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Investigation of Fatal Gunshot Wounds

Justin C. Smith*

CERTAIN ROUTINE STEPS are taken in investigating fatal injury inflicted by a firearm either as a result of foul play or accident.¹ A fatal gunshot case presents many challenging medical-legal problems which involve cooperation among the forensic pathologist, firearms identification expert,² laboratory technician and the police. The belief that an "expert" can view the body and without further corroborating evidence testify in court as to the range at which this person was shot and the calibre of the weapon is one of the most common fallacies.³

Since the average person interested in law enforcement is generally not trained in medicine it seems best to discuss the information which can be obtained from an examination of a gunshot victim's body. Suppose a male corpse is brought to a coroner's office for the purpose of identification and determination of cause of death.⁴ First, it must be established whether or not the individual has been shot and, secondly, whether or not the gunshot was the cause of death.⁵ If no projectiles can be found in the body through X-ray⁶ or exploration, the question of whether the individual has been shot is by no means resolved. For example, multiple wounds inflicted by an ice pick in the back oftentimes gives the appearance of buckshot wounds.⁷

Bullet wounds, from external appearance, are of two types:

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¹ Few injuries resulting from the discharge of a firearm rule out the possibility of foul play.

² Firearms identification is also known as "forensic ballistics." However, since the science of ballistics relates to the study of projectiles in flight the term firearms identification seems preferable.

³ A review of the leading American text, Hatcher, Jerry & Weller, *Firearms Identification, Investigation and Evidence*, Stackpole Company, Harrisburg (1957), should quickly dispel any doubts on this matter.

⁴ For an excellent discussion of the historical role of the coroner in identifying deceased persons see Harvard, *The Detection of Secret Homicide*, Cambridge (1960).

⁵ Smith and Glaister, *Recent Advances in Forensic Medicine*, Blakeston's, Philadelphia (1939) ch. 1, contains a variety of material on the mechanics of gunshot injury.

⁶ The use of X-ray examination to locate projectiles or fragments of pellets is particularly important where the investigator wishes to weigh the bullet in order to have some approximation of caliber.

⁷ Smith and Glaister, *op. cit. supra* n. 5 at 20.

entrance and exit. The entrance wound is generally elliptical with a rim of abrasion where the bullet rubbed off the epidermis or outside layer of skin as it stretched prior to the projectile breaking the continuity of the surface.⁸ There may also be a rim of lubricant which was deposited by the bullet in the case of a non-jacketed pistol bullet.⁹

When the fatal projectiles cannot be recovered either from the body or from the scene of the mishap, it is risky to attempt to state the calibre of the bullet from the dimensions of the wound. Skin stretches when the bullet enters the body, and the bullet may be tumbling or keyholing in its flight and not enter nose first.¹⁰

Other types of projectiles may also confuse an investigation. Devices used to drive small metal studs employed by the building trade, for example, have led to at least two reported deaths. Variations are being found today due to hand loading of shells and shells¹¹ loaded to exterminate snakes and rodents.¹²

Anatomical Findings

The location of the gunshot wound must be related to known landmarks on the body.¹³

Not all projectiles enter the body through perforating wounds. A bullet may graze the body without breaking the skin.¹⁴ An anatomical examination¹⁵ may suggest whether or

⁸ Gonzales, Vance, Halpern & Umberger, *Legal Medicine, Pathology and Toxicology* 400, Appleton, Century-Crafts (1954).

⁹ See generally Hatcher, Jerry & Weller, *op. cit. supra*, n. 3, particularly ch. 4.

¹⁰ Tumbling or keyholing is often attributable to a projectile having been deflected in flight unless either the arm from which the bullet was fired was defective or the rifling of the firearm failed to stabilize the projectile in flight.

¹¹ For an excellent text on hand loading techniques see Naramorse, *Principles and Practice of Loading Ammunition*, Samworth, Georgetown (1954).

