

## Expert Testimony

### FIREARMS AND FIREARMS IDENTIFICATION

Three experts gave testimony concerning firearms and firearms identification: Robert A. Frazier and Cortlandt Cunningham of the FBI, and Joseph D. Nicol, superintendent of the Bureau of Criminal Identification and Investigation of the State of Illinois. Frazier has been in the field of firearms identification for 23 years, following a 1-year course of specialized training in the FBI Laboratory. Cunningham has been in the field for 5 years, having also completed the FBI course. Nicol has been in the firearms identification field since 1941, having begun his training in the Chicago police crime laboratory. Each has made many thousands of firearms identification examinations.<sup>1</sup> Frazier testified on the rifle, the rifle cartridge cases, and the rifle bullets; Cunningham on the revolver, the revolver cartridge cases, the revolver bullets, and the paraffin test; and Nicol on all the bullets and cartridge cases and the paraffin test.<sup>2</sup> Nicol's conclusions were identical to those of Frazier and Cunningham, except as noted.

#### General Principles

A cartridge, or round of ammunition, is composed of a primer, a cartridge case, powder, and a bullet. The primer, a metal cup containing a detonable mixture, fits into the base of the cartridge case, which is loaded with the powder. The bullet, which usually consists of lead or of a lead core encased in a higher strength metal jacket, fits into the neck of the cartridge case. To fire the bullet, the cartridge is placed in the chamber of a firearm, immediately behind the firearm's barrel. The base of the cartridge rests against a solid support called the breech face or, in the case of a bolt-operated weapon, the bolt face. When the trigger is pulled, a firing pin strikes a swift, hard blow into the primer, detonating the priming mixture. The flames from the resulting explosion ignite the powder, causing a rapid combustion whose force propels the bullet forward through the barrel.

The barrels of modern firearms are "rifled," that is, several spiral grooves are cut into the barrel from end to end. The purpose of the rifling is to set the bullet spinning around its axis, giving it a stability in flight that it would otherwise lack. The weapons of a given make and model are alike in their rifling characteristics; that is, number of grooves, number of lands (the raised portion of the barrel between the grooves) and twist of the rifling. When a bullet is fired through a barrel, it is engraved with these rifling characteristics. For example, all S. & W. .38/200 British Service Revolvers have five grooves and

five lands, which twist to the right, and bullets fired through such a revolver will have five groove and land impressions, right twist.

In addition to rifling characteristics, every weapon bears distinctive microscopic characteristics on its components, including its barrel, firing pin, and breech face. While a weapon's rifling characteristics are common to all other weapons of its make and model (and sometimes even to weapons of a different make or model), a weapon's microscopic characteristics are distinctive, and differ from those of every other weapon, regardless of make and model. Such markings are initially caused during manufacture, since the action of manufacturing tools differs microscopically from weapon to weapon, and since the tools change microscopically while being operated. As a weapon is used, further distinctive microscopic markings are introduced by the effects of wear, fouling, and cleaning. As Frazier testified:

Q. Can you explain how you are able to come to a conclusion that a cartridge case was fired in a particular weapon to the exclusion of all other weapons?

Mr. FRAZIER. Yes, sir; during the manufacture of a weapon, there are certain things done to the mechanism of it, which are by machine or by filing, by grinding, which form the parts of the weapon into their final shape. These machining and grinding and filing operations will mark the metal with very fine scratches or turning marks and grinding marks in such a way that there will be developed on the surface of the metal a characteristic pattern. This pattern, because it is made by these accidental machine-type operations, will be characteristic of that particular weapon, and will not be reproduced on separate weapons. It may be a combination of marks that—the face of the bolt may be milled, then it may be in part filed to smooth off the corners, and then, as a final operation, it may be polished, or otherwise adjusted during the hand fitting operation, so that it does have its particular pattern of microscopic marks.

The bolt face of the 139 rifle I have photographed and enlarged in this photograph [Commission Exhibit No. 558] to show the types of marks I was referring to.

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The marks produced during manufacture are the marks seen on the bolt face; filing marks, machining marks of the various types, even forging marks or casting marks if the bolt happens to be forged or cast. And then variations which occur in these marks during the life of the weapon are very important in identification, because many of the machining marks can be flattened out, can be changed, by merely a grain of sand between the face of the cartridge case and the bolt at the time a shot is fired, which will itself scratch and dent the bolt face. So the bolt face will pick up a characteristic pattern of marks which are peculiar to it.

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\* \* \* [T]he marks which are placed on any bolt face are accidental in nature. That is, they are not placed there intentionally in the first place. They are residual to some machining operation, such as a milling machine, in which each cutter of the milling tool cuts away a portion of the metal; then the next tooth comes along and cuts away a little more, and so on, until the final surface bears the combination of the various teeth of the milling cutter. In following that operation, then, the surface is additionally scratched—until you have numerous—we call them microscopic characteristics, a characteristic being a mark which is peculiar to a certain place on the bolt face, and of a certain shape, it is of a certain size, it has a certain contour, it may be just a little dimple in the metal, or a spot of rust at one time on the face of the bolt, or have occurred from some accidental means such as dropping the bolt, or repeated use having flattened or smoothed off the surface of the metal.

\* \* \* \* \*

\* \* \* [A]s the blade of a milling machine travels around a surface, it takes off actually a dust—it is not actually a piece of metal—it scrapes a little steel off in the form of a dust—or a very fine powder or chip—that tooth leaves a certain pattern of marks—that edge. That milling cutter may have a dozen of these edges on its surface, and each one takes a little more. Gradually you wear the metal down, you tear it out actually until you are at the proper depth. Those little pieces of metal, as they are traveling around, can also scratch the face of the bolt—unless they are washed away. So that you may have accidental marks from that source, just in the machining operation.

Now, there are two types of marks produced in a cutting operation. One, from the nicks along the cutting edge of the tool, which are produced by a circular operating tool—which produce very fine scratches in a circular pattern. Each time the tool goes around, it erases those marks that were there before. And when the tool is finally lifted out, you have a series of marks which go around the surface which has been machined, and you will find that that pattern of marks, as this tool goes around, will change. In one area, it will be one set of marks—and as you visually examine the surface of the metal, these very fine marks will extend for a short distance, then disappear, and a new mark of a new type will begin and extend for a short distance. The entire surface, then, will have a—be composed of a series of circles, but the individual marks seen in the microscope will not be circular, will not form complete circles around the face of the bolt.

Q. Have you had occasion to examine two consecutive bolt faces from a factory?

A. Oh, yes.

Q. And what did you find on that examination?

A. There would be no similarity in the individual microscopic characteristics between the two bolt faces.

Q. There actually was none?

A. No, there was none.<sup>3</sup>

\* \* \* \* \*

Q. How are you able to conclude that a given bullet was fired in a given weapon to the exclusion of all other weapons, Mr. Frazier?

A. That is based again upon the microscopic marks left on the fired bullets and those marks in turn are based upon the barrel from which the bullets are fired.

The marks in the barrel originate during manufacture. They originate through use of the gun, through accidental marks resulting from cleaning, excessive cleaning, of the weapon, or faulty cleaning.

They result from corrosion in the barrel due to the hot gases and possibly corrosive primer mixtures in the cartridges used, and primarily again they result from wear, that is, an eroding of the barrel through friction due to the firing of cartridges, bullets through it.

In this particular barrel the manufacturer's marks are caused by the drill which drills out the barrel, leaving certain marks from the drilling tool. Then portions of these marks are erased by a rifling tool which cuts the four spiral grooves in the barrel and, in turn, leaves marks themselves, and in connection with those marks of course, the drilling marks, being circular in shape, there is a tearing away of the surface of the metal, so that a microscopically rough surface is left.

Then removing part of those marks with a separate tool causes that barrel to assume an individual characteristic, a character all of its own.

In other words, at that time you could identify a bullet fired from that barrel as having been fired from the barrel to the exclusion of all other barrels, because there is no system whatever to the drilling of the barrel. The only system is in the rifling or in the cutting of the grooves, and in this case of rifle barrels, even the cutters wear down as the barrels are made, eventually of course having to be discarded or resharpened.

Q. Have you examined consecutively manufactured barrels to determine whether their microscopic characteristics are identical?

A. Yes, sir; I have three different sets of, you might say, paired barrels, which have been manufactured on the same machine, one after the other, under controlled conditions to make them as nearly alike as possible, and in each case fired bullets from those barrels could not be identified with each other; in fact, they looked nothing at all alike as far as individual microscopic characteristics

are concerned. Their rifling impressions of course would be identical, but the individual marks there would be entirely different.<sup>4</sup>

When a cartridge is fired, the microscopic characteristics of the weapon's barrel are engraved into the bullet (along with its rifling characteristics), and the microscopic characteristics of the firing pin and breech face are engraved into the base of the cartridge case. By virtue of these microscopic markings, an expert can frequently match a bullet or cartridge case to the weapon in which it was fired. To make such an identification, the expert compares the suspect bullet or cartridge case under a comparison microscope, side by side with a test bullet or cartridge case which has been fired in the weapon, to determine whether the pattern of the markings in the test and suspect items are sufficiently similar to show that they were fired in the same weapon. This is exemplified by Frazier's examination of Commission Exhibit No. 543, one of the cartridge cases found in the Texas School Book Depository Building after the assassination :

Q. Mr. Frazier, we were just beginning to discuss, before the recess, Commission Exhibit 559, which is a picture, as you described it, of Exhibit No. 543 and a test cartridge under a microscope \* \* \*?

Mr. FRAZIER. Yes, sir.

Q. Could you discuss, by using that picture, some of the markings which you have seen under the microscope and on the basis of which you made your identification?

A. Yes, sir. In the photograph I have drawn some small circles and numbered them, those circles, correspondingly on each side of the photograph. The purpose of the circles is not to point out all the similarities, but to call attention to some of them and to help orient in locating a mark on one with a mark on the opposite side of the photograph. In general the area shown is immediately outside of the firing pin in the bolt of the 139 rifle, on the left side of the photograph, and Commission Exhibit 543 on the right side.

The circles have been drawn around the dents or irregularly shaped ridges, small bumps, and depressions on the surface of the metal in six places on each side of the photograph. It is an examination of these marks, and all of the marks on the face of the breech, microscopically which permits a conclusion to be reached. The photograph itself actually is a substitute to show only the type of marks found rather than their nature, that is, their height, their width, or their relationship to each other, which is actually a mental, visual, comparison on the two specimens themselves.

Q. Referring for a second to this mental, visual, comparison, Mr. Frazier, would a person without firearms training—firearms-identification training—be able to look under a microscope

and make a determination for himself concerning whether a given cartridge case had been fired in a given weapon?

A. In that connection that person could look through the microscope. He may or may not see these individual characteristics which are present, because he does not know what to look for in the first place, and, secondly, they are of such a nature that you have to mentally sort them out in your mind going back and forth between one area and the other until you form a mental picture of them in a comparison such as this.

If it was a different type of comparison, of parallel marks or something of that nature, then he could see the marks, but in either instance, without having compared hundreds and hundreds of specimens, he would not be able to make any statement as to whether or not they were fired from the same rifle.

Q. Would you say that this is, then, a matter of expert interpretation rather than a point-for-point comparison which a layman could make?

A. I would say so; yes. I don't think a layman would recognize some of the things on these cartridge cases and some shown in the photographs as actually being significant or not significant, because there will be things present which have nothing whatsoever to do with the firing of the cartridge case in the gun.

There may be a depression in the primer to begin with, and there are no marks registered at that point as a result of the firing. Unless these things are known to occur, someone may actually arrive at a different conclusion, because of the absence of similar marks.

Q. Now having reference to the specific exhibit before you, which is 559—

A. Yes.

Q. Are all the marks shown in both photographs identical?

A. No.

Q. And could you go into detail on a mark which is not identical to explain why you would get such a result?

A. Well, for instance, between what I have drawn here as circle 4 and circle 5, there is a slanting line from the upper left to the lower right on C-6. This line shows as a white line in the photograph.

On the other side there is a rough, very rough ridge which runs through there, having an entirely different appearance from the relatively sharp line on C-6. The significant part of that mark is the groove in between, rather than the sharp edge of the mark, because the sharp corner could be affected by the hardness of the metal or the irregular surface of the primer and the amount of pressure exerted against it, pressing it back against the face of the bolt, at the time the cartridges were fired. So that you would never expect all the marks on one cartridge case to be identical with all the marks on the other cartridge case.

In fact, you would expect many differences. But the comparison is made on the overall pattern, contour, and nature of the marks that are present.

\* \* \* \* \*

Q. Again there are dissimilar marks on these two pictures [of the firing-pin depressions on the cartridge case Commission Exhibit No. 543, and a test cartridge case], Mr. Frazier?

A. Yes; there are, for the same reason, that metal does not flow the same in every instance, and it will not be impressed to the same depth and to the same amount, depending on the type of metal, the blow that is struck, and the pressures involved.

Q. Is your identification made therefore on the basis of the presence of similarities, as opposed to the absence of dissimilarities?

A. No, that is not exactly right. The identification is made on the presence of sufficient individual microscopic characteristics so that a very definite pattern is formed and visualized on the two surfaces.

Dissimilarities may or may not be present, depending on whether there have been changes to the firing pin through use or wear, whether the metal flows are the same, and whether the pressures are the same or not.

So I don't think we can say that it is an absence of dissimilarities, but rather the presence of similarities.<sup>5</sup>

A bullet or cartridge case cannot always be identified with the weapon in which it was fired. In some cases, the bullet or cartridge case is too mutilated. In other cases, the weapon's microscopic characteristics have changed between the time the suspect item was fired and the time the test item was fired—microscopic characteristics change drastically in a short period of time, due to wear, or over a longer period of time, due to wear, corrosion, and cleaning. Still again, the weapon may mark bullets inconsistently—for example, because the bullets are smaller than the barrel, and travel through it erratically.<sup>6</sup>

### The Rifle

The rifle found on the sixth floor of the Texas School Book Depository shortly after the assassination was a bolt-action, clip-fed, military rifle, 40.2 inches long and 8 pounds in weight.<sup>7</sup> Inscribed on the rifle were various markings, including the words "CAL. 6.5," "MADE ITALY," "TERNI," and "ROCCA"; the numerals "1940" and "40"; the serial number C2766; the letters "R-E," "PG," and "TNI"; the figure of a crown; and several other barely decipherable letters and numbers.<sup>8</sup> The rifle bore a very inexpensive Japanese four-power sight, stamped "4 x 18 COATED," "ORDNANCE OPTICS INC.," "HOLLYWOOD CALIFORNIA," and "MADE IN JAPAN"<sup>9</sup> and a sling consisting of two leather straps, one of

which had a broad patch, which apparently had been inserted on the rifle and cut to length.<sup>10</sup> The sling was not a standard rifle sling, but appeared to be a musical instrument strap or a sling from a carrying case or camera bag.<sup>11</sup> A basic purpose of a rifle sling is to enable the rifleman to steady his grip, by wrapping the arm into the sling in a prescribed manner. The sling on the rifle was too short to use in the normal way, but might have served to provide some additional steadiness.<sup>12</sup>

