Thesis on

Gunshot wounds

considered
with reference
to Traumatic Medicine

by

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Of all the varieties of death from violence that occurred by gun-shot wounds, none is of the most interesting to the student of forensic medicine, not only from the strange effects produced upon the body by the different kinds of projectiles, from the perplexing questions that they sometimes give rise to, from the difficulty of deciding in many cases as to whether the deceased met his death by accident, by his own hand or of that of a third party, but also from the conflicting opinions of the various writers on Medical Jurisprudence concerning many points connected with this subject.
ment of volunteer corps the frequency of accidents from firearms has much increased, and on this account it behooves the medical practitioner now, more than ever to have a competent knowledge of this part of his profession, so that in case of being called upon for his opinion by any court of law, he may be able to give such information as will assist the administration of justice in many doubtful cases, and thus often be the means of preventing imprisonment, those who have been improperly accused, as well as bringing to just punishment those who have been guilty of acts of violence against the lives of their fellow.

In treating this subject I shall divide the present essay into two parts, in the first of which I shall consider what information as to the nature of a case may be obtained from the inspection of
a body found, bearing the marks of wounds resulting from firear
and in the second, what can be accomplisher in the respect of a physi-
chemical examination of the arm itself in cases where it has been
found.

In the first place as to the diagnosis of a fire shot wound
 incapable of depriving of life, there can be no difficulty, though it is not easy
to give an exact definition of what it is. Sometimes we find the body perforated
from side to side, at other times there exists nothing more than a mere con-
tinuation of more or less extend, in some vital region such as the epigastrium,
of no great depth, but still having for its effects a most extensive lesion of
the vessels contained behind the

parietes. As a general statement
way of definition it may be said
that it is a contused wound more or
less lacerated with greater or less loss of substance. The depth and shape of the wound depend on certain circumstances, which may be included under the following five principal heads: 1st the violence of the explosion; 2nd the distance between the arm fired and the person struck; 3rd the nature of the projectile and any matters with which it may be accompanied; 4th the softness or hardness of the part struck; 5th the direction of the wound.

The greater the violence of the explosion and the speed with which the projectile comes in contact with the body, the more complete is the destruction of the part struck, and the more even is the diameter of the wound throughout its whole length, and the more likely is its direction through the parts to be a continuation of the course of the projectile through the air, and the aperture of entrance to be equal in size that of exit; in those cases where neither the whole body itself nor a limb is pierced,
The impetus of the projectile is greater or less according to the kind of instrument from which it is propelled by the explosion, and the latter depends for its expansive power upon the manner in which the former is charged.

Thus if the powder is too hard pressed in a firm a great part of it is blown away without being ignited, and the explosion is all the greater when the charge is so arranged that a little air exists between its particles so as to favour its most perfect combustion.

The length of the barrel is of great importance, and the fact whether or not it is rifled: as in the latter case it will produce the most perfect solution of continuity.

As to the distance between the wounded and the spot from which the wound is found, when this is either very near a very little, the wound loses its character of a regular and even line through the tissues and becomes more or less contused and lacerated, and the more much less perfectly the form of the projectile.
When the distance between the firearm and the person wounded is very little or none, as when applied directly to the breast there may be produced an extensive lacerated wound without the projectiles penetrating the body at all.

Mr. Duprez says that when a pistol is fired with the mouth pressing against the body it must either burst or be expelled by its own force and the bullet fall harmless to the ground. As a proof of this he cites the case of a man who was brought to the Hôpital St. Louis with a severe contusion on the region of the breast. It appears that he had fought a duel with another in such a manner that his adversary's pistol was pressed against his chest, but the bullet instead of entering fell harmless to the ground, the lesion being produced by the compressed air forcibly driven against the man's breast, which also appeared to serve the purpose of an elastic cushion to repel the bullet.
In such cases death may be occasioned by the shock and extensive lesion of resinous contained behind it even when the parietes itself is not broken down.

When a bullet is fired from a very short distance, but still not absolutely touching, it may only penetrate slightly, making a large lacerated wound surrounded with ecchymosis and filled with clotted blood, mixed with carbonaceous matter and particles of gun powder, and should it pass entirely through the body the aperture of exit may be smaller than that of entrance and more regular.