¹² Recently one metropolitan police department was called upon to investigate a death caused by a revolver cartridge which had been loaded with two pellets (00 buck) plus a zinc washer intended for use in exterminating snakes.

¹³ If the mishap suggests that litigation may follow, it is preferable that measurement be made in inches as opposed to centimeters, which are confusing to the average American juror.

¹⁴ Gonzales, et al., *op. cit. supra* n. 8.

¹⁵ An attorney investigating a shooting mishap would be well advised to consult the excellent outline found in Mann, *Principles of Legal Medicine* 399-414, Medical College of Virginia (Richmond 1960).

not the deceased died prior to receiving the wounds or a short time afterwards.¹⁶ It may reveal many post mortem artifacts;¹⁷ the past health picture of the decedent, and the possibility that he was under the influence of alcohol or barbiturates.¹⁸ It may show the cause of death was not due to gunshot,¹⁹ e.g., the hunter who suffers a terminal heart attack and falls causing his weapon to discharge.

Further examination may yield one or more projectiles²⁰ or portions of them.²¹ These may indicate the type of weapon.²² Powder residue may also be found. If the fatal wound was inflicted at close range and the decedent's body was not covered by heavy clothing, unburned powder grains may be found impregnated in the skin. Small black or red dots are sometimes found in and around the entrance wound,²³ along with singeing of the skin. Chemical tests²⁴ will determine whether these grains are powder particles or dirt. With a few notable exceptions the flame from a revolver seldom reaches beyond six inches,²⁵ while powder particles may travel eighteen²⁶ to twenty-four

¹⁶ See generally Gonzales, et al., *op. cit. supra* n. 8, ch. 16.

¹⁷ Gradwahl, *Legal Medicine* 131-136, C. V. Mosly Co., St. Louis (1954).

¹⁸ Since death arrests normal body functions, e.g. blood, alcohol and barbiturate levels, the time of death must be established prior to decomposition.

¹⁹ However, death may be due to air or fat embolism caused by gunshot.

²⁰ Gonzales reports two interesting cases. One involves a Chinese who "in the presence of a witness, fired two pistols simultaneously, one into his head and the other into his chest." Had the witness not been present this situation would certainly suggest foul play. The second case revealed two bullets in the skull of the deceased with but one entrance wound. Examination of the spent cartridge case and projectiles indicated that a previously fired bullet had lodged in the barrel and was forced out by the bullet fired during the suicide.

²¹ In one reported case a metal curtain fastener from an automobile was found imbedded in the skull. On X-ray this object gave the appearance of being a bullet.

²² Burrard, the English authority on firearm identification, stresses in his works, *The Modern Shotgun*, Jenkins, London (2nd ed. 1947), and *The Identification of Firearms and Forensic Ballistics*, Jenkins, London (3rd ed. 1956), the fact that a particular bullet or cartridge case which has been found may not necessarily have been fired from the weapon for which it was designed.

²³ Unburned powder particles act as missiles. Depending on the range, the type of powder employed, the configuration of the cartridge case and length of barrel "tattooing" or stippling may or may not be present.

²⁴ See Soderman and O'Connell, *Modern Criminal Investigations* 221-224, Funk & Wagnalls, New York (5th ed. 1962).

²⁵ Smith & Glaister, *op. cit. supra*, n. 5 at 10, 11.

²⁶ *Ibid.* at 8-13.

inches. The presence of singeing and powder particles may suggest which is the entrance wound and the direction which the individual was facing.