The rifle was identified as a 6.5-millimeter Mannlicher-Carcano Italian military rifle, Model 91/38.<sup>13</sup> This identification was initially made by comparing the rifle with standard reference works and by the markings inscribed on the rifle.<sup>14</sup> The caliber was independently determined by chambering a Mannlicher-Carcano 6.5 millimeter cartridge in the rifle for fit, and by making a sulfur cast of the inside of the rifle's barrel which was measured with a micrometer.<sup>15</sup> (The caliber of a weapon is the diameter of the interior of the barrel, measured between opposite lands. The caliber of American weapons is expressed in inches; thus a .30-caliber weapon has a barrel which is thirty one-hundredths or three-tenths of an inch in diameter. The caliber of continental European weapons is measured in millimeters. A 6.5-millimeter caliber weapon corresponds to an American .257-caliber weapon, that is, its barrel diameter is about one-fourth inch.)<sup>16</sup> The identification was later confirmed by a communication from SIFAR, the Italian Armed Forces Intelligence Service. This communication also explained the markings on the rifle, as follows: "CAL. 6.5" refers to the rifle's caliber; "MADE ITALY" refers to its origin, and was inscribed at the request of the American importer prior to shipment; "TERNI" means that the rifle was manufactured and tested by the Terni Army Plant of Terni, Italy; the number "C2766" is the serial number of the rifle, and the rifle in question is the only one of its type bearing that serial number; the numerals "1940" and "40" refer to the year of manufacture; and the other figures, numbers, and letters are principally inspector's, designer's, or manufacturer's marks.<sup>17</sup>

The Model 91/38 rifle was one of the 1891 series of Italian military rifles, incorporating features designed by Ritter von Mannlicher and M. Carcano. The series originally consisted of 6.5-millimeter caliber rifles, but Model 38 of the series, designed shortly before World War II, was a 7.35-millimeter caliber. Early in World War II, however, the Italian Government, which encountered an ammunition supply problem, began producing many of these rifles as 6.5-millimeter caliber rifles, known as the 6.5-millimeter Model 91/38.<sup>18</sup> The 91/38 has been imported into this country as surplus military equipment, has been advertised quite widely, and is now fairly common in this country.<sup>19</sup>

Like most bolt-action military rifles, the 91/38 is operated by turning up the bolt handle, drawing the bolt to the rear, pushing the bolt forward, turning down the bolt handle, and pulling the trigger. Bringing the bolt forward and turning down the bolt handle compresses the spring which drives the firing pin, and locks the bolt into

place. When the trigger is pulled, the cocked spring drives the firing pin forward and the cartridge is fired. The face of the bolt bears a lip, called the extractor, around a portion of its circumference. As the bolt is pushed forward, this lip grasps the rim of the cartridge. As the bolt is pulled back, the extractor brings the empty cartridge case with it, and as the cartridge case is being brought back, it strikes a projection in the ejection port called the ejector, which throws it out of the rifle. Meanwhile, a leaf spring beneath the clip has raised the next cartridge into loading position. When the bolt is brought forward, it pushes the fresh cartridge into the chamber. The trigger is pulled, the cartridge is fired, the bolt handle is brought up, the bolt is brought back, and the entire cycle starts again. As long as there is ammunition in the clip, one need only work the bolt and pull the trigger to fire the rifle.<sup>20</sup>

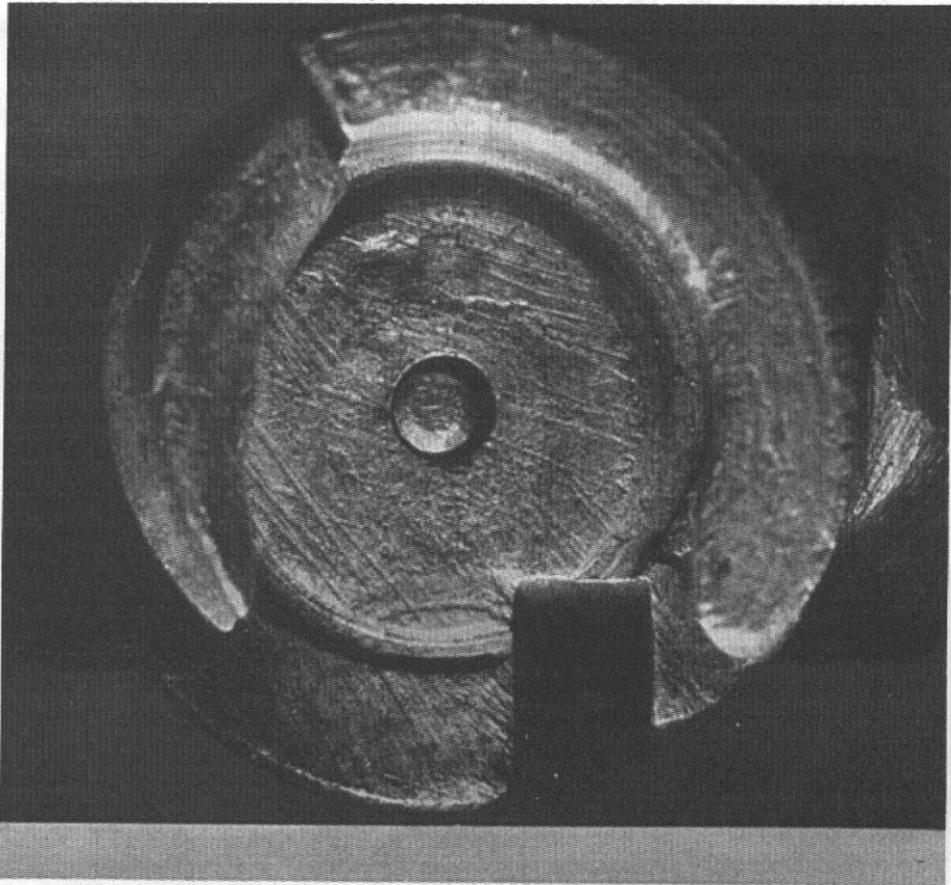
The clip itself is inserted into the rifle by drawing back the bolt, and pushing the clip in from the top. The clip holds one to six cartridges.<sup>21</sup> If six cartridges are inserted into the clip and an additional cartridge is inserted into the chamber, up to seven bullets can be fired before reloading.<sup>22</sup> When the rifle was found in the Texas School Book Depository Building it contained a clip<sup>23</sup> which bore the letters "SMI" (the manufacturer's markings) and the number "952" (possibly a part number or the manufacturer's code number).<sup>24</sup> The rifle probably was sold without a clip; however, the clip is commonly available.<sup>25</sup>

### Rifle Cartridge and Cartridge Cases

When the rifle was found, one cartridge was in the chamber.<sup>26</sup> The cartridge was a 6.5-millimeter Mannlicher-Carcano cartridge, manufactured by the Western Cartridge Co., at East Alton, Ill. This type of cartridge is loaded with a full metal-jacketed, military type of bullet, weighing 160-161 grains. The bullet has parallel sides and a round nose. It is just under 1.2 inches long, and just over one-fourth inch in diameter.<sup>27</sup> Its velocity is approximately 2,165 feet per second.<sup>28</sup> The cartridge is very dependable; in tests runs by the FBI and the Infantry Weapons Evaluation Branch of the U.S. Army, the C2766 rifle was fired with this Western Cartridge Co. ammunition over 100 times, with no misfires. (In contrast, some of the other ammunition available on the market for this rifle is undesirable or of very poor quality).<sup>29</sup> The cartridge is readily available for purchase from mail-order houses, as well as a few gunshops; some 2 million rounds have been placed on sale in the United States.<sup>30</sup>

The presence of the cartridge in the chamber did not necessarily mean that the assassin considered firing another bullet, since he may have reloaded merely by reflex.<sup>31</sup>

Apart from the cartridge in the rifle, three expended cartridge cases were found in the southeast portion of the sixth floor of the Texas School Book Depository Building, lying between the south



COMMISSION EXHIBIT No. 558

Bolt face of the C2766 rifle.

wall and a high stack of boxes which ran parallel to the wall.<sup>32</sup> The cartridge cases were a short distance to the west of the southeast corner window in that wall.<sup>33</sup> Based on a comparison with test cartridge cases fired from the C2766 rifle, the three cartridge cases were identified as having been fired from the C2766 rifle.<sup>34</sup> (See Commission Exhibit No. 558, p. 556.) A test was run to determine if the cartridge-case-ejection pattern of the rifle was consistent with the assumption that the assassin had fired from the southeast window.<sup>35</sup> In this test, 11 cartridges were fired from the rifle while it was depressed 45° downward, and 8 cartridges were fired from the rifle while it was held horizontally. The elevation of the ejected cartridge cases above the level of the ejection port, and the points on the floor at which the ejection cartridge cases initially landed, were then plotted. The results of these tests are illustrated by the diagrams, Commission Exhibits Nos. 546 and 547. Briefly, Commission Exhibit No. 547 shows that with the weapon depressed at a 45° angle, the cartridge cases did not rise more than 2 inches above the ejection port; with the weapon held horizontally, they did not rise more than 12 inches above the ejection port.<sup>36</sup> Commission Exhibit No. 546 shows that if a circle was drawn around the initial landing points of the cartridge cases which were ejected in the test while the rifle was held depressed at 45°, the center of the circle would be located 86 inches and 80° to the right of the rifle's line of sight; if a circle was drawn around the initial landing points of the cartridge cases ejected while the rifle was held horizontally, the center of the circle would be 80 inches and 90° to the right of the line of sight. In other words, the cartridge cases were ejected to the right of and at roughly a right angle to the rifle.<sup>37</sup> The cartridge cases showed considerable ricochet after their initial landing, bouncing from 8 inches to 15 feet.<sup>38</sup> The location of the cartridge cases was therefore consistent with the southeast window having been used by the assassin, since if the assassin fired from that window the ejected cartridge cases would have hit the pile of boxes at his back and ricocheted between the boxes and the wall until they came to rest to the west of the window.<sup>39</sup>

### The Rifle Bullets

In addition to the three cartridge cases found in the Texas School Book Depository Building, a nearly whole bullet was found on Governor Connally's stretcher and two bullet fragments were found in the front of the President's car.<sup>40</sup> The stretcher bullet weighed 158.6 grains, or several grains less than the average Western Cartridge Co. 6.5-millimeter Mannlicher-Carcano bullet.<sup>41</sup> It was slightly flattened, but otherwise unmutilated.<sup>42</sup> The two bullet fragments weighed 44.6 and 21.0 grains, respectively.<sup>43</sup> The heavier fragment was a portion of a bullet's nose area, as shown by its rounded contour and the

character of the markings it bore.<sup>44</sup> The lighter fragment consisted of bullet's base portion, as shown by its shape and by the presence of a cannelure.<sup>45</sup> The two fragments were both mutilated, and it was not possible to determine from the fragments themselves whether they comprised the base and nose of one bullet or of two separate bullets.<sup>46</sup> However, each had sufficient un mutilated area to provide the basis of an identification.<sup>47</sup> Based on a comparison with test bullets fired from the C2766 rifle, the stretcher bullet and both bullet fragments were identified as having been fired from the C2766 rifle.<sup>48</sup>

### The Revolver

The revolver taken from Oswald at the time of his arrest was a .38 Special S. & W. Victory Model revolver.<sup>49</sup> It bore the serial No. V510210, and is the only such revolver with that serial number, since S. & W. does not repeat serial numbers.<sup>50</sup> The revolver was originally made in the United States, but was shipped to England, as shown by the English inspection or proof marks on the chambers.<sup>51</sup> The revolver showed definite signs of use but was in good operating condition.<sup>52</sup> The revolver was originally designed to fire a .38 S. & W. cartridge, whose bullet is approximately 12 or 13 grains lighter than the .38 Special, and approximately .12 inches shorter, but has a somewhat larger diameter.<sup>53</sup> In the United States, the .38 Special is considered to be a better bullet than the .38 S. & W.,<sup>54</sup> and the revolver was rechambered for a .38 Special prior to being sold in the United States.<sup>55</sup> The weapon was not rebarreled, although the barrel was shortened by cutting off approximately  $2\frac{3}{4}$  of its original 5 inches.<sup>56</sup> The shortening of the barrel had no functional value, except to facilitate concealment.<sup>57</sup>

The weapon is a conventional revolver, with a rotating cylinder holding one to six cartridges. It is loaded by swinging out the cylinder and inserting cartridges into the cylinder's chambers. If all six chambers are loaded, the weapon can be fired six consecutive times without reloading.<sup>58</sup> To extract empty cartridge cases, the cylinder is swung out and an ejector rod attached to the cylinder is pushed, simultaneously ejecting all the cartridge cases (and cartridges) in the cylinder. If both live cartridges and expended cartridge cases are in the cylinder, before pushing the ejection rod one can tip the cylinder and dump the live cartridges into his hand.<sup>59</sup> The cartridge cases will not fall out, because they are lighter than the cartridges, and when fired they will have expanded so as to tightly fit the chamber walls.<sup>60</sup>

In a crouched stance a person can fire five shots with the revolver in 3-4 seconds with no trouble, and would need no training to hit a human body four times in four or five shots at a range of 8 feet.<sup>61</sup> A person who had any training with the weapon would not find its recoil noticeable.<sup>62</sup>

## Revolver Cartridges and Cartridge Cases

When Oswald was arrested six live cartridges were found in the revolver.<sup>63</sup> Three were Western .38 Specials, loaded with copper-coated lead bullets, and three were Remington-Peters .38 Specials, loaded with lead bullets.<sup>64</sup> Five additional live cartridges were found in Oswald's pocket,<sup>65</sup> all of which were Western .38 Specials, loaded with copper-coated bullets.<sup>66</sup> The Western and Remington-Peters .38 Special cartridges are virtually identical—the copper coating on the Western bullets is not a full jacket, but only a gilding metal, put on principally for sales appeal.<sup>67</sup>

Four expended cartridge cases were found near the site of the Tippit killing.<sup>68</sup> Two of these cartridge cases were Remington-Peters .38 Specials and two were Western .38 Specials.<sup>69</sup> Based on a comparison with test cartridge cases fired in the V510210 revolver, the four cartridge cases were identified as having been fired in the V510210 revolver.<sup>70</sup>

### Revolver Bullets

Four bullets were recovered from the body of Officer Tippit.<sup>71</sup> In Nicol's opinion one of the four bullets could be positively identified with test bullets fired from V510210 revolver, and the other three could have been fired from that revolver.<sup>72</sup> In Cunningham's opinion all four bullets could have been fired from the V510210 revolver, but none could be positively identified to the revolver<sup>73</sup>—that is, in his opinion the bullets bore the revolver's rifling characteristics, but no conclusion could be drawn on the basis of microscopic characteristics.<sup>74</sup> Cunningham did not conclude that the bullets had not been fired from the revolver, since he found that consecutive bullets fired in the revolver by the FBI could not even be identified with each other under the microscope.<sup>75</sup> The apparent reasons for this was that while the revolver had been rechambered for a .38 Special cartridge, it had not been rebarreled for a .38 Special bullet. The barrel was therefore slightly oversized for a .38 Special bullet, which has a smaller diameter than a .38 S. & W. bullet. This would cause the passage of a .38 Special bullet through the barrel to be erratic, resulting in inconsistent microscopic markings.<sup>76</sup>

Based on the number of grooves, groove widths, groove spacing, and knurling on the four recovered bullets, three were copper-coated lead bullets of Western-Winchester manufacture (Western and Winchester are divisions of the same company), and the fourth was a lead bullet of Remington-Peters manufacture.<sup>77</sup> This contrasts with the four recovered cartridge cases, which consisted of two Remington-Peters and two Westerns. There are several possible explanations for this variance: (1) the killer fired five cartridges, three of which were Western-Winchester and two of which were Remington-Peters; one Remington-Peters bullet missed Tippit; and a Western-Winchester cartridge case and the Remington-Peters bullet that missed were simply not found. (2) The killer fired only four cartridges, three

of which were Western-Winchester and one of which was Remington-Peters; prior to the shooting the killer had an expended Remington-Peters cartridge case in his revolver, which was ejected with the three Western-Winchester and one Remington-Peters cases; and one of the Western-Winchester cases was not found. (3) The killer was using hand-loaded ammunition, that is, ammunition which is made with used cartridge cases to save money; thus he might have loaded one make of bullet into another make of cartridge case.<sup>78</sup> This third possibility is extremely unlikely, because when a cartridge is fired the cartridge case expands, and before it can be reused it must be resized. There was, however, no evidence that any of the four recovered cartridge cases had been resized.<sup>79</sup>

