

PHYSICS AND JFK ASSASSINATION: FINAL EVIDENCE OF A SECOND SNIPER BEHIND THE STOCKADE FENCE.

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Abstract

This study is the first analyzing in a new and more accurate way the most important physical and ballistics features of the “fatal shot” (after “Z312” photograph of the Zapruder’s film) in Dealey Plaza, to the head of President Kennedy, which so far have almost totally been disregarded.

Particular emphasis is placed here to the key-concept of obliquity (nearly 60°) of the fatal bullet, and its ballistic devastating effect of collision on a human head (as compared to a “straight” [only 10° lateral + 12° downward obliquity], alleged shot from the 6th floor of Texas School Book Depository), along with the obliquity of limousine’s position, in connection with the obliquity of injuries on Kennedy’s head (60° as well), and his sudden backward-to-left movement.

Furthermore, a new terminal ballistics equation with a more precise and detailed distribution of kinetic energy of the oblique bullet and its fragmentation (rather than the less reliable and rough physical analysis of the “ballistic pendulum”) along with experimental data, provide compelling evidence that highest degree of bullet’s fragmentation occurs whenever impact of bullet on target exhibiting obliquity > 20° (with 60° as angle of biggest shattering!) is taking place. All these new factors are therefore definitely proving that the fatal bullet was shot from behind the stockade fence of the grassy knoll, and there is no physical possibility that it could have been so hugely fragmented as a result of an almost straight shot by a Mannlicher-Carcano rifle from the 6th floor of the TSBD.

“I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the state of Science, whatever the matter may be.”

(William Thomson, Lord Kelvin)

Prologue

“Information Entropy” [1], or “redundancy” is one of the main problems, or even a sort of “curse”, in the scientific approach to the study of the assassination of President John F. Kennedy, in Dallas’ Dealey Plaza, on November 22, 1963, at 12:30 p.m.

Information Entropy means that lots of information on a specific subject, from many conflicting sources, fatally end in spreading confusion among the people, making therefore difficult to reach a sound and well documented opinion on that issue.

That is the reason why, after 50 years, many persons all over the world are not convinced yet whether JFK was killed by a “lonely gunman” or as a consequence of an organized conspiracy, by several shooters, although that crime was probably the most viewed and documented in History!

Entropy of information, (or sheer disinformation!), in recent years, contributed to surround by a negative halo even the word “conspiracy” itself, as if the assassination of political leaders in History, from Caesar on to Benazir Bhutto, etc. , by several persons, was a sort of “oddity”, rather than a tragic rule!

Even more disappointing is the fact that, in these 50 years after the “murder of the century”, a lot of investigations, studies, articles, reports, books, etc., have been written by journalists, lawyers, politicians, historians, medical experts etc., but just a few physicists and engineers (apart from several experts of weapons and Ballistics) decided to analyze the dynamics of the shooting, although with contrasting results.

The first important physicist who – despite totally wrong results – used Physics to “disprove” even the second Newtonian Law of Dynamics, trying vainly to prove (using melons!) that the left-backward head snap was caused by a bullet from behind, was curiously the Nobel prize Dr. Luis W. Alvarez in 1976 [2]. Then, 3 years ago, G. Paul Chambers [3] tried to focus his analysis, as a physicist and expert in explosives, to the fatal head shot, trying to prove that the “fatal shot” was fired from the stockade fence. The attempt was really interesting, unfortunately some errors and wrong assumptions flawed his work.

Of course, this does not mean that several very good books (two for all: “Six Seconds in Dallas” by Josiah Thomson, 1967 [4], and “Rush to Judgment”, by Mark Lane, 1966 [5]), articles, investigations, expert’s reports, etc., contributed to shed light on what happened in that tragic moment, and it would be highly ungenerous to deny that!

What we mean is that – so far – Physics seems still an almost neglected specialty in the analysis of JFK’s murder.

This paper would like to contribute to add a more sound and accurate physical analysis of the “fatal shot”.

In order to avoid risks of “information entropy”, this analysis will focus only to the comparison between the fatal shot, as a result of a bullet reaching Kennedy’s head from the stockade fence with an obliquity around 60°, and a distance of nearly 103 feet, and an alleged straight shot from 264 feet behind, by a 6.5 mm. bullet from a Mannlicher- Carcano Mod. 91/38 rifle.

Once we prove that Physics and Terminal Ballistics totally refute any possibility that the fatal shot was fired from 88 yards (= 264 feet = 80 meters) behind, from TSBD, and it could produce the effects we know on JFK’s head, by a Carcano cartridge, then we can reach the final evidence of 2 different snipers (at least!) in the Dealey Plaza that day.

Of course, this does not mean at all that other important aspects of the shooting in Dealey Plaza do not deserve a very accurate analysis: the “magic bullet” theory, the “fingerprint” of “dictabelt” sound and the HSCA’s report [6], the wounds at the throat and at the back of JFK, the slight forward movement of JFK’s head just a fraction of second before the “fatal shot” (limousine braking or movement of Zapruder’s amateur handy camera?) etc.

But it seems enough, at the moment and for the sake of clarity , to focus our analysis just on the fatal shot, in order to underline the correct laws of Physics and Terminal Ballistics which – so far – have been many times disregarded or misinterpreted.

To achieve this end, only the most reliable sources and witnesses have been selected and considered.

1. The precise location and angle of wounds to the head: Parkland vs. Bethesda?

An accurate reconstruction of the precise locations, sizes and angle of the wounds to the head of President Kennedy is of paramount importance, of course, because it can tell us a lot about the origin of the shot and the weapon of murder.

However, in the Assassination Records Review Board [7], the agency set up in 1992 by the US Congress to collect and preserve the quality of assassination records, for a total and public disclosure, the conclusions of the Final Report (1998) in this respect are absolutely disappointing:

“ (1) The autopsy report in evidence today, Warren Commission Exhibit 387, is the third version prepared of that report; it is not the sole version, as was claimed for years by those who wrote it and signed it.

(2) The brain photographs in the National Archives that are purported to be photographs of President Kennedy’s brain are not what they are represented to be; they are not pictures of his brain, but rather are photographs of someone else’s brain. Normally, in cases of death due to injury to the brain, the brain is examined one or two weeks following the autopsy on the body, and photographs are taken of the pattern of damage. Following President Kennedy’s autopsy, there were two subsequent brain examinations, not one: the first examination was of the President’s brain, and those photographs were never introduced into the official record; the second examination was of a fraudulent specimen, whose photographs were subsequently introduced into the official record. The pattern of damage displayed in these ‘official’ brain photographs has nothing whatsoever to do with the assassination in Dallas, and in fact was undoubtedly used to shore up the official conclusion that President Kennedy was killed by a shot from above and behind.

(3) There is something seriously wrong with the autopsy photographs of the body of President Kennedy. It definitely is President Kennedy in the photographs, but the images showing the damage to the President’s head do not show the pattern of damage observed by either the medical professionals at Parkland hospital in Dallas, or by numerous witnesses at the military autopsy at Bethesda Naval hospital. These disparities are real and are significant, but the reasons remain unclear. “[8]

The wounds to the head were described as follows by the medical personnel of the autopsy at Bethesda Naval hospital:

“ 1.The wound to the back of the head is described by the Bethesda autopsy as being a laceration measuring 15 x 6 mm, situated to the right and slightly above the external occipital protuberance. In the underlying bone is a corresponding wound through the skull showing beveling (a cone-shaped widening) of the margins of the bone when viewed from the interior of the skull.

2.The large, irregularly shaped defect in the right side of the head (chiefly to the parietal bone, but also involving the temporal and occipital bone is described as being about 13 cm (5 inches) wide at the largest diameter.

3.Three fragments of skull bone were received as separate specimens, roughly corresponding to the dimensions of the large defect. In the largest of the fragments is a portion of the perimeter of a roughly circular wound presumably of exit, exhibiting beveling of the exterior of the bone, and measuring about 2.5 to 3.0 cm in diameter. X-rays revealed minute particles of metal in the bone at this margin.

4.Minute fragments of the projectile were found by X-ray along a path from the rear wound to the parietal area defect. “[9]

And yet, the official version of autopsy, focusing mainly to a large (13 cm., 5 inches) defect in the right, temporal area of skull, and almost “minimizing” the rear occipital wound, was challenged even by several persons who attended the autopsy:

“Witnesses at Bethesda

Besides the physicians who performed the autopsy, the authors have assembled the recollections of twenty-one witnesses who saw the body at Bethesda and described a rear skull wound. Among them are four physicians besides the autopsists, two autopsy photographers, three secret service agents, two FBI agents five technicians, a hospital corpsman, a presidential aid, and a mortician. All the witnesses' testimonies save one corroborate the Parkland descriptions of a rear skull defect...” [10]

Among those witnesses, **mortician Tom Robinson** (whose words are particularly candid and trustworthy, as not influenced by career concerns, or by aseptic and “cryptic” medical language) released an impressive and clear report of President’s skull injuries: “*there was not enough scalp to pull together over that large wound on the back. **The big hole was only in the back.** We filled the skull with plaster and put back the bones, but we did not have all of the bones, and **could not completely cover over the hole in the back. I do not remember any bone being missed at the top of the head.**”*

Just a few hours before the autopsy at Bethesda hospital, another very professional and qualified team of medical personnel, in Trauma Room One at Parkland Memorial Hospital in Dallas, 13 minutes after the shooting in Dealey Plaza (12:43 – 13:00 p.m., November 22, 1963), had already seen and described very well the injuries at the head.

Sixteen doctors tried to save the dying President. Here are their names:

Dr. Gene Aikin, Dr. Fouad Bashour, Dr. Charles Baxter, Dr. James Carrico, Dr. Kemp Clark, Dr. Charles Crenshaw, Dr. Delaney, Dr. A. H. Giesecke, Jr., Dr. Robert Grossman, Dr. Jackie H. Hunt, Dr. M. T. Jenkins, Dr. Ronald Jones, Dr. Robert McClelland, Dr. Malcolm Perry, Dr. Paul Peters, Dr. Kenneth Salyer

There were also several nurses, and some of them (Audrey Bell, Diana Hamilton Bowron) testified and even sketched themselves drawings of the wounds to the head.