To understand the mechanics of injury one should know what transpires when a cartridge is discharged. Since the projectile serves as a plunger,²⁷ the sequela is the captured air in the barrel is forced out rapidly, followed by the gases, unburned powder particles, and primer residue. If the weapon is held tightly against an exposed body area it may itself produce certain marks. Notable is the mark left by the muzzle of a .45 automatic pistol when held to the temple in suicide attempts. The action of the slide in returning to its normal position often produces a recognizable mark on the forehead.²⁸ When the weapon is held close to the skin, the skin may be perforated by the outrushing powder gas. These gases may produce a stellate or cruciform opening radiating out from the entrance wound.²⁹ Gas entering a closed portion of the body such as the skull or stomach causes physical damage which obscures any trace of flame or muzzle blast. The entrance wound would, in such a case, be larger than the exit wound owing to the outrushing of the gas from the body cavity.³⁰ However, in some cases the underlying organs will ingest the gases and expand normally. Sometimes the entrance will be smaller than the exit wound and give no indication of the proximity of the weapon to the skin. Examination of the body tissue beneath the skin, however, may show effects of charring by muzzle blast.³¹ There are instances, where although no powder deposits were found on the skin surface they were found deep in the body.

Injuries inflicted at a range of one to three inches present a slightly different picture.³² These wounds are distinguished by

²⁷ *Ibid.* at 6-7. If the fit of the bullet to the bore is loose as is the case when a projectile measuring .308 is fired in a 7.65 Mauser (.311 bore diameter) the bullet may be preceded by gas and powder residue.

²⁸ Gonzales, et al., *op. cit. supra* n. 8 at 398-400.

²⁹ Polson, *The Essentials of Forensic Medicine* 170 (Thomas, Springfield, no date).

³⁰ Gonzales, et al., *op. cit. supra* n. 8 at 418-426.

³¹ For an excellent diagrammatic representation of the mechanics of injury see Svensson-Wendel, *Crime Detection* 234-241, New York (1955).

³² Hatch & Adelson, *A Clinicopathologic Case Presentation*, 31 *Postgraduate Medicine*, No. 1, Jan. 1962. This article contains an excellent photomicrograph of an entrance wound at 80× magnification.

a certain amount of fouling or smoke caused by the burning of the propellant³³ plus evidence of singeing by the flame.³⁴ If this portion of the body is covered with hair, some of the hair may be burned or shriveled. Fouling and smoke are easily wiped on the surface of the skin. Unburned and partially burned grains of powder may be driven into the skin and underlying tissue. The skin may present a peppered appearance referred to by pathologists as tattooing or stippling.³⁵ This is not readily wiped off the skin. The smoke pattern on the skin may not be a true indication of the range because that portion of the deceased's body may have been covered by heavy garments, or he may have been holding something between the muzzle and his body.³⁶ In the case of a black powder cartridge,³⁷ there will be more deposit on the surface of the skin than from a wound inflicted by a smokeless powder cartridge. Tattooing will also show evidence of larger powder grains³⁸ with no characteristic shape. Such cartridges can be distinguished by a competent laboratory.

The term "near shot"³⁹ is used to describe a wound inflicted from outside the range of flame and singeing but within the range of powder blast.⁴⁰ Stippling and fouling will be spread over a greater area in the absence of clothing. No skin singeing will be present. The perforating wound takes on the characteristic of a distant wound as opposed to a wound inflicted from two or three inches. The near wound is therefore rather a matter of guess.

The so-called "distant shot" involving a gunshot from two feet or more does not have all the characteristics found in the

³³ Svensson-Wendel, *op. cit. supra* n. 31 at 238-241.

³⁴ Gonzales, et al., *op. cit. supra* n. 8 at 407. Also see discussion of third degree burns at 526.

³⁵ Smith and Glaister, *op. cit. supra* n. 5 at 8-13. Also see Burrard, *Identification of Firearms and Forensic Ballistics* 56-80, Jenkins, London (3rd ed. 1956).

³⁶ However, presence of clothing may substantiate other findings and afford some indication of position of body at the time of the fatal shooting.

³⁷ Burrard, *op. cit. supra* n. 35 at 59.

³⁸ Note list of variables by Burrard, *ibid.* at 37, particularly reference to pressure. See also Gonzales, et al., *op. cit. supra* n. 8 at 383.