### The Struggle for the Revolver

Officer McDonald of the Dallas police, who arrested Oswald, stated that he had struggled with Oswald for possession of the revolver and that in the course of the struggle, "I heard the snap of the hammer, and the pistol crossed my left cheek \* \* \* the primer of one round was dented on misfire at the time of the struggle. \* \* \*"<sup>80</sup> However, none of the cartridges found in the revolver bore the impression of the revolver's firing pin.<sup>81</sup> In addition, the revolver is so constructed that the firing pin cannot strike a cartridge unless the hammer (which bears the firing pin) has first been drawn all the way back by a complete trigger pull.<sup>82</sup> Had the hammer gone all the way back and then hit the cartridge, it is unlikely that the cartridge would have misfired.<sup>83</sup> It would be possible for a person to interject his finger between the hammer and the cartridge, but the spring driving the hammer is a very strong one and the impact of the firing pin into a finger would be clearly felt.<sup>84</sup> However, the cylinder and the trigger are interconnected and the trigger cannot be fully pulled back if the cylinder is grasped.<sup>85</sup> Therefore, if Oswald had pulled on the trigger while McDonald was firmly grasping the cylinder, the revolver would not have fired, and if the gun was grabbed away at the same time the trigger would have snapped back with an audible sound.<sup>86</sup>

### The Paraffin Test

During the course of the interrogation of Lee Harvey Oswald following the assassination a paraffin test was performed by the Dallas police on both of his hands and his right cheek. The paraffin cast of Oswald's hands reacted positively to the test. The cast of the right cheek showed no reaction.<sup>87</sup>

To perform the paraffin test, layers of warm liquid paraffin, interleaved with layers of gauze for reinforcement, are brushed or poured on the suspect's skin. The warm sticky paraffin opens the skin's pores and picks up any dirt and foreign material present at the surface. When the paraffin cools and hardens it forms a cast, which is taken off and processed with diphenylamine or diphenyl-

benzidine, chemicals which turn blue in the presence of nitrates. Since gunpowder residues contain nitrates, the theory behind the test is that if a cast reacts positively, i.e., if blue dots appear, it provides evidence that the suspect recently fired a weapon.<sup>88</sup> In fact, however, the test is completely unreliable in determining either whether a person has recently fired a weapon or whether he has not.<sup>89</sup> On the one hand, diphenylamine and diphenylbenzidine will react positively not only with nitrates from gunpowder residues, but nitrates from other sources and most oxidizing agents, including dichromates, permanganates, hypochlorates, periodates, and some oxides. Thus, contact with tobacco, Clorox, urine, cosmetics, kitchen matches, pharmaceuticals, fertilizers, or soils, among other things, may result in a positive reaction to the paraffin test. Also, the mere handling of a weapon may leave nitrates on the skin.<sup>90</sup> A positive reaction is, therefore, valueless in determining whether a suspect has recently fired a weapon. Conversely, a person who has recently fired a weapon may not show a positive reaction to the paraffin test, particularly if the weapon was a rifle. A revolver is so constructed that there is a space between the cylinder, which bears the chambers, and the barrel. When a revolver is fired, nitrate-bearing gases escape through this space and may leave residues on the hand.<sup>91</sup> In a rifle, however, there is no gap between the chamber and the barrel, and one would therefore not expect nitrates to be deposited upon a person's hands or cheeks as a result of his firing a rifle. As Cunningham testified:

Mr. CUNNINGHAM. \* \* \* I personally wouldn't expect to find any residues on a person's right cheek after firing a rifle due to the fact that by the very principles and the manufacture and the action, the cartridge itself is sealed into the chamber by the bolt being closed behind it, and upon firing the case, the cartridge case expands into the chamber filling it up and sealing it off from the gases, so none will come back in your face, and so by its very nature, I would not expect to find residue on the right cheek of a shooter.<sup>92</sup>

The unreliability of the paraffin test has been demonstrated by experiments run by the FBI. In one experiment, conducted prior to the assassination, paraffin tests were performed on 17 men who had just fired 5 shots with a .38-caliber revolver. Eight men tested negative in both hands, three men tested positive on the idle hand and negative on the firing hand, two men tested positive on the firing hand and negative on the idle hand, and four men tested positive on both their firing and idle hands.<sup>93</sup> In a second experiment, paraffin tests were performed on 29 persons, 9 of whom had just fired a revolver or an automatic, and 20 of whom had not fired a weapon. All 29 persons tested positive on either or both hands.<sup>94</sup> In a third experiment, performed after the assassination, an agent of the FBI, using the C2766 rifle, fired

three rounds of Western 6.5-millimeter Mannlicher-Carcano ammunition in rapid succession. A paraffin test was then performed on both of his hands and his right cheek. Both of his hands and his cheek tested negative.<sup>95</sup>

The paraffin casts of Oswald's hands and right cheek were also examined by neutron-activation analyses at the Oak Ridge National Laboratory. Barium and antimony were found to be present on both surfaces of all the casts and also in residues from the rifle cartridge cases and the revolver cartridge cases.<sup>96</sup> Since barium and antimony were present in both the rifle and the revolver cartridge cases, their presence on the casts were not evidence that Oswald had fired the rifle. Moreover, the presence on the inside surface of the cheek cast of a lesser amount of barium, and only a slightly greater amount of antimony, than was found on the outside surface of the cast rendered it impossible to attach significance to the presence of these elements on the inside surface. Since the outside surface had not been in contact with Oswald's cheek, the barium and antimony found there had come from a source other than Oswald. Furthermore, while there was more barium and antimony present on the casts than would normally be found on the hands of a person who had not fired a weapon or handled a fired weapon, it is also true that barium and antimony may be present in many common items; for example, barium may be present in grease, ceramics, glass, paint, printing ink, paper, rubber, plastics, leather, cloth, pyrotechnics, oilcloth and linoleum, storage batteries, matches and cosmetics; antimony is present in matches, type metal, lead alloys, paints and lacquers, pigments for oil and water colors, flameproof textiles, storage batteries, pyrotechnics, rubber, pharmaceutical preparations and calico; and both barium and antimony are present in printed paper and cloth, paint, storage batteries, rubber, matches, pyrotechnics, and possibly other items. However, the barium and antimony present in these items are usually not present in a form which would lead to their adhering to the skin of a person who had handled such items.<sup>97</sup>

### The Walker Bullet

On April 10, 1963, a bullet was recovered from General Walker's home, following an attempt on his life.<sup>98</sup> The bullet, which was severely mutilated, weighed 148.25 grains.<sup>99</sup> This bullet had the rifling characteristics of the C2766 rifle and all its remaining physical characteristics were the same as the Western 6.5 millimeter Mannlicher-Carcano bullet. However, while the bullet could have been fired from the C2766 rifle, it was severely mutilated and in Frazier's opinion could not be identified as having been fired or not fired from that rifle.<sup>100</sup> Nicol agreed that a positive identification could not be made, but concluded there was "a fair probability" that the bullet had been fired from the same rifle as the test bullets.<sup>101</sup>

## FINGERPRINTS AND PALMPRINTS

Two experts gave testimony concerning fingerprints and palmprints: Sebastian Latona<sup>102</sup> and Arthur Mandella.<sup>103</sup> Latona is the supervisor of the Latent Fingerprint Section of the Identification Division of the FBI. He has been with that Division over 32 years, having begun as a student fingerprint classifier and worked up to his present position. Mandella is a detective and fingerprint instructor with the police department of the city of New York. He has been in the fingerprint field for 19 years. Both have made a vast number of fingerprint examinations and have testified in Federal, State, and military courts.<sup>104</sup> Their conclusions were identical, except as noted.

### General Principles<sup>105</sup>

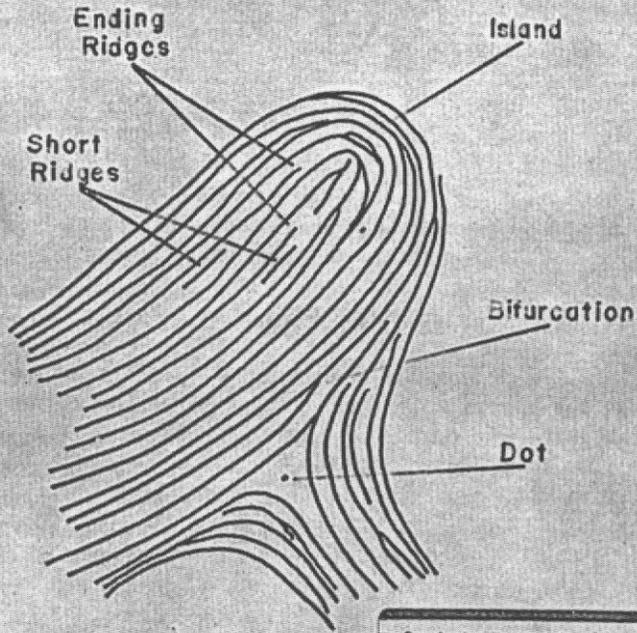
Fingerprints and palmprints are made by the ridges which cover the surface of the fingers and palms. These ridges first appear 2 or 3 months before birth, and remain unchanged until death. Commission Exhibit No. 634-A (p. 564) illustrates several common characteristics or "points" formed by the ridges; a clear fingerprint impression will contain anywhere from 85 to 125 such points. While many of the common points appear in almost every print, no two prints have the same points in the same relationship to each other.

A print taken by a law-enforcement agency is known as an "inked print," and is carefully taken so that all the characteristics of the print are reproduced on the fingerprint card; a print which is left accidentally, such as a print left at the scene of a crime, is known as a latent print. To make an identification of a latent print, the expert compares the points in the latent print with the points in an inked print. If a point appearing in a latent print does not appear in the inked print, or vice versa, the expert concludes that the two prints were not made by the same finger or palm. An identification is made only if there are no inconsistencies between the inked and latent prints, and the points of similarity and their relative positions are sufficiently distinctive, and sufficient in number, to satisfy the expert that an identity exists.<sup>106</sup>

There is some disagreement concerning whether a minimum number of points is necessary for an identification. Some foreign law-enforcement agencies require a minimum number of 16 points. However, in the United States, in which there has been a great deal of experience with fingerprints, expert opinion holds there is no minimum number of points, and that each print must be evaluated on its own merits.<sup>107</sup>

Palmprints are as distinctive as fingerprints, but are not as popularly known. Possibly this is because law enforcement agencies usually record only fingerprints for their identification files, since fingerprints can be much more readily classified and filed than palmprints. Also, latent fingerprint impressions are probably more common than latent palmprint impressions, because persons generally touch objects with their fingers rather than their palms. However,

Ridge Characteristics  
Used by Experts in Comparing Fingerprints



139A COMMISSION EXHIBIT No. 634-A

palprints will frequently be found on heavy objects, since the palms as well as the fingers are employed in handling such objects.<sup>108</sup>

A latent print is the result of perspiration exuded by the sweat pores in the ridges. This perspiration is composed of water, protein or fatty materials, and sodium chloride (salt). A latent print can be developed—made visible—in several ways. Sometimes a latent print can be developed merely by the use of correct lighting. A second method is to brush the print very lightly with a powder, which adheres to its outline. Once a print is powdered it can be photographed, lifted, or both. (In lifting, an adhesive substance, such as scotch tape, is placed over a powdered print. When the adhesive is lifted the powder clings to its surface. The adhesive is then mounted.) However, powder is usually effective only on objects which have a hard, smooth, nonabsorbent surface, such as glass, tile, and various types of highly polished metals and is usually not effective on absorbent materials, such as paper or unfinished wood or metal, which absorb perspiration so that there is nothing on the material's surface to which the powder can adhere. Prints on absorbent materials can sometimes be developed by iodine fumes, which may react with fatty or protein materials which have been absorbed into the object, or by a silver nitrate solution, which may react with sodium chloride which has been absorbed into the object.<sup>109</sup>

Not every contact of a finger or palm leaves a latent print. For example, if the surface is not susceptible to a latent print, if the finger or palm had no perspiration, or if the perspiration was mostly water and had evaporated, no print will be found.<sup>110</sup>

### Objects in the Texas School Book Depository Building

A number of objects found in the Texas School Book Depository Building following the assassination were processed for latent fingerprints by the FBI—in some cases, after they had been processed by the Dallas police. These objects included the homemade wrapping paper bag found near the southeast corner window; the C2766 rifle; three small cartons which were stacked near that window (which were marked "Box A," "Box B," and "Box C"),<sup>111</sup> and a fourth carton resting on the floor nearby (marked "Box D");<sup>112</sup> the three 6.5-millimeter cartridge cases found near the window; and the cartridge found in the rifle. The results were as follows:

*The paper bag.*—The FBI developed a palmprint and a fingerprint on the paper bag by silver nitrate. These were compared with the fingerprints and palmprints of Lee Harvey Oswald taken by the Dallas police, and were found to have been made by the right palm and the left index finger of Lee Harvey Oswald.<sup>113</sup>

*The C2766 rifle.*—The wood and metal of the rifle was absorbent, and not conducive to recording a good print.<sup>114</sup> However, the Dallas police developed by powder some faint ridge formations on the metal magazine housing in front of the trigger and also developed by powder and lifted a latent palmprint from the underside

of the barrel.<sup>115</sup> The faint ridge formations were insufficient for purposes of effecting an identification,<sup>116</sup> but the latent palmprint was identified as the right palm of Lee Harvey Oswald.<sup>117</sup>

*The cartons.*—Using the silver nitrate method, the FBI developed nine identifiable latent fingerprints and four identifiable latent palmprints on Box A,<sup>118</sup> seven identifiable fingerprints and two identifiable palmprints on Box B,<sup>119</sup> and two identifiable fingerprints and one identifiable palmprint on Box C.<sup>120</sup> One of the fingerprints on Box A was identified as the right index fingerprint of Lee Harvey Oswald,<sup>121</sup> and one of the palmprints on Box A was identified as the left palmprint of Lee Harvey Oswald.<sup>122</sup> All the remaining prints on Box A were the palmprints of R. L. Studebaker, a Dallas police officer, and Forest L. Lucy, an FBI clerk, who shipped the cartons from Dallas to the FBI Laboratory in Washington, D.C., and fingerprints of Detective Studebaker. All but one of the fingerprints on Box B belonged to Studebaker and Lucy and one palmprint was that of Studebaker. The fingerprints on Box C were those of Studebaker and Lucy and the palmprint was Studebaker's.<sup>123</sup> One palmprint on Box B was unidentified.<sup>124</sup>

The FBI developed two fingerprints on Box D by silver nitrate, and the Dallas police developed a palmprint on Box D by powder.<sup>125</sup> The fingerprints belonged to Lucy. The palmprint was identified as the right palmprint of Lee Harvey Oswald.<sup>126</sup> While the age of a print cannot be generally determined,<sup>127</sup> this palmprint must have been relatively fresh, because the carton was constructed of cardboard, an absorbent material, and if a long period had elapsed between the time the print was made and the time it was powdered, the perspiration would have been absorbed into the cardboard, and the print could not have been developed by powder.<sup>128</sup> Tests run by the FBI show that usually a latent impression on such cardboard cannot be developed by powder more than 24 hours after it is made.<sup>129</sup> Latona felt that the maximum age of the palmprint on Box D at the time of development (which was shortly after the assassination), would have been 3 days;<sup>130</sup> Mandella felt that the maximum time would have been a day and a half.<sup>131</sup>

*The three cartridge cases and the cartridge case found in the rifle.*—No prints were developed on the cartridge found in the rifle or on the three expended cartridge cases.<sup>132</sup>

## QUESTIONED DOCUMENTS

Two experts gave testimony concerning questioned documents: Alwyn Cole<sup>133</sup> and James C. Cadigan.<sup>134</sup> Cole apprenticed as a questioned document examiner for 6 years, from 1929 to 1935, and has been examiner of questioned documents for the U.S. Treasury Department since then. Cadigan has been a questioned document examiner with the FBI for 23½ years, following a specialized course of training and instruction. Both have testified many times in Federal and States courts.<sup>135</sup> Their conclusions were identical, except as noted.

