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## OPINION AND COMMENTARY

### FROM DALLAS TO CHAPPAQUIDDICK: A TALE OF FAILURE

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This November is the tenth anniversary of the assassination of President John F. Kennedy. Just as many members of an older generation asked "What were you doing when Pearl Harbor was attacked?", so does a younger generation talk about this event. The death of this young man, at the peak of his career, with an attractive wife and two young children was both a personal and national tragedy. The autopsy that followed represents the nadir of forensic medicine in this country. Here was a case, which because of the individual involved — the President —, demanded a complete, well documented forensic autopsy performed by experienced forensic pathologists. What happened instead? Not only was the autopsy performed by two physicians inexperienced in forensic pathology, but vital documentation — X-rays and photographs — were suppressed on the request of the late President's family. The physicians who performed the autopsy were not allowed to reexamine this material prior to writing their autopsy report or to testifying at the Warren Committee hearings. The suppression of this documentation has led to ambiguities and errors in both the autopsy report and the testimony before the Warren Commission. Only now are these errors and ambiguities being partially cleared up by individuals like Dr. Lattimer.

What has been the result of the mismanagement of the late President's autopsy? Critics — self proclaimed "experts" — have arisen to challenge the medical evidence, contending that the injuries incurred are incompatible with the weapon used, the number of shots fired and the position of the assassin. Grandiose plots, involving multiple mysterious assassins, Texas millionaires and various government agencies have been fantasized. Misinformation and errors are spread and accepted as fact. What would have been settled with a good scientific, forensic autopsy, will now never be settled.

Why did this fiasco occur? Why were no forensic

pathologists summoned to perform the autopsy? Panic and confusion partially explain and partially excuse some of these actions. Another explanation and one which forensic pathologists may not like to accept is the possibility that the law enforcement officials and military officers in custody of the President's body did not know what a forensic pathologist was, nor that forensic pathology is a specialized branch of medicine. To the courts, most lawyers, and law enforcement personnel one doctor is as good as another in a forensic case, whether he be a forensic pathologist or the local general practitioner. This feeling is especially true in gunshot wound cases where it is felt that you just need "hands" to "dig out" the bullet for ballistic comparison. As to a medical examiner system, why waste money on dead bodies!

What could have been done in the case of the assassination of the President if forensic pathologists had been consulted, is demonstrated by the death of Robert Kennedy. Here, the case was handled by the Los Angeles County Medical Examiner's Office. The autopsy was performed by forensic pathologists with other forensic pathologists as witnesses. The result was that there was no controversy and no flood of books or articles contending that the autopsy findings were wrong.

Some authorities would look at the Robert Kennedy autopsy and say "See how forensic medicine has progressed. The authorities have finally realized that autopsies in cases of violent deaths demand an expert trained in the field and not just 'any old physician'". One hates to disillusion such people, but the two most likely reasons that Robert Kennedy had such a professional autopsy were that he died in Los Angeles where there is an established medical examiner system and secondly, perhaps more importantly, he did not die immediately, giving a chance for the Medical Examiner's office to assert its authority.

The weakness of forensic medicine in another area of the United States was again demonstrated the year



after Robert Kennedy's death by the "incident at Chappaquiddick". Here, a political "hot potato" in a state with a medical examiner system in name only, dealt a second blow to forensic medicine. A death, in which a prominent individual was involved, occurring under peculiar circumstances, unwitnessed and not reported for many hours, was just "signed out" at the scene after a cursory external examination of the body. Completely ignored, if known, was the fact that in such circumstances drowning is a diagnosis of exclusion and an autopsy is necessary to determine the cause of death. Certainly no physician experienced in legal medicine would have signed the death certificate under these circumstances without an autopsy. This occurrence shows what can happen to a good medical examiner system that has been left to deteriorate. The Massachusetts Medical Examiner System was the best in the country when it was introduced in 1877. Unfortunately, no significant changes have been made in it since then. What was a good system in 1877 is now a poor one.

The Fred Hampton case in Chicago occurred because of a more common situation than that in Massachusetts. Chicago, like many other communities never had a good medical legal system. It always had, and still has, a coroner system. This system, in which the coroner is often elected and often not a physician, is especially sensitive to political intervention with all the attendant evils that this involves. In some areas a modified coroner system has been adopted in which the coroner must be a physician. These modified systems, however, do not require the physician to have any special forensic training.

In addition to defective medical legal systems another problem in legal medicine that is commonly encountered is the "dabbler". The "dabbler" is a physician who knows just enough forensic medicine to sound good but not enough to be or do good. He is a forensic dilettante. Unfortunately, there are far too many physicians (including pathologists) who seem to feel that forensic pathology training is not necessary to do forensic work. Anyone who has reviewed large numbers of forensic autopsy records where the autopsies were performed by individuals untrained in forensic pathology knows the gross errors and deficiencies in these autopsies, as well as derived incorrect conclusions. "Dabblers" are as a whole opposed to the establishment of good medical examiner systems. Some are opposed because of ignorance, or prejudice; others because of cupidity. A medical examiner system would deprive the "dabbler" of fees paid to perform forensic autopsies, prestige, and the excitement of an occasional sensational criminal case.

There have been numerous other incompetently handled cases in addition to those I have mentioned.

Yet, for any of these cases that have gained national attention how many thousands more went unpublicized and undetected because the deceased was just an ordinary citizen. How many faceless and nameless individuals have had their cause of death incorrectly certified? How many cases were signed out when they should have been autopsied? How many murderers are free because of this, and how many innocent people hounded and arrested? There is, of course, no way to know.

The time has come for the medical profession to do something about the disgraceful state of forensic medicine in large areas of this country. The medical profession, especially those now engaged in the practice of forensic medicine, must come forth and educate the courts, lawyers, police, and the general public to the long unheeded need for medical examiner systems staffed by experts in forensic medicine. State medical associations and medical schools must be enlisted in this educational program. State and county medical associations must recognize their responsibilities for the education of physicians and the public about forensic medicine and the need for medical examiner systems. Committees must be formed to work for enactment of legislation establishing such systems. Medical schools can foster forensic medicine by joint cooperation with these committees. The schools must also be willing to regularly devote a portion of their curriculum to forensic medicine. This latter policy will result in physicians with forensic orientation as well as encouraging future forensic pathologists.

A more indirect way of encouraging the establishment of medical examiner systems is by making judges and lawyers aware of the many unqualified physicians performing forensic autopsies and the inadequacy of the systems under which they work. After the impeachment at trial of a number of these unqualified medical witnesses with resultant dismissal of those cases, the prosecutors and judges may well pressure their legislature for establishment of a medical examiner system.

There is in existence an organization — the National Association of Medical Examiners (NAME) — which, because of its members' interest and expertise in forensic medicine, is best suited to help local groups in their campaigns for medical examiner systems. NAME can provide literature, advice and speakers for such local groups and local governments. If and when such proposals come before the legislature, NAME could provide experts to testify and to aid legislators in writing a medical examiner law. It behooves NAME to lead a nationwide campaign for the elimination of the antiquated coroners' systems and the establishment of modern medical examiner systems, staffed by qualified personnel.

*Vincent J. M. DiMaio, M.D.*



**EDITOR'S NOTE:**

The following contributions have been obtained from the two physicians who have been allowed access to restricted materials in the National Archives regarding the John F. Kennedy assassination. Their studies have produced somewhat divergent viewpoints. Now, ten years after this occurrence, we are pleased to present our readers with their respective opinions. We apologize for our inability to reproduce photographs that each would have submitted, but copies of pictures and references and further bibliography can be obtained by writing to the authors directly.

**FURTHER INFORMATION ABOUT THE  
AUTOPSY OF PRESIDENT JOHN F.  
KENNEDY**

—John K. Lattimer, M.D., Sc.D.

Jon Lattimer and Gary Lattimer

The precipitous removal of President Kennedy's body from the jurisdiction of the highly competent medical examiner at Dallas, Dr. Earl F. Rose, because of worry over the possibility of a wider assassination plot<sup>1,2</sup> and because some felt that Dallas had had enough bad publicity for one day, led indirectly to a wave of confusion and world-wide skepticism. As Dr. Milton Helpert has said, many European colleagues declared, in effect, that "because you people in the U.S.A. ordinarily do this sort of medico-legal thing so well, the fact that there was confusion over a President's autopsy could only mean that something mysterious must have going on." A host of books, critical of the Warren Commission, blossomed forth.

All of this probably could have been avoided, if Dr. Rose had been permitted to do a medical examiner's autopsy, on the spot, with the witnesses and the resuscitation team immediately available.

The doctors who conducted the desperate but futile resuscitative efforts at the Parkland Hospital in Dallas, had no occasion to find out that there was a bullet hole in the back of the President's neck, because they did not turn the President over, to continue their examination, once it was seen that his brain was irretrievably destroyed.<sup>3</sup> They assumed that the medical examiner would complete the examination forthwith.

On the other hand, the Bethesda Naval Hospital pathologists, Commanders Humes and Boswell, who were ordered to do the autopsy, despite their preference for wider consultation, did not know that there had been a bullet hole in the front of the President's neck until they deduced it from their study of the neck and inside of the thorax. They later confirmed this in the small hours of the next morning, by telephone, with Dr. Perry in Dallas, who had done the tracheostomy directly across the bullet hole.<sup>6</sup>

Incidentally, these men did a more competent and more complete autopsy (as can be seen from their

detailed testimony before the Warren Commission than anyone gives them credit for. The two navy doctors were hampered by being instructed, at first, to recover a bullet, so that the rifle of the suspect would be apprehended, could be tied to the crime.<sup>7</sup> X-rays of the body showed no bullet, they were given piecemeal permission to go ahead, one step at a time, until they had finally done a complete examination of the thorax and abdominal cavity including the shrivelled adrenal glands. During the time before they knew there had been a bullet hole in front of the neck, and before they were given permission to open the chest, all speculations as to what might have happened to the bullet were overheard and carried to reporters before all the facts were known. This added to the confusion.