³⁹ Svensson-Wendel, *op. cit. supra* n. 31 at 240-241.

⁴⁰ Gordon, *Medical Jurisprudence* 701-705, Williams & Wilkins, Baltimore (3rd ed. 1953). Apart from wounds caused by "bird shot" authors vary widely in what they consider a distant shot.

contact or close shot.⁴¹ Generally, a perforating wound is the only mark found on the body.⁴² If the bullet struck the body at a right angle, generally there will be a uniform zone of abrasion whereas a projectile striking the body at less than a right angle causes an eccentric zone. There may or may not be a zone of purplish discolorations surrounding the site of perforation. Also present at the skin perforation may be a greyish ring of soiling.⁴³

Comparatively small quantities of blood escape from an entrance wound. As the projectile strikes the body the skin is first indented and then yields to the projectile.⁴⁴ As the projectile enters it wipes off all matter from its exterior surfaces.

Summing up, the anatomical findings may indicate an accident or suicide, or may suggest foul play.⁴⁵

If the projectile is not recovered, few facts are available to determine the type of weapon.⁴⁶ A mild load may produce more injury than an ultra high velocity load. It is also possible for a low velocity lead bullet to do more damage than an expanding point bullet fired from a high velocity rifle if the former should hit bone or cartilage.

Exit Wound

The exit wound may vary in size, shape and configuration from the entrance wound. An exit wound does not always suggest that the projectile is lost to the investigator.⁴⁷ A single bullet may enter and leave the body only to re-enter at another place. Exit wounds are characterized by a stretching force supplied from beneath which tears the skin once the limits of elasticity have been exceeded. Exit wounds are usually larger than the corresponding entrance wounds.⁴⁸ Their size may be affected by the proximity of the skin to the muzzle of the weapon.

⁴¹ Svensson-Wendel, *op. cit. supra* n. 31 at 241.

⁴² Gonzales, et al., *op. cit. supra* n. 8 at 386.

⁴³ *Id.*

⁴⁴ Soderman and O'Connell, *op. cit. supra*, n. 24 at 224. Note in particular figure 103.

⁴⁵ Polson, *op. cit. supra* n. 29 at 174-177.

⁴⁶ The classic and still the best description of the work of the projectile is to be found in Smith and Glaister, *op. cit. supra* n. 5 at 1-5.

⁴⁷ See Gonzales, et al., *op. cit. supra* n. 8 at 406, fig. 16-31.

⁴⁸ Kerr, *Forensic Medicine* 140 (Adams and Black, London, 6th ed. 1957).

A bullet that passes through tough tissue tends to tear rather than perforate. A mutilated or blunt bullet, packing tissue in front of it, bursts its way through the body. It may deform to a greater or lesser extent depending upon its jacketing and point configuration. Further, a bullet may tumble within the body so that it does not travel nose first.⁴⁹

Exit wounds take on several forms including stellate, cruciate, triangular, et cetera. They even may resemble stab wounds. The characteristic rim of abrasion, fouling, singeing and stippling of the entrance are not seen. The bullet may disintegrate and each fragment may make a separate exit, or it may strike a bone which fragments and acts as a secondary missile.⁵⁰ More blood may escape from an exit wound than from an entrance wound. Tissue destruction is greater at the site of an exit wound than at an entrance wound if we eliminate the situation where the muzzle is close to the skin. Shreds of tissue and fat may be extruded from the exit wound as well as portions of specific organs. Because of the skin's elasticity the projectile may be found beneath the skin opposite the entrance wound.⁵¹

Although the projectile's course through the body is valueless in identifying the weapon, it is important in describing mechanics of injury and/or cause of death. A forensic pathologist will note this course from front to back, or back to front; from right to left, or left to right; from above downward, or from below upward.⁵² From an anatomical examination of the victim one can sometimes determine how long the victim survived, or what purposeful activity the victim could perform following the shooting.⁵³ However, some qualifications must be made. A bullet through the heart would preclude one hour's purposeful activity following the injury; but a person who has shot himself through the head may wander around for as long as an hour.