Both experts examined and testified on the following questioned documents: (1) The mail order to Klein's Sporting Goods of Chicago, in response to which Klein's sent the C2766 rifle; the accompanying money order; and the envelope in which the mail order and the money order were sent—all of which bore the name "A. Hidell" and the address "P.O. Box 2915, Dallas, Texas";<sup>136</sup> (2) the mail order to Seaport Traders, Inc., of Los Angeles, bearing the same name and address, in response to which the Seaport Traders sent the V510210 revolver;<sup>137</sup> (3) part of an application for Post Office Box 2915, Dallas, Tex., opened October 9, 1962 and closed May 14, 1963, and two change-of-address orders relating to that box, dated October 10, 1962 and May 12, 1963—all signed "Lee H. Oswald," and part of an application for Post Office Box 30061, New Orleans, La., naming "A. J. Hidell" as a party entitled to receive mail through the box, signed "L. H. Oswald";<sup>138</sup> (4) a spurious selective service system notice of classification and a spurious certificate of service in the U.S. Marine Corps, found in Oswald's wallet after his arrest, both in the name "Alek James Hidell";<sup>139</sup> (5) a spurious smallpox vaccination certificate, found among Oswald's belongings at his room at 1026 North Beckley, purportedly issued to Lee Oswald by "Dr. A. J. Hideel, P.O. Box 30016, New Orleans, La.";<sup>140</sup> and (6) a card, found in Oswald's wallet after his arrest, reading "Fair Play for Cuba Committee New Orleans Chapter," dated "June 15, 1963," bearing the name "L. H. Oswald" and the signature "Lee H. Oswald," and signed "A. J. Hidell" as chapter president.<sup>141</sup> Cadigan also examined (7) the unsigned note, Commission Exhibit No. 1, written almost entirely in Russian, which Marina testified Oswald had left for her prior to his attempt on the life of General Walker;<sup>142</sup> and (8) the homemade paper bag found on the sixth floor of the Texas School Book Depository following the assassination.<sup>143</sup>

*General principles.*<sup>144</sup>—The area of questioned document examination encompasses many types of inquiries, the most familiar of which is the identification of handwriting. Handwriting identification is based upon the principle that every person's handwriting is distinctive. As Cole testified:

Q. Mr. Cole, could you explain the basis on which you were able to make an identification of a questioned writing as being authored by the person who wrote a standard writing?

Mr. COLE. This is based upon the principle that every handwriting is distinctive, that since the mental and physical equipment for producing handwriting is different in every individual, each person produces his own distinctive writing habits. Of course, everyone learns to write in the beginning by an endeavor to repeat ideal letter forms but, practically no one is able to reproduce these forms exactly. Even though a person might have some initial success during the active period of instruction, he soon departs from these and develops his own habits. It may be said that habit in handwriting is that which makes handwriting pos-

sible. Habit is that which makes handwriting efficient. If it were not for the development of habit, one would be obliged to draw or sketch.

Some habit would be included even in those efforts. But the production of handwriting rapidly and fluently always involves a recording of personal writing habit. This has been confirmed by observation of a very large number of specimens over a long period of time, and it has further been demonstrated by, on my part, having a formal responsibility for rendering decisions about the identification of handwriting based upon an agreement of handwriting habit in situations where there would be a rigorous testing of the correctness of these decision by field investigators, for example, of the law-enforcement agencies, and a demonstration that these results were confirmed by other evidence.

This is the basis for identification of handwriting.<sup>145</sup>

The same principles are generally applicable to hand printing,<sup>146</sup> and in the balance of this section the term "handwriting" will be used to refer to both cursive or script writing and hand printing.

Not every letter in a questioned handwriting can be used as the basis of an identification. Most people learn to write letters in a standard or "copybook" form: a handwriting is distinctive only insofar as it departs significantly from such forms.<sup>147</sup> Correspondingly, not every variation indicates nonidentification; no two acts are precisely alike and variations may be found within a single document. Like similarities, variations are significant only if they are distinctive.<sup>148</sup> Moreover, since any single distinctive characteristic may not be unique to one person, in order to make an identification the expert must find a sufficient number of corresponding distinctive characteristics and a general absence of distinctive differences.<sup>149</sup>

The possibility that one person could imitate the handwriting of another and successfully deceive an expert document examiner is very remote. A forger leaves two types of clue. First, he can seldom perfectly simulate the letter forms of the victim; concentrating on the reproduction of one detail, he is likely not to see others. Thus, the forger may successfully imitate the general form of a letter, but get proportions or letter connections wrong. In addition, the forger draws rather than writes. Forged writing is therefore distinguished by defects in the quality of its line, such as tremor, waver, patching, retouching, noncontinuous lines, and pen lifts in awkward and unusual places.<sup>150</sup>

To make a handwriting identification, the handwriting in the document under examination (the questioned document) is compared against the handwriting in documents known to have been prepared by a suspect (the known or standard documents). This is exemplified by Cole's examination of Commission Exhibit No. 773, the photograph of the mail order for the rifle and the envelope in which it was sent:

Q. Now, Mr. Cole, returning to 773, the questioned document, can you tell the Commission how you formed the conclusion

that it was prepared by the author of the standards, that is, what steps you followed in your examination and comparison, what things you considered, what instruments or equipment you used, and so forth?

Mr. COLE. I made first a careful study of the writing on Commission Exhibit 773 without reference to the standard writing, in an effort to determine whether or not this writing contained what I would regard as a basis for identification, contained a record of writing habit, and as that—as a result of that part of my examination, I concluded that this is a natural handwriting. By that I mean that it was made at a fair speed, that it doesn't show any evidence of an unnatural movement, poor line quality, tremor, waver, retouching, or the like. I regard it as being made in a fluent and fairly rapid manner which would record the normal writing habits of the person who made it.

I then made a separate examination of the standards, of all of the standard writings, to determine whether that record gave a record of writing habit which could be used for identification purposes, and I concluded that it, too, was a natural handwriting and gave a good record of writing habit.

I then brought the standard writings together with the questioned writing for a detailed and orderly comparison, considering details of letter forms, proportion, pen pressure, letter connections, and other details of handwriting habit \* \* \*.<sup>151</sup>

The standards used by Cole and Cadigan consisted of a wide variety of documents known to be in the handwriting of Lee Harvey Oswald, including indorsements on his payroll checks, applications for employment, for a passport, for membership in the American Civil Liberties Union, and for a library card, and letters to the Immigration and Naturalization Service, the Marine Corps, the State Department, and the American Embassy in Russia.<sup>152</sup>

#### The Mail Order for the C2766 Rifle, the Related Envelope, and the Money Order

The mail order and envelope for the C2766 rifle were photographed by Klein's on microfilm, and then destroyed.<sup>153</sup> To identify the handwriting an enlarged photograph was made which showed the handwriting characteristics with sufficient clarity to form the basis of an identification.<sup>154</sup> Based on a comparison with the standards, the handwriting on the purchase order and the envelope were identified as Lee Harvey Oswald's.<sup>155</sup> The money order, which was retained by the post office after having been cashed by Klein's,<sup>156</sup> was also identified as being in Oswald's handwriting.<sup>157</sup> These identifications were made on the basis of numerous characteristics in which the writing in both the questioned and standard documents departed from conventional letter forms.<sup>158</sup> For example, in the return address on the envelope, the left side of the "A" in "A. Hidell" was made by a down-

stroke followed by an upstroke which almost exactly traced the downstroke, the "i" showed an elongation of the approach stroke and an exaggerated slant to the right, and the second "l" was somewhat larger than the first; the "B" in "Box" had an upper lobe smaller than the lower lobe; the "D" in "Dallas" exhibited a distinctive construction of the looped form at the top of a letter, and the "s" was flattened and forced over on its side; and the "x" in "Texas" was made in the form of a "u" with a cross bar. These characteristics were also present in the standards.<sup>159</sup> In addition, these items, as well as other questioned documents, resembled the standards in their use of certain erroneous combinations of capital and lowercase letters.<sup>160</sup> For example, in the mail order, "Texas" was printed with a capital "T," "X," "A," and "S," but a lowercase "e"; a similar mixture of capital and lowercase letters in "Texas" was found in the standards.<sup>161</sup>

The writing on the purchase order and envelope showed no significant evidence of disguise (subject to the qualification that the use of hand printing on the mail order, rather than handwriting, may have been used for that purpose).<sup>162</sup> However, it is not unusual for a person using an alias not to disguise his writing. For example, Cole, who is document examiner for the Treasury Department, has frequently examined forgeries evidencing no attempt at disguise.<sup>163</sup>

### Mail Order for the V510210 Revolver

Based on a comparison with the standards, the handwriting on the mail order<sup>164</sup> for the V510210 revolver was also identified as Lee Harvey Oswald's.<sup>165</sup>

### Post Office Box Applications and Change-of-Address Card

A post office box application consists of three parts: The first contains directions for use. The second provides applicant's name, address, signature space, box number, date of opening and closing. The third part provides instruction space concerning delivery of mail and names of persons entitled to use the box.<sup>166</sup> Under post office regulations<sup>167</sup> the second part was retained by the Dallas Post Office for box 2915; it destroyed the third part after the box was closed. Based on the standards, the signature "Lee H. Oswald," and other handwriting on the application, was identified as that of Lee Harvey Oswald.<sup>168</sup> The postal clerk appeared to have filled in the balance.<sup>169</sup>

The Fort Worth and Dallas post offices retained two change-of-address orders signed "Lee H. Oswald": One to "Postmaster, Fort Worth, Tex.," dated October 10, 1962, to send mail to "Oswald, Lee H" at 2703 Mercedes Av., Fort Worth, Texas" and forward to "Box 2915, Dallas, Texas"; the other to "Postmaster, Dallas, Texas" dated May 12, 1963, requested mail for post office box 2915 be forwarded to "Lee Oswald" at "4907 Magazine St., New Orleans, La."<sup>170</sup> Based on a comparison with the standards, the handwriting on these orders was identified as that of Lee Harvey Oswald.<sup>171</sup>

The New Orleans post office retained the third part of the application for post office box 30061, New Orleans, La., dated June 11, 1963, and signed "L. H. Oswald."<sup>172</sup> Inserted in the space for names of persons entitled to receive mail through the box were written the names "A. J. Hidell" and "Marina Oswald." On the basis of a comparison with the standards, the writing and the signature on the card was identified as the handwriting of Lee Harvey Oswald.<sup>173</sup>

### The Spurious Selective Service System Notice of Classification and U.S. Marine Corps Certificate of Service

When Oswald was arrested he had in his possession a Selective Service System notice of classification and a certificate of service in the U.S. Marine Corps in the name of "Alek James Hidell," and a Selective Service System notice of classification, a Selective Service System registration certificate, and a certificate of service in the U.S. Marine Corps in his own name.<sup>174</sup> (See Cadigan Exhibits Nos. 19 and 21, p. 573.) The Hidell cards were photographic counterfeits.<sup>175</sup> After Oswald's arrest a group of retouched negatives were found in Mr. Paine's garage at 2515 West Fifth Street, Irving, Tex.,<sup>176</sup> among which were retouched negatives of the Oswald cards.<sup>177</sup> A comparison of these retouched negatives with the Hidell and Oswald cards showed that the Hidell cards had been counterfeited by photographing the Oswald cards, retouching the resulting negatives, and producing photographic prints from the retouched negatives.

### The Hidell Notice of Classification

*Face side.*—The face of the Hidell notice of classification<sup>178</sup> was produced from the face of the Oswald notice of classification<sup>179</sup> by a two-step process. First, the counterfeiter photographed the Oswald notice, making a basic intermediate negative.<sup>180</sup> He then opaqued out of this intermediate negative all of the information typed or handwritten onto the Oswald notice, including the name "Lee Harvey Oswald," the selective service No., "41-114-39-532," the signature of the official of the local board, and the mailing date. In addition, he made another intermediate negative of the lowermost third of the Oswald notice, which contained a printed legend setting forth various instructions relating to draft board procedures.<sup>181</sup> This negative reproduced the printed material exactly, but reduced it in size.<sup>182</sup> The two intermediate negatives were combined to produce a third negative, substantially identical to the basic intermediate negative except that, by virtue of the reduction in the size of the printed legend, a square space had been created in the lower left-hand corner.<sup>183</sup> The counterfeiter then made a photographic print of this third negative, which contained blanks wherever typed or handwritten material had appeared on the original Oswald notice and a new space in the lower left-hand corner. Finally, new material was inserted into the blanks on

the Hidell notice where typed or handwritten material had appeared on the Oswald notice.<sup>184</sup> Thus the name "ALEK JAMES HIDELELL," the selective service No. "42-224-39-532," and the mailing date "Feb. 5, 1962," were typed into the appropriate blanks on the Hidell notice. Two typewriters were used in this typing, as shown by differences in the design of the typed figure "4,"<sup>185</sup> and by differences in the strength of the typed impression.<sup>186</sup> Probably the counterfeiter switched typewriters when he discovered that the ribbon of his first typewriter was not inked heavily enough to leave a clear impression (a problem which would have been aggravated by the fact that the glossy photographic paper used to make the Hidell notice did not provide a good surface for typewriting).<sup>187</sup> The face of the notice also bore many uninked indentations, which could only be made out under strong side lighting.<sup>188</sup> These indentations were apparently made with the typewriter set at stencil—that is, set so that the typewriter key struck the notice directly, rather than striking it through the inked typewriter ribbon.<sup>189</sup> This may have been done as a dry-run practice, to enable the counterfeiter to determine how to properly center and align the inserted material.<sup>190</sup> A sidelight photograph showed that the names "ALEK," "JAMES," and "HIDELELL" had each been typed in stencil at least twice before being typed in with the ribbon.<sup>191</sup> A capital letter "O" had been stenciled prior to one of the stenciled "ALEK's."<sup>192</sup> A serial number and a date of mailing had also been typed in stencil.<sup>193</sup>

In addition to the typed material, a signature, "Alek J. Hidell," was written in ink in the blank provided for the registrant's signature, and another, somewhat illegible signature, apparently reading "Good Hoffer," was written in ink in the blank provided for the signature of an official of the local board.<sup>194</sup> This name differed from the name written in ink on the Oswald notice, which appeared to consist of a first name beginning with an "E" or a "G" and the surname "Schiffen."<sup>195</sup> However, the legibility of the name on the Oswald notice was also quite poor, and the counterfeiter might have been attempting to duplicate it. A possible reason for deleting the original name and substituting another is that if the name had not been deleted it would have been reproduced on the Hidell notice as a photographic reproduction, which would look less authentic than a pen-and-ink signature.<sup>196</sup>

Based on a comparison with the handwriting in the standards, the signature "Alek J. Hidell" on the Hidell notice was identified as being in the handwriting of Lee Harvey Oswald.<sup>197</sup> The signature "Good Hoffer" could not be positively identified, being almost illegible; however, it was not inconsistent with Oswald's handwriting.<sup>198</sup>

To complete the face of the Hidell notice a picture of Lee Harvey Oswald was inserted into the space in the lower left-hand corner which had been created by reducing the size of the printed legend at the bottom.<sup>199</sup>

In creating the face of the Hidell notice, the counterfeiter left traces which enabled the experts to link together the Hidell notice, the retouched negatives, and the Oswald notice. To retouch the nega-

**SELECTIVE SERVICE SYSTEM  
NOTICE OF CLASSIFICATION** Approval not required

**Lee Harvey OSWALD**  
(First name) (Middle name) (Last name)

Selective Service No. **11 111 39 532** has  
been classified in Class **IV-A** (Unclassified)

19... by  Local Board  Appeal Board  
by vote of  Unanimous  2/3 Majority  1/2 Majority

**FEB 2 1960** 19...  
(Date of mailing) (Classification or date of hearing)

The law requires you, subject to heavy penalty for violation, to carry this notice, in addition to your Registration Certificate, on your person at all times—to exhibit it upon request to authorized officials—to surrender it to your commanding officer upon leaving the armed forces.  
The law requires you to notify your local board in writing (1) of every change in your address, physical condition, and occupational, marital, family, dependency, and military status, and (2) of any other fact which might change your classification.  
FOR ADVICE, SEE YOUR GOVERNMENT-APPEAL AGENT.

