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BALLISTICS: A STUDY OF THE EXPERT WITNESS

STUART R. HAYS

Introduction

> In this land of lies, an ounce of good circumstances is worth many pounds of oral evidence . . .[1]

Since the beginning of time, man has been in a never-ending quest for the most effective mode of killing his fellow man. With Sir Roger Bacon's discovery of black powder in the Fourteenth Century, man found the solution to an effective and yet selective mode of death—the firearm was born. With the discovery followed the improvements of the components, and today the modern firearm is capable of vast and powerful human destruction.

> The science of ballistics comes indirectly from the ancient's habit of writing a contract on two pieces of wood and then carving into the sides of the wood markings for the later purpose of identification . . . just as the metal parts of the weapon's barrel mark on the softer componants of the cartridge case and the bullet[2].

The purpose of this paper is dual: first to explain the methods of the ballistics expert in arriving at his opinion; and second, to show how these tests fit into the scheme of law and evidence. Rather than produce a technical monograph on scientific analysis and testing; the processes, and aspects of ballistics detection methods, as they fit into the fabric of admissable evidence, will be sketched. The attorney, in a case involving ballistics, will be primarily concerned with problems of evidence and the expert witness. Thus an attempt has been made to show why some courts are reluctant to accept testimony of scientific analysis in the court room. This reluctant attitude

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[1] Emperor v. Sahdeo, 3 Nagpur L. Rep 1 (1904).

[2] Inbau, Scientific Evidence in Criminal Cases, 24 J. Crim. L., C. & P. S. 825 (1933). (herein cited as Inbau)

is especially noticable in older cases, when the science of ballistics was still in the stages of infancy. Justice Story realized the problem of admissibility of new ideas, and the tendency of the courts to cling to the old ways. This tenacity has caused testimony of the "young" sciences of fingerprinting, radar, and ballistics a great deal of difficulty in gaining acceptance into American courtrooms.

> The rules of evidence are of great importance and cannot be departed from without endangering private as well as public rights. Courts of law are therefore extremely cautious in the introduction of any new doctrines of evidence which trench upon the old and established principles. Still, however, it is obvious that as the rules of evidence are founded upon general interest and convenience they must, from time to time admit modifications to adopt themselves to the changing conditions of men, or they would work manifest injustice . . .[3]

The courts have, indeed, been cautious to accept the expert witness and his scientific testimony.

A great stepping-stone to common acceptance were the decisions of the Supreme Court of the United States. It had been thought that the production of the defendant's personal firearm might be a violation of the Fifth Amendment, as causing the defendant to testify against himself. It has been held that such production is not self-incrimination; and does not come within the protection of the Fifth Amendment[4]. In fact, the Supreme Court has allowed the production of lead particles found under the defendant's fingernails into the evidence. *Medley* v. *United States*[5], involved the testimony of one familiar with a spectroscope. The expert testified that the foreign material removed from under the fingernails of the right hand of the defendant while he slept was of the same

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[3] Nicholls v. Webb, 8 Wheat. (21 U.S.S.Ct.) 326, 332, 5 L.Ed. 629, 629 (1823).

[4] Galenis v. State, 198 Wis. 313, 223 N.W. 790 (1929).

[5] Medley v. United States, 81 App. D.C. 85, 155 F.2d 857 (1946).

chemical and physical make-up as that of the bullets found in the body of the deceased. The Court held that such was neither an unreasonable search nor a "forcing" of self-incriminating evidence.

Further, *Goodall* v. *United States*[6], involved the question of whether the defendant must be present during the testing of the "questioned items" by the expert. In denying certiorari the Supreme Court affirmed the District Court's view that the actual tests are not a part of the trial, but the basis of the expert's opinion. If the expert is qualified, then his opinion is all that is required. The tests are incorporated into the expert's opinion.

By the middle Nineteen-forties, all states, where the question of admissibility of a ballistics expert's testimony had been passed upon, were in accord that such testimony was admissible. But while the courts agree that a qualified expert can give a valid opinion, there is strong disagreement as to what constitutes a qualified expert. Where an expert was asked to comment on the possibilities of two bullets being identical in all marking characteristics, and yet fired from two separate weapons, he commented, that if there were eight separate marks on the bullet the chances of the two bullets being identical were eight trillion to one. He noted in passing, that each bullet generally has markings numbering in the hundreds. To compute "odds" at such a level would be beyond human capacity. The appellate court commented on the defendant's contention that he was being tried on a mathematical possibility:

> He declared no man has ever examined enough fingerprints to say he will never find two alike, meaning, as we understand it, it is within remote possibility that some-day two identical fingerprints will be discovered, but such has not been encountered by one man. In other words, it is practically impossible for a pistol to make dis-similar markings on a bullet fired from it . . .[7]

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[6] Goodal v. United States, 86 App. D.C. 148, 180 F.2d 397 (1950).
[7] State v. Burney, Mo., 143 S.W.2d 273, 275 (1940).

This view is quite opposite to that of another court of an earlier era which stated, in a strong and positive tone, that it is quite obvious that all Colt .32 barrels are the same, and only an idiot could say they are different and would leave dissimilar markings[8]. Since wisdom comes with maturity, this court has since reversed itself. The science of ballistics is now in its adulthood.

THE CAUSATION OF MARKINGS BY THE FUNCTIONS OF WEAPONS

A fired bullet leaves two distinct types of characteristics on the bullet and the catridge case, called "class" markings and "accident" markings. Class markings are those common to a particular type of firearm firing a particular type of ammunition. For example, all Remington manufactured 138 grain wadcutter bullets of .38 Special caliber, will have the same general markings when fired through a factory fresh Smith and Wesson K-38 revolver. The steel rifling will impart its general markings on the softer lead bullet, and the firing pin will leave its "dent" on the primer cup in a similar manner. The class characteristics are the means by which an "unknown" firearm may be classified as to a particular manufacturer's make and model. Accident markings are those peculiar to each individual weapon when fired with the same type of ammunition. In the example above, even though the ammunition used remains the same, a Smith and Wesson K-38 revolver with serial number 456329 will have the same class characteristics as all others, it will not have the same accident markings[9]. It is the functioning of the firearm that causes both the accident and class markings. No matter how man tries he cannot duplicate exactly his own work.

Loading

All weapons, whether rifle, pistol, shotgun, or machine gun function in a similar manner. When a cartridge is loaded

[8] People v. Berkman, 307 Ill. 492, 138 N.E. 91 (1923).

[9] Wilson, Two New Instruments for the Measuring of Class Characteristics of Fired Bullets, 27 J. Crim L., C. & P. S. 97 (1936). (herein cited as Wilson-1).

into the chamber certain scratches result from the sliding of metal upon metal. In certain forms of weapons these markings may be more pronounced than in others due to the more violent loading process of the weapon. Thus a Thompson Sub-Machine Gun literally rams the unfired cases in and blows the empties out. The more violent the process of loading the more well defined are the resulting markings on the case.

Firing Pin Movement

The second function is that of the firing pin moving forward to strike the primer and ignite the powder. The motions of the firing pin are controlled to a degree by the strength of the firing pin spring. A strong spring will produce a deeper impression on the soft primer cup than a weak spring.

Ignition of the Powder

The ignition of the primer causes the ignition of the powder propellant. The gases of the ignited powder push equally in all directions. The bullet is pushed through the rifling by this pressure, while the cartridge case is pushed rearward by the pressure against the bolt face. The harder surface of the barrel and bolt mark the softer metals of the bullet and case. The lands and grooves will impart to the bullet their markings, both class and accidental; the bolt will impress on the rear of the case its markings, both class and accidental.

Cases have been solved by the rearward thrust of the gases under pressure. In one such instance the bolt was covered with grease when fired. The case left its impression in the grease on the bolt face. Magnification of the impression and the case showed a perfect match and permitted identification of the weapon[10].