⁴⁹ Hatcher, et al., *op. cit. supra* n. 3 at 276. References to a lacerating wound caused by the bullets wobbling in flight at extreme ranges is rather common. See Kerr, *op. cit. supra* n. 48 at 141, and Camps and Purchase, *Forensic Medicine* 141, Adams and Black, London (6th ed. 1957).

⁵⁰ Hatcher, et al., *id.* n. 49 at 277-278 cites a case where a soldier was killed by a piece of flying bone dislodged by a bullet which struck another man occupying the same tent.

⁵¹ Gonzales, et al., *op. cit. supra* n. 8 at 406.

⁵² Mann, *op. cit. supra* n. 15 at 398-413 provides an anatomical diagram as well as a suggested procedure to be followed by the examining physician.

⁵³ See Polson, *op. cit. supra* n. 29 at 176 where in three cases mobility of a victim of a firearms injury are discussed.

If the bullet has not been recovered, the question as to kind of firearm⁵⁴ is still unanswered. If multiple bullets were involved, were they fired from the same or different weapons? From what distance was the fatal shot or shots fired?

The Scene Investigation

An investigation of the scene of the event may uncover the bullet or fragment thereof, a weapon, or a spent cartridge case.⁵⁵ The scene may reveal overshot cards and overpowder wadding from a shotgun, or the plastic or cork obturator⁵⁶ which is placed over powder charges in loading shotgun cartridges. If multiple shots were fired from an automatic or semi-automatic weapon, a definite pattern will be laid down by the ejected cases.⁵⁷

Unfired cartridge cases at the scene of an accidental shooting may yield relevant information, also. For example, if unburned powder particles were found on clothing and loaded cartridges at the scene the powder from the ammunition may be compared with that found on the clothing.⁵⁸

The presence or absence of blood stains may be attributable to a number of circumstances including whether the premises had been rearranged after the shooting.⁵⁹ An elementary rule in criminal investigation is that the scene should not be disturbed until a mark is made at the place where the decedent was found,⁶⁰ and a systematic inventory made of the area. Such investigations may indicate the relative positions of the parties, time of day, and weather conditions.

⁵⁴ It is to be noted that in the case of the .45 automatic cartridge, a domestic auto loading pistol, two domestic revolvers and a domestic rifle (the post World War II Reising) all can use this cartridge thus making the firearms identification expert's role a difficult one.

⁵⁵ A description of investigation procedures with respect to location and distribution of spent cartridge cases is to be found in Hatcher, et al., *op. cit. supra* n. 3 at 285-287, particularly the illustration on p. 287.

⁵⁶ Burrard, *op. cit. supra* n. 35 at 73 believes that absence of wads and cards in the body, but presence at the scene along with spent cartridge cases might suggest the range.

⁵⁷ *Ibid.*

⁵⁸ Soderman and O'Connell, *op. cit. supra* n. 24 at 30-37.

⁵⁹ Wilson, *Homicide Investigation Techniques*, Thomas, Springfield (1961), see in particular "Investigation and Crime Scene Search" by R. A. Crowder at 5-9.

⁶⁰ *Id.* at 10-13; Turner, *Forensic Science and Laboratory Technics* 1-28, Thomas, Springfield (1949).