They did a very detailed external examination of the severely damaged brain, both before and after it was fixed, searching out and retrieving all visible fragments, for ballistic studies, as was their specifically assigned mission. At least one of these fragments was an exhibit before the Warren Commission and is now in the National Archives.<sup>4,5</sup> They were further hampered by the fact that their extensive and careful X-rays and color photographs of the body with rulers laid along the important lines) which had made to assist them in preparing a thorough report, were taken from them before they could develop them. They had a glance at the X-rays, but the photographs were taken away before they were developed.

As a consequence, they were compelled to prepare their report from memory and from hasty notes, ask an artist who had seen neither the body nor the photographs, to make up hypothetical drawings<sup>(8,9,10,11)</sup> on which they could point out features during their testimony before the Warren Commission. Unfortunately, these drawings, based on "hearsay", then became the "official" illustrations in the Warren Commission Report and led to even more confusion because they indicated (wrongly) that the bullet (which had traversed the President's neck) had apparently taken a course almost parallel to the ground, instead of at a downward angle of 15 degrees, as the autopsy photographs clearly reveal.

The actual photographs and X-rays show which are entirely in keeping with the allegations of the Warren Commission that the President was shot from above and behind by two highspeed, 6.5 millimeter fully jacketed Mannlicher-Carcano military rifle. One of these traversed the right side of the President's neck, probably grazing the tip of the transverse process of the seventh cervical vertebra, and then proceeded medially and downward through his neck, to penetrate



his trachea, before exiting at the level of his necktie knot. The second (about 5 seconds later) as determined from the Zapruder motion picture, entered the back of the right side of the President's head about three inches above and slightly to the right of the occipital tubercle, and disrupted. The fragments moved forward through the right side of the brain, removing most of the right cerebral hemisphere and driving three large segments of the right parietal bone upward and forward, as can be clearly seen in the original of frame 313 of the Zapruder movie. One large flap of bone and scalp was turned outward and downward above the right ear, but did not detach.

Two day-long reviews of the autopsy photographs, the X-rays, the motion picture films of the shooting taken by Zapruder and Muchmore, and of the President's clothing, the bullets and the various reports, by one of us (JKL)<sup>12</sup> brought out the following facts about the President's wounds.

#### 1. THE NECK WOUND

##### A. Round Bullet Hole in back of suitcoat and shirt.

There was a punctate bullet hole in the back of the suit coat and shirt worn by the President, which was round, with "punched-in" margins where the broken cloth fibers were bent inward, indicating that this was a wound of entry. The cloth fibers of the shirt were also bent inward in the same manner. Traces of copper as from a bullet such as Oswald used, were found on the margins of this hole in the coat by the F.B.I.,<sup>13</sup> again indicating that it was a wound of entrance. The sizes and rounded shapes of these holes were compatible with the passage of a 6.5 millimeter bullet which was not tumbling. (None of the test bullets fired showed any tendency to tumble until they struck something) the bullet holes in the clothing were about 13 or 14 centimeters below the upper edge of the collar,<sup>14,15</sup> whereas the bullet hole in the back of the body, in this general location, was only about half this distance down from the expected location of the top of the collar. This discrepancy was accounted for by the finding of several photographs of the President's coat "humped-up" on the back of his neck when he raised his arm to wave<sup>12</sup>. This would have caused the bullet holes in the cloth to be at an apparently lower location, than the hole in his back, when the coat and shirt were laid out flat.

##### B. Punctate Bullet Hole in Back

The bullet hole in the President's upper back, near the base of his neck, was about two inches below the prominent crease across the base of the back of his neck, possibly due to the corticosteroids he had been taking for years, and possibly abetted by his habit of carrying his shoulders high, in a "hunched-up" configuration.<sup>16,17</sup>

##### C. Halo around Bullet Hole in back

There was a faint circumferential halo, typical of a

"wound of entry" from a high speed bullet, around the bullet hole in the back of the President's neck.

##### D. Bullet Fragments in Neck

There were 2 tiny (two and four millimeter) slivers of metal (or possibly bone) seen in the upper rear area of the bullet track on the A-P. X-ray film of the right shoulder and neck area. Since no lateral film was taken of this area it was possible to determine only that these slivers lay near the high (rear) end of the bullet track, but not the exact distance they lay from the surface. They were near the tip of the transverse process of the seventh cervical vertebra, which the bullet may have grazed. These tiny fragments were not described in the original autopsy report because the men who did the autopsy were not permitted to study the X-rays they had taken of the President's body. They were first noted by Dr. Russell H. Morgan who was part of a governmental panel who reviewed the films in 1968.

##### E. Hematoma at Top of Right Pleura

The autopsy report clearly described a five centimeter bruise on the dome of the right parietal pleura even though there was no penetration from the bullet.<sup>18</sup> It is obvious that this soft tissue area would have lain along the course of a bullet through the neck just above this area. Army medical corps studies have shown that a cavity expands in the soft tissues as a high-speed bullet passes through, and since the President lived at least five seconds after being struck by this first bullet, it is not surprising that a hematoma formed.

##### F. Hematoma on Lung Apex

The adjacent lung at the upper end of the right lung, adjacent to the pleural bruise, was also bruised for an area of about five centimeters, probably for the same reason.

##### G. Air in the Tissues

There were tiny traces of air along the muscle planes visible in the X-rays, along the bullet track, near the hole in the trachea, indicating a "through and through" wound.

##### H. Hole in Trachea

There was a ragged hole in the right side of the trachea noted by the anesthetists and surgeons at Parkland Hospital at the time they placed the endotracheal tube and then the tracheostomy tube.

##### I. Tracheostomy Wound

There was a gaping 6.5 centimeter transverse tracheostomy incision low on the neck where the Dallas surgeon, Dr. Perry, had enlarged the bullet hole in the front of the neck in order to insert a "cuffed" tracheostomy tube.

##### J. Holes in Front of Shirt

There were one centimeter vertical slits in both sides of the overlapping portion of the shirt, immediately below the collar band, and touching it, just below the collar button, compatible with the exiting of a



bullet at this point.

#### L. Nick in Necktie

There was a "nick" or "crease" through only the outer layer of fabric on the lower left side of the knot of his necktie, compatible with the passage of a spinning 6.5 millimeter bullet at high speed. This examiner found the necktie to be in an "untied" configuration (whereas it had previously always been examined in a "tied" condition) and in this untied condition, a stain resembling the dried blood on the shirt was also found on the necktie. This stain has apparently never been examined to be sure it is dried blood, but it resembles it and should be so examined. If it is blood, it would add one more factor to the evidence suggesting that the course of the bullet was from "back to front".<sup>12</sup>

#### GOVERNOR CONNALLY'S WOUNDS

Circumstantial evidence indicates that this same bullet (W. C. Exhibit No. 399), which bore the unmistakable markings of Oswald's rifle, began to tumble as it exited from the President's neck at an angle, and continued on tangentially through Governor Connally's lateral chest wall. There it struck one of his ribs a tangential blow and exited below his nipple, travelling in a sideways configuration and causing an elongated wound. One can conjecture that it probably became flattened when it then struck his radius a glancing blow while travelling sideways, shattering the bone in situ, but not displacing the fragments particularly. It then presumably exited from his wrist, continuing its turn, to embed itself in his upper leg, while travelling backwards, leaving a tiny particle of lead on his femur.<sup>19</sup> This cartridge is so powerful that if the bullet had not been slowed down by going through something, such as President Kennedy's neck, it would undoubtedly have shattered the Governor's femur. (Dr. John Nichols has shown that these bullets can penetrate four feet of ponderosa pine without deforming.) The wound of entry in the Governor's back was greatly elongated, indicating that he was not hit primarily (since the wound was not punctate in configuration), but was hit by a bullet that was already tumbling.

#### BULLET FRAGMENTS IN GOVERNOR CONNALLY NOT EXCESSIVE

Another of the complaints against the Warren Commission Report has been that the four small fragments of lead seen to be present in Governor Connally's x-rays were said to be too many to be accounted for by the two grains of lead missing from the bullet which the Warren Commission alleged penetrated both President Kennedy and the Governor Connally.<sup>19</sup>

Careful experimentation by the authors has revealed that the two-grain fragment which extruded from the back of an experimental bullet, when it was deformed exactly like the bullet in question (WC 399) could be sliced to produce 41 fragments of lead of the

sizes in Governor Connally, so that four fragments or even six fragments, is by no means too many.

Here again, laboratory experimentation, where questions of fact arise which are amenable to experimentation, can give interesting results, quite different from simple expectations.

#### BACK BRACE MAY HAVE KEPT PRESIDENT UPRIGHT

Because of his weak back muscles, (probably due to years of steroid therapy), the president had laced a tight canvas girdle with metal stays, around his sacroiliac area, with a semi-rigid pad over the sacral area, and had bound it to him even more firmly with a wide knitted elastic bandage, laced in a "figure-eight" configuration through his legs and around his hips.<sup>12</sup> After he was shot through the neck by the first bullet, he did not crumple down as did Governor Connally, but remained upright, tilting slightly to his left, while Oswald zeroed in on the back of his head for the second shot, whether the bracing and binding of his body was a factor in keeping him upright to receive the second bullet, is a matter of conjecture.<sup>20</sup>

#### 2. THE HEAD WOUND

##### A. The Wound of Entry

The slightly ovoid "wound of entry" in the head was fairly high up on the back of the President's skull, well above the hair line, where the skull was starting to curve forward, and about 10 cm. above the occipital tuberosity. (The artist's drawing in the Warren Commission Report indicated that the point of entry was at the occipital tuberosity since the X-rays and the photographs were not available to the autopsy surgeons to demonstrate the actual location.) The bone at the lower margin of the hole was depressed slightly and the wound in the inner table was characteristically larger than the wound in the outer table (cone shaped) as one would expect from a "wound of entrance" into the back of the skull.<sup>12</sup> The largest of all the bullet fragments (6.5 mm in diameter) had been sheared off the sharp edge of the skull, (as with President Lincoln) and lay near the wound of entrance.