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10 Anon., Firearms Training, Federal Bureau of Investigation Law Enforcement Bulletin, May, 1958, pp 3-6. (herein cited as F.B.I. Bulletin)

Extration and Ejection

With the bullet fired, the empty cartridge case has no further function; it must be removed from the chamber in order to load a fresh round. The extractor is the part of the weapon that serves to grasp the cartridge case in its removal from the chamber. The extractor grips the rim of the cartridge case like a finger. The rearward motion of the bolt pushes the cartridge case against the ejector, which serves to release the grasp of the extractor and push the empty from the weapon. The functioning of these two parts and the amount of markings they will impart depend upon the type of weapon involved. For example, a Reising Sub-Machine Gun is of the "blow-back" type. This means that the pressure of the gases pushes the bolt rearward upon firing, the recoil spring pushes it forward again for loading and firing. This occurs at a rate of 600 shots-per-minute. The cartridge case is subjected to a great deal of "slamming around" during the ejection-extraction process, and more markings are imprinted on the case than if another type of weapon were used.

MARKINGS: THEIR TYPES AND LOCATIONS

The expert's testimony generally concerns the interpretation and analysis of several classes of items, including: bullets, powder, cartridge case, and shotgun range. Each of these items leaves its own personalized accident markings upon the discharge of a firearm. These marks are due to the inherent impossibility of *exact* duplication of all the factors and conditions present during firing and manufacture. Man cannot reproduce exactly two objects, although they appear to the naked eye to be similar.

Bullets

One step in the manufacture of pistols and rifles is the boring of the hole through the center of the steel barrel, and the reaming subsequent to it. The sharp cutter tool, no matter the degree of polish, will always leave its own particular markings. The probability of absolute duplication of one hundred cutter marks on two separate bullets fired from two

separate weapons is estimated to be thirty-eight trillion, forty billion to one[11]. With many hundreds of cutter marks alone present in a rifle barrel the range of probable duplication exceeds one hundred dectillion[12].

Cutter marks are not the only cause of bullet markings, there are hundreds of others. In fact any deviation or abrasion in the bore will leave its own individual mark. Rust, pitting, gas erosion, moisture, dirt, and oil film are but a few of the causes of accident markings. When a soft piece of lead, slightly larger than the bore, is forced through the rifling at pressures as high as 60,000 pounds-per-square-inch all the minor and microscopic markings of the barrel are imprinted on the bullet. One court has even allowed the showing of the direction of twist of the bullet into evidence. In *State* v. *Allison*[13], the Montana Supreme Court allowed the evidence that a Colt is the only American manufactured weapon with a "left-hand" twist, while all others are manufactured with "right-hand" twists. The defendant was the only person possessing a Colt, of those that could have committed the homicide. By process of elimination the bullet in the corpse convicted the killer.

The bullet, in addition to having the markings placed upon it by the action of the rifling, may have others caused by various factors which the experts must be familiar with during his examination. Some of these are: die markings, cannelures, stab cribbing, axial markings, stripping markings, carboneceous incrustations (caused by escaping gases), imperfections in casting, lubricant markings, and markings caused by leaving the cartridge case[14].

Another set of markings, opposed to the rifling and manufacture markings, are the "X-straie". These are the marks

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11 Inbau, p. 827.

12 id., p. 828.

13 State v. Allison, Mont., 199 P.2d 279 (1949).

14 Cross, Origin of Bullet Markings, 16 Royal Canadian Mounted Police Quarterly 318 (1955).

left on the bullet parallel to the axis. They are caused by lead and other deposits in the bore[15].

Powder

Powder is the bullet's propellant force. Its rapid combustion produces the gases which push the bullet from the rifle barrel. Due to its rapid combustion, the powder is seldom completely consumed into pure untraceable elements of free nitrogen, oxygen, carbon dioxide, and hydrogen. This incomplete combustion often leaves the investigator with a possible starting place in criminal detection.

Powder is of two distinct types, black and smokeless. Smokeless powder is divided into two distinct chemical types, single base (cellulose nitrate) and double base or cordite (cellulose nitrate, nitrated with nitro-glycerine). Through chemical analysis it is possible to tell the type of powder used. Once this is discovered, the manufacturer may be determined by further testing. Additional analysis may yield the range and particular type of weapon used[16].

Powder residues are of extreme value in determining range and the angle of fire. This becomes important in a case involving either a homicide or suicide, or self-defense or homicide. A jury would probably place little credibility on a defendant's testimony of self-defense, when the opinion of an expert would indicate a range of many feet rather than the close range claimed by the defendant[17]. The powder pattern could tell the true story.

Cartridge Cases

The cartridge case was the last recognized carrier of positive identification markings. On the case there are always hundreds

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15 Sutherland, Axial Bullet Engraving, 13 Royal Canadian Mounted Police Quarterly 259 (1952).

16 Goddard, Scientific Identification of Firearms and Bullets, 17 J. Crim. L., C. & P. S. 259 (1926). (herein cited as Goddard)

17 id., p. 260.

of markings, caused by loading, firing, and ejecting. They are often less distinct due to the harder metal of the case. It is accepted practice to rely upon positive identification of firing pin markings on the primer[18]. It is more difficult, if not impossible, to identify a cartridge case as to class markings of a particular manufacturer's make and model. This is due to the lack of relative individual characteristics produced by the bolt face, firing pin, and chamber of various weapons.

> . . . to summarize let us state that it is not difficult to identify a certain pistol (as having fired a particular shell) . . . but that it is often not possible to identify with certainty a definite make of pistol; and that in general a pistol of a certain trade name defies positive identification . . . [19]

The Mauser '08 Pistole is one of a few manufactured that leaves positive identification due to its triangularly shaped firing pin[20]. Generally, most weapons leave no such distinctive class markings. The expert is able to tell whether or not a particular cartridge case was fired in a particular weapon, but cannot tell from the case the make or model of the weapon.

The very firing of the weapon causes the firing pin to leave its mark, for without the firing pin the weapon could not be fired. The composition of the firing pin and the primer control the amount of distinctive markings left. The forces of Newton's "equal and opposite reaction" increase the amount of firing pin identations as well as other scratches, abrasions, and markings on the case. A semi- or fully automatic weapon will increase the markings by the more violent nature of its functions. A revolver will leave less distinctive markings[21].

Often the markings found on a cartridge case are used in a negative manner during the police investigations, while in

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18 Kent v. State, 121 Tex. Crim. 396, 50 S.W.2d 696 (1932).

19 Anon., Cartridge Case Markings, Am. Rifleman, Nov. 1955, p. 12.

20 Peltz, The Mauser '08 Pistole, 9 Kriminalistic 428 (1936).

21 Goddard, p. 260.

the courtroom they appear positively[22]. Some of these factors include: tightness or looseness of the case in the chamber, position of the firing pin in the bolt, fit of the firing pin in the bolt, the size and shape of the pin, and the length of the pin[23].

Shotgun Range

With the shot gun there is no bullet to trace, but many pellets, numbering in the hundreds. The case may be traced just as any other, but the lack of a single solid bullet causes certain difficulty. The courts have a tendency to shy away from using expert witnesses in the shotgun range determinations[24].

Each shotgun has its own individual pattern of shot when it is discharged. This depends upon the length of the barrel, the choke of the barrel, and the type of shell used in firing. The Federal Bureau of Investigation and other law enforcement agencies attempt to duplicate the pattern of the shotgun to determine range. For example, a certain Remington Model 50 is found at the defendant's home. The corpse contains shot produced by the Western Arms Company, size 4, 12 gauge. It can be shown just about what range the deceased was shot, by the size of the pattern at various ranges, the number of shot in a 30 inch radius at known ranges, and the location of any waddings. This is determined by experimentation following the actual conditions as they appear to have occurred. Such experimentation is a valid basis for an opinion, although many courts have not so held in the past.