Examination of the Bullet

Once the anatomical examination and scene investigation are completed, attention should return to the missile itself. The projectile may be a bullet, shot from a shotgun cartridge,⁶¹ or an unknown metallic substance.⁶² The most important thing is that as much of the projectile be obtained as is possible. Even if the projectile is mutilated beyond recognition it still may yield valuable information in terms of its weight.⁶³

The loading tables published by the arms companies are helpful in establishing the weight of a particular pellet.⁶⁴ X-rays of the deceased may reveal portions of the bullet still in the body and some approximation can be made of their weight and this may be added to the weight of the recovered projectile. Even with badly mutilated pellets, studies may suggest their former shape or appearance. A close examination of the bullet may reveal whether it was jacketed or half jacketed, suggesting, in turn, that the bullet was fired from a revolver or a semi-automatic weapon.⁶⁵ A further examination may reveal whether it is a cast or swaged projectile.⁶⁶

Where the bullet was recovered in good shape it may be examined for bore imprints.⁶⁷ These imprints, commonly re-

⁶¹ Since no test has been devised to trace fired shot to a particular gun barrel the value of recovered shot is limited to comparisons of known shot to suspect shot in terms of size, plating and chemical compositions. In the case of large shot (00 buck which is approximately .32 caliber) the pellet may in some cases carry tissue with it or bear the imprint of fabric through which it passed.

⁶² The possibility that the fatal shot or shots were caused by blank cartridges should not be overlooked. Black powder is employed in present day loading.

⁶³ In a recent case, the weight of the bullet suggested a .44 or .45 caliber. A check of pawn shop sales of .44 and .45 caliber weapons led police to a suspect.

⁶⁴ See also Naramores, *op. cit. supra* n. 11.

⁶⁵ With the exception of the rim-fire .22 cartridges, semi-automatic weapons fire jacketed bullets. Exceptions are generally limited to the Colt Government Model .45 in altered form, Colt Gold Cup .38, S & W Model .52 in .38 special and Clark-Colt .38 special AMU Model 61. However, a number of production revolvers may fire jacketed bullets, the most obvious being Colt and S & W, W.W.I. service revolvers chambered for the .45 ACP service load.

⁶⁶ A cast pellet is generally indicative of a hand or "home" loaded cartridge while a swaged bullet may indicate either a factory loaded cartridge, factory supplied bullet or a bullet produced by a hand loader.

⁶⁷ Hatcher, et al., *op. cit. supra* n. 3 at 106-162 contains an excellent discussion of the imprint of the bore in a fired projectile. See also Davis, *Tool Marks, Firearms and Striagraph* 107-133, Thomas, Springfield (1958).

ferred to as rifling marks, often will reveal whether the bullet was fired through a Smith and Wesson or Colt revolver as each have rifling turning in opposite directions.⁶⁸ The width and depth of the rifling marks may serve as an indication of the type of weapon or conversely may exclude arms from consideration.⁶⁹ Skid marks or the marks of the lands as the rifling "bites into the bullet and forces it to twist with the bore" suggests that the bullet was not firmly butted against the rifling at the time of discharge.⁷⁰ Battered bullet tips may indicate careless handling by a previous owner, resistance in flight by some object, or possibly that the magazine of the weapon allowed some motion of cartridges.⁷¹ In some instances the nose of a soft lead bullet may reveal that it went through fabric in the course of its flight.⁷² If it did, the fabric may be identified⁷³ as part of the clothing worn by the deceased. Much more information may be derived from a close examination of the bullet.⁷⁴

Effect of Gunshot on Clothing

Clothing worn by the decedent is an important investigative matter.⁷⁵ Its presence may materially alter the entrance site. Evaluating the effect of gunshot on clothing is important in determining whether the particular shooting was accidental. Powder, smoke and flame leave their marks on a garment⁷⁶ in addition to the projectile's wiping itself on the cloth.

The visual inspection should be followed by soft X-ray,⁷⁷

⁶⁸ Smith & Wesson 5 lands and grooves, right hand twist; Colt 6 lands and grooves, left hand twist.

⁶⁹ Mathews, *A Measurement of Land Impressions on Fired Bullets*, 44, *The Journal of Criminal Law, Criminology and Police Science* (1954); Mathews, *The Measurement of Rifling Characteristics of Firearms, Police*, 15-19, Thomas (1957).