The most important element, in those “first-hand” and genuine descriptions of the wounds, is the emphasis that all the Parkland medical personnel devoted to the rear right occipital wound, more than to the temporal wound (as it happened a few hours later during the autopsy, by the Bethesda hospital medical personnel):

Robert Grossman, MD:“He (Grossman) said that he saw two large holes in the head, as he told the (Boston) Globe, and he described a large hole squarely in the occiput, far too large for a bullet entry wound...”.

Kemp Clark, MD: Professor and Director of Neurological Surgery at Parkland,

“...in the occipital region of the skull... Through the head wound, blood and brain were extruding... There was a large wound in the right occipitoparietal region, from which profuse bleeding was occurring... There was considerable loss of scalp and bone tissue. Both cerebral and cerebellar tissue were extruding from the wound.” (WC--CE#392)

Gene Aikin, MD: “The back of the right occipitalparietal portion of his head was shattered with brain substance extruding.” (WC-V6:65.)

Charles Rufus Baxter, MD: "...the right temporal and occipital bones were missing (emphasis added) and the brain was lying on the table..." (WR:523).

Robert McClelland, MD: "...I could very closely examine the head wound, and I noted that the right posterior portion of the skull had been extremely blasted. It had been shattered...so that the parietal bone was protruded up through the scalp and seemed to be fractured almost along its right posterior half, as well as some of the occipital bone being fractured in its lateral half, and this sprung open the bones that I mentioned in such a way that you could actually look down into the skull cavity itself and see that probably a third or so, at least, of the brain tissue, posterior cerebral tissue and some of the cerebellar tissue had been blasted out...." (WC--V6:33)

Malcom Perry, MD: "I looked at the head wound briefly by leaning over the table and noticed that the parietal occipital head wound was largely avulsive and there was visible brain tissue in the macard and some cerebellum seen..." (HSCA-V7:302-interview with Purdy 1-11-78.)

Ronald Coy Jones: "...he had a large wound in the right posterior side of the head... There was large defect in the back side of the head as the President lay on the cart with what appeared to be some brain hanging out of this wound with multiple pieces of skull noted next with the brain and with a tremendous amount of clot and blood." (WC-V6:53-54)

Nurse Diana Hamilton Bowron: "...there was blood all over this neck and shoulders. There was a gaping wound in the back of his head." (Livingstone, Killing the Truth , p. 180)

Nurse Audrey Bell: "-Although only in Trauma Room One for 3-5 minutes, she did see the head wound. After asking Dr.Perry "where is the wound," she said he turned the President's head slightly to the President's anatomical left, so that she could see a right rear posterior head wound, which she described as occipital in both her oral remarks, and in her drawings

-She said she could see brain and spinal fluid coming out of the wound, but could not tell what type of brain tissue it was;

-She said it was her recollection that the right side of the President's head, and the top of his head, were intact, which is why she had to ask Dr. Perry where the wound was in the first place."(04/I 4/97 Summary of ARRB interview)" [11] [12]

Hence, descriptions of Bethesda's and Parkland's medical personnel are quite different, and the latter did not mention a so large wound at the right temple (apart from Dr. Baxter), whereas the former were minimizing the large occipital wound that so much attracted the attention of Parkland personnel.

Nevertheless, the major disagreement between Parkland and Bethesda doctors, arose after the release of the X-rays of President Kennedy's skull, during the autopsy at Bethesda hospital.

In the X-rays the occipital laceration seems almost invisible, whereas the sizes of temple wound seem much bigger than what doctors saw.

Therefore, **Dr. David W. Mantik**, who conducted, in 1993, a very accurate and up to date analysis, using an “optical densitometry” technique and a 3-D analysis of the skull and its wounds said:

“the information contained in the X-ray film is converted from two dimensions into three dimensions and is that much richer in detail. The range of peaks and valleys on such a topographic map would be expected to fall within a well defined range for a normal human skull. Any values which lie outside of this range - and especially those which lie unnaturally far outside - would not be consistent with ordinary skulls and would raise questions of authenticity... I discovered... new evidence that the autopsy X-rays of President John F. Kennedy have been altered, that there were 2 shots which struck the head, and that the magic bullet is anatomically impossible.” [13]

Hence, the possibility of a forgery, or manipulation of the X-rays film of the skull, to cover with white color the occipital wound, and to magnify the temporal wound with black, in order to make the latter as a huge exit wound and the former as a little entry wound, to support the “official” theory of the Warren Commission [14] of the “lonely gunman” (Lee H. Oswald) and the fatal shot coming from behind, from the 6th floor of Texas School Book Depository, is serious and cannot at all be dismissed.

Thus, the most reliable conclusions, in examining the documents of the wounds on Kennedy’s head can be summarized as follows:

- 1) All the Parkland witnesses were unanimous (the only exception was Dr. Adolph Giesecke, but the misunderstanding arose because he was surely meaning his own “left”) in placing the biggest wound of JFK’s head to the “rear right side”, whereas just one of them (Dr. Baxter) noticed a temporal laceration of skull as large as the one described in JFK’s autopsy at Bethesda. And yet, no “temporal missing bone” was reported by the last person who touched JFK’s head at Bethesda: mortician Tom Robison.**
- 2) The temporal wound showed also a diffuse fragmentation of the fatal bullet into many minute pieces**
- 3) The X-rays of skull and some of the photos or drawings of the autopsy cannot be taken as reliable scientific sources of evidence, and maybe they were manipulated, as the US Congress Final Report (ARRB) recognized in 1998.**
- 4) The angle of entrance/exit of temporal and occipital wounds was estimated approximately between 45°-60°, but very likely near 60° (see fig. 1 - 2)**

2. The precise position and obliquity of the presidential limousine at the moment of fatal shot.

If we take the most precise maps and reconstructions of Dealey Plaza at the moment of the shootings (the best seems a map by **Robert Cutler** of 1970 [15], where it is possible to locate even the positions of many known bystanders of that motorcade, from Newman family to Jean Hill, from Jim Tague to Mary Muchmore and Abraham Zapruder, etc. [but don’t take the scale in feet at the bottom of the map, it is incorrect]), we can discover that when the fatal bullet that hit Kennedy’s head was shot, his Lincoln Continental limo and himself were at a distance of about 31 meters (103 ft.) - as the crow flies - , from the corner of the stockade fence, separating the parking area to the grassy knoll.

Now, if we map out a line linking Kennedy's limo to the stockade fence, at an obliquity of nearly 60° (G. Paul Chambers suggests a 45° obliquity between the short axis of the limo and a point about 5-10 feet north of the corner of the stockade fence, but the most precise calculation leads to an obliquity near 57°-60°, and Josiah Thomson too indicated a 60° obliquity), we can precisely find the point where many witnesses saw a puff of smoke, and heard a shot.

Thus, the first remarkable evidence is that both the 60° obliquity of the temporal + occipital wounds at Kennedy's head, and the 60° obliquity of limo's angle with the point behind the stockade fence where many persons saw a puff of smoke and heard a shot, are totally coincident.

That seems to lead to a first incontrovertible conclusion: the fatal bullet that blew JFK's head off came from a frontal shot, by a sniper behind the stockade fence, when the limo was 31 meters distant and at 60° obliquity with the shooter.

Fig. 3, with a top view of the moment of fatal shot, is clear in explaining the behavior of Jackie Kennedy as well. Actually, the fatal shot was "frontal" for the sniper, but it was 60° oblique for President Kennedy, and bullet's energy extruded and propelled cerebral and skull fragments – through the occipital exit wound – "transversally" to limo's bonnet, right behind Mrs. Kennedy . And that's the reason why she stretched out her arm and immediately jumped onto the bonnet, in a natural gesture to seize and stop those slipping fragments, as clearly evidenced also by Nix's and Muchmore's films.

3. The "backward – and – to – the – left " movement of Kennedy's head as the most remarkable physical evidence (2nd Newton's Law of Motion) of a frontal shot from right. Rebuttal of Luis Alvarez's hypothesis

One of the most universal and commonly experienced laws of Physics and Mechanics, is **the second Newton's Law of Motion (Dynamics)**, that can be expressed as follows:

***"The acceleration of a body is directly proportional to, and in the same direction as, the net force acting on that body"* [16]**

This is basic, universal, classical Physics: when you see a football player kicking the ball in front of him to the right, you 100% expect the ball moving forward to the right, in the same direction of the kick.

And when you hit a tennis ball to the left, with your tennis racket, you can easily 100% foresee that the ball will travel to the left, in the same direction and more or less fast, in the same proportion as the force you wanted to transmit to it.

Thus, Kennedy's violent backward head snap, from right to the left, according not only to Zapruder's (the clearest), but also to Nix's and Muchmore's films, and to the famous Moorman's photo as well, seemed a clear and indisputable physical evidence that the fatal bullet was incontrovertibly shot by a frontal sniper, who fired from right to the left of President.

Yet, in 1976, a big surprise came from a paper written by a Nobel Prize of Physics, **Dr. Luis Alvarez**, who was a long time skeptical outspoken about "conspiracy theories", and was fully persuaded that the official "lone gunman " theory of the Warren Commission was correct. He tried to "refute" the universal 2nd Newton's law, trying to prove that a shot from behind (better, from the 6th floor of TSBD) could push Kennedy's head toward the shooter, and he called that mechanism: "jet effect".

To summarize the arguments proposed by Dr. Alvarez, who shot some melons with few handgun's bullets , to show that those melons were "recoiling" toward the shooter:

Alvarez wrote that a bullet traveling inside a melon at high speed produces a sort of "jet effect", namely a temporary increase of pressure and "cavitation" inside the pulp of the melon, moving and displacing it violently and abruptly (is the same way as a sailing boat is moving and separating the waters with its head) , producing also thereafter a contrary "recoil" movement of the pulp in the direction of bullet's first entrance hole, in the same way as the combustion of fuel inside a jet is propelling a lot of energy outside, and in the same way as the explosion in rifle's chamber produces a more or less powerful "recoil" effect toward the shooter.

Alvarez's attempt (followed by another similar with a can of tomatoes, by Dr. John Lattimer and Larry Sturdivan [17]) was unfortunately a totally wrong misapplication of the "jet effect" (or "recoil effect") to a melon, i.e. a totally different body than a human head.