##### B. Large Wound of Exit in Top of Skull

A large, roughly pentangular area of the skull (about 15 cm x 13 cm) had been carried away by the force of exiting fragments of the disrupted bullet.<sup>12</sup>

##### C. Fragments of Skull

Three fragments of skull picked up in the street at Dallas, accounted for a majority of bone that was missing, and were probably the fragments seen leaving the President's head in a forward-upward direction in frame 313 of the Zapruder movie of the shooting.<sup>21</sup>

##### D. Flap of Skull and Scalp Everted to Right

An additional flap of skull and scalp appeared to be everted and hanging down in front of and above the right ear, but had not become detached. It had three



tiny metallic fragments embedded in it, each about one to two millimeters in size.

#### E. Cluster of Fragments in Brain

An elongated (four centimeter) cluster of about nineteen tiny metallic fragments in the front of the head, was scattered along a line from the anterior edge of the large head-wound-of-exit, back in the direction of the wound of entrance. Four or five similar tiny metallic fragments were embedded in the frontal bone near the anterior edge of the wound of exit. There was a half-round notch, one centimeter in diameter, in the corner of the largest loose fragment of skull, also with a crescent of tiny metallic particles arranged around it.

#### F. Bullet Fragment in Front of Brain

The second largest metallic fragment (7 mm x 3 mm but crescentic) had come to rest in the front margin of the brain just above the top of the frontal sinus on the right. Several other tiny fragments were scattered between the wound of entry and the wound of exit. There were no metallic fragments in the left side of the brain case, so that there was no evidence to indicate that he was shot from either side.

All the metallic fragments on the right side were above a line between the wound of entry and the top of the frontal sinus and the majority were in the top and front of the brain case.<sup>12</sup> The brain stem and base were severely lacerated.

#### G. Huge Skull Fracture Lines

Multiple huge skull fracture lines extended from the margins of the large wound of exit, and smaller fractures from the wound of entrance as well. These were compatible with the great force exerted by a heavy (160 grain), fairly high speed (2200 feet per second) military bullet, on a thick part of the skull, and to have not found them would have raised suspicions that he might have been shot with some other (less powerful) type of weapon. These multiple devastating fractures on the base of the skull were very much in keeping, however, with the type of weapon used by Oswald.<sup>12</sup>

#### H. Locations of the Bullet Fragments in the President's Head

The A-P. X-ray of President Kennedy's head, taken at the beginning of the autopsy, showed the locations of all the metallic fragments to be confined to the right side of his brain case and that there were no wounds not connected to the principle wounds on the right side of the President's head, arguing against any possibility that he was shot from either side.

#### DID THE PRESIDENT'S BODY MOVE SIDEWAYS OR BACKWARDS?

Examination of the Zapruder movie leaves no doubt that the President's brain, skull and scalp splashed forward after the head wound, and that only after this did his body stiffen with an opisthotonos-like motion and continue its fall to the left and slightly backward

against the seat of the automobile.<sup>12</sup> Mrs. Kennedy rose and pivoted to let him fall down on the seat, and was then precipitated upon the rear deck of the car as the car jerked forward to start its desperate dash to Parkland Hospital.

#### DOWNWARD ANGLE OF WOUNDS

The downward angle of the neck wound can be clearly seen to be steep enough (about 20 degrees) that such a bullet wound could not have been caused from the President's front, unless the shooter was down in the automobile, perhaps ahead of Governor Connally, shooting upward and backward at the President.

Thus there were multiple evidences that the President was shot from the rear and above by a rifle such as the one which bore Oswald's handprint. Furthermore, there was evidence that he was not shot from the front or from either side.

#### WAS OSWALD'S RIFLE COMPETENT?

Critics who clearly never did any experiments of their own, have cried that Oswald's rifle was not good enough to do what was claimed for it. After examining Oswald's rifle minutely and repeatedly, the author and his two sons accumulated four such rifles, telescopes and slings identical to the type used by Oswald. They assembled several such composite units to be as similar as possible both as to condition and function, to Oswald's rifle, after carefully examining, measuring and manipulating his rifle at the National Archives in Washington. The accuracy of this Carcano rifle, when fired from the same type of rest and with the same type of sling used by Oswald, was found to be competent.<sup>(22)</sup> The four-power "Ordnance Optics" telescope, just like Oswald's was very helpful. After a two week period of familiarization, with much "dry" and "actual" firing, it was found possible to cluster three bullets consistently in an area two and three quarters inches in diameter, at 263 feet, when they were fired at five second intervals, which was the time between Oswald's two documented "hits" on President Kennedy. The author's two sons, then 17 and 14 years of age, also unfamiliar with this rifle, were also able to consistently place 3 bullets in the head area of the target after two weeks of familiarization, dry firing and actual firing, but their rates of fire were slower.<sup>12,22</sup>

When the rate of fire was speeded up to three shots in 6.5 seconds, at the shifting target, the size of the group of bullet holes then spread out to an area six inches in diameter. It was still possible to group all three shots in a life-size silhouette target of the head and neck, however.

In short, the rifle used by Oswald was entirely competent to achieve the mission alleged by the Warren Commission.

#### RELIABILITY OF THE AMMUNITION

During the course of these experiments<sup>22</sup> six



hundred fifty (650) rounds of the same type of cartridges as those used by Oswald (Lots 6000, 6001, 6002, 6003) manufactured by the Western Cartridge Co., A branch of the Winchester Repeating Arms Co., in the same year as that used by Oswald, were procured and used. None of these rounds failed to fire, on the first try, even though an additional four years had elapsed since the Kennedy shooting. Nichols had reported the same degree of dependability, and the FBI agents who fired ammunition from Lots 6000 and 6003 in Oswald's rifle, more than 100 times, also reported no failures to fire on the first attempt. Thus, the ammunition was found to be highly reliable when actually tested, in contrast to statements to the contrary by critics who did no experimentation of their own.

#### OSWALD'S CAPABILITY WITH THIS TYPE OF RIFLE

Oswald's Marine Corps rifle score book, which is in the authors possession, reveals that at "rapid fire," in the "sitting" position, at 200 yards (almost three times the distance at Dallas) and without a telescope Oswald scored 48 out of a possible 50, on one day, and 49 out of a possible 50, on another day. Practically all of his shots were grouped in the head area of the silhouette target used. Thus, while Oswald would not qualify as an "expert," according to Marine Corps standards, he was perfectly competent to do exactly what was alleged he did, by the Warren Commission. The fact that the author, who is not a skilled marksman, and his 17 and 14 year old sons could also achieve a similar accuracy with two weeks of intensive familiarization, lent further credibility to the possibility that Oswald did what was claimed for him.<sup>12</sup>

#### SUMMARY AND COMMENT

All of our lengthy reviews and experiments, to test the factual materials available about the assassination of President Kennedy, showed convincing evidence that the President was struck by two bullets, from a Mannlicher-Carcano 6.5 millimeter military carbine, firing fully jacketed bullets made by the Western Cartridge Company. The rifle in question bore Oswald's palm print and the evidence that he purchased the rifle was impressive. It must also be remembered that Oswald was captured with the pistol he used to shoot Officer Tippit, still in his possession. All four bullets removed from Officer Tippit's body came from Oswald's pistol, to the exclusion of all other pistols. Oswald was not just a passive decoy, by any means, as some have contended.

The first bullet entered the back of the President's neck, about two inches below and medial to the angle between the back of his neck and right shoulder, while he had his arm raised waving to the crowd, thus elevating the back of his suit and shirt in a "humped-up" configuration. This accounted for the apparently lower

location of the bullet holes in jacket and shirt, when compared with the location of the bullet hole in the back of his neck. The fibers around the holes in the back of his jacket and shirt were bent inward and bore the appearance of copper, according to the analysis by the laboratory. The punctate wound of entry in the back of his neck, clearly seen in the excellent color photographs taken by the men who did the autopsy, showed a circumferential darkened rim, characteristic of wounds of entry from high speed bullets. The bullet appeared to have grazed the tip of the transverse process of the seventh cervical vertebra, knocking off two splinters of metal or bone before traversing the soft tissues above the top of the pleura, and exiting, after penetrating the trachea, at the level of the neck-tie knot. A hematoma was found in the dome of the pleura also on the upper tip of the right lung. The bullet hole in the front of the neck had been obliterated by a transverse tracheostomy incision about 6.5 centimeters long, through which a cuffed tracheostomy tube had been inserted during the efforts at resuscitation. Air was visible in the tissue planes adjacent to the hole in the trachea and back along the bullet track, adding credence to the theory of a through and through nature of the wound through the neck. The bullet had caused a "nick" in the knot of the necktie and a "new" stain presumed to be dried blood was discovered running downward from this "nick." It was conjectured that the skin around the wound of entry in the front of the neck, had not been distorted much because it was contained and supported by the firm band of the shirt, which was fastened tightly immediately above this area, and would have kept the skin from stretching as the bullet exited.

There was persuasive circumstantial evidence that bullet (399) continued on through Governor Connally's chest and wrist, where it was flattened slightly before embedding itself in his femur, from which it was presumably knocked out onto the stretcher.

There are those who argue for the possibility that Governor Connally might not have been in a position directly ahead of the President at the moment he was hit, and they quote a photograph of a reenactment by the FBI. They neglect the fact that the FBI used a conventional Cadillac "convertible" for the reenactment, which was very different from the special presidential Lincoln, with its elevator rear seat, which placed the President well above the Governor.

The Governor testified that he was in the process of squirming around on his jump seat to look at the President over his other shoulder, when he felt the bullet strike his back. A man struck in this way, is ordinarily stunned by the blow for a brief interval, and indeed Governor Connally has testified that he did not even register the fact that he had been shot through the wrist and hand well, at that moment, so there may have been a



before he began to react again.