When the distance on the other hand is very great so that the force of the projectile is somewhat spent, according to most writers on the subject the wound of entrance is smaller than that of exit, and has its edges turned in, while the latter has them turned outward and presenting a much more lacerated appearance. But Cooper does not maintain this opinion, for
he declares that experience has taught him
the contrary, namely that the aperture of entrance
is smaller than that of exit, and has not its
edges as a plane or rule turned inward, an on
these of the latter directed outward, though, he
says "every perforated wound has the peculiarity of
becoming the larger the deeper it goes," not
withstanding that, its exit is smaller than its
entrance. When the shot comes from a very great
distance its course is often altered in the most
curious manner by very trifling causes; but
this will be considered under the head of the
projectile.

When a pistol is fired into the mouth, even
not loaded with a bullet yet produces effects
quite as dreadful as if it were.

When the distance is what might be
called "a just distance" that is such as would
permit the projectile to strike with its full
effects, but still not so near as to break with
the powder of the explosion, the perforation has
sometimes a very dry appearance which was
formerly thought to be due to salt being in
a state of insensibility, but this was proved not to be possible by the experiments of Archim- 
end of the body or burning of the clothes proves the case to be of sudden death, it may be said, that when it is me-
ner. The person has made an arrangement to shoot himself from a distance, as by fastening a gun in a certain position, and then from a distance pulling a trigger connected with the trigger as is said actually to have occurred. At the same time its presence does not exclude the idea of his being murdered by a third party. According to Cesar, when there is no mark of burning left on the body, it is to be considered as
about certain that the arm was at least three or four feet off when fired, and therefore that the presumption is in favor of murder or homicide, but still be cautious against receiving this as a rule and quote a case as being a remarkable exception.

We now come to the consideration of the projectile itself and every matter with which it may be connected.

Those projectiles which have a certain weight and hardness penetrate the body in a line most readily and display the greatest regularity with regard to diameter of the wound, and have the entrance and exit most alike, when the distance is considerable, but when this is very little a light and soft material produces effects very often similar to those of a ball. This has been proved spectably by Mr. Pulleyn who fired into a plank of a certain thickness, balls of wax and lead alternately and found the hole made had the same appearance in both cases. This death has been produced instantaneously.
As from the wadding alone striking the peri-
derm. The effect produced by a conical bul-
let is very startling. Very often the aperture it
produces is triangular, medially fused, slightly
entranced, and even presenting a trifling ap-
pearance outside, though the vaporous clots,
while one very neat, as lines, tendons and
all it cuts across are completely penetrated
if struck. These are almost never de-
flected from their courses, whereas the en-

core round bullets are early turned
aside (especially when somewhat slow)
bY very slight structures such as ex-
cample of the pectoral. With regard to
this, some curious cases have been recorded
such as that of Dr. Hermen quoted J. Scott,
where a bullet entered the neck in front of
the principal Adam’s, and after completely
making a circuit of the neck beneath the
skin was forced in the very aperture where
it entered. Balls have been known to exit
the upper extremity I made their exit in the
lower. This is caused by their striking
the body obliquely. Very often a bullet gets broken up into separate pieces after having entered the body from coming in contact with a sharp edge of bone. A case is cited where a common round bullet split into two across the cross, and others where the same effect has been produced by contact with the tibia. A remarkable case of this kind is quoted by Dupuytren where the ball split into two over the crest of the shin bone, and leaving the calf of the leg by two apertures of exact extension, the other, thus producing five wounds.

The ball besides, being split up may get flattened some very resisting structure such as bone or tendon. A case is mentioned by Pirey where a ball has penetrated the external table of the skull, and has put flattened on the internal, but such a case does not seem to have been met with by others.

In cases where the ball has been found split into different pieces the question naturally arises could this not have been
done before the bullet was placed in the arms from which it was discharged in order to make its effects more deadly. In answer to this it has been said that when the cut faces of the portions of the bullet are smooth and even, we may consider it probable that the ball was cut up before being placed in the arm, but when they are rough and marked with lines, which could reasonably have been made by contusions from mines or the bones along which the ball had passed, it is more probable that it was split after entering the body.

If a bullet were thus divided before being fired off, unless the arm were held very near there would be two apertures instead of one and thus there would be no occasion for doubt.

With regard to the substances which might accompany the projectile, any such if found ought to be carefully examined, as they might throw light upon some doubtful case.

For example, a murderer might make use of a part of a letter bearing his own name to keep the charge in its place and
this being afterwards found in the wound, or near it, would lead to his conviction.