⁷⁰ Davis, *op. cit. supra* n. 67 at 134; Hatcher, et al., *op. cit. supra* n. 3 at 409, see illustration at bottom of page.

⁷¹ Certain types of bolt action rifles tend to allow cartridges to move within the magazine thereby causing damage to soft painted bullets.

⁷² Davis, *op. cit. supra* n. 67 at 158, illustration VII-8.

⁷³ Soderman & O'Connell, *op. cit. supra* n. 24 at 260 figure 118, provide a photomicrograph to illustrate that the substance against which a bullet struck in flight may be identified under favorable circumstance.

⁷⁴ *Ibid.*

⁷⁵ The type of clothing worn by the decedent may suggest the time the mishap occurred, e.g. topcoat, work overalls, bathrobe.

⁷⁶ Turner, *op. cit. supra* n. 60 at 101-106.

⁷⁷ *Id.*

infrared photography,⁷⁸ and certain chemical analysis to determine the presence of metal shavings,⁷⁹ powder pattern and its distribution.⁸⁰

Any clothing found at the scene should be examined to determine if it belonged to the deceased, whether he had worn it, and if it has entrance and exit holes.⁸¹

Powder patterns found on the clothing, particularly clothing which was folded, may suggest the position of the deceased at the time of the mishap.⁸² For example, a coat found with powder patterns on the back panel when the victim had an entrance wound in his chest suggests that the jacket was not worn by the victim at the time of the fatal injury.⁸³

Since clothing may obscure anatomical findings on the distance between the individual and the muzzle of the weapon, this must be kept in mind when making the examination. Again, clothing may survive a fatal accident where the body, remaining undiscovered for a period of time, is no longer of value in determining range.

A leading text has suggested that the distance between the victim and a shotgun may be ascertained by measuring the diameter of the shot pattern and subtracting one in inches, thereby yielding the range in yards.⁸⁴ Experiments conducted in this country have not borne this out. There is the possibility that the gun will be choked tightly or open bored, with the result that the pattern will produce narrow or broad dispersion.⁸⁵ There are variations due to loading such as the new over-powder shot concentrator. In addition to loading factors, it is known

⁷⁸ *Id.*

⁷⁹ Soderman & O'Connell, *op. cit. supra* n. 24, at 221-225.

⁸⁰ See Burrard, *op. cit. supra* n. 22, Ch. IV.

⁸¹ Since the majority of fabrics used in dress garments today have been treated with silicones and possibly stain inhibitors, these factors must be taken into consideration.

⁸² By the same token shot patterns may be of great importance where the range was such as to preclude soiling by the products of combustion.

⁸³ For example, the deceased may have had a coat covering him as a blanket when he was fatally injured.

⁸⁴ Polson, *op. cit. supra* n. 29 at 169.

⁸⁵ Choking is the use of a slight constriction at the muzzle of a shot gun to produce more dense patterns. The degrees of choke in common use, a narrowing of 3 to 5 thousandths if an "improved cylinder," 15-20 thousandths and a narrowing of 35-40 thousandths produces "full choke." Normally a full choked gun will deliver at least 25 per cent more shot into a 30" circle at 40 yards than an "improved cylinder." For a definitive treatment of boring and pattern see Burrard, III *The Modern Shotgun*, Ch. I, Jenkins, London (2nd ed. 1948).

that the larger the shot the better the pattern, with the result that at longer ranges coarser shots tend to produce a smaller pattern of dispersion.⁸⁶

Where the deceased is examined by a physician or in a hospital emergency ward, his clothing should be preserved and made available for later tests. In many homicide cases the medical examiner himself may have an opportunity to remove the clothing. In such an instance, the garments may be cut away so that powder pattern,⁸⁷ entrance and exit holes will remain undisturbed.