The most persuading and sound rebuttal of the whimsical "Jet Effect Theory" by Dr. Alvarez was in a recent (2012) paper by **Dr. Tony Szamboti** [18], a Mechanical Engineer.

First of all it is physically incorrect to compare the engine of a jet, or the chamber of a rifle, to a melon being hit by a bullet.

Both jet's engine and rifle's chamber are – from a physical standpoint - isolated systems, in which the pressures causing the recoil originate inside, whereas melon's interior is being hit from an external force.

The main argument put forward by Szamboti was that a shot toward a melon needs only 17 entry + 17 exit = a total + 34 pounds of bullet's shear force, to cut and perforate the soft rind of the melon and get out, whereas the temporary cavitation and pressure generated inside the melon by the bullet would be – 413 pounds.

Thus, the difference between + 34 pounds (total shear forces to penetrate and pass through the melon) and – 413 pounds (contrary pressure originated by the temporary cavitation of pulp inside the melon) make a total - 379 pound force, in the direction of the shooter.

Though, this "jet effect" with melon does not take place at all with a shot toward a much harder bone of human skull!

Actually, as Dr. Szamboti explains, it takes at least $1,700 + 1,700 = 3,400$ pounds of shear force (100 times higher than the minimum force to cut the melon!), for a 6.5 mm. bullet like that of the Mannlicher-Carcano, to pierce and perforate a human living skull.

Even assuming a temporary "cavitation pressure" inside the brain of – 413 pounds, the net resulting force would be $3,400 - 413 = 2,987$ pounds in the direction of shot (according to Newton's 2nd law of dynamics) , and not toward the shooter!

In addition, the shear force necessary to cut and penetrate a human skull is at least 7,100 psi (total 14,200 psi to go through it), and the maximum pressure of a bullet from a Mannlicher-Carcano rifle is around 38,000 psi, [19] so it takes a lot of energy even to a rifle to pass through a human head.

As Dr. Szamboti himself noticed at the end of his paper, the clearest rebuttal of Alvarez's theory came from an experimental test in 1964, to replicate the Dealey Plaza head shot:

“This was actually demonstrated in testing at the U.S. Army's Edgewood Arsenal. Ten human skulls, filled with the same tissue replicating material as that used by the Army Wound Ballistics Research program, were shot with 6.5 millimeter ammunition. All ten skulls went forward, in the direction of the bullet, with none moving backward towards the shooter.”

In short, Dr. Alvarez's attempt to “refute” the universal Newton's 2nd Law of Dynamics, failed because Alvarez went wrong in comparing the physical reaction to a shot toward a hard human skull bone with a shot toward the soft rind of a melon.

4. G. Paul Chambers and “Conservation of Momentum” problem.

In 2010 Dr. G. Paul Chambers, a physicist and expert in detonation and radiation, who worked also for the NASA and the US government, published an interesting and surely unusual (in the literature on Kennedy's murder) book: “Head Shot”, whose purpose was to meticulously use the laws of Physics and motion, to prove – among other things - in the most scientific and compelling way that: a) a second sniper fired the fatal bullet that killed President Kennedy ; b) killer's location was the grassy knoll; c) the former L.A. prosecutor **Vincent Bugliosi**, who spent years investigating and writing also on JFK's murder (see “Reclaiming History” [20]), failed in evaluating physical evidence of the “fatal bullet”, because he totally disregarded the physical laws explaining why Kennedy's head was pushed backwards to the left.

Although both the purpose of the book and the conclusions above can surely be praised and shared, there are unfortunately some wrong assumptions, and confusion in the application of “conservation of momentum” that flawed his otherwise noteworthy analysis.

Therefore, it is important to “re-make” correctly that physical analysis of the fatal bullet's motion.

First of all, Chambers complains of a poor understanding of the physical law of momentum, by Vincent Bugliosi because, in short: *“Bugliosi thinks that because a bullet doesn't weigh very much, less than an ounce, it wouldn't have been able to push Kennedy's head backwards. However, it's the bullet's momentum that counts. Momentum is a compounding of mass and velocity. The bullet carries substantial momentum because it moves very, very fast. Although small, a micrometeorite, about the size of a sand grain, will still punch a hole in your spaceship because it is moving at extremely high velocity, tens of thousands of miles per hour. Bugliosi points to videos of prisoners being executed by gunshots to the head. The prisoners do not recoil backwards, but merely sink to the ground. This is because the bullets entered and exited their heads. In this case, the bullet carries away its own recoil momentum as it exits the body.”* [21]

According to Chambers' own words, a bullet that remains inside the head of the victim (like a bullet remaining inside a “ballistic pendulum”) would “conserve its own momentum”, whereas a bullet that exits the head of the victim would “carry away its own momentum as it exits the body”.

Chambers' conclusion was that the sudden and violent backward movement of JFK's head can only be explained because the fatal bullet remained inside Kennedy's head and “conserved its own momentum”, thereby pushing back the head of the President, in the same way as a bullet shot toward a “ballistic pendulum” can push upward the pendulum, because the bullet does not exit, and its whole momentum is being transmitted to the pendulum and becomes 100% motion of the latter.

Unfortunately it seems that Chambers is misinterpreting the concept of the “conservation of momentum”.

Conservation of momentum in Physics means that in a collision between a body A and a body B, in an isolated system (where no other external force is acting on the 2 bodies), the total momentum of the bodies before the impact is equal to the total momentum of the two bodies after the impact. [22] [23]

“Conservation” is synonymous of “unchanging”, it simply means that the sum of momentum of 2 bodies before the collision does not change after, no matter whether the first body remains in close contact with the second, or not.

In mathematics, the above concept can be expressed as follows:

$$\mathbf{p = m * v} \tag{1}$$

Where p = momentum

m = mass of body

v = velocity of body

Thus, in a collision between 2 different bodies:

$$\mathbf{m1 * dv1 = - m2 * dv2} \tag{2}$$

namely: the momentum change of body 1 is equal in magnitude and contrary to the momentum change of body 2, or also: the momentum lost by body 1 is equal to the momentum gained by body 2.

Furthermore, in the above equation (1), since velocity in Physics can also be expressed as acceleration:

$$\mathbf{v = a * dt} \tag{3}$$

Then we know that an “instant impulse” in a collision, can be written in integral form as:

$$\mathbf{\int F * dt} \tag{4}$$

i.e.: the impulse of a force in an infinitesimal moment

but Force (F) can be written as well as:

$$\mathbf{F = m * a} \tag{5}$$

Force = mass * acceleration.

So $\int F * dt$ becomes

$$\mathbf{\int m * a * dt = \int m * v/dt * dt = \int m * v} \tag{6}$$

Therefore, momentum mathematically coincides with “instant impulse”, and “conservation of momentum” is the same as saying that the instant impulse lost by body A in a collision is the instant impulse gained by body B.

But this means that it is not important what happens after the collision between 2 bodies, in terms of “conservation of momentum”.

Momentum is conserved both when body A remains in close contact with body B after the impact, and when body A immediately separates from body B after the collision!

It is irrelevant whether a bullet remains inside the head or not after the shot, in terms of “conservation of momentum”.

If you shoot a bullet toward a tissue paper, and then you shoot another bullet toward a bullet-proof vest, of course the first bullet is “losing” just 1/1,000 of its speed - more or less - after perforating the paper, whereas the second bullet will be totally “absorbed” and stopped by the metal of the bullet-proof vest.

Yet, in both cases momentum is “conserved”, the only difference is that first bullet is “losing” and yielding just 1/1,000 of its momentum (and its residual velocity will remain almost unchanged), whereas second bullet loses and yields 100% of its momentum, then it stops and its residual velocity becomes 0.

So, it is incorrect to believe that backward movement of Kennedy’s head could be physically explained by resorting to ballistic pendulum and the “conservation of momentum” of the fatal bullet allegedly “remaining” inside his head.

In this respect, it is also important to remark that most of the right side of JFK’s brain almost exploded and was flung, through the occipital wound, onto the bonnet of the limo, and cerebral matter, blood, fragments of skull ran over the secret service agent Clint Hill, and the agent Bobby Hargis, who was riding his motorcycle behind Mrs. Kennedy, at the left side of the motorcade.

Therefore, just a portion of the bullet remained and was found (in minute fragments) inside JFK’s head. Another part was lost, along with the right side of his brain.

But the most compelling evidences against such a “rough” application of the ballistic pendulum to the head movement of victims of shootings, are some plain experimental data.

If we think about the power of some handguns, we can find that a bullet of a Colt .45 can reach a muzzle pressure (maximum) up to 14,000 psi, and a 38 S&W around 14,500 psi. [24]

But, as we have seen above, it takes a shear/cutting force of 7,100 psi (at least) to perforate a human skull, namely a total 14,200 psi to pass through it.

This explains why, in many cases bullets that have been shot by many less powerful (in comparison with rifles) handguns remain inside the head of victims, and there’s almost no backward movement after shooting, as Bugliosi pointed out.

A .45 Colt cartridge can reach an average velocity of 300 m/s and its weight is around 15 grams.

Hence, its max. momentum ($p = m * v$) is:

$$300 \text{ m/s} * 15 \text{ g} = 4.5 \text{ kg} * \text{m/s} = 4.5 \text{ N} * \text{s} \quad (7)$$

Now, if we consider a boxer’s punch, whose hand can weight around 500 g., and whose velocity can reach around 9 m/s , then curiously we get almost the same momentum:

$$9 \text{ m/s} * 500 \text{ g} = 4.5 \text{ kg} * \text{m/s} = 4.5 \text{ N} * \text{s} \quad (8)$$

And yet: whereas a boxer's punch can push violently back the head of his opponent, victims of many near distance handgun shots simply drop down, with almost no remarkable backward movement, even when bullets remain inside the head, and although "momentum" transmitted to head was the same in both cases .

Hence, a logic question : if the backward movement of Kennedy's head cannot physically be explained simply through a comparison with a "ballistic pendulum" and an alleged "permanence" of the fatal bullet inside his head, how can we better explain that movement? Besides: why a close gunshot to head of many executed prisoners was not pushing back their heads as violently (as Bugliosi noticed) as JFK's head? Is there a persuading explanation for that in Physics?