In cases where the shot has been fired quite close to the body either by a suicide himself or a third party, any grains of unburnt powder that may be found on the body should be examined, as the circumstances might assist in clearing up a difficult case. From our experience we know that there are certain classes of men who have a certain kind of gun powder, always in their possession, such as quarry men, who employ it for blasting the rocks. This powder is characterized by the coarse mass of its grains, which can easily be distinguished from that ordinarily employed for firearms. If such a quarry man were found shot in such circumstances as to render it doubtful whether he was the author of the deed himself, or that he purchased the hand of a third party, the fact of grains of unburnt powder of a kind peculiar to said man being found upon the clothes, both in the person.
upon which the lay might quite well decide
the case as suicidal. 2. A bullet might
also be accompanied by a portion of the clothing
of the individual wounded.
When the force of the projectile is great
and the clothing not yielding it is perforated
and displays an opening of less diameter than
that of the bullet; but when again the force
is less and the clothing very yielding it is car-
rried into the wound, and perhaps not pierced
but retains the bullet in the skin formerly
and whose deeper parts may allow the bullet
to fall out of the wound. It has also hap-
penned that portions of the individual's clothing
have been found in the wound in an non-
different form, that in which they are
worn, for example a portion carried from
the overcoat deeper in the wound than
another from his shirt.
Water even has been shown by a sui-
cide as a projectile, as in the case men-
ed by Casper. He speaks of another also when
the mouth was filled with gunpowder and
We now proceed to the consideration of the different qualities of the parts struck as they influence much the effect produced by a bullet or other projectile.

The hard parts of the body such as bone and cartilage preserve much more easily the form of the projectile than the soft parts. Very often a bullet lodges in a bone as in the head of the humerus or the tibia. When the shaft of a bone is struck it is almost always more or less split, and this may extend even to a neighbouring joint.

Next to these the parts that lie over them preserve best the form of the projectile and are less liable to be torn and ragged when a soft part is struck. When there is a good deal of fat, such as the abdomen, the wound of entrance is apt to have its edges turned outwards. These preserve the form of the projectile much less perfectly than the others, and are more apt to be torn and ragged. From the nature of the
part struck much may be inferred as to the probability of suicide or murder. Thus, when the roof of the mouth has been blown away along with the parts above it, the most natural suspicion would be that of suicide, since it is well known that suicides often select this part of the body, and also the difficulty of placing a pistol barrel in the mouth by a third party. But still it might be asked could not this be accomplished when the individual was asleep? One could easily imagine an assassin creeping stealthily and cautiously up to the bed side of his victim and then suddenly pushing the muzzle of a pistol into his mouth and directing it in, then laying the weapon beside him on the bed to give the appearance of suicide. Such is within the range of possibility, but there would be almost always in such a case circumstances to indicate that the individual had not perished in our hand, such as
time and place being unsuitable to the idea of suicide. A horrid case is related by Casper where a father shot his own son while in bed, being actuated by motive of jealousy, but he chose the night by premeditation agin', and did not pretend that it was a case of suicide. The parts must be those of suicide. On the head, the mouth, heart, and temples, on the body, the epigastric region, and the abdomen, over the extremities. Of course, when there was evidence of a shot entering by the back, the idea of suicide would be precluded.

The direction must now occupy our attention. When a ball strikes obliquely, its course may be very peculiar as already mentioned. The more oblique the direction, the more oval will be the aperture of entrance, even until it becomes a straight line, and the more eccentric will be the course of the ball through the tissues, especially when it is a common wound bullet. The conical ball is already...
mentioned, tried to keep straight on in the direction, penetrating whatever they encountered, breaking and splitting the lines they met with.

The course of a ball may be peculiar even before entering the body, as in the case related by Dupuytren, where two young men were fishing each on opposite banks of a river, and one them firing his piece at a fish, the bullet struck the water obliquely, was reflected from its surface, and came into contact with the eye of his companion on the opposite bank, reflecting a reverse around whereby he lost the sight of it.

The direction of the wound sometimes helps to distinguish murder from suicide, as when a wound is directed from behind forwards, or in such a manner as to make it evident that the individual could not have inflicted it by his own hand.

In considering the direction it is of importance occasionally to record whether a person found dead from a gunshot wound suffered to be
reflected by his own hand, was left handed a right handed

Having now considered
the first part of the subject chosen for this
essay, the examination of the second raises
remains—namely, as to what information may
be obtained from the inspection of weapon found
in a pocket near a body, or in the house of a sus-
ppect person.