Thus, Governor Connally's exact position, relative to that of the President, at the moment he was struck, is not known. There is certainly no actual evidence that Governor Connally was not in a position to receive the bullet that had gone through the neck of President Kennedy. There was no third bullet found in the car as there would have to be, and the other circumstantial evidence is very strong that both men were hit by the same bullet, despite opinions to the contrary.

The second bullet hit the President about five seconds later, entering about three inches above his occipital tubercle, just to the right of the midline, fragmented and then carried away most of the right cerebral hemisphere. The bullet fragments also exited "explosively" (to quote the report to the Government Panel)<sup>23</sup> from the upper right side of the head, removing a large segment of skull which broke into three pieces and which could be seen flying forward and upward from the President's head in Frame 313 of the Zapruder movie. The wound of entry at the back of the skull was marked by the typical cone-shaped deformity wherein the hole in the inner table was larger than the hole at the point of entrance in the outer table, and a majority of the bullet fragments were scattered through the anterior part of the right side of the brain case. There were no bullet fragments or holes in the left side of the brain case, as there would have been, had the bullet entered from the right side of the President's head as contended by some.

In addition, there was a flap of skull and scalp turned downward and outward above the right ear, in a configuration which also could not have been achieved, had the President been shot (as alleged by some) from the "grassy knoll" to his right. Fragments of the disrupted second bullet appeared to have hit the frame of the windshield of the car after traversing the President's head, and then dropped into the front seat area, where they were recovered.

Oswald's rifle proved to be perfectly competent and the ammunition proved to be entirely reliable after 650 rounds with no failures to fire on the first attempt. Oswald's capability with a rifle was clearly competent to do what the Warren Commission alleged he did and the author and his 17 and 14 year old sons were able to acquire similar accuracy with the Carcano rifle with only two weeks of intensive familiarization and practice.

The decision of the Warren Commission to not request a viewing of the autopsy photographs, was based in part upon the knowledge that if they did so, the color photographs (which were undeniably shocking to laymen), would have become part of the public record, as such they would have been displayed in bookshops where the late President's children and family would inevitably have seen them.

The fact that the X-rays of the President's body were also sequestered, along with the autopsy photographs, was unfortunate, since they are impersonal and would have answered many of the questions that were raised by critics of the Warren Commission.

The brain was examined with particular attention by Commander Humes, looking for bullet fragments and foreign material, as well as lacerations, both before and after it was fixed.

The details of the examination of the adrenal glands have been withheld, presumably as a matter of privacy, on the basis that their condition was not relevant to his cause of death. We join with those historians who urge the release of this information, now that sufficient time has passed, on the basis that adrenal insufficiency is an "honorable condition" and that it would encourage other sufferers to know that with modern treatment, a man could withstand even the stresses and harrassments of the Presidency.

While Commander Humes testified that a photograph of the bruise at the top of the right pleural cavity had been taken, the photographer, upon interrogation, could not recollect whether he had actually been able to get a picture of this bruise, up inside the chest cavity. No such picture is present, at the National Archives, in any case.

It is of interest that both Commanders Humes and Boswell were and are strongly in favor of effective liaison between medical examiners and the military hospitals. It was not their wish to be caught up in the powerful cross-currents of grief and frustration which led to this disruption of our medical examiner procedures which ordinarily work so well.

In short, two careful studies of the autopsy materials, the X-rays, the photographs, the clothing, the rifle and the bullets, plus a series of extended experiments, failed to reveal any discrepancies in the theses about the actual woundings, put forward by the Warren Commission. As with the Lincoln assassination (where there was also confusion as the direction from which the fatal shot was fired),<sup>24</sup> the facts about the actual shooting appeared fairly straightforward when the dust had settled.<sup>19,24</sup>

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**THE MEDICAL EVIDENCE  
IN THE ASSASSINATION OF  
PRESIDENT JOHN F. KENNEDY**

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**BACKGROUND**

**The Assassination**

Ten years ago, during a motorcade in Dallas, Texas, President John F. Kennedy was assassinated by gunfire before hundreds of horrified onlookers. The President was first seen to clutch at his throat, and then, a few seconds later, his skull was seen to burst. Reports of the post-mortem examination later indicated that he was struck by two bullets, the first entering the upper right side of his back and the second entering the back of his head.

Five other persons were seated in the Presidential limousine, which was uncovered at the time. Mrs. Kennedy was to the left of the President in the rear seat. Then-Governor John Connally of Texas was directly in front of the President, and Mrs. Connally was seated at his left. Two Secret Service agents occupied the driving compartment. Several other vehicles were behind the Presidential car in the procession, the immediate followup car containing eight Secret Service agents.

Governor Connally was severely wounded during the same gunfire. He sustained wounds through the right side of his chest and through his right forearm near the wrist, plus a less severe wound of his left thigh. One of his ribs was shattered, and the radius of his right arm suffered a comminuted fracture. The other occupants of



the Presidential car were not hit.

Several photographs and some motion picture films were taken during the assassination sequence, as well as shortly before or after. These, along with the many eyewitness reports and the presence at the scene of numerous federal agents and local law enforcement officers, made the crime one of the most thoroughly observed in history.

#### The Investigation and the Official Findings

Investigation by the Dallas Police and the FBI led to an early belief that there was only a single assassin, a man named Lee Harvey Oswald. Oswald was arrested about an hour and a half after the assassination in a theater several miles from the scene, after having purportedly slain a police officer. Oswald himself was murdered two days later while in the custody of the Dallas Police, without ever having admitted any role in either killing.

Several months later, after extensive investigation by the FBI and other government agencies under the direction of a special commission known as the "Warren Commission", the official findings and conclusions were reported to the new President, Lyndon Johnson, and to the American public. In essence, these boil down to a restatement of the early belief reached by the Dallas Police and the FBI: Oswald was the assassin, he had acted alone and unaided, and there had been no conspiracy of any kind, either in the assassination of the President or in the killing of Oswald.

The investigation was massive in scope, and it produced a huge volume of documentation. In addition to its Report, the Warren Commission published 26 volumes of exhibits and the testimony of more than 500 persons. Easily ten times more such materials remain unpublished at the National Archives. Most of them are accessible to the public, although some portions are still withheld.

Yet today, despite the massiveness of the investigation, the precise details of the shooting are still far from clear, and there remain legitimate grounds for doubt that the crime was correctly or fully solved. The Warren Commission itself found it necessary to hedge on some of its most fundamental findings, a fact sometimes overlooked or forgotten by its defenders. In reference to such matters as the number of shots fired, their sequence, and the precise manner in which Governor Connally was wounded, the Commission repeatedly resorted to language expressing uncertainty. Some examples (with emphasis supplied by the authors of this paper) are as follows:

"The weight of the evidence indicates that there were three shots fired."

"Two bullets probably caused all the wounds suffered by President Kennedy and Governor Connally."

"... it was not possible to determine whether the two bullet fragments were from the same bullet or from two different bullets." (This statement is in reference to two mutilated but sizable bullet fragments found in the front of the Presidential car.)

"... there is very persuasive evidence from the experts that the same bullet which pierced the President's throat also caused Governor Connally's wounds. However, Governor Connally's testimony and certain other facts have given rise to some difference of opinion as to this probability..."

Are such uncertainties significant? The answer is that every one of them has an important bearing on the Commission's reconstruction of the shooting and, in conjunction with other evidence, on the crucial question of whether or not it was physically possible for one man to have fired all the shots. The Commission's lone-assassin conclusion cannot logically be more certain than its findings in respect to these details.

Questions of this kind do not arise in the majority of murder cases. Complex plots with multiple participants and contrived deception do not usually merit serious consideration, and the available evidence ordinarily rules them out anyway. But the assassination of a President, with its high stakes for the participants, is a different situation and demands the most careful scrutiny to ensure that "the evidence fits".

The Commission's defenders have tended to be more certain of the official findings than the Commission itself, while its critics have found additional areas of doubt not acknowledged by the Commission. Several of these questioned findings involve medical evidence, or a combination of medical evidence with ballistic, photographic, or other forms of evidence. They relate to the questions of whether or not one person could have committed the assassination and from where the shots were fired. It is with these questions alone, and the medical evidence bearing on them, that this paper is concerned.

#### The Major Areas of Doubt Involving Medical Evidence

The question of whether the Governor was wounded by a bullet which had previously struck the President or by an entirely separate bullet was of crucial importance to the lone-assassin conclusion. Although the Commission acknowledged some uncertainty on this point, it also claimed, too glibly, that its theory in this regard was "not necessary to any essential findings of the Commission". The fact is that a motion picture film of the assassination (the so-called Zapruder film) shows convincingly that the initial wounding of the President and the wounding of Governor Connally occurred within a very brief time span, of the order of 1½ seconds at most. This interval is too short by about a second for the



firing of two consecutive shots with the particular rifle found at the scene. Tests conducted by the Army and the FBI demonstrated this fact beyond doubt with the actual rifle, and cannot be overcome by tests made with replica rifles.

Hence if the non-fatal wounds of the President and the Governor were not caused by the same bullet, another rifle besides the one found at the scene is necessarily implicated. A bullet and two fragments recovered after the assassination matched the found rifle, but another whole bullet was lost entirely, as the Commission conceded. Therefore the possibility that another rifle was used is not refuted by the ballistic evidence. With another rifle in use, a second assassin would necessarily have been involved, and the failure to find that other rifle might raise the specter of a still larger conspiracy.