Selective Service System  
**Texas Local Board No. 114  
Selective Service System**

**300 W. Vickory, Bldg. 2227  
Fort Worth 4, Texas**  
(LOCAL BOARD STAMP)  
**OFFICIAL BUSINESS**

Lee Harvey  
312 1/2 West  
Fort Worth

3013

Face and reverse sides of the Oswald Notice of Classification.

CADIGAN EXHIBIT No. 19

**SELECTIVE SERVICE SYSTEM  
REGISTRATION CERTIFICATE** FORM FIVE No. 2  
(Rev. 3-20-59)  
Approval not required

THIS IS TO CERTIFY THAT IN ACCORDANCE WITH THE SELECTIVE SERVICE LAW  
**Lee Harvey OSWALD**  
(FIRST NAME) (MIDDLE NAME) (LAST NAME)

Selective Service No. **11 111 39 532**  
312 1/2 West 5th St.

RESIDENCE AT REGISTRATION  
**Fort Worth 7 Tarrant Tex.**  
Oct. 18, 1939 (Date of Birth) **New Orleans, La.**  
(Place of Birth)

HAS DULY REGISTERED ON THE **11** DAY OF **Sept.** 19 **59**  
(Date of Mailing) (Classification or Date of Hearing)

W. J. Burgeo

COLOR OF EYES **Blue** COLOR OF HAIR **Brn.**

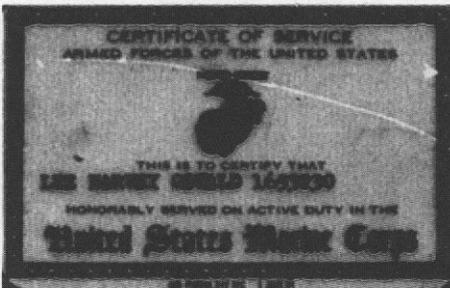
COMPLEXION **Med.**

HEIGHT **5** FT. **11** IN. WEIGHT **150**

**TEXAS LOCAL BOARD NO. 114  
SELECTIVE SERVICE SYSTEM  
RM 2000 300 W. VICKORY ST.  
FORT WORTH 4, TEXAS**

(LOCAL BOARD STAMP)

THE LAW REQUIRES YOU TO HAVE THIS CERTIFICATE IN YOUR PERSONAL POSSESSION AT ALL TIMES FOR IDENTIFICATION AND TO NOTIFY YOUR LOCAL BOARD OF ANY CHANGE OF ADDRESS. GPO: 1959-O-361468



PERIOD OF ACTIVE DUTY

FROM **24 October 1955**

TO **11 September 1959**

SIGNATURE OF INDIVIDUAL  
*Lee Harvey Oswald*

SIGNATURE OF COMMANDING OFFICER (Typed name and grade)  
**L. J. JAMES**

Face and reverse sides of the Oswald Selective Service System Registration Certificate and the Oswald Certificate of Service in the U.S. Marine Corps.

CADIGAN EXHIBIT No. 21

**SELECTIVE SERVICE SYSTEM  
NOTICE OF CLASSIFICATION** Approval not required

**ALEX JAMES HIDELL**  
(First name) (Middle name) (Last name)

Selective Service No. **42 229 25 22** has  
 been classified in Class **1-A** (Class) (Units) (Status)  
 19... by  Local Board  Appeal Board,  
 by vote of  President

19... (Date of mailing) (Month or class of mail)

The law requires that notice of draft proceedings be given to all males of draftable age in the United States... The law requires you to appear before local board in writing... For advice, see your Government Appeal Agent.



COLOR OF EYES **BLU** COLOR OF HAIR **BRN**

COMPLEXION **Fair**

HEIGHT **5 FT 11 IN** WEIGHT **150 LB**

**LOCAL BOARD BOARD**

**THE LAW REQUIRES YOU TO HAVE THIS CERTIFICATE IN YOUR PERSONAL POSSESSION AT ALL TIMES FOR IDENTIFICATION AND TO NOTIFY YOUR LOCAL BOARD OF ANY CHANGE OF ADDRESS.**

SP-100-O-201880

Face and reverse sides of the Hidell Selective Service System Notice of Classification.

**CERTIFICATE OF SERVICE  
ARMED FORCES OF THE UNITED STATES**

**UNITED STATES MARINE CORPS**

THIS IS TO CERTIFY THAT  
**Alex JAMES HIDELL**  
 HONORABLY SERVED ON ACTIVE DUTY IN THE  
**United States Marine Corps**

DD FORM 133 (Rev. 1-1-58)

**PERIOD OF ACTIVE DUTY**

FROM **Oct. 15 1958**

TO **APR 1 1961**

SIGNATURE OF INDIVIDUAL **[Signature]** **78**

SIGNATURE OF CERTIFYING OFFICER (Typed name and grade)  
**A. B. ATKINS Lt. JGMC**

If found, drop in mail box. Postmaster: Postage guaranteed. Return to Commandant of the 4th Marine Depot (Code 4021), Washington 25, D. C.

SP-100-O-201880

Face and reverse sides of the Hidell Certificate of Service in the U.S. Marine Corps.

CADIGAN EXHIBITS NOS. 15 AND 16

tives the counterfeiter simply painted a red opaque substance on one side of the negative over the material he wished to delete. When the negative was printed, the opaquing prevented light from passing through, so that the print showed blanks wherever the negative had been opaqued. However, the original material was still clearly visible on the negative itself.<sup>200</sup> In addition, at several points the typed or handwritten material in the Oswald notice had overlapped the printed material. For example, the signature of the official of the local board overlapped the letters "re" in the printed word "President," "l" and "a" in the printed word "local," and "viola" in the printed word "violation." When this signature was opaqued out, the portions of the printed material which had been overlapped by the signature were either removed or mutilated. The consequent distortions were apparent on both the retouched negative and the Hidell notice itself. Similarly, the selective service number typed on the Oswald notice overlapped the margins of the boxes into which it was typed. Although the counterfeiter opaqued out the numerals themselves, the margins of the boxes remained thickened at the points where they had been overlapped by the numerals. These thickened margins were apparent on both the retouched negative and the Hidell notice.<sup>201</sup>

*Reverse side.*—The reverse side of the Hidell notice, which was pasted back-to-back to the face, was actually a form of the reverse side of a Selective Service System registration certificate. Essentially, it was counterfeited the same way as the face of the notice: a photograph was made of the reverse side of the Oswald registration certificate, the material which had been typed or stamped on the Oswald registration certificate was opaqued out of the resulting negative, and a photographic print was made from the retouched negative. This is shown by the negative, in which the opaqued-out information is still visible, and by defects in the printed material on the Hidell notice at point where typed-in material had overlapped printed material on the Oswald registration certificate.<sup>202</sup>

As the final step, new information was typed on the print in the blanks which resulted from the retouching operation.<sup>203</sup> Thus "GR" was substituted for "Blue" under color of eyes; "BROWN" was substituted for "Brn" under color of hair; "FAIR" was substituted for "Med." under complexion; "5" [ft.] "9" [in.] was substituted for "5" [ft.] "11" [in.] under height; and "155" was substituted for "150" under weight. The name and address of the local board on the Oswald registration certificate were opaqued out, but substantially the same name and address were typed back onto the Hidell notice.<sup>204</sup> As in the signature of the local board official on the face of the notice, a possible reason for deleting the original draft board name and the address and substituting substantially similar material in its place is that if the original material had not been deleted it would have reproduced as a photographic reproduction, which would look much less authentic than typed-in material.<sup>205</sup>

A limited number of typed uninked indentations are also present. Thus the indented letters "CT" appear before the letters "GR" (under

color of eyes) and the indented letters "EY" follow "GR." An indented "9" appears above the visible "9" for the inch figure of height, and an indented "i" appears before the weight, "155." Much of the typed material on the reverse side of the Hidell notice was not very legible under ordinary lighting, since it was typed with a typewriter which left a very weakly inked impression.<sup>206</sup> In fact, it is difficult to tell whether some of the material, particularly the word "Brown" under color of hair, was put in by stencil or by ribbon.

### The Hidell Certificate of Service

The face and reverse side of the Hidell certificate of service were produced from the face and reverse side of the Oswald certificate of service<sup>207</sup> by photographing the Oswald certificate, retouching the resulting negatives to eliminate typed and handwritten material, and making a photographic print from the retouched negative.<sup>208</sup> As in the case of the notice of classification, this is shown by the negative itself, in which the opaqued-out information is still visible, and by defects in the printed material on the Hidell certificate at points where handwritten material had crossed over printed material on the Oswald certificate. Thus, in the Oswald certificate the upper portion of the name "Lee" in Oswald's signature crosses the letter "u" in the printed word "signature." The consequent mutilation of the printed letter "u" can be seen on the Hidell certificate. Similarly, the ending stroke in the letter "y" in the name "Harvey" in Oswald's signature crosses the letter "n" in the printed word "certifying." This stroke was not removed at all, and can be seen as a stroke across the "n" in the Hidell certificate.<sup>209</sup> As the final step in producing the Hidell certificate, new material was typed into the blanks on the photographic print. On the face, the words "ALEK JAMES HIDE LL" were typed into the blank where "LEE HARVEY OSWALD 1653230" had appeared. A sidelight photograph shows that these words had been typed in stencil at least twice before being typed in with the ribbon apparently to determine proper centering and alinement.<sup>210</sup> In producing the reverse side of the Hidell certificate, the signature "Lee Harvey Oswald," and the dates "24 October 1956" and "11 September 1959," showing the beginning and end of the period of active service, had been opaqued out. No signature was inserted into resulting blank signature space. However, just below the word "of" in the printed line "signature of individual," there are two vertical indentations which fill about three-fourths of the height of the signature blank, and a diagonal indentation which slants from approximately the base of the left vertical to approximately the midpoint of the right vertical—the total effect being of a printed capital letter "H." Also, just below the second and third "i's" in the printed word "individual" are two more vertical indentations, which could be the vertical strokes of "d's" or "l's"—although the circular portion of the letter "d" is not present.<sup>211</sup> These indentations could have been made by any sharp instrument, such as a ballpoint pen which was not

delivering ink, a stylus of the type used in preparing mimeograph forms, or even a toothpick.<sup>212</sup> The indentations are brought out rather clearly in a sidelight photograph, but can also be seen on the card itself if the card is held so that light strikes it at an angle.<sup>213</sup>

Into the space for the beginning of active service was typed the date "OCT. 13 1958." The space for the end of active service contains several light-impression and stencil typewriting operations. It was apparently intended to read "OCT. 12 1961," but because of the lightness of the impression and the many stenciled characters, the date is barely legible.<sup>214</sup> Interestingly, one of the stenciled impressions in the blank for end of active service reads "24 October 1959," as determined under a microscope, while a stenciled impression in the blank for beginning of active service reads "24 October 1957."<sup>215</sup>

The counterfeiting of the Hidell cards did not require great skill, but probably required an elementary knowledge of photography, particularly of the photographic techniques used in a printing plant.<sup>216</sup> A moderate amount of practice with the technique would be required—perhaps half a dozen attempts. Practicing retouching on the balance of the negatives found at the Paine garage would have been sufficient.<sup>217</sup> The retouching of the negatives could have been accomplished without any special equipment. However, the preparation of the negative, apart from retouching, would probably have required a very accurate camera, such as would be found in a photographic laboratory or printing plant.<sup>218</sup>

### The Vaccination Certificate

A government-printed form entitled "International Certificates of Vaccination or Revaccination against Smallpox"<sup>219</sup> was found among Oswald's belongings at his room at 1026 Beckley Avenue, Dallas.<sup>220</sup> The form purported to certify that "LEE OSWALD" had been vaccinated against smallpox on "JUNE 8, 1963" by "DR. A. J. HIDEEL, P.O. BOX 30016, NEW ORLEANS, LA." The card was signed "Lee H. Oswald" and "A. J. Hideel," and the name and address "Lee H. Oswald, New Orleans, La." were hand printed on the front of the card. All of this material, except the signatures and the hand printing, had been stamped onto the card. The Hideel name and address consisted of a three-line stamp—"DR. A. J. HIDEEL/P.O. BOX 30016/NEW ORLEANS, LA." A circular, stamped, illegible impression resembling a seal appeared under a column entitled "Approved stamp."<sup>221</sup>

On the basis of a comparison with the standards, Cole identified all of the handwriting on the vaccination certificate, including the signature "A. J. Hideel," as the writing of Lee Harvey Oswald.<sup>222</sup> Cadigan identified all of the writing as Oswald's except for the "A. J. Hideel" signature, which in his opinion was too distorted to either identify or nonidentify as Oswald's handwriting.<sup>223</sup> The stamped material on the certificate was compared with a rubber stamping kit which be-

longed to Oswald.<sup>224</sup> In this kit was a rubber stamp with three lines of print assembled: "L. H. OSWALD/4907 MAGAZINE ST/NEW ORLEANS, LA."<sup>225</sup> Cole found a perfect agreement in measurement and design between the letters stamped on the certificate and the letters he examined from Oswald's rubber stamping kit. However, he was unable to determine whether the characteristics of Oswald's rubber stamping kit were distinctive, and therefore, while he concluded that Oswald's rubber stamping kit could have made the rubber stamp impressions on the certificate, he was unable to say that it was the only kit which could have made the impressions.<sup>226</sup> On the basis of the comparison between the words "NEW ORLEANS, LA." set up in the rubber stamp in Oswald's kit, and the words "NEW ORLEANS, LA." on the certificate, Cadigan concluded that these words had been stamped on the certificate with Oswald's rubber stamp. However, he could draw no conclusion as to the remaining stamped material, which was not directly comparable to the remaining lines set up on Oswald's rubber stamp.<sup>227</sup>

On close examination, the circular impression resembling a seal consisted of the words "BRUSH IN CAN," printed in reverse.<sup>228</sup> Apparently, the impression was made with the top of a container of solvent or cleaning fluid which bore these words in raised lettering. In the center of the impression was a mottled pattern which was similar to the blank areas on a date stamp found in Oswald's rubber stamping kit.<sup>229</sup>

#### The Fair Play for Cuba Committee Card

The Fair Play for Cuba Committee card had two signatures: "L. H. Oswald" and "A. J. Hidell." Based on the standards, both Cole and Cadigan identified "L. H. Oswald" as the signature of Lee Harvey Oswald,<sup>230</sup> but both were unable to identify the "A. J. Hidell" signature.<sup>231</sup> Cadigan noted differences between the Hidell signature and Oswald's handwriting, indicating the possibility that someone other than Oswald had authored the signature.<sup>232</sup> Cole believed that the signature was somewhat beyond Oswald's abilities as a penman.<sup>233</sup> On the basis of a short English interlinear translation written by Marina Oswald, Cole felt that she might have been the author of the signature,<sup>234</sup> but the translation did not present enough of her handwriting to make possible a positive identification.<sup>235</sup> In subsequent testimony before the Commission, Marina stated that she was indeed the author of the Hidell signature on the card.<sup>236</sup> Cadigan confirmed this testimony by obtaining further samples of Marina Oswald's handwriting and comparing these samples with the signature on the card.<sup>237</sup>