Casper says that the finding or
not of the weapon near the body signifies nothing;
neither when it has not been found it
may have been stolen by some person by.
He also remarks that when an old and
useless pistols or the mere barrel of a gun is
found near a body, the probability is for sui-
cide, as a third party would not likely em-
ploy such an uncertain and clumsy
weapon. It is also stated by most auth-
orities, that the fact of the pistol being
found in a pocket favours the idea of sui-
cide.
as suicides generally overload in order to make death more certain.

(We now proceed to the question of the recognition of a firearm as having been used, to be determined by a pathologist and, in the third place, with the help of this will be examined.) In the first place, we shall consider whether it can be determined that a certain firearm has been employed at all; in the second place, when was it discharged? And in the third, should any attempt be found loaded, can it be determined that this occurred after its having been just discharged? To both such questions, a then pathologist and apothecary at Frear contributed a series of experiments, and seems fairly to have accomplished his purpose, and to have presented to the profession certain data useful in doubtful cases to a great extent.

Of course, his experiments had reference only to such firearms as were charged with gunpowder and in cases where fire
cotton and fulminating mercury are employed could lead to no result. These investiga-
tions are more applicable to firearms con-
structed on the old principles of the flint
lock, and less reliable in those instances
where percussion caps have been em-
ployed.

Common fire powder is composed
of Sulphur, Carbon and Nitrates of Potassa and
when it is set fire to an enormous volume
of gas is generated composed of Nitrous oxide,
Gas, Carbonic oxide, Carbonic acid, Sul-
phurous acid gas, Sulphured hydrogen,
Carbonated hydrogen and aqueous vapour.
Along with these gases there are particles
of charcoal in the form of dust, mixed with Sul-
phate of Potassium and carbonate of Potassa,
which combine with the aqueous vapour from
the smoke, which we see in the air after an
explosion of fire powder.

Now certain of these products, on account
of the low temperature of the iron, condense
upon it, along with the vapour, and there are
the Sulphate of potassium and the carbonate of potassa, and particles of soot, others again being held in collections in the aqueous vapours, condensed on the iron, iron enters into chemical combination with it, and these are the Sulphureous and corrosive acid.

If a gun is examined immediately after being discharged it will be found that there is a coating of black black in the bore, if it be a flint lock gun, and also in the interior of the barrel, as may be seen for some distance on looking into it. This appearance lasts for two hours, but after that practically begins to change to a chocolate colour and at the same time loses its humidity and becomes dry. This period lasts about 24 hours. After this the colour becomes greyish from the deposition of crystals of Carbonate of potassa, and Sulphate of iron. This period ending after two days or so. And lastly the
grey colour becomes gradually transformed into reddish grey, and from that to the ordinary colour of wine rust.

Now it was from a careful observation of what has just been stated, and the application of tests at different periods after the discharging of a gun that Bontegney established his system, which we must now consider.

When a suspected firearm is given to a chemist (or to a country medical practitioner, who has perhaps also to do the duty of chemist), this being so, then in the neighborhood for examination, he should first examine the point of the weapon is of the old kind, and the interior of the barrel as far as he can see, whether it be old or new, and adapted for percussion caps or not; in order to mark the colour of the layer upon the iron.

He must then wash this off with distilled water, and make out perhaps a camel hair brush. He then passes these washings through a piece of filtering paper moist
end with hydrochloric acid. The carbonaceous and other solid matter will remain in the filter and the liquid which passes through should then be taken and subjected to the following tests. It must be divided between four test glasses, out the first of which a few drops of acetate of lead should be let fall. If there is a black precipitate this is an indication of the presence of Sulphuric of Potassium which predominates during the first period of two hours after the discharge. Another of the glasses, Chloride of Barium is to be dropped. If there is a white precipitate this will indicate Sulphuric acid, either free or passed to the state of a soluble sulphate, which is the prevailing compound during the second period.

In the third of these glasses ice is to be put a little of the ferro cyanide of potassium. If this shows a blue precipitate it indicates the presence of the Carbonate of Iron, the prevailing combi-
atom during the third period. To the fourth glass Tannic acid should be added and a black gritty colouration will be the result of the fourth period is extraordinary as this indicates the presence of the Sulphate of iron. The black matter left upon the filter, and the reaction with the Chloride of Barium would be sufficient proof that the residue contains some pure crystalline powder as we have thus identified two of its elements namely Sulphur and Carbon; and so the first question is answered.