Moreover, the Commission's reconstruction required that a certain nearly whole bullet, designated as Commission Exhibit 399, had inflicted all the non-fatal wounds on the President and on Governor Connally. This bullet was found under puzzling circumstances\* at Parkland Hospital in Dallas, where the President and Governor had been taken immediately after the shooting. Its history and chain of possession are far from clear, but the Commission accepted its authenticity and theorized that it had fallen out of Governor Connally's thigh wound at some stage. It is a 6.5 mm Mannlicher-Carcano bullet manufactured by the Western Cartridge Co., consisting of a lead core fully covered, except at the cartridge end, but a substantial copper jacket. In its found state, it weighed 158.6 grains, as compared to an average weight of 161 grains for undamaged test bullets of the same manufacture. Its copper jacket is still fully intact, except for a small notch near the nose end where the FBI removed a sample for spectroanalysis. In appearance, it is exactly like a cotton-tube test bullet, except for a slight flattening and small loss of lead at its base. Yet by the Commission's reconstruction of the shooting, this bullet is required to have penetrated the upper right portion of the President's body, traversed the right side of Governor Connally's chest (removing several inches of his right fifth rib), pierced the Governor's right arm near the wrist (shattering the distal radius and leaving several particles of lead), and finally to have entered the Governor's left thigh (leaving another metallic particle embedded in his femur), after which, at some unknown

time, it fell out. Several years after the assassination when the photographs and X-rays of the President's autopsy became accessible, other metallic particles seen in the X-rays of the upper right side of the President's body (unknown to the Commission). There is also some indication of metallic particles in the X-rays of the Governor's chest. While the cumulative weight of these particles may be less than the weight missing in Commission Exhibit 399,\*\* the larger problem is to explain how an essentially undamaged, copper-jacketed bullet could have left them at all, and how the bullet could have caused so much bone damage without suffering substantial surface marking or distortion of shape.

The Commission's findings postulated that the shots were fired from a certain window on the floor of a building known as the Texas School Depository. This building was behind and somewhat to the right of the Presidential car at the time the shots were fired, the distance and angle varying with the position of the car as it moved down the street. The sixth-floor window looked down upon the car at an angle which varied from roughly 20 degrees to 45 degrees over the shooting interval. The street curved appreciably and sloped downward from the Depository by a few degrees, making the calculated trajectories somewhat involved. Because of the complexity of the car's movement on the possible trajectories, the calculations also depend on the times of the shots, which these are not precisely known in the case of the non-fatal wounds of the President and the Governor. Nevertheless, they are known approximately (within a range), and it thus becomes important to determine the locations and apparent pathways of the wounds so that they can be reconciled with the postulated location of the assassin.

The Commission purported to carry out these calculations with considerable precision, reporting distances to tenths of a foot and angles to minutes of arc, ultimately claiming consistency with the available data. Closer examination, however, shows this claim to be in agreement to be specious. There is so much contradiction, and general vagueness about the locations of the wounds, as known to the Commission, that the part of their calculation is almost meaningless. Inaccurate data, the Commission relied on an inaccurate sketch as its authority for the angle of the decline through the President's back/throat wound, rep-

\*The bullet was reportedly found under a stretcher in a remote part of the hospital in the afternoon of the assassination. It was never conclusively determined whether the President or the Governor (or neither) had occupied the stretcher.

\*\*The weight of the bullet was no more than 2.5 grains above the average of several unmutated test bullets. One fragment from Governor Connally's wrist, alone weighed 0.5 grain.



that an angle of 17° 43' 30" was "approximately" the angle shown in the sketch, when in fact the sketch angle measures less than 10 degrees.\* The Commission also claimed satisfactory alignment of this wound with the Governor's chest wound (about 25 degrees downward). Simultaneously, the Commission entirely ignored the problem of reconciling the assumed flight path of the bullet with the angles through the wounds in the horizontal plane.

#### ORIGIN OF THE MEDICAL EVIDENCE

##### The Immediate Medical Treatment

Immediately after the last shot was fired, the Presidential car was driven to Parkland Hospital in Dallas where the President and Governor were given emergency treatment. The effort to save the President was unsuccessful in the face of the extensive damage to his brain. However, it produced a significant change in the character of one of his other wounds and led to much confusion later.

When the President was examined at Parkland Hospital, he was seen to have a massive head wound, with profuse bleeding and loss of brain tissue, and a much smaller wound in the anterior neck below the "Adam's apple". The latter wound was thought to be an entry wound in view of its small size and other characteristics, an interpretation which led to a number of erroneous early news stories about the source of the shots. No other external wounds were noted by the doctors at Parkland, reportedly because the President's body was not turned over for examination of his back.

In an effort to restore the President's breathing, an endotracheal tube was inserted through the neck wound and connected to a respirator. When this proved ineffectual, a tracheotomy was performed to ensure a clear airway. The Parkland doctors also reported the insertion of chest tubes through surgical incisions in the chest.

The tracheotomy incision was made through the anterior neck wound, thus changing its appearance completely and preventing its recognition as a missile wound during the autopsy later that night.

Concurrently, Governor Connally was examined and given surgical treatment for wounds in the right side of his chest, his right arm, and left thigh. Observations of these wounds later played an important role in the Warren Commission's reconstruction of the shooting.

##### Circumstances of the Autopsy

The President was pronounced dead about one-half hour after admission to Parkland Hospital. An

\*The Commission's purported measurement of angles to minutes and seconds of arc is absurd. At the supposed range of fire (about 200 feet), one minute of arc corresponds to less than one inch in the position of the rifle.

hour or two later, after a dispute in which the Texas authorities were refused their lawful right and duty to perform the autopsy in Texas, the President's body was flown back to Washington, D.C. An autopsy was performed by military doctors that evening at the U.S. Naval Hospital in Bethesda, Maryland.

The circumstances of this autopsy were unusual. At least 30 persons are known to have been present in the autopsy room at one time or another, most of them military. Five were agents of the Secret Service or the FBI.

The members of the autopsy team had had only limited forensic experience at that stage of their careers. Some years afterward, it was revealed that an Army General, not otherwise identified, had claimed to be in overall charge of the autopsy and that orders had been given not to dissect the President's back/throat wound.

Moreover, it is now known that one roll of film taken during the autopsy was seized from a medical corpsman by a Secret Service agent, who then deliberately ruined the film by exposing it to the light. This incident is not mentioned by the Warren Commission, and there has never been any official explanation for the act.

Under these circumstances, we should not be surprised that a thorough and accurate autopsy was not performed. The decision of the military authorities to rely exclusively on military pathologists, acting under military orders, appears to have been grounded on their concept of the President as Commander-in-Chief of the Armed Forces rather than as Chief Executive of the United States. It produced a seriously defective autopsy.

##### The Autopsy Findings

As ultimately published in the Warren Report, the essential autopsy findings were that the President had been struck by two bullets and that both had been fired from behind and "somewhat" above the President. One of these bullets was reported to have entered the upper right posterior thorax just above the scapula and to have exited from the anterior neck at the midline. The other was said to have entered the skull about 2.5 cm to the right of and "slightly" above the external occipital protuberance, then to have fragmented and erupted through the right parietal region of the skull, carrying with it substantial portions of the skull, scalp, and cerebral tissue.

The locations and pathways of these wounds were not precisely reported, and in some instances the reference points for measurements were inept. For example, the vertical position of the wound in the upper back was measured from the right mastoid process, which is both vague in extent and, relative to other points on the body, subject to variation with changes in posture. The horizontal position of this wound was referred only to the right acromion process, no



measurement being given for the distance from the midline of the spine, which was both shorter and more precise. No measurements at all were reported from the top of the head, a commonly used referenced point.

During the autopsy examination, the missile wound in the anterior neck was not recognized as such because of the tracheotomy incision. It was discovered only through a telephone call the following day to one of the attending physicians in Dallas. While the failure to recognize the presence of this wound may be rationalized on the basis of the surgical incision, the failure to consult the Dallas physicians before or during the autopsy cannot. Moreover, the failure to dissect and tract the back wound is incomprehensible, particularly when the outlet for this wound was not then known.

Inasmuch as the X-rays did not show a whole bullet anywhere in the President's body and the exit path was not known, the autopsy team resorted to sheer speculation. It was thought that the bullet must have "worked its way out" of the back wound during external cardiac massage. That opinion was noted and reported by the attending FBI and Secret Service agents, who were not present during the telephone conversations and subsequent revisions of the findings on the following days. The FBI agents reported that the bullet which struck the President's back entered at a point "below the shoulders" along a path which was "45 to 60 degrees" downward, and had "no point of exit". Indeed, FBI Headquarters continued to make such assertions as facts for almost two months in its reports to the President and to the Warren Commission, apparently without ever being notified of the corrections. For these and other reasons,\* serious questions have been raised as to when the final version of the autopsy report was actually written and what its predecessor versions might or might not have contained. The report itself is undated, although the doctors testified that it was completed on the morning of November 24, 1963.

Several other findings were also reported, including the sizes and appearances of the wounds, descriptions of certain skull fragments, and the disposition of various metallic fragments in the skull as disclosed by the X-rays. In a supplemental report dated December 6, two weeks after the autopsy, the results of microscopic examination of various sections through the formalin-fixed brain are described, as well as sections through the skin at the wounds of entry.

\*At least one draft of the autopsy report appears to have been burned. One of the pathologists testified that he destroyed his "preliminary draft notes" in the fireplace of his home on the morning of November 24.

However, certain procedures that would have been invaluable in fully locating and characterizing the wounds were not carried out, or carried out only partially. The wound in the upper back, as already noted, was not dissected. Coronal sections through the fixed brain were not made, although this is a routine procedure in cases of gunshot wounds of the head in order to track the pathway of a bullet or bullet fragment. The left side of the brain is described only superficially in the autopsy report, as though the X-ray findings alone were enough to guarantee that no bullet or fragment had traversed it.

As a result, the autopsy failed to provide the detailed and unequivocal findings necessary to settle beyond any dispute the number and general directions of the bullets which struck the President. Nor did it provide the investigative team with any but the most superficial assistance in determining the locations of possible assassins. Instead, the investigation was forced to rely on assumptions and on the recollections of various eye- and earwitnesses, many of which were contradictory and required careful selection. Today, some of the Warren Commission's assumptions and witness selections appear to be wrong in a way which vitiates the Commission's central conclusion that there was only one assassin. A thorough autopsy would almost certainly have avoided this situation.