5. New equation of kinetic energy distribution in projectile's impact and penetration.

As the physical explanation linking a shorter or longer "permanence" of projectile inside the head of victims is too rough and inadequate to clarify the behavior of a human head being struck by a bullet, it seems important to point out some main concepts involving a collision and subsequent perforation of target by projectile.

Bullets are – in physical terms - moving objects, with different masses, having high speed (it is commonly considered "high velocity" above 500 m/s, and "hypervelocity" whenever it exceeds 2 km/s), and so its motion is normally expressed as a function of kinetic energy (KE) , i.e. : $\frac{1}{2} m*v^2$.

Momentum ($m*v$) is therefore derivative of kinetic energy function, namely it is the energy that a bullet is displaying on impact point.

In Physics and Terminal Ballistics, based on countless experimental tests and data, we can identify and extrapolate **three main components of bullet's kinetic energy**: [25]

a) Shear force (Sh) : it is the minimal cutting force on the surface of material that is necessary to the bullet to fully penetrate it, and it is the main factor of penetration. It depends also on the shape of projectile (linked to the shear stress). A sharp-nosed bullet needs less shear force to penetrate a material than a blunt-nosed bullet, in the same way as a sharp knife needs less shear force to cut and penetrate than a blunt paper-knife.

In mathematical symbolism, we can write down shear force as follows:

$$Sh = (\pi * D * \tau * T^2)/2 \quad (9)$$

Where:

π = 3.14 ; D = diameter of bullet ; τ = shear stress (depending upon shape, mass, etc. of bullet) ; T = thickness of material

As we can see from the above formula, any growth in diameter of bullet (D), shear stress of bullet (τ), and thickness of target material are increasing the minimum shear force, thereby making more difficult to perforate the material.

It is very important to introduce also the concept of "sectional density" [26] of bullet, as strictly connected with the shear stress τ .

Sectional density of a projectile is:

$$SD = F/D^2 \quad (10)$$

i.e. the ratio between weight of bullet (F) and its squared diameter (= cross-sectional area)

This factor is very important in Terminal Ballistics, as an immediate and first-hand parameter to determine the ability of projectile to penetrate target material.

A long and narrow "needle shaped" bullet, can penetrate an object much better than a wider and more "squat" projectile.

It is noteworthy, in this respect, that sectional density of 6.5 mm. Mannlicher – Carcano's bullet is one of the biggest, among all rifle's cartridges, thus it is not so difficult for such a projectile to penetrate through a human head.

b) Compressive force (Co)

Compressive force of bullet is the component of pressure (other than pure shear force) that a bullet is imparting to the target surface at the moment of collision and immediately after, during the whole contact with target material .

Formula of Co is:

$$(E * V)/2 C \quad (11)$$

Where: E is the elasticity Young's modulus, whose magnitude (in psi) is directly proportional to the hardness of target material; V and C are respectively the impact velocity and the sonic velocity at impact.

Sonic velocity can be calculated as:

$$C = \sqrt{E/\rho}$$

where ρ is the density (Kg/m³; lb/ft³) of target material

It is easy to understand from the above equation that compressive force increases proportionally with the elasticity modulus of the target material, as bullet needs to spend more and more kinetic energy to penetrate (if possible) a target material the more its hardness increases, whenever pure shear force is not sufficient anymore to perforate harder materials.

Finally, we get the last component:

c) Residual velocity (Vr)

Residual velocity (Vr) of projectile is the final velocity of a bullet at the end of target material's perforation .

Formula of Vr is:

$$[M_p/(M_p + M_{sn})] * V_o \quad (12)$$

Where: M_p is the bullet; M_{sn} is the “plug mass” of target material extruded by the bullet, and V_o is the impact velocity, in accordance to the conservation of momentum.

Residual speed of projectile, of course, can be higher or lower, (or even = 0) depending upon hardness of target material. The harder will be the target material, the lower (down to 0) will be residual velocity of bullet after collision.

Thus, we can at last write down the equation of bullet’s kinetic energy distribution as follows:

$$KE = Sh + Co + Vr \quad (13)$$

That is: kinetic energy of bullet is the sum of shear force, plus compressive force plus residual velocity.

Or, in expanded, mathematical formalism:

$$\frac{1}{2} mv^2 = (\pi D \tau T^2)/2 + EV/2C + M_p/(M_p+M_{sn}) \quad (14)$$

The equations above are more precisely describing – in physical symbolism - what happens whenever a projectile is striking a surface and passing through it.

Whenever target material is “soft”, then minimum Sh (shear force) to perforate it will be small, and the same will be with minimum Co (compressive force). As a result Vr (residual velocity) of bullet will be high, because most of initial kinetic energy will be saved.

Conversely, for harder materials, most (or all) of initial kinetic energy will be spent as shear and – above all – compressive force to penetrate them, and residual velocity of bullet will be very much lower, or even nil.

And yet, it is still unclear why JFK’s head was pushed violently backward, like the head hit by boxer’s punch, whereas heads of prisoners executed by a near gunshot did not display such a violent movement.

To understand that physical mechanism, we have to introduce another very important – although almost totally neglected in JFK’s shooting analysis – concept:

6. The importance of projectile’s obliquity at the moment of impact on JFK’s head

It is very surprising, to discover that such a paramount factor, in the appraisal of the effects of Kennedy’s head shot, is almost totally disregarded even by several specialist articles, written by weapon and ballistics experts.

Why is the obliquity of bullets so important?

First of all, let us think about cliff divers in Acapulco, or platform (10 m.) divers.

We all know that divers always try to keep their bodies as much as possible perpendicular (i.e. 0° obliquity), at the moment of impact on water, to maximize the shear force, to minimize the bad effects (splashes, shocks, etc.) of a more oblique entry, thereby gaining a better (aesthetic) evaluation of dive from judges.

Thus, a more oblique dive means more water displacement, more “compressive force” which is being spent to the water surface, and a more difficult and sometimes even dangerous penetration in water.

Something very similar is taking place whenever projectiles are striking and perforating surfaces.

A superb experimental study of different behaviors of bullets according to obliquity, was a very accurate ballistic test conducted in 1962 by the Denver Research Institute of Denver University, (see [25]) under the technical direction of Detroit Arsenal (with Mr. H. Spiro as Project Engineer, and Rodney Recht as Project Supervisor).

That ballistic test was conducted with AP (armor-piercing) projectiles, which are designed to defeat and perforate armor targets, and which are even harder than FMJ (Full Metal Jacket) bullets, as a 6.5 mm. of a Mannlicher-Carcano rifle.

Moreover, target materials of those bullets were steel, aluminum, and titanium plates, a lot harder than human skull bones.

The main result of that test was as follows:

“Shattering occurs when axial compressive stresses produce shearing and tensile hoop stresses which exceed the strength of the core material. The projectile breaks up near the nose since axial stress decreases from maximum to zero from nose to tail (this effect is intensified by reduced frontal cross sections).

At zero obliquity, a matching AP projectile will commonly defeat armor without breaking up. However, at obliquities greater than 20-degrees, the projectile will break up at moderate velocities (1500 ft/sec at 20.-degrees, 1000 ft/sec at 30-degrees). Bending stresses, which increase in severity with impact obliquity, add to the axial stresses, causing the projectile to break up. At the usual impact velocities, the time involved in impact has been determined to be of the order of 100 micro.- seconds; the time required for the elastic wave to travel the length of the 0. 50 cal. AP is about 10 micro-seconds. Thus, it is reasonable to assume for stress analyses that stresses are set up without delay in the projectile. A preliminary stress analysis, at several impact obliquities, of the 0.50 cal. AP M2 was performed on a National Science Foundation grant. **Compressive stresses due to combined axial and bending stresses near the center of the 0. 50 cal. projectile were computed to be about 250, 000 psi at a 30 -degree obliquity, 600, 000 psi at a 60-degree obliquity (impact velocity, 2100 ft/sec). “ (Denver Research Institute. Terminal Ballistics, p. 28-47)**

Hence:

a) Impact obliquity (O) of AP bullets : $0^\circ < O < 20^\circ$ = no bullet's break-up

b) Impact obliquity of AP bullets : $20^\circ < O < 60^\circ$ = bullet's break-up, with increasing degree of fragmentation from 20° to a maximum at 60° due to a massive increase of bending forces

c) Growth of bending + axial stresses from 250,000 psi for impact at 30° obliquity up to 600,000 psi at 60° obliquity

The last result c) is particularly impressive and noteworthy, because it is the experimental proof that **compressive stresses of projectile, at collision, are more than doubling, from 250,000 psi up to 600,000 psi, just as a result in change of obliquity from 30 to 60 degrees of impact!** (see fig. 4 – 5)

This means that a lot of kinetic energy is being spent at the surface of impact and becomes compressive force (C_o), as obliquity increases in the range 30° - 60° , because projectile faces an increase of bending forces, and penetration becomes more and more difficult. Hence, whenever bullet penetrates, this is

mostly due to compressive more than shear forces, and fragmentation of bullet is always taking place, along with penetration.

Moreover, whenever the angle of penetration is higher than 0°, projection of penetration area of bullet on target surface, is changing and it is increasing, from a perfect circle to a growing elliptic area, making in its turn increase the minimum energy required for perforation, and that is particularly dramatic whenever obliquity approaches 60°.

Over 60° impact obliquity, ricochet forces of tangential impact begin to increase and dominate, making more and more likely a rebound of projectile, with no penetration at all, but just a “scratch” effect on target material, whenever tangential obliquity reaches 1° - 12°, even on liquid surfaces (Vincent Di Maio, “Gunshot Wounds”, p. 109-110) [27]

As evidenced by Denver Institute, the extent of fragmentation is greater near a 60° obliquity impact with 0.30 cal bullets (whose size is more similar to 6.5 mm. Mannlicher-Carcano bullets) and a bit more uniform at any degrees of impact between 30°-60°, with bigger 0.5 cal. bullets.

The Final Report of Denver Institute, is a final proof that the same AP (or FMJ with softer materials) bullet can either penetrate a metal plate with no fragmentation, if the impact obliquity was within 0° (= perpendicular with target surface) and 20°, or break-up and shatter into minute fragments, if angle of impact was bigger than 20°, with a huge fragmentation near 60° impact obliquity.