Despite the amount of wear to which clothing has been subjected, whether it was moist at the time of the fatal mishap,⁸⁸ or whether it has been treated by a water repellent solution,⁸⁹ certain information can be obtained by the scientific examination barring previous contamination. The garment may be viewed under a low-power stereomicroscope⁹⁰ to note the manner in which fibre damage was produced and the presence of blood and body tissue in and about the exit wounds. Use of infrared photographic materials⁹¹ in identifying powder pattern is helpful where the clothing, dark in color, does not lend itself to visual study. X-ray is useful in examining the garment for small metal fragments either from the projectile or the barrel. Some of the newer approaches in micro-chemical analyses hold great promise. The metal content of the area around the bullet hole is examined for by-products of primer ignition. Since most modern am-

⁸⁶ The reappearance within the last year or two of factory loads utilizing shot concentrations should be considered in evaluating the patterning of any shotgun. See III *American Rifleman* 58 (1963), for a discussion and evaluation of Winchester Western's new Mark V buckshot load which is already in use by law enforcement agencies. In the case of the latter load the maker has added "... powdered polyethylene to fill the spaces between the pellets to protect them further. This also makes the buckshot charge more nearly 'fluid' and responsive to the choke, which usual buckshot loads are not."

⁸⁷ Even where there is no occult evidence of powder patterns, care should be taken not to subject the clothing to contamination. Where possible the clothing should be hung from a clean coat hanger until dry and then placed in new paper bags or large suit boxes. All items should be properly tagged and identified as to the person handling them.

⁸⁸ Burrard, *op. cit. supra* n. 35 at 57 notes that the degree of scorching is dependent on whether the surface is wet or dry.

⁸⁹ Preliminary tests conducted by the writer suggest that certain types of fabrics are selected for rain repellent garments and that this selection rather than treatment with water repellent materials tends to inhibit scorching.

⁹⁰ Soderman & O'Connell, *op. cit. supra* n. 24, Ch. KVI, KVII, at 236-262.

⁹¹ A very typical example of what may be uncovered by infrared photography is to be found in Soderman and O'Connell, *id.* at 222, figure 102.

munitions contain a fair amount of the organic lead compounds, an examination of the amount of this material transferred along with powder residue may help in comparative studies of shooting distance. This may not yield the exact distance, but provide information on the outer margin with which deposits from this particular weapon using this ammunition might be found.⁹²

The following method is used: Small pieces of tissue around the bullet hole are heated, ashed, and dissolved in nitric acid. The acid solution which contains the lead of the smoke, is made to react with a dithizone solution, a very sensitive and highly specific reagent for lead. A brick red color results, intensity of which is proportionate to the lead content. The intensity of the color is read in a colorimeter, and the lead content estimated from the value obtained.⁹³ In addition to the products of combustion, Svensson and Wendel suggest that traces of iron may be found in the clothing and in the entrance wounds where the weapon has been allowed to become rusty, internally.⁹⁴ The same authors have suggested that "Traces from cartridge cases, particularly produced by bullets from automatic handguns of the jacketed variety may be found in the tract of the wound and in perforated clothing up to a range of 6 to 8 inches."⁹⁵ Such traces come from a cartridge case and from small particles of metal worn off by expansion of the case under pressure in the firearm's chamber after detonation of the powder.⁹⁶

Conclusion

Many of the techniques suggested here do not lend themselves to every investigation. As new techniques are evolved, older ones become obsolete. The validity of observations is dependent upon the skill and practice of the investigator. However, his observations may be misleading, if not dangerous.

Dangerous because too few judges and jurors are trained in the scientific method with the result that often greater weight is given to the findings of an investigator than he himself would claim for them.

⁹² Soderman & O'Connell, *id.* at 225.

⁹³ *Id.*

⁹⁴ Svensson-Wendel, *op. cit. supra* n. 31, at 242.

⁹⁵ *Id.*

⁹⁶ The writer has purposely omitted any discussion of either the "dermal nitrate test" or the "Walker test" for detection and arrangement of powder particles. For a brief discussion of both tests see Turner, *op. cit. supra* n. 60 at 98-102.