The autopsy report omits all reference to the adrenal glands. Although this information would not have had any bearing on the assassination whatever, its omission is a clear indication of the degree of control exercised over the autopsy team by the military authorities.

One further illustration of the quality of the autopsy is worth pointing out, although again it is not relevant to any of the Commission's findings. Several of the Parkland Hospital doctors testified that surgical incisions were made into the President's chest. They were quite positive about this, describing in some detail the insertion of chest tubes and connection to equipment. There seems to be no reason for them to have imagined or fabricated these statements. Yet the autopsy doctors testified that the incisions did not enter the chest cavity and that the pleural lining was completely intact. If the Parkland Hospital doctors were correct, what are the implications for the capacity of the autopsy team to find and characterize wounds?

#### The Autopsy Materials and Restrictions on Access

Numerous photographs and X-rays were taken in the course of the autopsy. The Warren Commission declined to examine these, relying instead on the testimony of the autopsy pathologists and a few artist's sketches drawn from oral descriptions of the wounds. The materials were held to be the property of the Kennedy family prior to their donation to the United



States Government in late 1966. They are now at the National Archives, but access to them is subject to restrictions imposed by the Kennedy family as a condition on the gift.

Following a rash of public controversy engendered by various books critical of the Warren Report, the photographs and X-rays were reviewed by the autopsy team in early 1967. They reported that the materials corroborated their original findings in all respects.

In early 1968, a second review of the materials was made, this time by a team of four prominent physicians (three pathologists and one radiologist) appointed by Attorney General Ramsey Clark. The report of this review disclosed several observations not previously reported and provided important new details. Chief among these are:

(1) The entry wound in the President's skull was located 25mm to the right of the midline and about 100 mm above the external occipital protuberance, a difference of some three to four inches from its location as reported by the original autopsy team;

(2) A gray brown rectangular structure measuring approximately 13x20mm was visible in photographs of the right cerebral hemisphere (the panel was unable to establish its identity);

(3) Locations of the President's back and throat wounds are given with some precision and in relation to reasonably well-defined reference points, thus permitting, for the first time, approximate determination of the trajectory of the bullet path;

(4) A large metallic fragment measuring 6.5mm in diameter, embedded in the outer table of the skull at the lower edge of the entry hole, was seen on the X-rays of the President's head; and

(5) Several small metallic fragments and some subcutaneous emphysema were seen in the lower neck region just to the right of the cervical spine on the X-rays of the upper thorax.

In late 1971, the restrictions on access to the autopsy photographs and X-rays relaxed somewhat to permit non-government pathologists to examine them if approved by the Kennedy family representative. One individual, not a pathologist and not the first to apply for such access, was granted permission in early 1972. One of the authors of this article is the first non-government pathologist given permission to examine these materials, and he conducted his examination on August 23 and 24, 1972.

#### OBSERVATIONS OF THE AUTOPSY MATERIALS

##### The Available Materials

The materials examined consist of X-rays, photographs, and film negatives from the autopsy, the President's clothing, medical sketches, the bullet and bullet fragments recovered after the assassination, the rifle, the X-rays of Governor Connally, photographs and

a diagram of the Presidential car, the Zapruder film and its individual frames, the Nix and Muchmore motion pictures, photographs from the FBI re-enactment of the assassination, and various documentary materials. With the exception of the autopsy X-rays, photographs, film negatives, and clothing of the President, these materials are also accessible to the public.

The X-rays and photographic materials give every indication of being authentic. Their numbers and general descriptions are in agreement with the corresponding data reported by the Ramsey Clark panel, for example, and the facial features, where they can be seen, are consistent with the examining author's recollections of the President.

##### The Missing Evidence

Unfortunately, some of the autopsy materials, including some of the most important from the forensic standpoint, are not at the National Archives. We know, for example, that the President's brain was preserved and that several sections were prepared for microscopic examination. Moreover, certain sections were taken through the skin at the supposed wounds of entry in the scalp and in the upper back of the President. The preserved brain and these various brain and skin tissue sections were examined by the autopsy team about two weeks after the original autopsy, and additional photographs were then made. All of these are described in the supplemental autopsy report published in the Warren Report. Yet, these items - - the brain, the microscopic sections, and the supplemental photographs - - are all missing from the National Archives.

We also know from the testimony of the original autopsy team that color photographs were taken of the interior of the President's chest cavity. These photographs are important to the determination of the path of the bullet which struck the President's upper back. They are missing also.

All these items had been turned over to the National Archives by Admiral George Burkley on April 26, 1965, according to a memorandum of that date. However, they are not included in the inventory of items officially transferred to the United States Government by the Kennedy family on October 29, 1966. There has been no accounting for these missing items, and there are no known reports of re-examination of them since the original autopsy team examined them in December, 1963.

##### The Author's Observations

The most important of the author's observations are depicted in the accompanying illustrations,\* with additional details provided in the text beneath the captions. No attempt has been made, however, to depict

\*Copies available upon written request from the authors.



the massive head wound of the President in these illustrations. Its appearance is consistent with other verbal descriptions which have been published.

Generally speaking, the author's observations and measurements of the wounds and locations of bullet fragments are in agreement with the findings of the Clark Panel in 1968. However, certain additional observations, not reported by the Clark Panel, are worthy of note:

(1) The unidentified "rectangular structure" seen by the Clark panel in the photographs of the right cerebral hemisphere is perhaps better described as parallelogram-shaped. The precise configuration cannot be ascertained inasmuch as the margins are concealed by overlying brain tissue. It has a slight focal shimmering effect in some pictures, which could be due to photographic artifacts or to light reflection from materials contained within the object. There are no metallic densities visible in the corresponding X-rays which can be readily associated with it, suggesting that its nature is most probably organic.

(2) Color photographs of the back of the head disclose a little flap of skin or other tissue, not easily identifiable, just above the hairline at the base of the skull and slightly to the left of the midline. It has a pale, pinkish red, slightly glistening appearance and is shaped like a small foot with the toes pointing toward the vertex. In one of the photographs, a black line is also visible running from the midportion of the flap to the right occipital-parietal region. It is not possible to determine whether this is a thread of some kind or a line drawn by some person on the negative. The flap itself does not appear to be associated with any underlying wound, and its location does not correspond with any X-ray features or any previous observations by other examiners of these materials.

(3) The wound in the upper back is slightly elliptical, with the longer axis in the horizontal direction, measuring about 5 x 7 mm. A darkened, abraded rim around the upper and right margins adds about 2 mm to each of these measurements. The medial margin is between 4 and 4.5 cm from the midline of the back, and the superior margin about 5.7 cm below the lowest crease in the neck. X-rays of this region disclose densities at the right lateral margin of the sixth and seventh cervical vertebrae. The clavicles, ribs, and other bones appear intact. (These observations differ from those of the Clark panel only in respect to slight variations in the measurements.)

(4) The tracheotomy incision is about 1.5 cm wide at the widest part of the gap. There is an irregular notch at the midpoint of its lower margin, possibly caused by the endotracheal tube used by the Parkland Hospital doctors. Lack of sharp focus in the photographs showing the tracheotomy prevented the author from

identifying and locating the alleged exit wound bullet.

(5) X-rays of Governor Connally's chest reveal a number of small particles suggestive of bullet fragments. Although very small, they appear metallic. (The report of the Clark Panel gives no indication that these X-rays of Governor Connally were examined by them.)

#### INTERPRETATION OF THE DATA

##### The Basic Medical Data

Photographs of the President's back indicate that its center is located about 4.5 cm to the right of the midline of the spine and about 6 cm above the lowest crease in the back of the neck. Accepting this wound line up with an exit hole in the midline of the throat at the level of the third or fourth thoracic vertebra, the path length of this wound is approximately 10 cm. Adopting also the Clark Panel's measurement of the vertical position of the exit hole, namely 9 cm above the same crease (although the author was unable to corroborate this measurement from his own observations), we are able to compute the trajectory of the bullet relative to the horizontal and sagittal planes through the President's body at the time he was struck.

The downward angle works out to be 13½ degrees, and the lateral angles from right rear (to front) is 17½ degrees. Allowing for a potential error in the measurements of these wound locations, the possible variation in these calculated angles is at least 1 degree, either plus or minus. Thus the bullet struck the President's back entered at an angle of 12½ or 13½ degrees downward relative to the horizontal plane. The corresponding angles relative to the vertical plane, of course, depend on the orientation of the car and the posture of the President's body at the time he was struck.

The pathway of the bullet which struck the President's head is not amenable to the same kind of calculation. This bullet fragmented, and the points of exit of the fragments are not known with precision. Nor, because of the bone impact and fragmentation, is it likely that the bullet fragment followed a course in line with the original flight. Because of the extensive loss of skull, it cannot be absolutely ascertained that no more than one bullet struck the President's head, at least from the available autopsy photographs and X-rays. However, one wound is definitely identifiable, and its location on the rear of the skull points to a rearward location for the source of the shot.

The data on the wounds of Governor Connally establish that he was struck by a bullet which entered the far right side of his back near the axilla, the corresponding exit wound being in the right chest, below the nipple. Photographs of the Governor's



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coat show a hole in the back, corresponding to the entry wound location, which is appreciably elongated in the horizontal direction. Angular measurements on this wound as reported by witnesses before the Warren Commission estimate that the bullet was on a downward angle of 25 degrees and a right-to-left angle of 20 degrees relative to the appropriate planes through the Governor's body. A portion of the fifth rib on the right side was shattered by this bullet.

The Governor's right arm was penetrated near the wrist, the bullet or missile entering the back side 5 cm above the wrist joint and exiting from the palm side about 2 cm from the crease of the wrist. The right radius suffered a comminuted fracture with deposition of several particles of lead.