Now, we know that the fatal bullet, that struck President Kennedy from the stockade fence, was being shot at 60° obliquity.

Hence, the Final Report of Denver Institute, on fragmentation of bullets, is another compelling evidence that the “cloud” of minute fragments of bullets that were found near the right temple, and in JFK’s brain, comes from an oblique impact of the fatal bullet!

According to Dr. Michael Kurtz’s [28] words, the cluster of minute fragments visible on x-rays of JFK’s autopsy, are indicating a high-speed bullet, rather than a low or medium-velocity projectile.

“One of the expert radiologists who examined the x-rays noticed “a linear alignment of tiny metallic fragments” located in the “posterior aspect of the right frontal bone.” The chief autopsy pathologist, Dr. James J. Humes, remarked about the numerous metallic fragments like grains of sand scattered near the front head wound. The medical evidence, then, definitely proves the existence of a cloud of fragments in the right front portion of Kennedy’s head, convincing evidence, according to Sturdivan[29], that an exploding bullet actually did strike the president there. (Crime of the Century, pp. 177-178)

However, there’s no need to assume neither an “exploding” (hollow-point) bullet, nor a faster bullet than a 650 m/s, 6.5 mm. FMJ bullet from a Mannlicher-Carcano.

Some researchers (Livingston [30], Griffith [31]) told about a 5.56 x 45 mm., others mentioned a .223 Remington bullet (G. Paul Chambers), because of its high tendency to fragmentation when impacting human tissues, others – more vaguely – said about a “dum-dum bullet” that exploded when struck JFK’s head, and others (Clark Panel Report [32], Donahue [33]) indicated a “high velocity bullet”.

Yet, it seems that those experts and authors missed the point.

The point is that several bullets and rifles, even FMJ bullets as 6.5 mm. Mannlicher-Carcano, could have fragmented in a “cloud” of minute fragments, ONLY IF the impact obliquity was between 30° - 60°, as the one from the stockade fence!

On the contrary, as experimental tests proved, there was no possibility that a “straight” shot, from the 6th floor of Texas School Book Depository, at 10° lateral, and 12° downward obliquity, could have produced such a huge fragmentation of bullet!

And finally, to address Bugliosi’s and Chambers’ point, the great increase of compressive force (bending + axial), whenever a head shot is taking place with bullet’s obliquity near 60°, compared with the prevalence of pure shear force when a bullet is being shot with a perpendicular, almost “straight” obliquity between 0° - 20°, can adequately explain why JFK’s head (that was struck at 60° obliquity) was pushed backward more violently than many executed prisoners, whose heads were struck by less powerful handguns, at straight obliquity near 0°, and receiving therefore much less compressive (= pushing) energy on them.

7. Impossibility of a “nervous reaction” by JFK’s head after the shot.

_A widespread and yet preposterous “urban legend”, claimed an alleged “nervous reaction” of Kennedy’s head, after the fatal shot, to explain the violent backward movement of his head. Nevertheless, it takes just a moment, and a little mathematical reasoning, to understand how clearly untenable this hypothesis can be.

First of all, a bullet of rifle is normally traveling at more than 500 m/s.

A bullet passing through a human head – whatever its trajectory could be – is only traveling 15-18 cm. **Thus, it takes no more than $1 / (500/0.18) = 1/2777$ of second = 0.00036 seconds for a bullet of rifle to pass through a human head.** Though, the fastest “human reflex” from our human body cannot exceed 3/100 of second = 0.03 seconds. Therefore, the instant impulse transmitted to the head by a bullet of rifle is 83 times faster than any possible “human reflex” and the latter cannot “counteract” the former, in the same way as a back thrust of a man falling from a roof cannot counteract the force of gravity and slow-down his impact with soil . **Considering also a “slowing down” of bullet (see section 8 below) of 400 ft/s (= 120 m/s), due to a double penetration of skull, even the final velocity of bullet (380 m/s) would correspond to a time of penetration/displacement of head not higher than 0.00047 sec. = 63 times faster than 0.03 sec. of the fastest human reflex. Before a nervous reflex could occur, JFK’s head was already pushed backward by the fatal bullet.**

Thus, it is simply and physically impossible that such a late “nervous reaction” of JFK’s head could have predominated over the previous and much stronger instant impulse from the fatal bullet.

8. Analysis of an alleged 6.5 mm. Mannlicher-Carcano shot, from the 6th floor of Texas School Book Depository

When the fatal shot struck Kennedy’s head, he was 88 yards far from the alleged “sniper’s nest”, at the most eastern window of 6th floor of TSBD.

A sniper who was shooting from that point, to that target, had to keep his rifle at a lateral obliquity (see figure 6) of just 10° , whereas downward obliquity had to be nearly 12°. Some sources are confusing the downward obliquity between TSBD and Kennedy’s head at the moment of fatal bullet, which was 12°, with the downward obliquity of 17°, when Kennedy was hit at his back, between his shoulders, 12 cm. below his neckline, when his limo was more than 50 feet behind.

The most important point it is fundamental to underline is that such a shot against a human head, could never have produced such a huge fragmentation of a 6.5 mm. Mannlicher Carcano bullet, as the fatal shot at JFK’s temple.

The physical and ballistic reasons are that both obliquities (lateral + downward) from TSBD would have been much less than 20°, and almost “straight” (= perpendicular) with President’s head, making therefore almost negligible the possibility of a bullet’s fragmentation, as we have seen above.

Denver Research Institute proposed another very interesting ballistic formula, from experimental tests, proving how much the obliquity of shooting can influence the final fragmentation of the bullet.

Fragmentation of bullets is the result of the ratio:

$$\mathbf{Ft/Fb} \tag{15}$$

between the lateral force Ft, and the breaking force Fb

“Now if the lateral force, Ft, acting upon the core can be determined, the ratio Ft/Fb will provide the required break-up information. If the ratio exceeds unity, the projectile will break; if it does not, the projectile will not break.” (Denver Research Institute. Final Report, p.72)

For instance, a 0.30 cal. (close to 6.5 mm. bullet) AP projectile fragmentation can be calculated as follows:

$$\mathbf{Ft/Fb (.30 cal) = 1.7 * 10^{-6} * (Vr \sin\beta) * (V\cos\beta + Vr)/T + 0.89} \tag{16}$$

Where:

β = obliquity of bullet at impact

T = thickness of target material (in inches)

V = impact velocity (in ft./s)

Vr = residual velocity (in ft./s)

If we take an average speed (V) of 6.5 mm. cartridge at the moment of collision on JFK’s head around 1826 ft./s (as calculated in the Edgewood Test in 1964, by Dr. Olivier), and a residual velocity (Vr) of 1426 ft./s (each straight skull bone penetration is experimentally slowing down the impact velocity for 200 ft./s [34]), then we can compare the fragmentation of a 10° shot with a 60° shot.

Thus we have, for a 10° head shot:

$$\mathbf{[1.7 * 10^{-6} * (1426 * \sin 10^\circ) * (1826 * \cos 10^\circ + 1426)]/(0.6 + 0.89) =}$$

$$\mathbf{[1.7 * 10^{-6} * (1426 * 0.17) * (1826 * 0.98 + 1426)]/1.49}$$

Whose result is :

0.88, less than 1 = no fragmentation (17)

Whereas, for a 60° head shot, we get:

$$[1.7 * 10^{-6} * (1426 * \sin 60^\circ) * (1826 * \cos 60^\circ + 1426)] / (0.6 + 0.89)$$

$$[1.7 * 10^{-6} * (1426 * 0.86) * (1826 * 0.5 + 1426)] / 1.49$$

And the result is:

3.27 , much more than 1 = very high fragmentation! (18)

Hence, ballistic and experimental equations by Denver Research Institute are a further evidence that a bullet's impact at 60° (as from the stockade fence) produces a dramatic and enormous effect of minute fragmentation, whereas an impact at nearly 10°/12° obliquity (as from 6th floor of TSBD) does not produce any fragmentation at all of the impacting bullet!

This physical and ballistic rule is confirmed by Connally's wounds as well!

Governor John Connally was hit both in his chest (the bullet broke his fifth rib) and then in his right wrist by another bullet, an instant after the other fatal bullet struck JFK's head . And yet, NO fragment of bullet was found in his chest, as testified by Dr. Robert Shaw before the Warren Commission: " **Question by Arlen Specter: "Was any metallic substance from the bullet left in the thoracic cage as a result of the passage of the bullet through the Governor's body?"** Ans. by Dr. Robert Shaw "No. We saw no evidence of any metallic material in the X-ray that we had of the chest, and we found none during the operation." (WC, p. 105)

On the contrary, with reference to the wounds on Connally's wrist : "An X-ray of the Governor's wrist showed very minute metallic fragments, and two or three of these fragments were removed from his wrist" (WC, p. 95).

This means that the bullet entered Connally's chest (while he was turning to Kennedy before the fatal shot), and after passing through his rib bone, without fragmenting, then it was slightly deflected downward and entered his right wrist, producing a final impact obliquity higher than 20°-30°, and a resulting "secondary" fragmentation.

Larry Sturdivan was in error, believing (according to his "Diminishing Velocity Theory") that a 6.5 mm. bullet (CE-399) could have caused all Kennedy/Connally damage without suffering any kind of distortion, because he disregarded the problem of bullet's obliquity, after bullet's first impact on Connally's chest and rib!

Therefore, a careful examination of Connally's wounds and dynamics of shooting, is a further proof that obliquity of impact higher than 20°-30°, up to 60°, is a fundamental factor of fragmentation, even for full metal jacket projectiles as 6.5 mm. Mannlicher-Carcano bullets, and NO fragmentation of those bullets takes place as a result of a "straight" first collision against bones (skulls, ribs, etc.) at less than 20° obliquity. This does not mean at all that bullet's shape remains unchanged, after the impact! The bullet could – more or less – "mushroom" at the nose, or display a "petaling" (= nose splitting) effect,

depending upon hardness and thickness of bones. But no “ fragmentation in a cloud of minute fragments” as that observed on JFK’s temple and brain is taking place after a straight impact (within 20°) against bones.

