for these roots.

My deep appreciation goes to our editor, Jim Fetzer, for insisting that this work come to print, and for resolutely encouraging me to continue. Robert Livingston, M.D., has been an enormous pillar of support throughout. His passion for truth, forthrightness, courage, and basic humanity are unsurpassed. I am honored to count him a friend.

Noel Twyman, Roy Schaeffer, and Milicent Cranor have been unrelenting conversationalists--always with "good stuff." I also have the greatest admiration for the work of Chuck Marler and Darryl Weatherly, good friends all. And then there is Jack White--photo analyst, friend, but most of all, a very good man.

Special thanks must go to David Lifton, Harrison Livingstone, Philip Melanson, and Harold Weisberg for their initial skepticism of the film; their pioneering efforts inspired me to explore this trail. I hope they will not think that I have strayed too far off their maps.

Though still counted among skeptics of alteration, I must not forget Josiah Thompson or Martin Shackelford. "Tink" has offered a patient listening ear, high quality photographs, encouragement, documents, and a useful historical perspective. Martin