SCIENTIFIC DETECTION: ITS VALUE TO THE EXPERT WITNESS

The opinion of the expert witness is grounded in testing and analysis. It is a result of study and equipment. Microscopic

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22 Berg, Factors Influencing Firing Pin Impressions, 6 Identification Mag. 5 (1933).

23 id., p. 6.

24 Brown v. Commonwealth, Ky., 275 S.W.2d 929 (1948).

markings cannot be seen with a magnifying glass. The expert and the detective depend upon similar processes, some of which are suited for the laboratory alone, others for the courtroom. For an example of lab analysis which would not be admissible as courtroom evidence consider the following situation: During the Capone Reign, a Treasury Agent was found dead in his car. He had been shot with two bullets, both fired through the front of the car, through the dashboard and firewall. One was totally mutilated upon passing through the corpse. The other was found in small pieces. The largest piece taken from the agent's leg weighed 9.56 grains. Firing bullets from selected weapons in the Federal Bureau of Investigation's collection it was discovered that the class markings were similar to those of a Remington .35 rifle. The owner of the weapon upon questioning admitted the homicide[25]. Without the confession it would have been impossible to convict the killer, yet the inadmissible laboratory evidence aided in the detection of the killer.

The major areas of criminal detection involve the microscopic examination of the bullet and the cartridge case with a comparative study of both "fatal" and "test" bullet or case. The examination should start with a general survey of the crime and include the following. Empty shell case(s) found near the scene as to location, number, contents of interior, class of manufacture, caliber, and markings. Bullet(s) should be examined as to caliber, location, number, markings, and manufacturer. Traces of powder residue, wads, or shot should be noted[26]. The body and clothes should be turned in to a laboratory for complete analysis, with particular attention paid to the further discovery of powder traces and foreign substances that may aid in the evidence[27].

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25 Wilson, The Identification of a Bullet Fragment, 30 J. Crim. L., C. & P. S. 768 (1939).

26 Marity and Durta, Scientific Evidence in Cases of Injury by Gunfire, 24 N.C.L.R. 173 (1949).

27 Walker, Bullet Holes and Chemical Residues in Shooting Cases, 31 J. Crim. L., C. & P. S. 518 (1940). (herein cited Walker)

Mechanical Measuring Devices

Through mechanical means many measuring devices have evolved for the measuring of the lands and grooves. Micrometric Calipers and Dial Micrometers are used for these purposes. They are used with some success in the determination of the depth and width of the lands and grooves of the rifling, the caliber of the bullet, and the length of the bullets. They have the major drawbacks of relative inaccurate measurements in the regions of ten-thousands of an inch and a tendency to damage soft lead bullets[28]. The courts require that the bullet not be mutilated during the testing process[29]. Mechanical measurements should be avoided if possible.

Mechanical measurements can be better made with coating the bullet with graphite and then carefully electroplating. The electroplating is then removed, leaving a complete impression of the lead bullet in the "flat" for easier measuring, photography, and comparison. This method has the advantage of doing little if any damage to the bullet, and increases the use of mechanical measuring devices to ten-thousands of an inch[30]. An even better method is that of using clay, wax, plaster, or plastics for casting and impressions. The plastics have the advantage of being used also in the casting of barrel interiors, which cannot be cast with other material. The ease and greater accuracy of three dimensional comparison, rather than two dimensional comparison, is the same as with electroplating. Two of the plastics have the additional advantage of being applied by a non-technically trained officer at the scene of the crime[31]. The commercial names of the two best plastics are Dip-pak and Plastisols[32].

While the relative distinctness of the class markings are determined by the wear in the barrel, the accident markings are not so limited, but increase with wear. It may be more

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28 Wilson, p. 98.

29 id., p. 100.

30 Anon., Electroplating of Bullets, 15 Fingerprinting Mag. 17 (1936).

31 Blasooti, Plastic Replicas in Firearms and Tool Mark Identification, 47 J. Crim. L., C. & P. S. 110 (1946).

32 id., p. 118.

difficult for the expert to tell the manufacturer's name, than it would be to give positive identification. The mechanical measuring devices are to be used only in the collection of class marking data, and *cannot* be used to determine accident markings. Where plastics or other impressions are used, they give positive points of identification when used with photography, but not when used to facilitate measuring[33].

Occular Measuring and Comparison Devices

There are two types of occular devices, those used for measuring and those used for comparison. The comparison types of instruments are designed to provide separate images, split in the center, to provide a merged view of the two objects. Two bullets may be placed in the stages, when the microscope is focused there will be a center line dividing the two images. This is the type of microscope that should *always* be employed in making either direct or photographic records of the points of positive identification.

The Variable Stage Microscope is designed so that the bullet is placed horizontally to the lenses on a revolving stage and locked into place. It is then rotated, with the number of degrees of rotation noted. The degrees of rotation are then converted to give the distance between the lands and grooves. The depth of the shadow cast can be used to determine the depth of the lands and grooves[34]. This device is best used for the determination of class rather than accidental characteristics and should not be used for the basis of positive identification.

A Filar Microscope is a microscope having a fixed power of magnification. It is arranged with a glass scale divided into ten divisions. A sliding glass cross-hair is moved by means of a screw of known pitch. Attached to the screw is a drum marked off in one hundred divisions; measurements accurate to one micron can be made, provided the instrument is checked for calibration before and after use and after changing the

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[33] Mathews, A Measurement of Land Impressions on Fired Bullets, 44 J. Crim. L., C. & P. S. 799 (1943).

[34] Wilson, p. 98.

power of magnification[35]. Again, this is a mode of determining class characteristics rather than accident markings, and should not be used as a basis of positive identification. When it is used, special care should be used to determine whether or not the instrument was checked for calibration before and after use[36].

A Fixed Occular Microscope consists of a focusing occular lens arranged with a glass reticule super-imposed over the image produced by the microscope. Calibration is necessary for each setting of the draw tube. It is not recommended because the intermediate measurements between reticules involves guess work. It is only for the measuring of class characteristics and should not provide a basis for positive identification. Special care should be used to determine if the instrument was carefully calibrated before and after use. In fact an objection should be lodged against its very use, due to the guess work involved and the presence of far more accurate instruments[37].

A Helixometer is a device used to measure the pitch of the rifling. Pitch is expressed in the number of inches it takes for the bullet to make a complete revolution within the rifle barrel and the direction of the twist[38]. For example, a Remington Model 722 rifle in .30-06 caliber has a right hand twist of 1/16 inches[39]. The Helixometer should be used with a Bore-scope to determine the condition of the interior of the barrel. The conditions of the inside of the barrel may have changed since the firing of the "fatal" bullet, thus making positive identification difficult. Erosion by wear, gases, fouling, and rust may cause these changes[40]. The Helixometer or Bore-scope should never serve as the basis of positive identification, but as an aid in the determination of the class characteristics.

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35 id., p. 99.

36 id., p. 100.

37 id., p. 98.

38 Goddard, p. 258.

39 id., p. 259.

40 Wilson, p. 107.

The Inclometer is another device used to measure the rate of twist. It is superior to the Helixometer in that it also measures the length of the rifling on the bullet. The bullet is mounted on a shaft and rotated under a microscope. The degrees of rotation are the twist, which is converted into inches-per-rotation[41]. This device should not be used as the basic of positive identification, but to determine class characteristics.

Powder Analysis: Experimental and Chemical

Powder, the propellant force of the firearm, may give the trained investigator vital information relating to criminal detection and courtroom presentation. Satisfactory distance determinations may be made by comparison and experimentation[42]. This is very true where the bullet has passed through a glass window[43]. Determination of distance is based on the "spread" of residue in particular patterns and by the determination of the existence of powder residue by chemical analysis where none appears. Distance determinations should be made only by trained personnel. It has been shown that lay witnesses cannot recall with accuracy the patterns seen at the crime. This determination may be the determining factor between a homicide and a suicide[44].