#### The Unsigned Russian-Language Note

Cadigan's examination confirmed Marina's testimony that the handwriting in the unsigned note, Commission Exhibit No. 1, was that of

Lee Harvey Oswald.<sup>238</sup> Since the note was written almost entirely in the Russian language, which uses the Cyrillic alphabet (as opposed to the Latin alphabet used in the English language), in making his examination Cadigan employed not only Oswald's English language standards, but also letters written by Oswald in the Russian language.<sup>239</sup>

### The Homemade Wrapping Paper Bag

In the absence of watermarks or other distinctive characteristics, it is impossible to determine whether two samples of paper came from the same manufacturer.<sup>240</sup> The homemade paper bag found on the sixth floor of the Texas School Book Depository following the assassination was made out of heavy brown paper and glue-bearing brown paper tape, neither of which contained watermarks or other distinctive characteristics.<sup>241</sup> However, Cadigan compared the questioned paper and tape in the paper bag with known paper and tape samples obtained from the shipping department of the Texas School Book Depository on November 22, 1963, to see if the questioned items could have come from the shipping room.<sup>242</sup> The questioned and known items were examined visually by normal, incidental, and transmitted natural and electric light, and under ultraviolet light; <sup>243</sup> examined microscopically for surface, paper structure, color, and imperfections; <sup>244</sup> examined for their felting pattern, which is the pattern of light and dark areas caused by the manner in which the fibers become felted at the beginning stages of paper manufacture; <sup>245</sup> measured for thickness with a micrometer sensitive to one one-thousandth of an inch,<sup>246</sup> subjected to a fiber analysis to determine the type of fibers of which they were composed, and whether the fibers were bleached or unbleached; <sup>247</sup> and examined spectrographically to determine what metallic ions were present.<sup>248</sup> The questioned and known items were identical in all the properties measured by these tests.<sup>249</sup> (The width of the tape on the paper sack was 3 inches, while the width of the sample tape was 2.975, or twenty-five thousandths of an inch smaller; however, this was not a significant difference).<sup>250</sup> In contrast, a paper sample obtained from the Texas School Book Depository shipping room on December 1, 1963, was readily distinguishable from the questioned paper.<sup>251</sup>

Examination of the tape revealed other significant factors indicating that it could have come from the Texas School Book Depository shipping room. There were several strips of tape on the bag.<sup>252</sup> All but two of the ends of these strips were irregularly torn; the remaining two ends had machine-cut edges. This indicated that the person who made the bag had drawn a long strip of tape from a dispensing machine and had torn it by hand into several smaller strips.<sup>253</sup> Confirmation that the tape had been drawn from a dispensing machine was supplied by the fact that a series of small markings in the form of half-inch lines ran down the center of the tape like ties on a railroad track. Such lines are made by a ridged wheel in a tape dispenser which is constructed so that when a hand lever is pulled, the wheel, which is

connected to the lever, pulls the tape from its roll and dispenses it. Such dispensers are usually found only in commercial establishments. A dispenser of this type was located in the Texas School Book Depository shipping room. The length of the lines and the number of lines per inch on the tape from the paper bag was identical to the length of the lines and the number of lines per inch on the tape obtained from the dispenser in the Texas School Book Depository shipping room.<sup>254</sup>

## WOUND BALLISTICS EXPERIMENTS

### Purpose of the Tests

During the course of the Commission's inquiry, questions arose as to whether the wounds inflicted on President Kennedy and Governor Connally could have been caused by the Mannlicher-Carcano rifle found on the sixth floor of the Texas School Book Depository Building and Western Cartridge Co. bullets and fragments of the type found on the Governor's stretcher and in the Presidential limousine. In analyzing the trajectory of the bullets after they struck their victims, further questions were posed on the bullet's velocity and penetration power after exiting from the person who was initially struck. To answer these and related questions, the Commission requested that a series of tests be conducted on substances resembling the wounded portions of the bodies of President Kennedy and Governor Connally under conditions which simulated the events of the assassination.

### The Testers and Their Qualifications

In response to the Commission's request, an extensive series of tests were conducted by the Wound Ballistics Branch of the U.S. Army Chemical Research and Development Laboratories at Edgewood Arsenal, Md. Scientists working at that branch are engaged in full-time efforts to investigate the wound ballistics of missiles in order to test their effects on substances which simulate live human bodies.<sup>255</sup> The tests for the Commission were performed by Dr. Alfred G. Olivier under the general supervision of Dr. Arthur J. Dziemian with consultation from Dr. Frederick W. Light, Jr.<sup>256</sup> Dr. Olivier received his doctorate in veterinary medicine from the University of Pennsylvania in 1953. Since 1957 he has been engaged in research on wound ballistics at Edgewood Arsenal and is now chief of the Wound Ballistics Branch.<sup>257</sup> His supervisor, Dr. Dziemian, who is chief of the Biophysics Division at Edgewood Arsenal, holds a Ph. D. degree from Princeton in 1939, was a national research fellow in physiology at the University of Pennsylvania and was a fellow in anatomy at Johns Hopkins University Medical School.<sup>258</sup> Since 1947, Dr. Dziemian has been continuously engaged in wound ballistics work at Edgewood Arsenal.<sup>259</sup> In 1930, Dr. Light was awarded an M.D. degree from

Johns Hopkins Medical School and in 1948 received his Ph. D. from the same institution.<sup>260</sup> After serving a residency in pathology, he worked as a pathologist until 1940 when he returned to Johns Hopkins University to study mathematics. Since 1951, Dr. Light has been engaged in the study of the pathology of wounding at Edgewood Arsenal.<sup>261</sup> All three of these distinguished scientists testified before the Commission.

### General Testing Conditions

The Commission made available to the Edgewood Arsenal scientists all the relevant facts relating to the wounds which were inflicted on President Kennedy and Governor Connally including the autopsy report on the President, and the reports and X-rays from Parkland Hospital.<sup>262</sup> In addition, Drs. Olivier and Light had an opportunity to discuss in detail the Governor's wounds with the Governor's surgeons, Drs. Robert R. Shaw and Charles F. Gregory.<sup>263</sup> The Zapruder films of the assassination were viewed with Governor and Mrs. Connally to give the Edgewood scientists their version.<sup>264</sup> The Commission also provided the Edgewood scientists with all known data on the source of the shots, the rifle and bullets used, and the distances involved. For purposes of the experiments, the Commission turned over to the Edgewood testers the Mannlicher-Carcano rifle found on the sixth floor of the Depository Building.<sup>265</sup> From information provided by the Commission, the Edgewood scientists obtained Western bullets of the type used by the assassin.<sup>266</sup>

### Tests on Penetration Power and Bullet Stability

Comparisons were made of the penetrating power of Western bullets fired from the assassination rifle with other bullets.<sup>267</sup> From the Mannlicher-Carcano rifle, the Western bullet was fired through two gelatin blocks totaling 72½ centimeters in length.<sup>268</sup> As evidenced by Commission Exhibit No. 844, which is a photograph from a high-speed motion picture, the Western bullets passed through 1½ blocks in a straight line before their trajectory curved.<sup>269</sup> After coming out of the second gelatin block, a number of the bullets buried themselves in a mound of earth.<sup>270</sup>

Under similar circumstances, a bullet described as the NATO round M-80 was fired from a M-14 rifle.<sup>271</sup> The penetrating power of the latter is depicted in Commission Exhibit No. 845 which shows that bullet possesses much less penetrating power with a quicker tumbling action. Those characteristics cause an early release of energy which brings the bullet to a stop at shorter distances.<sup>272</sup> A further test was made with a 257 Winchester Roberts soft-nosed hunting bullet as depicted in Commission Exhibit No. 846. That bullet became deformed almost immediately upon entering the block of gelatin and released its energy very rapidly.<sup>273</sup> From these tests, it was concluded that the Western bullet fired from the Mannlicher-Carcano had "terrific penetrating ability" and would retain substantial veloc-

ity after passing through objects such as the portions of the human body.<sup>274</sup>

### Tests Simulating President Kennedy's Neck Wound

After reviewing the autopsy report on President Kennedy, the Edgewood scientists simulated the portion of the President's neck through which the bullet passed. It was determined that the bullet traveled through 13½ to 14½ centimeters of tissue in the President's neck.<sup>275</sup> That substance was simulated by constructing three blocks: one with a 20-percent gelatin composition, a second from one animal meat and a third from another animal meat.<sup>276</sup> Those substances duplicated as closely as possible the portion of the President's neck through which the bullet passed.<sup>277</sup> At the time the tests were conducted, it was estimated that the President was struck at a range of approximately 180 feet, and the onsite tests which were conducted later at Dallas established that the President was shot through the neck at a range of 174.9 feet to 190.8 feet.<sup>278</sup> At a range of 180 feet, the Western bullets were fired from the assassination weapon, which has a muzzle velocity of approximately 2,160 feet per second, through those substances which were placed beside a break-type screen for measuring velocity.<sup>279</sup> The average entrance velocity at 180 feet was 1,904 feet per second.<sup>280</sup>

To reconstruct the assassination situation as closely as possible both sides of the substances were covered with material and clipped animal skin to duplicate human skin.<sup>281</sup> The average exit velocity was 1,779 feet from the gelatin, 1,798 feet from the first animal meat and 1,772 feet from the second animal meat.<sup>282</sup> Commission Exhibit No. 847 depicts one of the animal meats compressed to 13½ to 14½ centimeters to approximate the President's neck and Commission Exhibit No. 848 shows the analogous arrangement for the gelatin.<sup>283</sup> The photograph marked Commission Exhibit No. 849 shows the bullet passing through the gelatin in a straight line evidencing very stable characteristics.<sup>284</sup>

Commission Exhibit No. 850 depicts the pieces of clipped animal skin placed on the points of entry and exit showing that the holes of entrance are round while the holes of exit are "a little more elongated."<sup>285</sup> From these tests, it was concluded that the bullet lost little of its velocity in penetrating the President's neck so that there would have been substantial impact on the interior of the Presidential limousine or anyone else struck by the exiting bullet. In addition, these tests indicated that the bullet had retained most of its stability in penetrating the President's neck so that the exit hole would be only slightly different from the appearance of the entry hole.<sup>286</sup>

### Tests Simulating Governor Connally's Chest Wounds

To most closely approximate the Governor's chest injuries, the Edgewood scientists shot an animal with the assassination weapon

using the Western bullets at a distance of 210 feet.<sup>287</sup> The onsite tests later determined that the Governor was wounded at a distance of 176.9 feet to 190.8 feet from the sixth-floor window at the southeast corner of the Depository Building.<sup>288</sup> The average striking velocity of 11 shots at 210 feet was 1,929 feet per second and the average exit velocity was 1,664 feet per second.<sup>289</sup>

One of the shots produced an injury on the animal's rib very similar to that inflicted on Governor Connally.<sup>290</sup> For purposes of comparison with the Governor's wound, the Edgewood scientists studied the Parkland Hospital report and X-rays, and they also discussed these wounds with Dr. Shaw, the Governor's chest surgeon.<sup>291</sup> The similar animal injury passed along the animal's eighth left rib causing a fracture which removed a portion of the rib in a manner very similar to the wound sustained by the Governor.<sup>292</sup> The X-ray of that wound on the animal is reproduced as Commission Exhibit No. 852.<sup>293</sup> A comparison with the Governor's chest wound, shown in X-ray marked as Commission Exhibit No. 681, shows the remarkable similarity between those two wounds.<sup>294</sup>

The bullet which produced the wound depicted in Commission Exhibits Nos. 851 and 852 was marked as Commission Exhibit No. 853 and possessed characteristics very similar to the bullet marked as Commission Exhibit No. 399 found on Governor Connally's stretcher and believed to have been the bullet which caused his chest wound.<sup>295</sup> Those bullets, identified as Commission Exhibits Nos. 399 and 853, were flattened in similar fashion.<sup>296</sup> In addition, the lead core was extruded from the rear in the same fashion on both bullets.<sup>297</sup> One noticeable difference was that the bullet identified as Commission Exhibit No. 853, which penetrated the animal, was somewhat more flat than Commission Exhibit No. 399 which indicated that Commission Exhibit No. 853 was probably traveling at somewhat greater speed than the bullet which penetrated the Governor's chest.<sup>298</sup> After the bullet passed through the animal, it left an imprint on the velocity screen immediately behind the animal which was almost the length of the bullet indicating that the bullet was traveling sideways or end over end.<sup>299</sup> Taking into consideration the extra girth on the Governor, the reduction in the velocity of the bullet passing through his body was estimated at 400 feet.<sup>300</sup> The conclusions from the animal shots are significant when taken in conjunction with the experiments performed simulating the injuries to the Governor's wrist.

### Tests Simulating Governor Connally's Wrist Wounds

Following procedures identical to those employed in simulating the chest wound, the wound ballistics experts from Edgewood Arsenal reproduced, as closely as possible, the Governor's wrist wound. Again the scientists examined the reports and X-rays from Parkland Hospital and discussed the Governor's wrist wound with the attending orthopedic surgeon, Dr. Charles F. Gregory.<sup>301</sup> Bone structures were then shot with Western bullets fired from the assassination

weapon at a distance of 210 feet.<sup>302</sup> The most similar bone-structure shot was analyzed in testimony before the Commission. An X-ray designated as Commission Exhibit No. 854 and a photograph of that X-ray which appears as Commission Exhibit No. 855 show a fracture at a location which is very similar to the Governor's wrist wound depicted in X-rays marked as Commission Exhibits Nos. 690 and 691.<sup>303</sup>

The average striking velocity of the shots was 1,858 feet per second.<sup>304</sup> The average exit velocity was 1,786 feet per second for the 7 out of 10 shots from bone structures which could be measured.<sup>305</sup> These tests demonstrated that Governor Connally's wrist was not struck by a pristine bullet, which is a missile that strikes an object before hitting anything else.<sup>306</sup> This conclusion was based on the following factors: (1) Greater damage was inflicted on the bone structure than that which was suffered by the Governor's wrist; <sup>307</sup> and (2) the bone structure had a smaller entry wound and a larger exit wound which is characteristic of a pristine bullet as distinguished from the Governor's wrist which had a larger wound of entry indicating a bullet which was tumbling with substantial reduction in velocity.<sup>308</sup> In addition, if the bullet found on the Governor's stretcher (Commission Exhibit No. 399) inflicted the wound on the Governor's wrist, then it could not have passed through the Governor's wrist had it been a pristine bullet, for the nose would have been considerably flattened, as was the bullet which struck the bone structure, identified as Commission Exhibit No. 856.<sup>309</sup>

### Conclusions From Simulating the Neck, Chest, and Wrist Wounds

Both Drs. Olivier and Dziemian expressed the opinion that one bullet caused all the wounds on Governor Connally.<sup>310</sup> The wound to the Governor's wrist was explained by circumstances where the bullet passed through the Governor's chest, lost substantial velocity in doing so, tumbled through the wrist, and then slightly penetrated the Governor's left thigh.<sup>311</sup> Thus, the results of the wound ballistics tests support the conclusions of Governor Connally's doctors that all his wounds were caused by one bullet.<sup>312</sup>

In addition, the wound ballistics tests indicated that it was most probable that the same bullet passed through the President's neck and then proceeded to inflict all the wounds on the Governor. That conclusion was reached by Drs. Olivier and Dziemian based on the medical evidence on the wounds of the President and the Governor and the tests they performed.<sup>313</sup> It was their opinion that the wound on the Governor's wrist would have been more extensive had the bullet which inflicted that injury merely passed through the Governor's chest exiting at a velocity of approximately 1,500 feet per second.