The Governor's left thigh received a puncture wound in the medial aspect of the distal third, with a small metal fragment revealed by X-rays to be embedded in the femur.

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As noted previously, metallic fragments were also seen in X-rays of the President's upper back and neck region and in X-rays of Governor Connally's chest, although they are not reported by the Warren Commission.

#### Relevant Collateral Data

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In addition to the nearly whole bullet recovered at Parkland Hospital and subsequently designated as Commission Exhibit 399, numerous bullet fragments were recovered. Two large fragments, Commission Exhibits 567 and 569, were found late on the night of the assassination in the front seat of the Presidential car. These weighed 44.6 and 21.0 grains respectively, the larger consisting of both lead and copper while the smaller consisted of copper alone. The two together aggregated less than one-half of a whole bullet, and it was never determined whether they originated from one bullet or from two separate bullets.

Other, much smaller, fragments were removed from the President's brain, from Governor Connally's wrist, and from the carpet on the floor of the Presidential car near where Governor Connally and Mrs. Connally were seated. In addition, metallic smears were noted on the inner surface of the windshield of the car and on a street curb in the general vicinity where the assassination took place. All of these smaller fragments and smears together aggregated only about 5 grains. All were identified spectrographically as lead.

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The nearly whole bullet and the two large fragments were examined microballistically and found to have been fired by the same rifle, a 6.5 mm Mannlicher-Carcano reported to have been found on the sixth floor of The Texas School Book Depository, a building near the scene of the assassination. Three cartridge cases found near a window of the same floor were also determined to have been fired in this rifle.

Motion pictures taken during the assassination show that when the President received his head wound, his head was momentarily driven forward about two inches. About one-ninth of a second later (two frames of the film), his head begins a backward and leftward movement, along with the upper part of his body, until he has fallen over to the left side of the car. The moment of bullet impact is clearly visible on the film because of the eruption of brain tissue and fluid in that particular frame. A kind of pinkish mist is visible near the President's head for several frames of the film, ultimately fading away. No such impact or eruption is evident in any other frame of the film.

Reactions to other wounds of the President and Governor Connally are also evident in the films, but the precise times when the wounds were inflicted does not appear to be determinable. However, Governor Connally's reaction is clearly seen to occur later than that of the President by an interval of at least one-half of a second, and possibly as long as 1-1/2 seconds. Tests of the Mannlicher-Carcano rifle found at the scene have established that it cannot be fired twice consecutively in less than 2.3 seconds, even without allowing for the time required to reposition and re-aim at a moving target.

Governor Connally was seated directly in front of President Kennedy in the Presidential car. Diagrams of the car show the separation between the seats, back to back, to be about 30 inches, so that the horizontal distance from the President's throat to the Governor's back would be of the order of 24 inches. The Governor's seat was three inches lower than the President's at the time of the assassination, according to Secret Service agents who examined the car, but this difference is partially canceled out by the fact that the Governor was about two inches taller.

On-site measurements and re-enactment tests by the FBI established that during the interval when the President and Governor could have received their non-fatal wounds, the suspected assassin's site (sixth-floor window) looked down on the Presidential car at an angle which varied from 22 to 20 degrees as the car receded; the corresponding right-to-left lateral angle, relative to the longitudinal axis of the car, varied from about 12 to 8-1/2 degrees. The street over this interval slopes downward (away from the suspect window) by about 3 degrees.

Motion pictures and still photographs taken just before or during the early portion of the interval when the President and Governor could have received their non-fatal wounds show both men to have turned their heads to the right, but that the upper parts of their bodies are not turned or tilted from their normal erect positions. Turning of the head alone does not change the positions of the wound sites involved.

The President's tie showed a distinct abrasion of

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the outer fabric where the knot had been tied. Photographs and reports establish that the abrasion was on the left side of the knot as worn by the President.

#### Evaluation and Judgment

Commission Exhibit 399, the bullet which was believed by the Commission to have caused all the non-fatal wounds in President Kennedy and Governor Connally, shattering two bones in the process, shows no deformity (other than an FBI artifact) on its nose or anywhere in the upper two-thirds of its length. The lower third, though it shows some flattening and a small loss of lead at the base, has no impact marks on its surface. Moreover, the completely intact copper jacket of the bullet is entirely inconsistent with the observation that all four wound sites show depositions of metallic fragments. This is not the appearance of a bullet which has struck and fractured two bones, particularly Governor Connally's right radius. A bullet that had caused such damage would have been much more deformed and mutilated, would have shown clearly visible surface markings, and would have lost substantially more substance than the 2 to 2-1/2 grains estimated by the FBI.

On these grounds, we reject the Commission's hypothesis as incompatible with experience. It should be pointed out, however, that these grounds do not entirely eliminate the possibility that some lesser combination of wounds (not including the wrist wound of Governor Connally) might have been caused by the bullet in question, or that some different bullet (not recovered or possibly not recognized among the fragments) may have caused them.

When we examine the indicated trajectories of the wounds and the bullet flight paths required by the Commission's hypothesis, other major obstacles arise. According to the Commission's theory, a bullet entered the upper right side of the President's back and emerged at the midline of the anterior throat, grazing the left side of the knot of the President's tie as it emerged. Thereafter, this bullet is said to have entered the far right side of Governor Connally's back near the axilla and then to have traversed his chest, exiting just below the right nipple.

Governor Connally was seated directly in front of the President. Motion pictures and still photographs taken at the time or just before these body wounds were inflicted show no indication that either man's body was appreciably turned, tilted, or displaced relative to the car or each other. The lateral angle of the wounds, relative to the longitudinal axis of the car as the men were seated, is approximately the same for both men, 17-1/2 degrees for President Kennedy and 20 degrees for Governor Connally, the bullet moving from right to left as it traversed forward. The Commission's theory therefore requires that the bullet, just after leaving the

President's throat and grazing the left side of the knot of his tie, make an acute angular turn to the right in midair in order to enter the far right side of Governor Connally's back. Bullets have been known to take inexplicable pathways in bodies, but they do not make spontaneous sharp turns in midair. The theory that one bullet caused both the President's back/neck wound and the Governor's chest wound is therefore untenable.

It should also be pointed out that the indicated pathways of these wounds are in considerable disagreement with the calculated trajectories from the postulated firing position of the assassin. The supposed assassin's site looked down on the car at an angle which varied from 22 to 20 degrees in the vertical plane and from 12 to about 8 degrees (right to left) in the horizontal plane, during the time interval over which these wounds might have been inflicted. The slope of the street, about 3 degrees, might perhaps be deducted from the vertical angle if we assume that the men's seating posture was determined by the slope of the car rather than their own sense of balance. (The Warren Commission made this correction although it is open to some question.) However, the vertical angle through the President's back/neck wound measures only about 11-1/2 degrees, while that through the Governor's chest is larger, namely about 25 degrees. The indicated lateral angles (right to left in the horizontal plane) are about the same for both men, namely about 20 degrees.\* While these angular measurements are subject to error of a few degrees either way, the discrepancies seem too large to explain away in this fashion.

We now have three major objections to the Commission's "single-bullet theory", namely the near-pristine condition of Exhibit 399, the impossibility of the bullet flight path from the President's throat to the right side of the Governor's back, and the large discrepancies between the wound angles and the postulated firing trajectories. To these could be added the visible difference in times of reaction by the two men as seen in the Zapruder film and Governor Connally's own testimony that he believes he was hit by a separate shot.

However, it is clear that both men were hit within a very short time interval, not over 1-1/2 seconds. Since the rifle found at the scene could not be fired twice consecutively in less than 2.3 seconds, another rifle is required to account for one of the shots. Presumably the ballistic evidence from that other rifle was not recovered, nor was the rifle itself. This is not at all

\*The fact that both wounds were inflicted at substantial lateral angles is also supported by the horizontal elongation of the President's back wound and of the hole in the back of Governor Connally's suit coat.



implausible, considering the confusion that ensued at the scene immediately after the assassination. The Warren Commission itself, having concluded that three shots were fired, was forced to concede that one whole bullet was lost, since the bullet and bullet fragments recovered aggregated only 1-1/2 bullets altogether. The Commission postulated that the missing bullet missed the Presidential car and its occupants entirely. In the absence of that bullet, there can be no microballistic examination to determine what rifle fired it.

The wound angle data from the President's back/neck wound and Governor Connally's chest wound suggest very strongly that both guns were fired from a position considerably further west in the Texas School Book Depository than was thought to be the location of the assassin. The size and position of this building, relative to the Presidential car at the time of the assassination, is entirely compatible with this judgment. Moreover, the angles of the wounds in the vertical plane suggest that President Kennedy's wound was inflicted by a bullet fired from a low or intermediate floor, while Governor Connally's was inflicted by a bullet fired from a high floor or possibly the roof.

The available evidence, assuming it to be valid, gives no support to theories which postulate gunmen to the front or right-front of the Presidential car. The wound in the President's head, as evidenced in the autopsy photographs and X-rays, can only have been fired from somewhere to the rear of the President. However, it cannot be determined whether this shot was fired from the same location or locations as the shots which caused the non-fatal wounds. If any other bullet struck the President's head, whether before, after, or simultaneously with the known shot, there is no evidence for it in the available autopsy materials.

The absence or unavailability of certain evidence in this case leaves a number of residual doubts and unexplained mysteries. The missing evidence includes several autopsy items - the preserved brain tissue slides, including sections of brain and of skin at the wounds of supposed entry, and several photographs of the chest cavity - and the analytical data from the FBI's laboratory examination of the bullet and bullet fragments. All of these items are known to exist, or to have existed at one time. Their continued withholding leaves important questions unanswered and is a disservice to the nation.