The paraffin test or powder nitrate test is one used to detect the presence or absence of nitrates and nitrites on cloth or flesh. It is based on the supposition that a certain amount of "leakage" occurs during firing, leaving in some instances a residue on the hands of the firer. Any chemical reagent that will react with the nitrate family may be used[45]. It is to be noted that the test is *never* to be considered as either positive or negative. Nitrates are common in everyday living and their presence does not mean that a weapon has been fired; certain

41 id., p. 103.

42 McLaughlin and Beardsley, Distance Determinations, 1 J. of Forensic Science 3 (1921).

43 id., p. 5.

44 Wilson, Observations in a Case Involving Powder Patterns and the Fallibility of Eye-Witnesses, 26 J. Crim. L., C. & P. S. 601 (1935).

45 Walker, p. 514.

weapons do not have sufficient "leakage" to deposit nitrates in detectable amounts on the hand. The wearing of gloves or other covering will eliminate the value of the test. The results of this test are *inadmissible* because of the lack of positive or negative results[46]. A man may have shot someone or have been putting fertilizer on his yard. The test will show positive in either instance, yet it will not tell whether a weapon has been fired as opposed to the spreading of a nitrate based fertilizer.

With the nitrate test are other similar tests for the detection of chemical residues caused by the discharge of a firearm. These are of the same value as the powder nitrate test. The attorney should also be aware that in certain instances these tests may be of some value, within limitations. For example, where the issue is suicide or homicide, a positive powder nitrate test showing nitrates on a certain portion of the hand might help in the building of other evidence showing suicide. Only in the few instances where there is a positive reaction within a particular region of the hand should the attorney waive the objection to the introduction of the nitrate tests[47].

Photography

Photography and film play an important part in the gathering of exhibits and evidence, both to the investigator and the attorney. Photographs showing the points of comparison serve both to record and preserve the evidence and provide an exhibit aiding court presentation.

Of particular value is Eastman-Kodak's "Translight" film which contains an emulsion on both sides of the film. A picture of the "fatal" bullet may be taken on on side, and a picture of the "test" bullet on the other. Upon development the two images will be superimposed[48]. This presents an understandable exhibit of tangible evidence for the jury to see.

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[46] Castellanos and Plasentia, Paraffin Gauntlet: New Technique for the Dermo-Nitrate Test, 32 J. Crim. L., C. & P. S. 465 (1942).

[47] id., p. 466.

[48] Wilson, New Positive Film as an Aid in Firearms, Fingerprinting, and Questioned Document Comparisons, 28 J. Crim. L., C. & P. S. 126 (1937).

In a case presented to the Scientific Crime Detection Laboratory of Northwest University, concerning the identification of two 12 gauge shells it was discovered that the rear portions were pock marked by the bolt face. It was thought that the pock marks on the bolt were caused by gas erosion due to the poor headspacing of the weapon. The nature of these marks did not lend themselves to comparison under the microscope. The "Translight" film was used, taking photo-microscopic pictures of the shell and bolt face and then enlarging the pictures. This resulted in positive identification and a conviction[49].

Where the investigation involves firearms the investigative as where it is lodged in the brain of a living person, stero-X-rays may be used to determine the caliber of the bullet[50]. When X-rays are used, the expert should always have the X-ray technician testify as to the taking of the pictures, and the position of the person when the pictures were taken.

Statistical Data, Samples, and Patent Data

Where the investigation involves firearms the investigative agency or expert should have at his disposal all types of data available on firearms. It should include samples of weapons, cartridge cases, bullets, complete cartridges, patent data, and measurements. The Bureau of Scientific (then Forensic) Ballistics of New York City, which was formed in 1915 by Col. Calvin Goddard (ballistics expert), John Fisher (micrometric expert), and Phillip Gaueville (photographer), set forth the following standards, which have since been adopted by every major law enforcement agency in America[51]. Complete shop statistics on the manufacturing tolerances and procedures of all firearms produced in America and the common foreign imports. Patent data on all revelant inventions that pertain to firearms. A collection of as many weapons and cartridges as it is possible to reasonably collect. This collection of data and samples should include: bore diameter, number of lands and

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49 id., p. 127.

50 Chabat, Stero X-Rays and Firearms, 4 Revue de Criminologie et de Police Technique 280.

51 Goddard, p. 254.

grooves, groove diameter, groove width, land width, and modifications of the manufacturing runs by serial numbers[52]. The laboratory should contain the proper instruments for complete detection also. All final opinions should be rendered in the light of what the data says the class characteristics should be. If the day should come when the accident markings are similar but the class markings are not, then the statistical data could play an important role in the final opinion of the expert.

Test Bullet Recovery

Even with the finding of the "fatal" bullet, there remains the problem of recovering the "test" bullet fired from the same weapon. With the advent of the extreme high power firearm this becomes a difficult problem, when viewed in the light that the courts demand testing similar to the actual firing. This precludes merely pushing the bullet through the bore of the weapon[53].

The methods considered as unsatisfactory include: vertical firing into the air (impractical); moving the weapon rearward at the velocity of the bullet (impractical); firing into snow, wax, flesh, or plastics (mutilates the bullet); and vertical firing into water (hydro-dynamic shock destroys container)[54].

Methods considered as satisfactory include: firing into cotton or oiled sawdust; and horizontal firing into water[55]. The Federal Bureau of Investigation, The New York City Police, and the Royal Canadian Mounted Police all prefer the use of oiled sawdust[56].

Where mutilation of the "test" bullet occurs, it becomes difficult to determine the degree of similarity and points of positive identification. The attorney should always examine

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52 id., p. 255.

53 Cross, Test Bullet Recovery in Water, 42 J. Crim. L., C & P. S. 259 (1952).

54 Kiray and Hart, Water Tank Bullet Recovery, Am. Rifleman, Feb. 1957, p. 40.

55 id., p. 41.

56 id., p. 42.

both the "test" and "fatal" bullets to determine the degree of mutilation. Where it appears to be severe, the expert should be asked to explain how he was able to conduct adequate tests in view of the mutilation. It is impossible to do so!

Serial Numbers

With the increasing requirements of registration, a number of police officers feel that the tracing of serial numbers is of a great advantage in criminal detection. Through chemical analysis, destroyed or obliterated serial numbers can be restored to show the original. If the serial number has been completely removed chemical analysis is of no value[57]. In fact most criminals do not register their weapons anyway. Serial number tracing may be next to useless if the weapon is one which is frequently counterfitted by foreign manufacturers. The National Rifle Association of America has in its collection several F. N. Mauser Browning Pistole Model 1900 in 7.65 caliber with identical serial numbers. There are at least three of these Mausers with the same serial number, 126063[58]. A case cannot be built around a serial number without adequate proof that there are no counterfeits or similar imitations just "floating" around. This burden of proof seems impossible to bear; therefore, the investigator should not attempt to bring a prosecution on such evidence.

Wounds

The corpse is just as important to the detective as the bullet. The corpse may show traces of powder residue; the direction of bullet travel; the entrance hole; the exit hole; the distance from the weapon; and other segments of evidence useful in criminal detection. This type of evidence is very important in where the bullet has passed completely through the body and cannot be located[59]. This type of detective work generally involves the ballistics expert and the state medical examiner.

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57 Anon., F.B.I. Bulletin, May 1958, p. 8.

58 Anon., Watch Those Serial Numbers, Am. Rifleman, Dec. 1955, p. 130.

59 Walker, p. 497.

As for accurately stating the caliber of weapon, medical evidence as it pertains to the size and shape of the wound is of little or no value.

> From looking at the wound it would be nearly impossible to determine without the bullet the weapon which caused it. Bullet weight, stability during flight, bullet shape, and velocity, all greatly determine the form, shape, and characteristics of the resultant wound[60].