Thus, the Governor's wrist wound indicated that the bullet passed through the President's neck, began to yaw in the air between the President and the Governor, and then lost substantially more velocity than 400 feet per second in passing through the Governor's chest.<sup>314</sup> A bullet which was yawing on entering into the Governor's back would lose substantially more velocity in passing through his body than a pristine bullet.<sup>315</sup> In addition, the greater flattening of the bullet that struck the animal's rib (Commission Exhibit No. 853) than the bullet which presumably struck the Governor's rib (Commission Exhibit No. 399) indicates that the animal bullet was traveling at a greater velocity.<sup>316</sup> That suggests that the bullet which entered the Governor's chest had already lost velocity by passing through the President's neck.<sup>317</sup> Moreover, the large wound on the Governor's back would be explained by a bullet which was yawing although that type of wound might also be accounted for by a tangential striking.<sup>318</sup>

Dr. Frederick W. Light, Jr., the third of the wound ballistics experts, testified that the anatomical findings alone were insufficient for him to formulate a firm opinion on whether the same bullet did or did not pass through the President's neck first before inflicting all the wounds on Governor Connally.<sup>319</sup> Based on the other circumstances, such as the relative positions in the automobile of the President and the Governor, Dr. Light concluded that it was probable that the same bullet traversed the President's neck and inflicted all the wounds on Governor Connally.<sup>320</sup>

### Tests Simulating President Kennedy's Head Wounds

Additional tests were performed on inert skulls filled with a 20 percent gelatin substance and then coated with additional gelatin to approximate the soft tissues overlying the skull.<sup>321</sup> The skull was then draped with simulated hair as depicted in Commission Exhibit No. 860.<sup>322</sup> Using the Mannlicher-Carcano rifle and the Western bullets, 10 shots were fired at the reconstructed skulls from a distance of 270 feet which was the estimated distance at the time those tests were conducted.<sup>323</sup> It was later determined through the onsite tests that President Kennedy was struck in the back of the head at a distance of 265.3 feet from the assassination weapon.<sup>324</sup>

The general results of these tests were illustrated by the findings on one skull which was struck at a point most nearly approximating the wound of entry on President Kennedy's head.<sup>325</sup> The whole skull, depicted in Commission Exhibit No. 860, was struck 2.9 centimeters to the right and almost horizontal to the occipital protuberance or slightly above it, which was virtually the precise point of entry on the President's head as described by the autopsy surgeons.<sup>326</sup> That bullet blew out the right side of the reconstructed skull in a manner very similar to the head wounds of the President.<sup>327</sup> The consequences on that skull are depicted in Commission Exhibits Nos. 861 and 862, which illustrate the testimony of Dr. Alfred G. Olivier, who supervised the experiments.<sup>328</sup> Based on his review of the autopsy report,

Dr. Olivier concluded that the damage to the reconstructed skull was very similar to the wound inflicted on the President.<sup>329</sup>

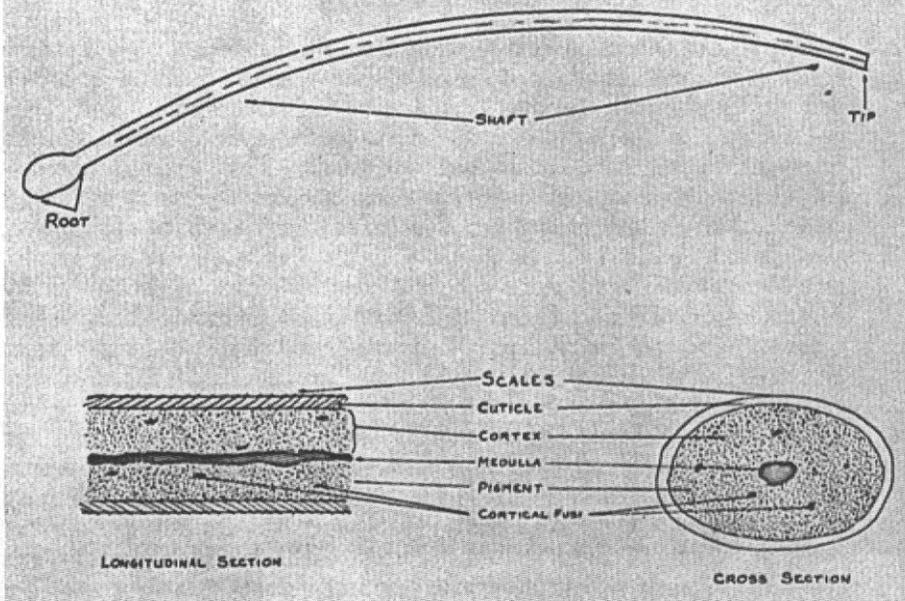
Two fragments from the bullet which struck the test skull closely resembled the two fragments found in the front seat of the Presidential limousine. The fragment designated as Commission Exhibit No. 567 is a mutilated piece of lead and copper very similar to a mutilated piece of copper recovered from the bullet which struck the skull depicted in Commission Exhibit No. 860. The other fragment, designated as Commission Exhibit No. 569 which was found in the front seat of the Presidential limousine, is the copper end of the bullet.<sup>330</sup> Commission Exhibit No. 569 is very similar to a copper fragment of the end of the bullet which struck the test skull.<sup>331</sup> The fragments from the test bullet are designated as Commission Exhibit No. 857 and are depicted in a photograph identified as Commission Exhibit No. 858.<sup>332</sup> A group of small lead particles, recovered from the test bullet, are also very similar to the particles recovered under the left jump seat and in the President's head. The particles from the test bullet are a part of Commission Exhibit No. 857 and are depicted in photograph designated as Commission Exhibit No. 859.<sup>333</sup> That skull was depicted as Commission Exhibit No. 862.<sup>334</sup>

As a result of these tests, Dr. Olivier concluded that the Western bullet fired from the Mannlicher-Carcano rifle at a distance of 270 feet would make the same type of wound found on the President's head.<sup>335</sup> Prior to the tests, Dr. Olivier had some doubt that such a stable bullet would cause a massive head wound like that inflicted on the President.<sup>336</sup> He had thought it more likely that such a striking bullet would make small entrance and exit holes.<sup>337</sup> The tests, however, showed that the bones of the skull were sufficient to deform the end of the bullet causing it to expend a great deal of energy and thereby blow out the side of the skull.<sup>338</sup> These tests further confirmed the autopsy surgeons' opinions that the President's head wound was not caused by a dum-dum bullet.<sup>339</sup> Because of the test results, Dr. Olivier concluded that the fragments found on and under the front seat of the President's car most probably came from the bullet which struck the President's head.<sup>340</sup> It was further concluded that the damage done to Governor Connally's wrist could not have resulted from a fragment from the bullet which struck President Kennedy's head.<sup>341</sup>

## HAIRS AND FIBERS

Testimony on hairs and fibers was given by Paul M. Stombaugh<sup>342</sup> of the FBI. Stombaugh has been a specialist in hairs and fibers since 1960, when he began a 1-year period of specialized training in this field. He has made thousands of hair and fiber examinations, and has testified in Federal and State courts in approximately 28 States.<sup>343</sup> Stombaugh examined and gave testimony on the following objects: (1) The green and brown blanket found in the Paine's garage, Commission Exhibit No. 140; (2) the homemade paper bag found on the sixth floor

# DIAGRAM OF A HAIR



COMMISSION EXHIBIT No. 666

of the Texas School Book Depository following the assassination, Commission Exhibit No. 142; (3) the shirt worn by Oswald on November 22, 1963, Commission Exhibit No. 150; and (4) the C2766 rifle, Commission Exhibit No. 139.

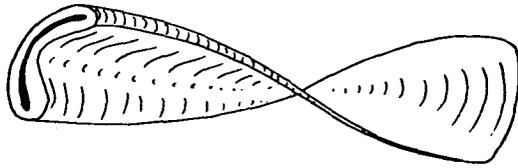
### General Principles

*Hairs.*—As shown in Commission Exhibit No. 666 (p. 587), a hair consists of a central shaft of air cells, known as the medulla; a cortex containing pigment granules (which give the hair its color) and cortical fusi (air spaces); and a cuticle and an outer layer of scales. Unlike fingerprints, hairs are not unique. However, human hairs can be distinguished from animal hairs by various characteristics, including color, texture, length, medullary structure and shape, shape of pigment, root size, and scale size. In addition, hairs of the Caucasian, Negroid, and Mongoloid human races can be distinguished from each other by color, texture, size and degree of fluctuation of diameter, thickness of cuticle, shape and distribution of pigment, and shape of cross-section. Moreover, even though individual hairs are not unique, the expert usually can distinguish the hairs of different individuals. Thus, Stombaugh, who had made approximately 1,000 comparison examinations of Caucasian hairs and 500 comparison examinations of Negroid hairs, had never found a case in which he was unable to differentiate the hairs of two different Caucasian individuals, and had found only several cases in which he could not distinguish, with absolute certainty, between the hairs of two different Negroid individuals.<sup>344</sup>

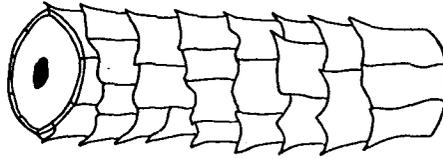
*Fibers.*—Like hairs, the various types of natural and artificial fibers can be distinguished from each other under the microscope. Like hairs too, individual fibers are not unique, but the expert usually can distinguish fibers from different fabrics. A major identifying characteristic of most fibers is color, and under the microscope many different shades of each color can be differentiated—for example, 50–100 shades of green or blue, and 25–30 shades of black. The microscopic appearance of three types of fibers—cotton, wool, and viscose—is illustrated in Commission Exhibit No. 665 (p. 589). Two of these, cotton and viscose, were the subject of testimony by Stombaugh. Cotton is a natural fiber. Under the microscope, it resembles a twisted soda straw, and the degree of twist is an additional identifying characteristic of cotton. Cotton may be mercerized or (more commonly) unmercerized. Viscose is an artificial fiber. A delustering agent is usually added to viscose to cut down its luster, and under the microscope this agent appears as millions of tiny spots on the outside of the fiber. The major identifying characteristics of viscose, apart from color, are diameter—hundreds of variations being possible—and size and distribution of delustering agent, if any.<sup>345</sup>

*The blanket.*—Stombaugh received the blanket, Commission Exhibit No. 140, in the FBI Laboratory at 7:30 a.m., on November 23, 1963.<sup>346</sup> Examination showed that it was composed of brown and green fibers, of which approximately 1–2 percent were woolen, 20–35 percent

TEXTILE FIBERS



COTTON



WOOL



VISCOSE

COMMISSION EXHIBIT No. 665

were cotton, and the remainder were delustered viscose.<sup>347</sup> The viscose fibers in the blanket were of 10–15 different diameters, and also varied slightly in shade and in the size and distribution of the delustering agent. (The apparent cause of those variations was that the viscose in the blanket consisted of scrap viscose.)<sup>348</sup> The cotton also varied in shade, about seven to eight different shades of green cotton being present, but was uniform in twist.<sup>349</sup>

When received by Stombaugh, the blanket was folded into approximately the shape of a narrow right triangle.<sup>350</sup> A safety pin was inserted in one end of the blanket, and also at this end, loosely wrapped around the blanket, was a string.<sup>351</sup> On the basis of creases in the blanket in this area it appeared that the string had been tied around the blanket rather tightly at one time while something was inside the blanket.<sup>352</sup> Other creases and folds were also present, as illustrated in Commission Exhibit No. 663.<sup>353</sup> Among these was a crease or hump approximately 10 inches long.<sup>354</sup> This crease must have been caused by a hard protruding object approximately 10 inches long which had been tightly wrapped in the blanket, causing the yarn to stretch so that the hump was present even when the object had been extracted.<sup>355</sup> The hump was approximately the same length and shape as the telescopic sight on the C2766 rifle, and its position with respect to the ends of the blanket was such (based on the manner in which the blanket was folded when Stombaugh received it) that had the rifle been in the blanket the telescopic sight could have made the hump.<sup>356</sup>

The string wrapped around the blanket was made of ordinary white cotton.<sup>357</sup> It had been tied into a granny knot (a very common knot tied right over right, right over right) and the dangling ends had been further tied into a bow knot (the knot used on shoelaces).<sup>358</sup>

After receiving the blanket, Stombaugh scraped it to remove the foreign textile fibers and hairs that were present.<sup>359</sup> He found numerous foreign textile fibers of various types and colors, and a number of limb, pubic, and head hairs, all of which had originated from persons of the Caucasian race, and had fallen out naturally, as was shown by the shape of their roots.<sup>360</sup> Several of the limb and pubic hairs matched samples of Oswald's limb and pubic hairs obtained by the Dallas police in all observable characteristics, including certain relatively unusual characteristics.<sup>361</sup> For example, in both Oswald's pubic hairs and some of the blanket pubic hairs, the color was a medium brown, which remained constant to the tip, where it changed to a very light brown and then became transparent, due to lack of color pigments; the diameters were identical, and rather narrow for pubic hairs; the hairs were very smooth, lacking the knobiness characteristic of pubic hairs, and the upper two-thirds were extremely smooth for pubic hairs; the tips of the hairs were sharp, which is unusual for pubic hairs; the cuticle was very thin for pubic hairs; the scales displayed only a very small protrusion; the pigmentation was very fine, equally dispersed, and occasionally chained together, and displayed only very slight gapping; cortical fusi were for the most part absent; the medulla was either fairly continuous or completely absent; and the

root area was rather clear of pigment, and contained only a fair amount of cortical fusi, which was unusual.<sup>362</sup> Similarly, in both Oswald's limb hairs and some of the limb hairs from the blanket the color was light brown through its entire length; the diameter was very fine and did not noticeably fluctuate; the tips were very sharp, which is unusual; the scales were of medium size, with very slight protrusion; there was a very slight gapping of the pigmentation near the cuticle; there was an unusual amount of cortical fusi, equally distributed through the hair shaft; and the medulla was discontinuous, granular, very bulbous, and very uneven.<sup>363</sup>

Other limb, pubic, and head hairs on the blanket did not come from Oswald.<sup>364</sup>

*The paper bag.*—Stombaugh received the paper bag, Commission Exhibit No. 142, at 7:30 a.m. on November 23, 1963.<sup>365</sup> No foreign material was found on the outside of the bag except traces of fingerprint powder and several white cotton fibers, which were of no significance, since white cotton is the most common textile, and at any rate the fibers may have come from Stombaugh's white cotton gloves.<sup>366</sup> Inside the bag were a tiny wood fragment which was too minute for comparison purposes, and may have come from the woodpulp from which the paper was made; a particle of a waxy substance, like candle wax; and a single brown delustered viscose fiber and several light-green cotton fibers.<sup>367</sup>

The fibers found inside the bag were compared with brown viscose and green cotton fibers taken from the blanket. The brown viscose fiber found in the bag matched some of the brown viscose fibers from the blanket in all observable characteristics, i.e., shade, diameter, and size and distribution of delustering agent.<sup>368</sup> The green cotton fibers found in the bag were, like those from the blanket, of varying shades, but of a uniform twist. Each green cotton fiber from the bag matched some of the green cotton fibers from the blanket in all observable characteristics, i.e., shade and degree of twist. Like the blanket cotton fibers, the cotton fibers found in the bag were unmercerized.<sup>369</sup>

*The shirt.*—Stombaugh received the shirt, Commission Exhibit No. 150, at 7:30 a.m. on November 23, 1963.<sup>370</sup> Examination showed that it was composed of gray-black, dark blue, and orange-yellow cotton fibers.<sup>371</sup> The orange-yellow and gray-black cotton fibers were of a uniform shade, and the dark-blue fibers were of three different shades.<sup>372</sup> All the fibers were mercerized and of substantially uniform degree of twist.<sup>373</sup>