For example, the detailed data from the spectrographic analysis and from the neutron activation analysis of the bullet, Commission Exhibit 399, and the various bullet fragments and lead particles recovered, could settle a number of questions important in reconstructing the shooting. For example, is the lead fragment removed from Governor Connally's wrist of the same composition as the lead in Commission Exhibit

399 or is it not? Does its composition match that of any other fragment recovered, e.g., one of the large fragments found in the front of the car? Is the copper in the two large fragments found in the front of the car from the same bullet or from two different bullets? From what bullet or fragment did the lead found on the inside of the windshield originate? Or the lead smear found on the street curb in the vicinity? Are there any fragments or particles whose composition indicates a different manufacturer from the others? Such questions can be answered by good analytical work, and in a case so fraught with difficulties in explaining the shooting, there can be no legitimate excuse for not providing the results of the tests already performed and for not conducting other appropriate scientific tests which might well resolve these questions conclusively.

#### SUMMARY AND CONCLUSIONS

##### Autopsy Conditions and Procedures

The autopsy of President Kennedy was deficient in failing to report a number of important facts about the nature of the President's wounds and in neglecting to make accurate measurements of the locations of the wounds. At least one serious oversight occurred in respect to a wound in the President's throat, which oversight was not corrected until the following day, after belated consultation with doctors who treated the President in Dallas.

The autopsy was completely dominated by military personnel under military orders. Instructions were given to the autopsy doctors which prevented the performance of important procedures, such as dissection of an observed wound in the upper back and the sectioning of the brain.

Too many extraneous personnel were in attendance, while highly qualified civilian forensic pathologists, who might have ensured a thorough autopsy, were deliberately not invited.

##### Governmental Handling and Disclosure of Evidence

The Government's handling of the evidence in the case created much unnecessary confusion and skepticism. The FBI itself was unaware, for almost two months as reflected in their official reports, that the autopsy team had corrected itself the day after the autopsy and concluded that a bullet had exited from the President's throat. Photographs and X-rays of the President's body were not examined by the Warren Commission, and instead reliance was placed on the artist's sketches and verbal descriptions which were later found to be in error.

After the Warren Report was published, the Government continued to withhold fundamental medical and other evidence. The autopsy photographs and X-rays have been kept secret from the public and, until recently, they have even been withheld from



qualified, independent, non-government pathologists.

Important analytical data concerning the bullet and bullet fragments continues to be withheld. The data could settle a number of critical questions about the details of the shooting, and it is known to have been acquired by the FBI Laboratory, but there is no indication that the Warren Commission ever saw it or even asked for it.

Certain important autopsy materials, including the preserved brain, certain tissue and skin sections, and several photographs are unavailable and unaccounted for.

#### Present State of Knowledge of the Details of the Shooting

The Warren Commission's "single-bullet theory" is untenable, and the Commission's conclusion that there was only one assassin cannot be reconciled with available evidence. Medical and photographic data, including measurements of wound angles and calculations of bullet trajectories, strongly suggest that there were two rifles used. The indicated locations are in the same building concluded by the Warren Commission to be the site of a lone assassin, but at points further west in this building and on two different floors.

So far as the available medical evidence shows, all shots were fired from the rear. No support can be found for theories which postulate gunmen to the front or right-front of the Presidential car. The medical evidence indicates that the President's back was hit by one bullet and that his head was hit by one other bullet only.

Residual doubts exist about the details of the shooting. At least some of these can be cleared up by making all of the autopsy materials available, and by releasing the detailed FBI Laboratory data on the spectrographic and neutron activation analyses of the bullet and bullet fragments recovered.

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#### NEWS RELEASE

Dr. Charles L. Winek, the Allegheny County Coroner's Chief Toxicologist, and Professor of Toxicology at Duquesne University, has accepted the editorship of the annual publication entitled:

#### *TOXICOLOGY ANNUAL*

This new book will be published on an annual basis by Marcel Dekker, Inc. of New York. The first "Toxicology Annual" will appear in 1974 and will contain approximately 24 chapters dealing with all aspects of toxicology, including such topics as, 1) saccharin toxicity, 2) drugs in urine, 3) dialysis of drugs, 4) marihuana, etc.

Interested scientists are asked to contact Dr. Winek about contributing chapters to the Annual in their field of Toxicology. No area of toxicology will be excluded.

#### ADVANCES IN ANALYTICAL TOXICOLOGY Dec. 3, 4, & 5, 1973

The Institute of Clinical Toxicology will sponsor a three day symposium on the analytical toxicology of drug abuse and drug intoxication. The symposium will focus on six areas of immediate interest to both clinical and laboratory personnel. Each session will conclude with a position paper by a prominent authority in the field, followed by selected contributed papers.

The program is designed for physicians, pharmacists, and laboratory staff who have responsibility for patients involved in drug abuse and drug related illness.

The following position papers will be presented:

**Street Drug Analysis Programs** by George L. M.D., Professor of Pathology, L.A. County Medical Center, Los Angeles, California, on the technical problems on street drug analysis programs.

**Emergency Drug Analysis Programs** by Harrison Jr., Ph.D., Genesee Hospital, Rochester, New York, on the laboratory support necessary for immediate continuing care of acutely intoxicated patients.

**Rapid Screening Procedures For Drugs** by Walter J. Decker, Ph.D., Chemistry Department, Army Medical Laboratory, Fort Sam Houston, Texas, on the role of rapid screening procedures in the diagnosis of acute intoxication in the emergency room.

**Analytical Problems Faced By The Medical Examiner** by William Q. Sturner, M.D., Medical Examiner, Tarrant County, Dallas, Texas, on approaches to the analytical problems of determining the presence or absence of drugs in the body as well as the interpretation of analytical results.

**Role of the Laboratory In Monitoring Drug Treatment Programs** by David C. Fenimore, Section Chief, Instrumental Analysis Section, Research Institute of Mental Sciences, Houston, Texas, on the function of the analytical toxicology laboratory in monitoring the treatment or withdrawal of patients from intoxicating drugs.

**Laboratory Proficiency Monitoring** by a representative of the Toxicology Staff of the Community Control Center, Atlanta, Georgia, on experienced issues in the establishment of programs to monitor the proficiency of services provided by analytical toxicology laboratories.

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Contributed Papers in the field of drug abuse and drug intoxication are welcomed; however abstracts not submitted to the Institute of Clinical Toxicology, Box 2565, Houston, Texas 77001 before November 1973.



## BOOK REVIEW

## SCIENTIFIC EVIDENCE IN CRIMINAL CASES

Andre A. Moenssens, Ray Edward Moses,  
and Fred E. Inbau (Foundation Press, 1973)

The key to this treatise is stated in the introduction: "It often happens that both the prosecution and the defense fail to fully utilize . . . the great potential of expert testimony as a courtroom technique for proving or disproving allegations of fact."

The authors emphasize the point in the first sentence of Chapter I: "There is no aspect of effective pretrial and trial planning more neglected by the Bar than the effective use of expert testimony."

This book, as indicated from the above, was written for the trial attorney. It encompasses the forensic sciences and includes such recent additions as spectrographic voice identification, forensic odontology, narcoanalysis and neutron activation analysis. Without question, it will be a most useful reference for attorneys to bridge the gap between law, medicine and science.

Sixteen chapters are contained in the book with an unusually good Summary of Contents and Index. Numerous references to cases and scientific notation explanations are found on the page, rather than at the end of the Chapter. At the end of each Chapter is given a Bibliography of Additional References; I found this to be well done, including many recent scientific references. In general, the organization is excellent.

Chapters on the "Expert Witness," "Firearms Evidence," "Neutron Activation Analysis," "Questioned Documents," and, "Photography, Motion Pictures, etc.," are well-written. The chapters on "Toxicology, Chemistry, Serology" and "Microanalysis" suffer from two problems. First, it is uncomfortable to me to separate serology from microanalysis; in the laboratory and courtroom, these overlap in great part.

The second objection is not of the authors' making. It deals with the positiveness or singularity with which some so-called expert testimony has been received in court. It is a travesty, almost a burlesque, to realize that testimony has been accepted positively identifying a particular person with a particular place or crime scene, on the basis of one pubic hair, or one shard of glass, or a soil sample on shoes. The blame for such testimony rests with the forensic scientist.

Possibly books of this type will permit and

encourage attorneys to meet in pre-trial conference with the expert witness. Knowing that the defense has access to a work written in reasonably plain English concerning the nature of evidence analysis and the conclusions to be drawn, being cognizant that scientific limitations exist, should alert counsel that he needs to understand the conclusions to be drawn. If prosecuting counsel ignores this preparation, then defense counsel hopefully will intervene with proper expert testimony. Forensic science is, and should be, just that - - examination and analysis of specimens with conclusions reached which can bear scientific scrutiny. The courts must receive proper expert testimony and it behooves the attorney to be aware of the limitations, as well as the power, of expert testimony.

Within each chapter, the authors furnish brief, but fairly comprehensive coverage of each subject. Trial aids are discussed as is the testimony of the expert witness in each field. In the chapter on "Firearms Evidence", the examination and analysis of gunshot residues is covered, and again in the chapter on "Neutron Activation Analysis". Once again, the dermal nitrate test is laid to rest, but no mention is made of atomic absorption analysis as an alternative to the Harrison and Gilroy, or neutron activation analysis techniques. The chapter on "Forensic Pathology" is relatively brief but adequate references are given.

On balance, I find this to be a well referenced, well-written, brief book covering essentially all of the important facets of scientific evidence. It has additional, unusual features such as addresses of organizations helpful in procuring bonafide expert witnesses in the various fields. The type used is bold and clear, not cramped and small. The illustrations used are more than adequate and I believe sufficient in quantity.

This treatise could well be found before each defense attorney, permitting intelligent questions pertaining to qualifications and subsequent testimony. The prosecuting attorney should take note that the most value can be elicited from the expert witness if pretrial conference is held. The expert witness should place this on his or her bookshelf with books by Gradwohl, Helpert, Kirk and similar pioneers in the forensic sciences.

I. C. Stone, Ph.D.