> . . . a bullet from a .45 could leave a larger wound hole than a bullet from a .30-06 . . .[61]

An interesting situation could occur with a corpse with a single wound and two bullets of different calibers lodged in the wall behind it. For example, consider that one of these bullets was from a .45-70-500 and the other a Winchester .220 Swift. The huge .45 slow moving bullet creates a large wound, tunneling through the flesh. The tiny .220 bullet depends upon the hydrodynamic shock of its high velocity for its killing power. If the wound was one occurring in the body cavity, the smaller .220 could create a larger wound hole than the .45 because of the effect of the hydrodynamic shock transmitted to the body fluids. A flesh wound from the .45 would be much larger because of the huge bullet, not dependent upon the hydrodynamic effect. Now which bullet caused the death of the hypothetical corpse mentioned?

Consider there are some 400 American cartridges that have been produced in the last fifty years. It becomes easily understood why a doctor must guess as to the caliber. From the .22 rim-fires through to the .600 Nitro Express, each cartridge overlaps with another. Some are slow moving bullets, others travel at fantastic speeds, in between are hundreds more. The attorney should always question either the expert or the Doctor if he attempts to name a particular cartridge as causing the wound, where the wound alone is the determining factor.

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60 Lambert, Wounding Efficiency of Bullets, Am. Rifleman, Oct. 1955, p. 29.

61 id., p. 30.

THE EXPERT WITNESS

> The complexities of modern civilization in recent years have made necessary an exception to the general rule that witness should testify as to facts and not opinions. As we know . . . the opinions of witnesses are, in general, irrelevant. To this general rule, there are, however, important exceptions. One of these is opinion evidence. Evidence of this character is usually held admissible upon subjects that are not within the common knowledge of all men of common education and experience . . . In many cases, where the subject under investigation is wholly unfamiliar to the jury, if expert testimony were rejected, there could be no adequate way of arriving at a satisfactory conclusion. Because of this, courts have adopted the rule of admitting the opinion of witnesses whenever the subject matter is such that inexperienced persons are unlikely to prove capable of forming a correct judgment without such assistance . . . no one is permitted to testify what he has never learned, whether it be ordinary or scientific facts . . .[62]

Ballistics experts are those who testify as to "in my opinion" certain events did or did not occur. It is by necessity that they are used in court.

QUALIFICATIONS OF THE EXPERT

One of the essential duties of the attorney when using an expert is to qualify him. Without qualification, his opinion testimony will be inadmissible in court. The foundation for admission as an expert will be sufficient if the training and experience of the ballistics expert are shown. Each court has its own standards as to what will constitute qualification of the expert.

> While the science of ballistics is now well recognized both in this country and abroad, testimony based on it should be admitted with the greatest care. No witness should be permitted to testify regarding the identification of firearms and bullets by the use of this science

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62 Goldstein, Trial Technique, (1935) Callagan and Company, Chicago, p. 383.

unless the witness has clearly shown that he is qualified to give such testimony . . .[63]

A second illustration occurs in those instances where the expert is qualified, but the testimony required is within the knowledge of the common man according to the court. On appeal, a reversal and new trial were gained, where the issue concerned how recently the defendant's weapon had been fired. The court said that the testimony of the expert was more than surplusage; it was an abuse of discretion. The jury was as competent to determine the issues of fact as the expert[64].

All courts have allowed Special Agents of the Federal Bureau of Investigation to qualify upon the showing of training and experience[65]. State police officers with sufficient training and experience may be allowed to qualify[66]. Alabama courts allow agents of the State Department of Toxology where qualified to give an opinion[67].

With city and county police the courts may require a greater showing of qualifications through training and practical experience. This is particularly true where the law enforcement agency is without adequate equipment to conduct tests. A Tucson, Arizona, policeman was allowed to testify he had twenty-three years of hobby experience with firearms. This experience was sufficient to qualify him as a ballistics expert[68]. Being the head of the technical division of the Texas Rangers was deemed sufficient in itself to qualify the Ranger, without further showing of skill or experience[69]. The Director of Pub-

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63 People v. Fiorita, 339 Ill. 78, 170 N.E. 690 (1930).

64 Fishbeck v. State, —Tex. Crim. App.—, 255 S.W.2d 854 (1944).

65 State v. Hackett, 215 S.C. 434, 55 S.E.2d 969 (1949);
McKenna v. People, —Col.—, 235 P.2d 351 (1951);
State v. DeMai, 227 N.C. 657, 44 S.E.2d 218 (1947).

66 McGuire v. State, 239 Ala. 315, 194 So. 815 (1940);
Commonwealth v. Yeager, 329 Pa. 81, 196 Atl. 827 (1938).

67 Redus v. State, 243 Ala. 320, 9 So.2d 914 (1942);
Pilley v. State, 247 Ala. 523, 25 So.2d 57 (1946);
Collins v. State, 250 Ala. 58, 33 S.2d 18 (1947).

68 Viera v. State, —Tex. Crim.—, 245 S.W.2d 257 (1951).

69 State v. Lane, 72 Ariz. 220, 233 P.2d 437 (1951).

lic Safety in Brownsville, Texas, is another position accorded status as an expert by position rather than training and experience[70]. Merit positions as an expert witness, rather than extensive studies and experience, do not prove valid as qualifications. An attorney should require the showing of adequate training and experience before allowing the witness to testify. It should be noted that the older cases are the ones tending to place qualifications on the basis of position rather than qualifications of study, training, and experience.

Where the witness was a deputy sheriff who had eight years of experience, visited all the major arms manufacturers, and gone to Northwestern University's School of Police Science, he was deemed qualified[71]. Where any type of special schooling or training is shown the courts will generally admit the witness as qualified[72].

A more difficult problem arises when the witness is not professionally connected with firearms, as a paid technician, police officer, or Special Agent (F.B.I.). A well-known pistol expert has been qualified upon the showing of knowledge and training[73]. An Ohio case allowed a Doctor to testify on the basis of a life-long hobby of firearms, even though he modestly disclaimed being an "expert"[74]. Where the witness is a private detective or owner of a private bureau of ballistics, the courts will require a stronger showing of qualifications, than generally required. A man being in thirty odd cases and with four years of experience was held qualified[75].

Still other cases involve the "quasi-expert", who is qualified to testify only to a particular portion of the science of ballistics. They are generally laboratory technicians who have made dis-

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70 Cantu v. State, —Tex. Crim.—, 135 S.W.2d 705 (1939).

71 McLeod v. State, 128 Fla. 35, 174 So. 466 (1937).

72 Collins v. State, 15 Okla. Crim. 96, 175 Pac. 124 (1918).

73 State v. Casey, 108 Ore. 386, 213 Pac. 771 (1923).

74 Burchette v. State, 35 Ohio App. 463, 172 N.E. 555 (1930).

75 Macklin v. State, 64 Okla. Crim. 20, 76 P.2d 1091 (1938).

tance determinations or certain chemical analysis[76]. They may not exceed the scope of their qualifications by attempting to give an opinion that would require a true expert.

Missouri allows the qualifications of the expert not on familiarity of firearms alone, but also on the recognized techniques of identification. Where the witnesses were not qualified ballistics experts, but were well qualified in the use of comparative microscopics, they were allowed to testify as to the similarities of firing pin markings[77].

It is best to have an expert qualified in training, experience, and the techniques of investigation. A witness that cannot qualify in all three aspects will be more of a liability than an asset on the witness stand when the cross-examination gets "tough". If he is well versed in *all* aspects of ballistics, as well as the techniques of investigation, he will be able to give the jury a better "show". A good "show" from the witness will have more effect on the jury than all the concrete evidence he is able to discover. For an excellent example of direct (and cross-examination) examination of an expert's qualifications it is recommended that the reader see *Evans* v. *Comm.* 230 Ky. 411, 19 S.W. 2d 1091, 33 A.L.R. 1407 (1930). This case points up the difference between a well-qualified expert and one not so well qualified. It should serve as the perfect example for any attorney contemplating direct examination.