In Lattimer’s 1980 book: “Kennedy and Lincoln” [35], Dr. John K. Lattimer (who conducted with Dr. Alfred Olivier some ballistic tests in 1964, with a Mannlicher-Carcano rifle, on behalf of the Warren Commission, and that we will scrutinize in the next chapter) tried to persuade his readers about the fragmentation of the alleged “bullet that struck Kennedy in the head”, by showing two large fragments of 6.5 mm. Mannlicher-Carcano bullet, that were found in the front-seat area of the presidential limousine. (p. 219, fig. 91)

Unfortunately for Lattimer, the only thing that he himself recognized - and we can agree upon - is that those fragments had struck “the inside of windshield and its frame” and they were found inside the limousine, and that’s correct, whereas – sadly for him - it is physically impossible that those fragments could belong to the alleged 6.5 bullet that struck Kennedy in the head from the 6th floor of TSBD, because, as Dr. Di Maio explains:

“If the 6.5 mm object seen on the JFK autopsy x-rays is a fragment from a bullet that struck the head, then it would have to be the cross-section of the head-shot bullet, according to the lone-gunman theory. Why? Because the nose and tail of a bullet were recovered from the limousine, and these must have come from the supposed single shot to the head from the sixth-floor window, according to the lone-gunman scenario. But there’s no way the cross-section of an FMJ missile striking skull bone would end up embedded on the outer table of the skull. This is simply a physical impossibility” (V. Di Maio, “Gunshot Wounds”)

9. Experimental and historical records from shootings of Mannlicher-Carcano rifles. The 1964 Edgewood Ballistic Test

All the “theoretical” and experimental data, as introduced above, about the behavior of FMJ bullets of rifles as - or similar to – 6.5 mm. Mannlicher-Carcano bullets, can find an overwhelming confirmation from many medical military records and sources, in different times.

One of the most interesting is the medical description of wounds, of soldiers who had been hit by 6.5 mm. bullets from several distances, as collected by Pat Speer: (“A New Perspective on the Kennedy Assassination. Chapter 16: Digging the Dirt”)

“The autopsy protocols of those dying from 6.5 mm bullet wounds to the head follow. These refer to the bullets as .25 caliber, which wasn’t quite true. According to Bolt Action Rifles, by Fred de Haas and Wayne Zwoll, “much erroneous information circulated about that “small caliber Jap rifle” during WWII, with many believing its 6.5 mm bullets, which were .263 caliber, to be only .25 caliber. These protocols have been arranged in order of shot distance. For the sake of brevity, references to wounds other than head wounds have been removed.

•*Case 10: A Fijian soldier, peering over the edge of an open foxhole to fire at the enemy, was struck by a .25 caliber Japanese bullet fired **from a distance of 15 yards**. He was killed instantly at 1400 hours on 1 April 1944. Examination revealed a perforating wound of the head and multiple wounds of the extremities. The **head wound of entry (3.7 cm. in diameter)** was located at the inner canthus of the left eye and **the exit***

wound (8.7 cm. in diameter) at the vertex of the skull. The skull was comminuted, and there was almost complete destruction of the left half of the brain.

•Case 2:A Fijian soldier, while on patrol, was standing behind a tree when he was struck by a .25 caliber Japanese **bullet fired from a distance of 20 yards**. He was killed instantly on 31 March 1944. Examination revealed a perforating wound of the head. **The entrance wound (0.5 cm. in diameter)** was situated over the lateral border of the right supraorbital ridge and the **exit wound (1.2 cm. in diameter)** over the occipital bone. Stellate fractures of the frontal and occipital bones radiated from both perforations. The frontal and parietal lobes of the brain were perforated, and the cerebellum was grooved.

•Case 11:A soldier of the 129th Infantry was crouching and moving forward in a skirmish line when he was struck by a Japanese .25 caliber bullet fired from a **distance of 20 yards**. He was killed instantly at 1300 hours on 24 March 1944. cursory examination revealed an **extensive gutter wound 15 x 10 cm.** involving the left temporal, occipital, and parietal regions. Large portions of these bones and underlying brain were absent. Extensive comminution of the remaining cranial vault was present.

•Case 8:A soldier of the 129th Infantry, 37th Division, was standing on his bunk in an open tent in battalion headquarters firing at the enemy, when he was struck by a .25 caliber Japanese bullet fired from a **distance of 25 yards**. He was killed instantly at 0630 hours on 24 March 1944. Examination revealed a **gutter wound (5 x 2½ cm.)** of the left parietal region. Brain tissue exuded through the perforation in his helmet. Lacerated brain tissue, portions of the frontal and parietal lobes, was herniated through the wound. Marked subgaleal hemorrhage was present. The cranial vault was comminuted by stellate fractures. Both hemispheres of the brain were extensively lacerated. A mushroomed .25 caliber bullet was found in the right anterior fossa.

•Case 20:A soldier of the 129th Infantry was sitting on a log holding a flamethrower when he was struck in the head by a .25 caliber Japanese bullet fired from a **distance of 75 yards**. His perforated helmet was found lying on the ground. He was killed instantly at 1130 hours on 27 March 1944. Examination revealed a **gutter wound 17.5 x 4 cm.** involving the right temporal and frontal regions. There were deep lacerations of the frontal, parietal, and temporal lobes. Disorganized brain tissue filled the wound. Extensive comminution of the cranial vault was found.

•Case 25: A soldier of the 129th Infantry was standing in an open foxhole when he was struck by a .25 caliber Japanese bullet fired by a sniper from a **distance of 75 yards**. His helmet was perforated. He was wounded in action at 1430 hours on 24 March 1944 and died 5 hours later, despite shock therapy. Examination revealed a **gutter wound (15 x 7½ cm.)** occupying the right parieto-occipital region. Portions of these bones as well as the underlying cerebral hemisphere were absent. A small metal fragment was recovered from the remaining brain tissue and was identified as part of the jacket of a .25 caliber Japanese bullet. The right lateral ventricle was filled with blood. Petechial hemorrhages were present in the left half of the brain. Stellate fracture lines coursed through the bones of the vault.

•Case 59:A soldier of the 24th Infantry, while running forward in a skirmish line, was struck by .25 caliber Japanese machinegun bullets fired from a **distance of 75 yards**. He was killed instantly at 1100 hours on 14

April 1944. Examination revealed multiple wounds. (One) bullet struck the left side of the face producing a **gutter wound 12.5 x 3.7 x 0.25 cm.**, which destroyed the left temporomandibular joint.

•Case 17: A soldier of the 129th Infantry, while walking up a jungle trail, was struck by a Japanese .25 caliber bullet fired from a distance of 100 yards. He was killed instantly at 1320 hours on 24 March 1944. Examination revealed a perforating wound of the head. The wound of entrance (2.5 cm. in diameter) traversed the right infraorbital ridge; the exit wound (3 cm. in diameter) was located in the left parieto-occipital region. When the body was received, the helmet had not been removed and brain tissue was extruded over its surface. “

Records above are very useful to debunk another common place: destruction and damage of skull, and wounds' extension, in this kind of shots, are not strictly dependent on the distance, i.e. sometimes we may find wider lacerations of head, from a 75 yards shot, than from a 15 yards shooting, and that is a clear clue of the importance of shooting's obliquity, in the evaluation and distribution of shear and compressive forces at the impact, and the resulting wounds and damages to the head of victims.

At any rate, the above medical records are also important to refute another whimsical idea spread by followers of the “lonely gunman” theory: i.e. the idea that a near shot, from the grassy knoll and the stockade fence would have “obliterated” the head of President!

In a 2008 documentary (“Inside the Target Car”), by Discovery Channel, a lot of theatrical – a bit “luna park” - effects, with green laser beams, cranes, a professional sniper, and an anthropomorphic dummy in soft plastic- foam material , have been used to prove that a near shot (replicating the distance from Kennedy and the grassy knoll) would have totally blown-off his head!

Unfortunately for Discovery Channel, no serious comparison can be made, in Physics, between the behavior and resistance of a soft plastic-foam dummy, and a hard human skull bone after a near shot with 6.5 mm. FMJ bullets. No medical record ever showed an “obliteration” of human head, after such shootings!

Another important ballistic test, whose purpose was a “re-enactment” of the effects of the alleged shooting by Lee H. Oswald from the 6th floor of TSBD, was conducted **by Dr. Alfred Olivier, of Edgewood Arsenal, on behalf of the Warren Commission**, where he testified on May 6, 1964.

To fulfill this task, Olivier shot 10 human skulls, filled with gelatin, in order to simulate in the most similar way the behavior of JFK's head.

9 skulls out of 10 were only slightly damaged. Moreover, the bullets that were shot to the occipital bone did not exit from the temple (as the official “single gunman” theory purported) but from right eye socket!

Only 1 (out of 10) skull showed (exhibit 861) a huge damage of the skull, with a destruction of the right side, and a break-up of bullet into minute (almost 40) fragments.

Yet, it is hard to believe that Olivier's test had “replicated” the effect of the alleged head shot by Oswald.

As Pat Speer summarizes:

“There are reasons to doubt Kennedy's wounds were accurately replicated, however. Since, as subsequently acknowledged by Larry Sturdivan, who worked with Olivier, the shooters were trying to make the bullet follow the Warren Commission's proposed path, entering low in the occipital bone and exiting above the

temple, we can only assume the skulls were turned slightly to the left of these shooters. This, in turn, makes it reasonable to assume that the damage to the bullet and skull cited by Olivier came as a result of the bullet's striking the thick occipital bone almost on edge along the curvature behind the ear. (A bullet striking skull bone on edge meets more resistance and is more likely to explode)."

That is the point!

No official record by Olivier has ever reported the actual obliquity of that shot!

Of course, if the skull was turned, and the sniper was shooting from a more oblique position, then it was very easy to totally change the impact obliquity, making it higher than 30° and thereby producing a devastating shattering effect, both of bullet and skull!

It seems better to amend a little Speer's words, because the great damage to the bullet and skull, in Olivier's test, does not seem the aftermath of a "tangential", or "edge" shot, as tangential shots tend to ricochet without penetration of target. Instead, it is quite probable that the bullet struck the occipital bone at obliquity in the range 30°-60°.