Now as to this time, a variety of circumstances must be taken into consideration. If then, if the colour of the residue was black, black, slightly moist, and did not display any prey under spirits, and if even after a strong glass or crystals of Sulphate of lead or of Carbonate of iron could be discovered and the acetate of lead alone gave a precipitate with perhaps a faint indication of a free Sulphate of free Sulphuric acid by the
chloride of baryum, we may conclude that not more than from two to three hours have elapsed since the discharge of the patient.

If the colour of the residue is still inclined to be black, but approaches more to chocolate and nothing of the shape of crystals can be discovered with a powerful lens; and if the reaction with the acetate of lead is faint, while that of the chloride of baryum is strongly marked, and the ferroyanide of potassium, in the tamis acid, have any marked effects, a period of not less than two hours, nor more than about twenty-four is indicated.

If the colour of the residue is blackish grey, with here and there scattered crystalline points of a whitish or reddish color, and the acetate of lead has given no reaction at least but a faint trace of turbidity, and the chloride of baryum but a slight precipitate, while that of the ferroyanide of potassium is very manifest, we can
clue for the third period, namely that which commences twenty four hours after
the discharging of the firearm and terminates at the tenth day.

Firstly of the colour of residuum is more
red than black, and if when examined with
a lens, there are many points of the colour with
out any indication of crystalline forms such as
would show the presence of the Sulphate of iron
and the reaction of the peroxide of
potassium well marked, but still
more to that of the tannic acid, while
the acetate of lead and Chloride of
arsenic give no precipitates or at least
show mere traces of turbulency, the
fourth period is indicated, which
lasts from the tenth day to the fifteenth.

After fifty days no result
can be obtained to indicate that
the firearm has been discharged at all, for nothing remains but the con-
sumption, which all show takes up.
the atmosphere
These are the results of the experiments of Balligey, submitted in order to determine the amount of
true elapsed time the discharge of firearms, but they are always more or less modified by
the heat and moisture of the atmosphere, and
the phenomena described occur sooner when
it is damp and warm, and are more prolonged
in the opposite case.

The consideration of the
third part now remains, namely, as to whether
in the event of an arm being fired and loaded it
can be determined, by a physical or chemical
inspection that this occurred after its being just
discharged. This is the most difficult of all
and in many cases impossible, and even in
all very doubtful and unsatisfactory
Bougeley in considering this part makes
certain assumptions. In the first place, if
again is immediately reloaded after being fired
without washing. In the second place the
fire may be washed after being discharged,
and loaded again. But before this it may
be dried or it may be loaded without
...staining. When a piece has been loaded immediately after being discharged without deep washing, the washing will be found to have a black colour which remains for about four days, but after that becomes more and more grey till the fifteenth, when it has decidedly a grey color more than a black.

If this be washed with distilled water and tested with Chloride of barium it will be found that Sulphuric acid prevails in the residue.

When an arm has been washed before being recharged, after a day or two the cylinder made by the washing will have a red yellowish colour caused by the carbonate of iron, but after this period it becomes more and more of the color of rust till the sixth day when the presale alters. If in this case the washings of the washing be tested with acetate of lead and chloride of barium, no unite will be obtained, but if by the peroxicate of potassium, or gallic acid, precipitates will...
immediately be thrown down.

If the arm was washed and then recharged without being properly dried, then the cylinder formed by the winding will have a black colour, tending more or less to yellowish green from the formation of the Sulphate of iron, but after the fifth day the colour will be that of rust. In this case, during the first period the winding would give precipitates with SULPHATE

of barium and Tannic acid, more es-

pecially the latter, but after the fifteenth day feasible only to the latter.

As regards the different chemical re-

actions just mentioned, it should be kept in mind that no cleansing agents substances might be used that would harm them also, and moreover that where the paper used as wrapping contained alum, which is a Sulphate

of alumina and nitrate, the Sulphate of

barium would throw down a white precipi-

te just as in the other case of the Sulphate

of iron. If the water with which the barrel was
cleaned contained acetic acid and salt might be formed with the iron that would give a reaction with the ferrocyanide of potassium and tannic acid, supposed to be due to changes in the medium itself. Suppose again after the drying of the arm, the interior of the band was well oiled, it would not be possible to arrive at any result. Or if the arm were deposited in a very damp place, warm, still or water, the rust would be completely formed in a few hours.

After all, the conclusion to be arrived at with regard to Bonting’s experiments for the solution of the third proposition, if they are very little applicable to law cases when the arm of tannic acid is called in, and it would not be justifiable to make life or death depend on conclusions arrived at from any such procedures.