Mere qualifications of the expert are not enough to gain acceptance by the court of the expert as a witness. Because opinion evidence is accepted only where there is a situation involving highly technical matters, the expert must be further qualified by the showing of a need for his testimony. This may be easily accomplished on the direct examination. If the expert is questioned as to the complexities of ballistics analysis the attorney is able to show the court the need for his testimony. It is important that the need be shown, because some courts, even though they will instruct the jury that the testi-

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[76] State v. Nagel, 25 R.I. 105, 54 Atl. 1063 (1903).

[77] State v. Shawley, 334 Mo. 352, 67 S.W.2d 74 (1932); State v. Couch, —Mo.—, 111 S.W.2d 147 (1939);

mony of the expert is not binding, will reverse and grant a new trial where the expert does in fact testify[78]. The grounds for a new trial seem to rest in the very introduction and acceptance of the expert witness, and not that such is an abuse of discretion. It would appear that the courts are aware that juries often take the expert's opinion as the "flat" truth, without regard to the instructions of the court to the contrary, hence they allow the new trial.

Some of the instances where an expert may not be allowed to testify are those involving sight and hearing. Where a witness heard the shot fired, an expert will not be allowed to give an opinion as to the direction of the fire. It is settled that where the issue involves the positive (or negative) identification of a bullet or cartridge case it is always proper to submit this to an expert for an opinion. Where there is a question of powder pattern or distance determination the courts are in conflict as to allowing the expert's opinion. The majority and better rule is to allow the expert to testify in all instances, after the showing of adequate qualifications, except where there is no need of the opinion. The courts rely on the jury placing the proper weight on the testimony given by the expert. Some courts limit the testimony of the expert in cases of distance determination, direction of fire, and powder patterns, to impeaching the testimony of lay witnesses[79]. This would seem to place the horse before the cart. Once the jury hears the expert's testimony it cannot be erased from their minds. A better rule would be to allow the expert to testify and let the jury place the weight on his testimony and opinion.

Qualification of the expert witness is not completed until the witness, himself, has stated the types of tests involved in the determination of his opinion. These tests may take a multitude of forms, but basically should be those resulting in positive (or negative) identification of the *accident* marks. All positive (or negative) accident marking tests should be performed either visually or with photographic film through a comparison microscope, according to a Special Agent of the

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78 State v. Willis, —La.—, 158 So. 826 (1935).

79 Anon., F.B.I. Bulletin, July-Aug. 1949, p. 3.

Federal Bureau of Investigation. Tests involving the determination of range should include test samples of the weapons and powder patterns and haloes. These samples should start at point-blank range and continue outward at intervals until the patterns are no longer visible.

Cross-examination of the Expert Witness

Cross-examination of the expert may consist of an "attack" on the schooling, experience, or method of the expert. It may even go to the type of case and issue involved. The only objection to cross-examination of a "real expert" is the possible effect on the jury. A drawn-out examination of an expert from the Royal Canadian Mounted Police Laboratory, who is obviously well qualified could alienate the jury with repetition and boredom.

Certainly it is proper to ask a witness how his methods compare with the standards of other law enforcement agencies or the Schools of Police Science at Northwestern University or Michigan State University[80]. The questions asked on the cross-examination should be designed to require short answers and keep a rapid pace. A quick survey of methods and qualifications is about all that should be attempted unless the expert is not well qualified. Remember, this is where the jury is to be the most or the least impressed, both with the expert and the attorneys. For an excellent example of intelligent and proper questions of cross-examination see *Evans* v. *Comm.,* supra[81], in which an interesting form of cross-examination destroyed the jury's confidence in the defense[82] where the defense, after intelligent examination, obtained several .45 1911-A1 weapons with several shots fired from each. The expert was given these weapons, the fired bullets, and cartridge case with a fresh supply of ammunition. He was invited to determine which weapons fired which bullets. The expert returned to the court room the next day with the bullets and cartridge cases properly identified. The defendant is now serving a life sentence in the

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80 State v. Dallero, 187 La. 392, 175 So. 4 (1937).

81 Evans v. Commonwealth, 230 Ky. 411, 19 S.W.2d 1091 (1929).

82 Evans v. Commonwealth, 230 Ky. 411, 19 S.W.2d 1091 (1929).

Kentucky State Penitentiary. This addition to the cross-examination did more harm than good. In fact it probably helped to convict the defendant more than the expert's positive identification.

Where the expert is of known stature in his field it is recommended that the defense waive the qualifications of the expert. This will prevent the jury from being impressed with his qualifications and attaching more weight to his opinion than the defense would like. Contra, the prosecution should show the qualifications of the expert. This is for two reasons; first to impress the jury with the qualifications, and secondly to let the jury think the defense is holding back important information. Much of the expert's value is in his psychological effect on the jury.

A danger of waiver is shown in *Commonwealth* v. *Sacco*[83], where the defense waived the qualifications of the expert. The expert then proceeded to testify that the weapon of the defendant fired the shot that killed the deceased and the DEFENDANT FIRED THAT SHOT. If the expert had been cross-examined it would have been found that he did not use proper tests or equipment, and that he was not familiar with the science of ballistics. How can the expert place the weapon in the hands of the defendant if no one was present at the time of the shooting? That is a question of the Sacco-Vancetti case that has never been answered. A qualified expert was called in after the verdict for the defense. The results of his tests showed that Sacco did not fire the fatal shot[84]. Sacco was not pardoned because the homicide occurred during a felony in which he was participating.

The Opinion of the Expert Witness

Once the expert has been properly qualified, he may not testify as to facts; the finding of the ultimate fact is the function of the jury. He may testify as to the tests used and then give

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83 Commonwealth v. Sacco, 255 Mass. 369, 151 N.E. 839 (1926).

84 Goddard, p. 270.

his *opinion* as to what his tests have shown. To attempt to do more than this is an invasion of the province of the jury, resulting in prejudicial error[85].

Before giving his opinion the expert should testify as to how that opinion was reached. It is wise, therefore, for the expert to avoid a discussion of the tests during his examination for qualification, but give them just before the opinion. In this manner they are fresh in the minds of the jury, giving the opinion its optimum value. For example, he could give a description of how a barrel is rifled; how the gases expand during firing; how the bullet is pushed through the rifling; how he looks for points of comparison; the function of the comparison microscope; and then the opinion as based on these factors[86]. Everything is fresh in the minds of the jury, brought out in a single sweep of testimony.

In some instances the expert has been the court's witness, qualified by the court alone. In *Evans* v. *Commonwealth*[87], the expert was given the weapon and the "fatal" bullet and asked to retire to form his opinion. His opinion was delivered later to the open court, resulting in positive identification and a conviction of the defendant. There are many pros and cons to the allowance of the court to choose the expert. Some feel that it results in more qualified opinions; others argue that it is opposite to the advocacy type of court system in America.

Dean v. *Commonwealth*[88], is an example of negative expert testimony. In this old Virginia case the Supreme Court of Appeals approved the showing that the defendant was the only person in the community-area that owned a weapon of the caliber that killed the deceased and that the deceased and the defendant did not get along together. The court held proper the introduction into evidence the caliber of the defendant's weapon. This appears to be guilt by negative association.

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85 State v. Marinez, —N.M.—, 198 P.2d 256 (1948).
Ferrel v. Commonwealth, 177 Va. 861, 14 S.E.2d 293 (1941).