Moreover, Dr. John Lattimer (who performed another unsatisfactory ballistic test with skulls, some years after Olivier), recognized in a 1975 letter that the lack of scalps, in those tests, could increase the magnitude of skull blast for a factor of 4 (!)

Thus, we can conclude that Edgewood test, and others with human skulls, failed to replicate the alleged head shot from 6th floor of TSBD, and its purported "devastating effect" on Kennedy's head.

10. Witnesses of the shooting from the stockade fence

The main purpose of this work was to define more precisely the main physical and ballistics laws involved in the scientific analysis of the fatal shot, and to amend some errors in previous papers, in order to put the scientific and investigative study of JFK assassination on a better and more sound foundation.

Josiah Thompson was the first, with his monumental work "Six Seconds in Dallas", in 1967, to meticulously investigate and focus his attention to the stockade fence, as the key-point (also from an historical standpoint) to understand how really things went in Dealey Plaza, that November 22.

His conclusion was: *"...With regard to the shot from behind the stockade fence, the evidence indicates unambiguously that a shot came from that location. " In 1967 Thompson expressed his wish that details of the shot "may yet fill in through a future investigation, a sudden revelation or the patient labors of other researchers and historians".*

This paper would like to be – to address Thompson's wish - a patient labor of research, in the field of Physics and Terminal Ballistics, adding further details to the historical truth.

However, not less compelling than physical laws, are many witnesses that saw, and/or hear, something strange and unusual behind the stockade fence, at the moment of JFK's shooting, and that Josiah Thompson interviewed, in 1966.

First of all, we have to mention 7 railroad workers. That day they were atop of the railroad overpass, and they could enjoy a commanding "top-down" view of the presidential motorcade. Here are their names:

S.M. Holland (railroad signal supervisor, who testified that he heard 4 shots, and “a puff of smoke came out about 6 or 8 feet above the ground right out from under those trees”), **Richard C. Dodd, Clemon E. Johnson, Austin L. Miller, Thomas J. Murphy, James L. Simmons, Walter L. Winborn.**

Holland, Simmons and Dodd dashed to the picket fence, after the shot, where they saw the smoke, and there, “they found about a hundred foot-tracks in that little spot, going in every direction. Holland later told the Warren Commission he had the impression that *“someone had been standing there for a long period”* Holland also noted two spots of mud on the bumper, *“as if someone had cleaned their foot, or stood up on the bumper, to see over the fence”*. Simmons reported the same thing, and Dodd added: *“There were tracks and cigarette butts laying where someone had been standing on the bumper looking over the fence”*.

Even more telling and detailed, about the whole preparation of the killing, were the famous statements by another experienced railroad technician, **Lee Bowers**:

“Lee Bowers, stationed atop a 14-foot railroad tower, observed three cars cruising around the railroad lot less than half an hour before the assassination, although police sealed off the area. Two of the cars had out-of-state license plates, one of which, a 1961 or 1962 Chevrolet Impala, was muddy up to the windows. Lone male drivers rode in the Chevrolet and the third car; one held something to his mouth that appeared to be a microphone or a telephone. As the motorcade came within his commanding view, Bowers noticed two men standing behind the picket fence. They were the only people in the vicinity unfamiliar to the 15-year Dallas railroad veteran. When the shots were fired, a “flash of light or smoke” or “some unusual recurrence” near the two strangers attracted Bowers’ eye.” [36]

Among many other witnesses, indicating the stockade fence as the source of a shot, one was **William Newman Jr.**, who was waiting for the motorcade with his wife and two children, at the bottom of the grassy knoll.

He said: *“ The President’s car turned left off Houston onto Elm Street...all of sudden there was a noise, apparently gunshot...then we fell down on the grass as it seemed that we were in the direct path of fire..I thought the shot had come from the garden directly behind me”*

Mary Elizabeth Woodward was standing near the Newmans. Here is what Woodward told a reporter, that November 22: *“There was a horrible, ear-shattering noise coming from behind us and a little to the right”* (from the stockade fence).

Very impressive were **Gordon Arnold’s** (a soldier under training in the army) statements. He was standing about three feet in front of the stockade fence in the grassy knoll, when the motorcade was approaching. Suddenly he felt *“a bullet whiz”* by his left ear, and then he heard a *“crack as if I was standing there under the muzzle”*, and immediately Arnold fell to the ground, and then he heard another shot go over him. Although Arnold’s presence itself in Dealey Plaza, that day, was challenged by several researchers (no photo or film is showing Arnold), Senator **Ralph Yarborough** saw him *“throwing himself onto the ground”* during the shooting, and corroborated his version.

Moreover, among more than 50 policemen that, in a few minutes after the shooting, swarmed toward the grassy knoll, 4 policemen: **Dallas County Deputy Sheriffs L.C. Smith, A.D. McCurley, J.L. Oxford and Seymour Weitzman,** testified that several bystanders were mentioning the picket fence as the source of smoke or shots. Then Weitzman joined Holland, Simmons and Dodd near the corner of the stockade fence, where he saw: *“numerous kinds of footprints that did not make sense because they were going different directions”*

And last, but not least, two witnesses: **Dallas Police officer Joe M. Smith** and another witness testified before the Warren Commission that they met a “suspicious man” in the lot behind the stockade fence, after the shooting, and the man displayed a badge identifying himself as a “Secret Service agent”.

As clarified by **Secret Service Chief James Rowley**, and other agents, all Secret Service agents that day were serving with the motorcade, as requested by regulations, and none of them was expected to be in the parking lot behind the stockade fence.

Thus, it is evident – to address Bugliosi’s doubt regarding an alleged “easy discovery” of the grassy knoll as “sniper’s nest” , making it dismissible, in his opinion, as a shooter’s location – that only a careful planning of murder by several well organized criminals, could have foreseen also fraudulent badges of Secret Service, as a way to allow the escape of an assassin.

Hence, we can conclude this work just saying that Physics, Terminal Ballistics, and many direct witnesses are unanimously proving beyond any reasonable doubt that the fatal bullet which killed President Kennedy was surely shot by a sniper behind the corner of the stockade fence, on the grassy knoll.

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November 6, 2013

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IMAGES

Fig. 1 Skull top view. Bullet's 60° trajectory

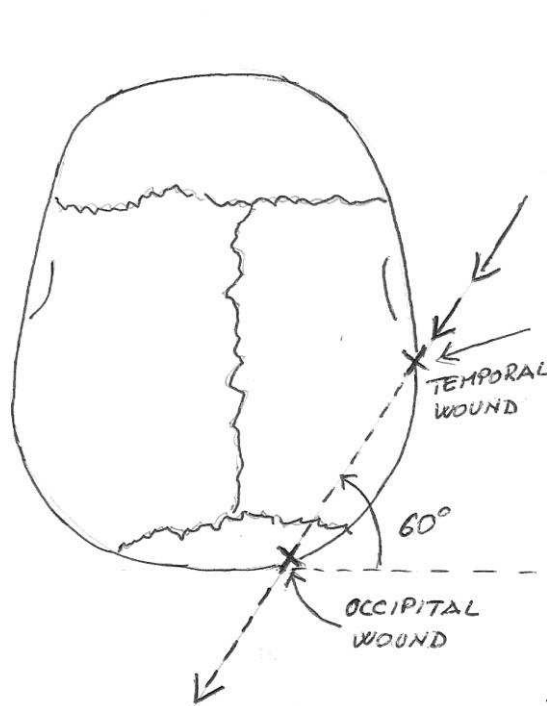


Fig. 2 Head wounds . Lateral view.

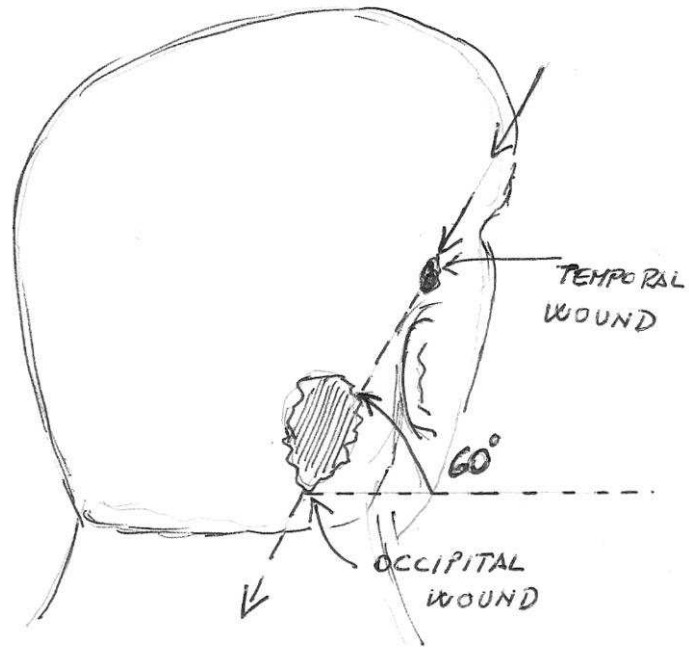


Fig. 3 Limo's position at the moment of fatal shot

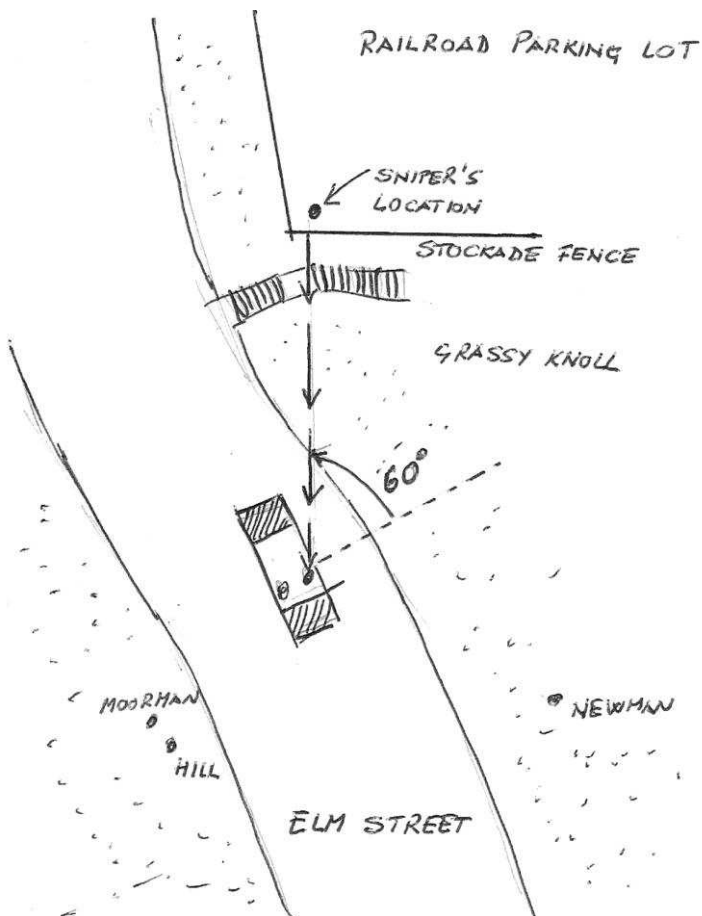


Fig. 4 Forces acting on impacting bullets. A)