*The C2766 rifle.*—The rifle, Commission Exhibit No. 139, was received in the FBI Laboratory on the morning of November 23, 1963, and examined for foreign material at that time.<sup>374</sup> Stombaugh noticed immediately that the rifle had been dusted for fingerprints, "and at the time I noted to myself that I doubted very much if there would be any fibers adhering to the outside of this gun—I possibly might find some in a crevice some place—because when the latent fingerprint man dusted this gun, apparently in Dallas, they use a little brush to dust with they would have dusted any

fibers off the gun at the same time \* \* \*.”<sup>375</sup> In fact, most of the fibers Stombaugh found were either adhering to greasy, oily deposits or were jammed down into crevices, and were so dirty, old, and fragmented that he could not even determine what type of fibers they were.<sup>376</sup> However, Stombaugh found that a tiny tuft of fibers had caught on a jagged edge on the rifle’s metal butt plate where it met the end of the wooden stock, and had adhered to this edge, so that when the rifle had been dusted for fingerprints the brush had folded the tuft into a crevice between the butt plate and the stock, where it remained.<sup>377</sup> Stombaugh described these fibers as “fresh,”<sup>378</sup> by which he meant that “they were clean, they had good color to them, there was no grease on them and they were not fragmented.”<sup>379</sup> However, it was not possible to determine how long the fibers had been on the rifle, in the absence of information as to how frequently the rifle had been used.<sup>380</sup> Examination showed that the tuft was composed of six or seven orange-yellow, gray-black, and dark-blue cotton fibers. These fibers were compared with fibers from the shirt, Commission Exhibit No. 150, which was also composed of orange-yellow, gray-black, and dark-blue cotton fibers. The orange-yellow and gray-black tuft fibers matched the comparable shirt fibers in all observable characteristics, i.e., shade and twist. The three dark-blue fibers matched two of the three shades of the dark-blue shirt fibers, and also matched the dark-blue shirt fibers in degree of twist.<sup>381</sup> Based on these facts, Stombaugh concluded that the tuft of fibers found on the rifle “could easily” have come from the shirt, and that “there is no doubt in my mind that these fibers could have come from this shirt. There is no way, however, to eliminate the possibility of the fibers having come from another identical shirt.”<sup>382</sup>

## PHOTOGRAPHS

Two photographs of Lee Harvey Oswald holding a rifle were found among Oswald’s possessions in Mrs. Ruth Paine’s garage at 2515 West Fifth Street, Irving, Tex.<sup>383</sup> In one, Commission Exhibit No. 133-A, Oswald is holding the rifle generally in front of his body; in the other, Commission Exhibit No. 133-B, he is holding the rifle to his right. Also found at Mrs. Paine’s garage were a negative of 133-B and several photographs of the rear of General Walker’s house.<sup>384</sup> An Imperial reflex camera,<sup>385</sup> which Marina Oswald testified she used to take 133-A and 133-B, was subsequently produced by Robert Oswald, Lee Harvey Oswald’s brother.<sup>386</sup> Testimony concerning the photographs, the negative, and the camera was given by Lyndal D. Shaneyfelt of the FBI.<sup>387</sup> Shaneyfelt has been connected with photographic work since 1937. He has made 100-300 photographic examinations, and has testified frequently on the subject in court.<sup>388</sup>

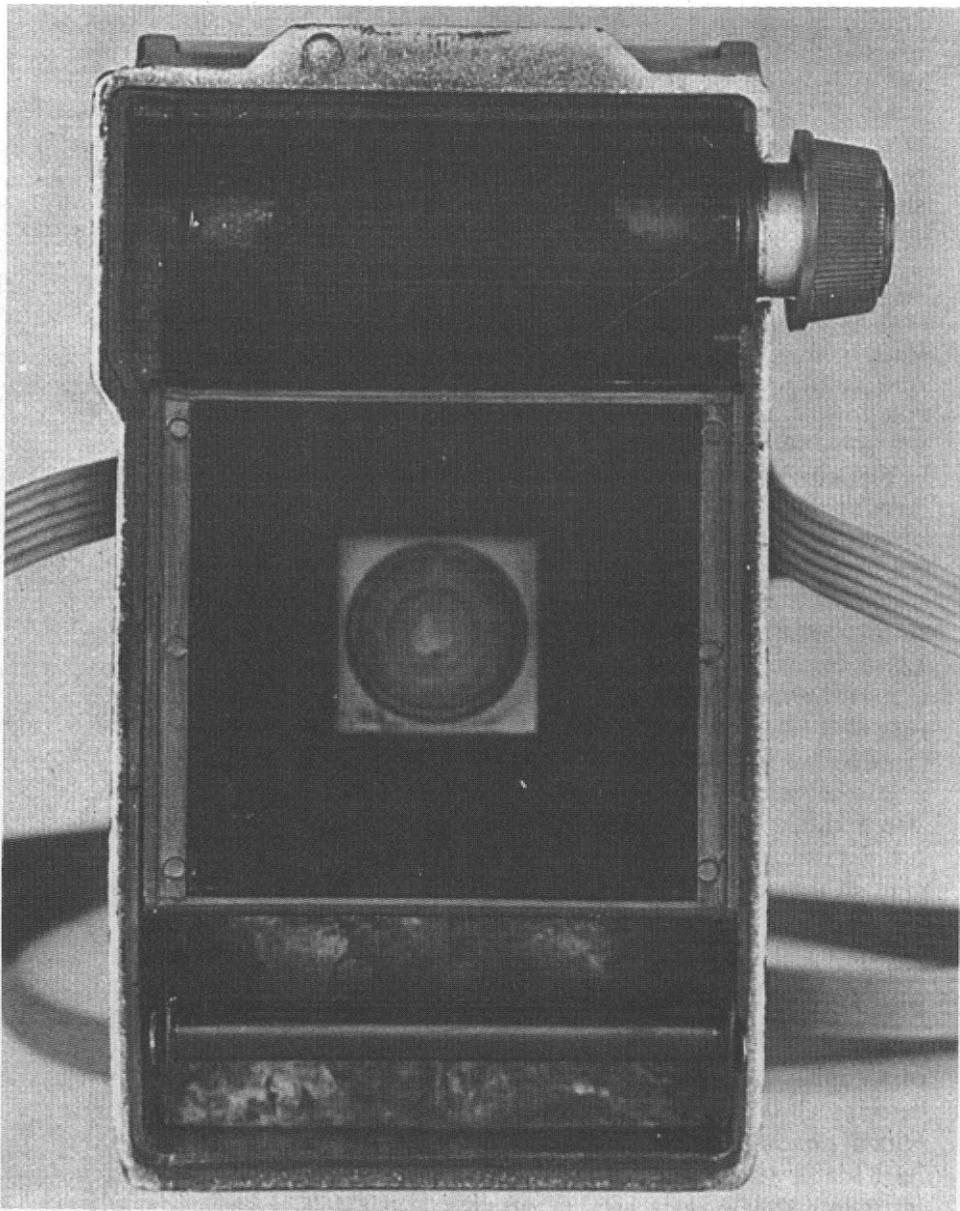
*Photographs 133-A and 133-B.*—The background and lighting in 133-A and 133-B are virtually identical; the only apparent difference between the two photographs is the pose. However, in 133-A the rifle

is held in a position showing many more of its characteristics than are shown in 133-B.<sup>389</sup> In order to bring out the details in the rifle pictured in 133-A, Shaneyfelt rephotographed 133-A and prepared prints of varying densities from the new negative.<sup>390</sup> He also took two new photographs of the C2766 rifle itself: one shows the rifle in approximately the same position as the rifle pictured in 133-A. The other shows a man holding the rifle simulating the pose in 133-A.<sup>391</sup> Shaneyfelt compared the actual rifle, the photograph 133-A, his rephotographs of 133-A, and the two new photographs to determine whether the rifle pictured in 133-A was the C2766 rifle. He found it to be the same in all appearances, noted no differences, and found a notch in the stock of the C2766 which also appeared very faintly in 133-A. However, he did not find enough peculiarities to positively identify the rifle in 133-A as the C2766 rifle, as distinguished from other rifles of the same configuration.<sup>392</sup>

The rifle's position in 133-B is such that less of its characteristics were visible than in 133-A; essentially, 133-B shows only the bottom of the rifle. However, the characteristics of the rifle visible in 133-B are also similar to the observable characteristics of the C2766 rifle, except that while the C2766 rifle was equipped with a homemade leather sling when it was found after the assassination, the rifle in 133-B seems to be equipped with a homemade rope sling.<sup>393</sup> The portion of the sling visible in 133-A is too small to establish whether it is rope or leather, but it has the appearance of rope, and its configuration is consistent with the rope sling pictured in 133-B.<sup>394</sup>

*The negative.*—Shaneyfelt's examination of the negative, Commission Exhibit No. 749, showed that the photograph, 133-B, had been printed directly or indirectly from the negative. It was Shaneyfelt's opinion that 133-B had been directly from the negative, but he could not absolutely eliminate the possibility of an internegative, that is, the possibility that a print had been produced from the negative 749, a photograph had been taken of that print, and 133-B had been produced from the new negative, rather than from the original negative.<sup>395</sup> "I think this is highly unlikely, because if this were the result of a copied negative, there would normally be evidence that I could detect, such as a loss of detail and imperfections that show up due to the added process."<sup>396</sup> In any event, any "intermediate" print would have been virtually indistinguishable from 133-B, so that Shaneyfelt's testimony conclusively established that either 133-B or a virtually indistinguishable print had been produced from the negative 749.

*The camera.*—The Imperial camera, Commission Exhibit No. 750, was a relatively inexpensive, fixed-focus, one-shutter-speed, box-type camera, made in the United States.<sup>397</sup> Shaneyfelt compared this camera with the negative, Commission Exhibit No. 749, to determine whether this negative had been taken with the camera.<sup>398</sup> To make this determination, Shaneyfelt compared the margins of the image on Commission Exhibit No. 749 with the margins of the image on a negative



COMMISSION EXHIBIT No. 751

Oswald's Imperial Reflex camera, with the back removed to show the camera's film-plane aperture.

he himself had taken with the camera. Microscopic examination shows that the margins of a negative's image, although apparently straight, are actually irregular. The irregularities usually do not show on a finished print, because they are blocked out to give the print a neat border.<sup>399</sup> The cause of these irregularities can be best understood by examination of Commission Exhibit No. 751 (p. 594), a photograph of the Imperial camera with the back removed to show the camera's film-plane aperture. When the camera's shutter is opened, light exposes that portion of the film which is not blocked off by this aperture. The edges of the aperture, therefore, define the edges of the image which will appear on the developed negative. In effect, the edge of the image is a shadowgraph of the edge of the aperture. As Shaneyfelt testified:

\* \* \* the basis of the examination was a close microscopic study of the negative made in the camera to study the shadowgraph that is made of the edge of the aperture.

As the film is placed across the aperture of the camera, and the shutter is opened, light comes through and exposes the film only in the opening within the edges. Where the film is out over the edges of the aperture it is not exposed, and your result is an exposed negative with a clear edge, and on the negative then, the edges of that exposure of the photograph, are actually shadowgraphs of the edges of the aperture.<sup>400</sup>

The basis of the identification is that the microscopic characteristics of every film-plane aperture, like those of a rifle barrel, are distinctive, for much the same reason; that is, when the camera is manufactured, certain handwork is done which differs microscopically from camera to camera, and further differences accrue as the camera is used. As Shaneyfelt testified:

Q. Mr. Shaneyfelt, what is the basis of your statement, the theoretical basis of your statement, that every camera with this type of back aperture arrangement is unique in the characteristics of the shadowgraph it makes on the negative?

Mr. SHANEYFELT. It is because of the minute variations that even two cameras from the same mold will have. Additional handwork on cameras, or filing the edges where a little bit of plastic or a little bit of metal stays on, make individual characteristics apart from those that would be general characteristics on all of them from the same mold.

In addition, as the film moves across the camera and it is used for a considerable length of time, dirt and debris tend to accumulate a little—or if the aperture is painted, little lumps in the paint will make little bumps along that edge that would make that then individually different from every other camera.

Q. Is this similar then to toolmark identification?

Mr. SHANEYFELT. Very similar; yes.<sup>401</sup>

Based on his examination of the shadowgraph on the negative, Commission Exhibit No. 749, Shaneyfelt determined that it had been taken with the Imperial camera.<sup>402</sup>

Three edges of the shadowgraph of the film-plane aperture were also visible on one of the photographs of General Walker's house, not having been blocked out in the making of the print. On the basis of these three margins, Shaneyfelt determined that this photograph had also been taken with Oswald's Imperial Reflex camera. Shaneyfelt could not determine whether 133-A had been photographed with the Imperial camera, because the negative of 133-A had not been found, and the print itself did not show a shadowgraph area.<sup>403</sup>

During his interrogations Oswald had been shown 133-A, and had claimed it was a composite—that the face in the picture was his, but the body was not.<sup>404</sup> Shaneyfelt examined 133-A and 133-B to determine if they were composite pictures. He concluded that they were not:

\* \* \* it is my opinion that they are not composites. Again with very, very minor reservation, because I cannot entirely eliminate an extremely expert composite. I have examined many composite photographs, and there is always an inconsistency, either in lighting of the portion that is added, or the configuration indicating a different lens used for the part that was added to the original photograph, things many times that you can't point to and say this is a characteristic, or that is a characteristic, but they have definite variations that are not consistent throughout the picture.

I found no such characteristics in this picture.

In addition, with a composite it is always necessary to make a print that you then make a pasteup of. In this instance paste the face in, and rephotograph it, and then retouch out the area where the head was cut out, which would leave a characteristic that would be retouched out on the negative and then that would be printed.

Normally, this retouching can be seen under magnification in the resulting composite—points can be seen where the edge of the head had been added and it hadn't been entirely retouched out.

This can nearly always be detected under magnification. I found no such characteristics in these pictures.

Q. Did you use the technique of magnification in your analysis?

A. Yes.<sup>405</sup>

Furthermore, the negative, Commission Exhibit No. 749, showed absolutely no doctoring or composition.<sup>406</sup> Since the negative was made in Oswald's Imperial camera, Commission Exhibit No. 750, a composite of 133-B could have been made only by putting two pictures together and rephotographing them in the Imperial camera—all without leaving a discernible trace. This, to Shaneyfelt, was "in the realm of the impossible":

In addition, in this instance regarding 133-B which I have just stated, I have identified as being photographed or exposed in the camera which is Exhibit 750, for this to be a composite, they would have had to make a picture of the background with an individual standing there, and then substitute the face, and retouch it and then possibly rephotograph it and retouch that negative, and make a print, and then photograph it with this camera, which is Commission Exhibit 750, in order to have this negative which we have identified with the camera, and is Commission Exhibit 749.

This to me is beyond reasonable doubt, it just doesn't seem that it would be at all possible, in this particular photograph.<sup>407</sup>

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Q. You have the negative of this? [Referring to Exhibit 133B.]

A. We have the negative of 133B.

Q. You have the negative of 133B. That negative in itself shows no doctoring or composition at all?

A. It shows absolutely no doctoring or composition.

Q. So that the only composition that could have been made would have been in this process which you have described of picture on picture and negative and then photographing?

A. And then finally rephotographing with this camera.

Q. Rephotographing with this camera, this very camera?

A. That is correct, and this then, to me, becomes in the realm of the impossible.<sup>408</sup>

Following the assassination, photographs similar to 133-A appeared in a number of newspapers and magazines.<sup>409</sup> At least some of these photographs, as reproduced, differed both from 133-A and from each other in minor details.<sup>410</sup> Shaneyfelt examined several of these reproductions and concluded that in each case the individual publisher had taken a reproduction of 133-A and retouched it in various ways, apparently for clarifying purposes, thus accounting for the differences between the reproductions and 133-A, and the differences between the reproductions themselves.<sup>411</sup> Subsequently one of the publishers involved submitted the original photographs which it had retouched. Shaneyfelt's examination of this photograph confirmed his original conclusion.<sup>412</sup> The remaining publishers either confirmed that they had retouched the photographs they had used, or failed to contradict Shaneyfelt's testimony after having been given an opportunity to do so.<sup>413</sup>