86 Goddard, p. 262.

87 Evans v. Commonwealth, 230 Ky. 411, 19 S.W.2d 1091 (1929).

88 Dean v. Commonwealth, 32 Gratt. (77 Va.) 912 (1879).

Positive identification is preferred to guilt by negative circumstance. Consider the following as an example of an explanation supporting the expert's opinion:

> . . . a section of wood floor was examined and found to contain a hole, oval in shape, having a short axis of one inch and a long axis of one and one half inches. Surrounding the hole were scattered impressions made by 8-C shot (pellets), all contained in a circular area two and three quarters inches in radius, having at its center the entrance hole . . . Investigation revealed that a 12-gauge shotgun with a twenty-eight barrel was used, firing Remington Shur-Shot . . . shells, with a full-cylinder choke. Using this same shotgun and the same type of ammunition for test purposes the suspected weapon was fired at varying distances from a target . . . the results of this test . . . zero feet . . . three feet . . . six feet . . . nine feet . . . twelve feet: most of the shot penetrated a hole in the target one and three quarters inches in radius, scattered shot surrounded the entrance hole within a contained circle of two and one half inches in diameter . . . fifteen feet; most of the shot penetrated a hole in the target two and a quarter inches in radius, scattered shot surrounded the entrance hole contained in a circle four and one half inches in diameter . . .[89]

The expert would testify that, in his opinion, the deceased was shot at a range between twelve and fifteen feet. Without the summary of the tests performed would you place much weight on the naked opinion? A jury like anyone else, likes to know the HOW and WHY the opinion was reached. The attorney should bring these "hows" and "whys" out during his direct examination, if the expert omits to do so.

In addition to telling the jury how he reached his opinion, the expert also informs the court and opposing counsel. This could prove harmful where the expert has not used tests considered satisfactory for the situation involved. One attorney may wish an unsupported opinion, while the opposition may

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89 Anon., F.B.I. Bulletin, July 1954, p. 6.

desire a supported opinion for discovery reasons. If the modes of testing used are not brought out by the expert or his counsel, then the opposing counsel should pay attention to finding out just why the opinion is unsupported. A great deal of damage to a case may be done where the expert's tests are shown to be unsatisfactory upon cross-examination. The effect on the jury is quite obvious. A reversal is not always granted when the tests of the expert are shown to be inadequate, because the jury determines the amount of credit to be placed on the testimony of the expert[90].

With the standardization of the science of ballistics, came the standardization of the tests deemed sufficient by the courts. Identification by the expert of the accident markings *must* involve the use of some type of comparison instrument. With the acceptance of a branch of science there occurs a broadening of that field in the courts. Modern courts allow the expert more leaway in the scope of his opinion. Questions involving distance determinations and recency of firing were at one time questions for the jury alone, then a "semi-expert" was allowed to give a partial opinion, now the expert may give his opinion. An early Texas case allowed the expert to testify that because the barrel was damp, the percussion cap dull, and powder residue in the muzzle, the weapon had been fired recently[91]. In this case the jury, sitting without the expert, had convicted the defendant's brother of the homicide, and the defendant of being an accessory before the fact. The defendant's appeal resulted in a new trial, with an expert, which resulted in the defendant's conviction of homicide instead of his brother. The opinion of the expert must have been of some meaning for the same jury to change its mind during the second trial.

One court allowed the expert's opinion, and then caused the jury to examine the bullet with their naked eyes. If they could not see any similarity between the two, then they should not place any credit on the expert's opinion. This was held not to be error because the jury is the sole judge of the credi-

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90 State v. Clark, 99 Ore. 629, 196 Pac. 360 (1921).

91 Meyers v. State, 14 Tex. App. 35 (1883).

bility of the expert's testimony[92]. It would seem that while the jury is the sole judge of credibility, they should at least have the chance to use the same tests as the expert used in the formation of his opinion.

Other courts have allowed considerable leaway in allowing the expert to explain to the jury just how the opinion was reached. As to what is an invasion of the privacy of the jury is within the discretion of the court. Some states have not allowed explanations to the jury as such, but in reality allow technical testimony during qualification, under the guise of qualification. It is very important for the attorney to know just how far the court will allow the expert to explain his opinion and illustrate his opinion.

An increasingly more difficult problem occurs when the ballistics expert and a medical doctor appear together. This occurs generally in three instances: where there is reason to keep track of the path of the bullet after removal from the body, where there is reason to use X-rays for measuring purposes, and where there is an attempt to determine the caliber and type of the bullet by the shape of the wound produced. In some instances it may be necessary to have the doctor testify that he removed the bullet and gave it to another. This becomes important when building up the "chain of delivery" to the expert. It must be shown that the expert tested the bullet removed from the corpse, and not another bullet.

In a few instances it has been impossible to remove the bullet from the person shot. In one case the person was shot in the head but not killed. Removal was medically impossible. The doctor testified to the existence of the bullet, the location in the head and the taking of the X-rays. The expert testified to the making of measurements from the stero-X-rays. The defendant was convicted of felonious shooting during a prison riot[93].

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92 Commonwealth v. Best, 180 Mass. 492, 62 N.E. 748 (1902).

93 State v. Sullivan, —Iowa—, 298 N.W. 884 (1941).

During the early days of ballistics as a science, the testimony of the expert was often not allowed as an invasion of the province of the jury. Today there are still many problems surrounding that vast area of the jury's province. An expert may not state his opinion in a manner as to answer the ultimate fact. This is the jury's province. In reality the expert does encroach upon the jury's domain. This occurs from necessity, rather than from a change in common law procedures. Either the expert is allowed to give his opinion on a hypothetical question or he can say nothing and serve no function. There is no way out of this apparent dilemma. Either the ultimate fact is answered in effect or the processes of justice suffer. A Colorado court said not only was the opinion of the expert an invasion of the province of the jury, but that the science of ballistics was not a science but "incompetent muttering" of so called experts. In this case the expert used a household magnifying glass for the tests. Rather than reject the method, the court rejected the science[94]! This court has since reversed itself[95].

Where the bullet was found in the earth under the deceased, an Arkansas court found the jury more capable of determining which weapon fired the bullet than the expert[96]. A Tennessee court allowed the witness to testify as to the distance between the weapon and the body when the shooting occurred. The appellate court upheld the trial court's denial of expert testimony, on the ground that the jury is familiar with powder burns and judging distance from them[97]. To allow an expert's opinion would have been a strong invasion of the rights and functions of the jury.

A more confusing dilemma was reached in Georgia when the appellate court ruled as error, for invading the province of the jury, a question on cross-examination concerning the

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[94] Mathews v. People, 89 Colo. 461, 3 P.2d 409 (1931).

[95] McKenna v. People, —Colo.—, 235 P.2d 351 (1951).

[96] Jones v. State, 191 Ark. 331, 86 S.W.2d 7 (1935).

[97] Colbaugh v. State, —Tenn.—, 216 S.W.2d 741 (1948).

methods of the expert. The expert was asked why he did not make any measurements, but relied completely on comparative micro-analysis. He replied that this was the most accurate mode of determining points of positive identification, and that measurements were an investigator's tool not suited for positive identification. The court held this was a statement of the ultimate fact[98]. This view would indicate that the defense could "block" the expert by asking what the best tests were. If the defense did not choose to ask the question, it would have no idea just what tests were used. This is a confusing state of affairs. It would appear that in Georgia the expert may only give an unsupported opinion[99].

In a Virginia case, *Ferrell* v. *Commonwealth*[100], the Supreme Court of Appeals took a more reasonable view. In this case the expert said that the shells found at the scene of the crime were from the defendant's weapon. The court said that this was not a statement of the ultimate fact, but merely a statement that all of the shells had been fired from the weapon the defendant claimed he owned. Where an expert testified that the pistol of the defendant could not have fired the fatal bullet because it contained rifling and the bullet devoid of rifling, the court reversed, as an invasion of the jury's province. It said that the jury was as competent to discover rifling on the bullet as the expert[101]. The court took special notice that the expert was trying to prove through negative evidence the innocence of the defendant. It should not make any difference if the identification is positive or negative, because both are really positive statements of opinion.

Other courts have determined there can be no invasion of the province of the jury because it alone determines the weight to be attached to the expert's testimony. Under this theory, a naked opinion is sufficient without any explana-

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98 Henderson v. State, 208 Ga. 73, 65 S.E.2d 175 (1951).

99 Gibson v. State, 56 Ga. 113 (1876);
Wynne v. State, 178 Ga. 707, 174 S.E. 354 (1934).

100 Ferrell v. Commonwealth, (herein all cases repeated are cited with the number of the footnote in which they first appear.) 85.