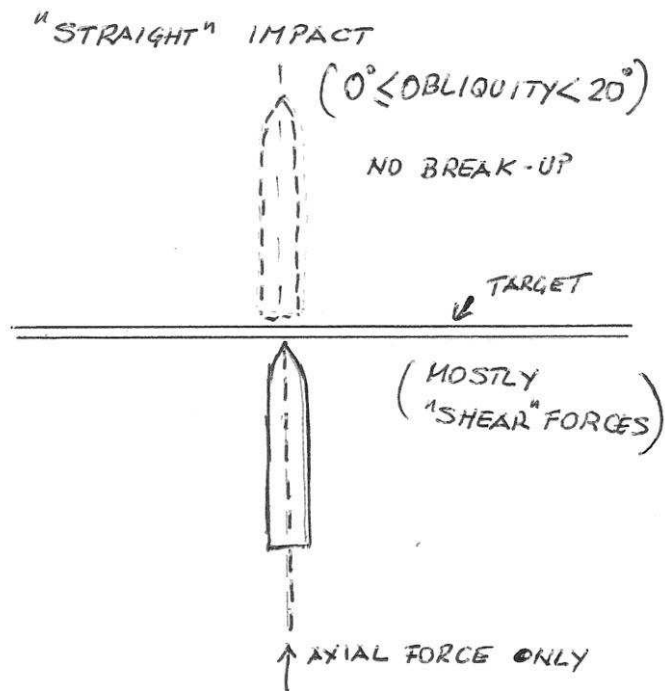
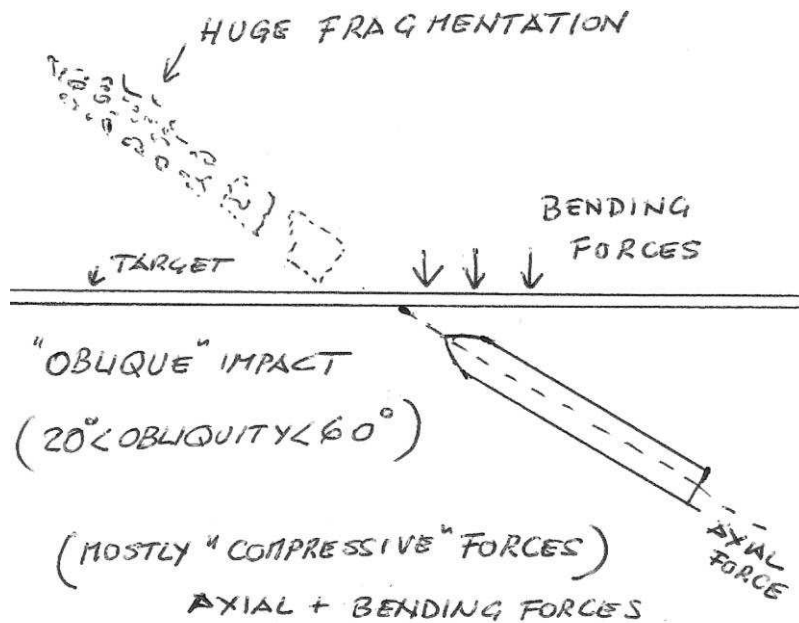
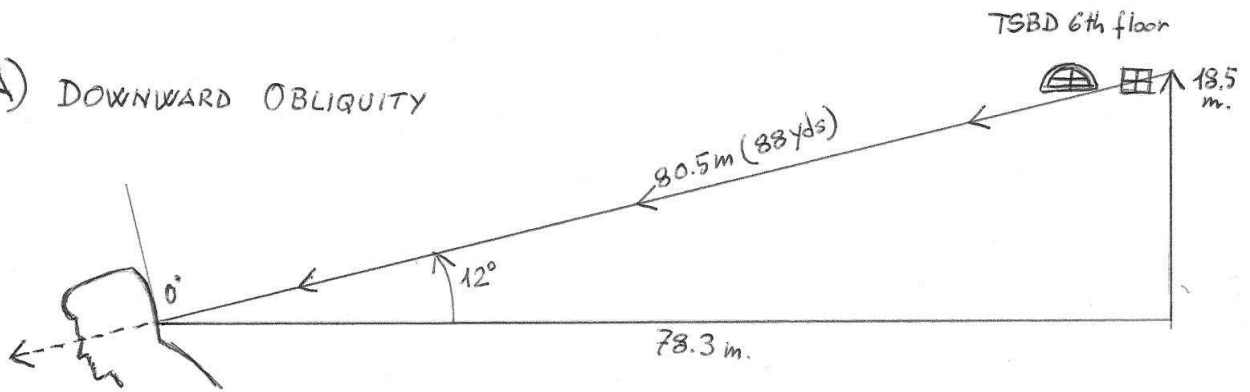


Fig. 5 Forces acting on impacting bullets. B)



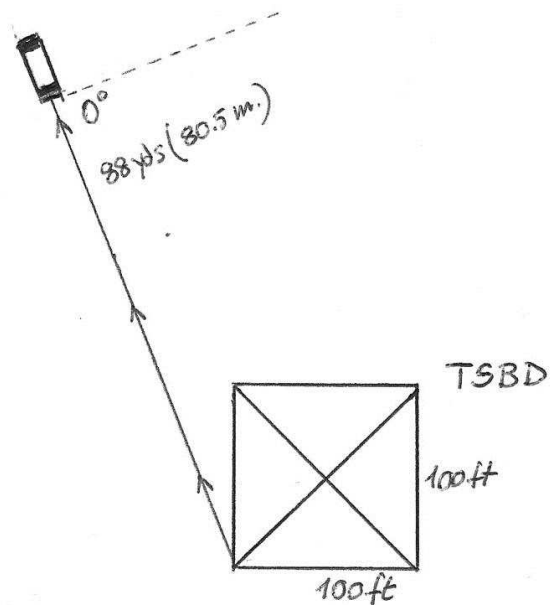
ADDENDUM (MARCH 21, 2014)

A) DOWNWARD OBLIQUITY



As Kennedy's head was bending forward, at the moment of fatal shot, an occipital shot from 6th floor of TSBD would have been almost totally orthogonal/perpendicular to his head (= nearly 0° obliquity), and that bullet would have had therefore the highest degree of penetration, and the lowest degree of fragmentation.

B) LATERAL OBLIQUITY



The same was for the "lateral obliquity" of the shot, as JFK limo was leaning to the left (with respect to the axis and position of the TSBD), at the moment of fatal shot. A shot from TSBD would have been **totally straight**, both as downward and as lateral obliquity. Such a shot would have:

1. Easily penetrated JFK's right occipital bone
2. Exited his right eye socket

with no fragmentation at all as experimentally proved by the Edgewood test with skulls, in 1964.

J.D. TIPPIT AND HIS “PALINDROMIC” NAME AND SKULL BONES.



The famous Swiss psychoanalyst **Carl Gustav Jung**, and the great physicist and Nobel prize **Wolfgang Pauli** were both believing that “**synchronicities**” (i.e. meaningful “coincidences” in our life, going beyond any mathematical probability and pure chance) should be carefully studied and interpreted as signs of Destiny.

Difficult to find more “synchronicities” than those linking President Kennedy’s life and death to the one of President **Abraham Lincoln**, in such a way that many persons are telling about “parallel lives” linking them beyond time and space.

However, another amazing synchronicity/coincidence linked forever President Kennedy to another person who died in Dallas that day, just 45 minutes after him.

J.D. Tippit was an agent of the Dallas Police Dept. He was shot dead to his head, on November 22, 1963, at 1:15 p.m, then Lee H. Oswald was arrested as suspected author of that crime, before having been accused of Kennedy's murder.

Tippit is a rare "palindromic" surname, i.e. his surname can be read both from left and from right (or, from another point of view, the first left letters of his surname "tip" are "mirroring" the last right letters "pit").

Another incredible "coincidence" was that, although Tippit's look/face was a bit resembling, but not exactly the same as that of JFK, yet his skull bones were identical to those of the President, as a sort of "palindromic skull", left skull bones of J.D. Tippit are "mirroring" the right skull bones of the President, as it is possible to see in the above "photocomposite".

What this could mean?

Some researchers, such as **David Lifton**, suggested (in his book: "Best Evidence" 1981) the absurd "theory" that Kennedy's body was removed from his coffin, aboard the Air Force One en route from Dallas to Washington after the murder, and replaced with that of someone else, to explain the discrepancies in descriptions of JFK's head wounds, between Parkland and Bethesda doctors, totally forgetting that Kennedy's coffin, during that travel, was closely and constantly watched by some of the closest friends of the President.

The best comment to this "theory" was the one of Harrison Salisbury of the New York Times, who wrote: *"...no one before Mr. Lifton has constructed a theory so complicated, so quirky, in such violation of every law of common sense and reason."*

Therefore, the most reasonable explanation of such an incredible "palindromic" coincidence/synchronicity between Kennedy's and Tippit's skull bones and Destinies, can be that **more likely and easily Tippit's x-rays of skull wounds have been used to replace Kennedy's x-rays of skull after Bethesda's autopsy, so that to falsely persuade everyone that Kennedy's occipital wound was caused by an "entry" bullet from behind (TSBD), and the temporal hole was an "exit" wound.**