

took place, it is possible to know how much total time the shooter had. The third shot is the easiest to pinpoint. On the Zapruder film, the President is hit in the head at frame 313. No matter what number of shots they heard, the witnesses are almost unanimous that the head shot was the final one.<sup>4</sup> That sets the end of the time clock at frame 313.\*

Determining the time of the first shot, the start of the assassination clock, is more difficult. The Warren Commission was unsure when the first shot was fired, or if it even hit Kennedy or Connally.<sup>5</sup> Yet because the Commission thought the first shot would be the most accurate, it implicitly favored the theory that the first bullet hit Kennedy in the base of the neck.<sup>6</sup> It relied on several factors in determining the timing of that shot. When the President's car turned in front of the Depository, the shooter had to make a fast decision because soon after the turn, the car disappeared under the foliage of a large oak tree. A reconstruction showed the President was blocked from the sniper's view from frame 167 until 210, a period of 2.3 seconds, with only a small break in the foliage at 186.<sup>7</sup> On the Zapruder film, the presidential car is obscured from sight by a freeway sign from frames 200 to 224. Before the President and the Governor disappear behind that sign, neither shows any reaction to being struck by a bullet. However, when the President emerges from behind the road sign at frame 225, he appears to be reacting to a bullet, which means he was wounded somewhere behind the sign. Since the assassin did not have a clear shot until frame 210, when Kennedy emerged from under the tree cover, the Commission concluded that is the earliest he could have been shot. The latest would have been at frame 225, when he is apparently raising his right arm in response to the wound.

\*Because a Mannlicher-Carcano bullet travels at approximately 2,000 feet per second, the sniper must squeeze the trigger before frame 313 shows the President hit. The bullet flight time, measuring the distance from the Depository's sixth floor to the presidential limousine at the moment of the head shot, would have been 0.13 second, or 2.4 frames on the Zapruder film (HSCA Vol. VI, p. 27). This is essentially true of the other shots as well, but the tenth of a second is statistically insignificant and does not affect the overall calculation for Oswald's shooting.

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frames 158-160, just at the time Oswald would have had to fire to avoid losing his target under the tree.<sup>24</sup> The largest spastic movement by Zapruder came at frames 313-314, the moment of the head shot.<sup>25\*</sup>

An enhanced version of the Zapruder film, together with the ear- and eyewitness testimony, is strong evidence that Oswald fired the first shot near frame 160, shortly after the car had turned the corner onto Elm Street and before the tree blocked his view. Since the last shot to JFK's head was at frame 313, that translates to 8.0 to 8.4 seconds total shooting time (the period between frames 160-166 and 313). That is enough time for even a mediocre shooter to aim and operate the bolt twice.\*\*

After the assassination, two large bullet fragments were found on the front floorboard of the limousine, and a nearly intact bullet on the Parkland stretcher. Neutron-activation tests done on the whole bullet and the fragments show they represent only two bullets.<sup>26</sup> No part of a third bullet was ever found. So how was it possible that Lee Oswald, who put one bullet into President Kennedy's neck and another into his head, missed not only the occupants of the car with his first shot but even the car itself? What happened to that first bullet?\*\*\*

The Warren Commission did not try to resolve the issue, although it was close to unraveling the mystery when FBI firearms expert Robert Frazier was asked where the missing bullet could have gone. "I have seen bullets strike small twigs," said Frazier,

\*The other two movements are evident between frames 189-197 and between 220-228. As is discussed at pages 327-29, the jiggle between 220-228 is caused by the second shot.

\*\*The failure of the Warren Commission to examine the Zapruder film for reactions to an early shot is evident by the fact that when the Commission reprinted still frames from the film in Volume XVIII, it began with frame 171, under the assumption that nothing of interest happened earlier.

\*\*\*Upon detailed inspection after the assassination, there were no marks on the car indicating any bullet had struck it. There was, however, a crack on the inside of the windshield and a dent in the chrome stripping along the top of the windshield. Experts concluded that if either of those had been struck directly by a nondeflected stray bullet, the shell would have penetrated the glass or the chrome. Rather, they were damaged from fragments that came from the President's head wound.

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