101 People v. Mitchell, 94 Cal. 550, 29 Pac. 1088 (1892)

tion[102]. If the expert attempts to tell the jury how the opinion was reached he runs the danger of a reversal for invading the rights of the jury. In *Burchette* v. *State*[103], the Ohio court commented, when the expert talked about the rifling and how it came to be imprinted on the bullet, that such testimony was of great value to the untrained jury; it gave the jury a basis to evaluate the testimony of all the witnesses. As a general rule it appears that the courts are in hopeless conflict as to exactly what constitutes an invasion of the jury. Even a naked opinion may state the ultimate fact. The determining factor seems to be the testimony the expert gives in support of his findings; it would appear that most states will allow the expert some leaway in explaining the opinion he has given[104].

Where the expert did not match the "fatal" and "test" bullets, but examined each separately, the court did not reverse, but allowed the jury to weigh the testimony as it desired[105]. This would indicate that the jury is the sole judge of the expert's qualifications, because the testing is a part of the qualifications. The jury should not be allowed to weigh the mode of testing, that should be the duty of the court in determining the qualifications of the expert before he testifies or gives an opinion[106].

Where the court refused to admit the photographs of the expert as a basis for explaining his opinion to the jury, it was on the ground that the jury was the sole judge of the facts. It commented that if there had been sufficient time for the jury to examine the evidence under a comparison microscope that would not have gone to the weight of the testimony, but eliminated the need for the expert. The use of

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102 Higdon v. State, 213 Ark. 881, 213 S.W.2d 621 (1947); McKenna v. State, 65.

103 Burchette v. State, 74.

104 Burchette v. State, 74; Collins v. State, 72.

105 People v. Soper, 243, N.Y. 320, 153 N.E. 433 (1926).

106 State v. Couch, 77; State v. Shawley, 77.

photographs was considered secondary evidence[107]. The vast majority of courts now allow the use of illustrations to demonstrate to the jury how the opinion was reached[108]. Blackboards[109], photographs[110], and comparison microscopes are most frequently used to demonstrate to the jury the modes of arriving at a final opinion. One court, Arizona, has refused to allow photographs on the basis that the jury is the tryer of the facts and must accept the opinion of the expert and attach weight thereto. The expert cannot illustrate, because to do so the jury would then understand the problem and the expert would not be needed[111]. This reasoning indicates that the expert must give an opinion without support. Supporting the opinion would seem to give rise to the same objections as the photographs did.

In one series of cases the courts have seemingly confused the invasion of the province of the jury with the power of the jury to determine the amount of credibility to be accorded the witness. Where the expert was allowed to state without a supporting statement that the shots were fired at a range greater than five feet it was allowed as an attack on the credibility of the eye-witness who said the shooting was closer[112]. Here the expert has answered the ultimate fact, under the assumption by the court that this was an attack on credibility.

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107 State v. Campbell, 213 Iowa 677, 239 N.W. 715 (1931); Morris v. Commonwealth, 306 Ky. 349, 208 S.W.2d 58 (1948); Edwards v. State, —Md.—, 81 A.2d 631, 83 A.2d 578 (1851); State v. Burney, 346 Mo. 859, 143 S.W.2d 273 (1940); Commonwealth v. Beloff, 166 Pa. Super. 286, 70 A.2d 689 (1950); Redus v. State, 67; McKenna v. State, 65; People v. Fisher, 81; Evans v. Commonwealth, 81; State v. Shawley, 77; State v. Couch, 77; Burchette v. State, 74; Macklin v. State, 75; State v. Hackett, 65; Ferrell v. Commonwealth, 85; State v. Kent, 18.

108 McKenna v. State, 65.

109 People v. Fisher, 107; Evans v. Commonwealth, 87.

110 Commonwealth v. Willen, 289 Mass. 441, 193 N.E. 463 (1935); Commonwealth v. Giaconazza, 311 Mass. 456, 42 N.E.2d 506 (1952); State v. McKeever, 339 Mo. 1066, 101 S.W.2d 22 (1936); Dobry v. State, 130 Neb. 51, 236 N.W. 681 (1935); State v. Clark, 90.

111 State v. Lane, 69.

112 Colbaugh v. State, 97.

Another case held the question of who did the actual shooting as one for the jury without an expert, because the homicide occurred during a felony[113].

It is suggested that perhaps the best and most reasonable use of experts by the courts in ballistics matters, would be to allow them to give an opinion and statement in support of their opinion. A complete analysis of the methods used in reaching the opinion and their value would be of more aid to the jury than the naked opinion. Let the jury attach the weight to the testimony after it has heard all the testimony.

THE COURT AND THE EXPERT WITNESS

As the counsel for either party should examine the qualifications of the expert, so must the court. It may accept the findings and testimony evoked by counsel's questions, or may further question the expert. The final determination of the acceptance of the expert's opinion rest within the sound discretion of the trial court. If the court determines the expert to be ill-qualified, then a new trial may be gained only upon the proof of an abuse of discretion, not that it was mere error. The discretion of the trial court in determining who shall be qualified is just as much a part of the case as is the laying of a proper foundation for qualification.

> We know of no legal standard by which to determine a person's qualifications as an expert (ballistics) on the subject mentioned . . .[114]

The Illinois courts rejected the idea that ballistics is a science in *People* v. *Berkman*[115]. The trial court was held to have committed an abuse of discretion in allowing the opinion of a ballistics expert. The court termed the idea "preposterous". The court has since changed this early view[116]. Kentucky has said the discretion is within the court, but the testimony of a

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113 Commonwealth v. Mayer, 357 Pa. 181, 53 A.2d 736 (1946).

114 Contu v. State, 70, p. 705.

115 People v. Berkman, 7.

116 People v. Dale, 355 Ill. 330, 334, 189 N.E. 269, 273 (1934).

witness, who said only a casual glance was necessary to determine positive identification, was an abuse of discretion[117].

Where the witness testified that the bullet must have been shot from a Mauser .32 because of the particular type of rifling, the court qualified the witness as a "semi-expert", qualified to give an opinion only on the rifling. The Arizona Supreme Court said that limited qualification was not an abuse of discretion provided the "semi-expert" did not testify in excess of his limited knowledge[118]. Where the witness was qualified and then disqualified, there is no abuse of discretion. If there was error it was harmless error[119].

In *State* v. *Vuckovich*[120], the expert called special attention to the matching of the bullet crimp in the "fatal" and "test" bullet. There was no abuse of discretion, even though the expert was only "semi-qualified". This result was reached because the "semi-qualifications" included a study of ammunition, and the expert did not attempt to do more than give an opinion on ammunition.

Edwards v. *State*[121], brought forth the interesting proposition of the expert changing his mind. When first sent the bullets, a Special Agent of the Federal Bureau of Investigation, stated that it would be impossible to give any opinion, there being too few points of identification. Later through spectrographic analysis, microscopic analysis, and chemical analysis the Special Agent stated in court, that the defendant's weapon *could* have fired the bullet. There was evidence indicating the similarity in the rates of pitch and the direction of the pitch. The Agent also testified that severe cleaning with steel wool would remove the rifling to cause a bullet to appear similar to the fatal bullet. The defendant admitted cleaning his weapon in such a manner. The Maryland court noted particularly that this was not an abuse of discretion.

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117 Conley v. Commonwealth, 265 Ky. 78, 95 S.W.2d 1094 (1936).

118 Hadley v. State, 25 Ariz. 23, 212 Pac. 458 (1923).

119 People v. Webber, 149 Cal. 325 Pac. 671 (1906).

120 State v. Vuckvich, 61 Mont. 480, 203 Pac. 491 (1921).

121 Edwards v. State, 108.

Where the witness modestly disclaimed being an expert, the Ohio court stated, ". . . that is up to the court to determine . . ."[122] A witness does not need to be a professional expert, but he must be qualified through training, experience, and method. Where he is not so qualified then there is an abuse of discretion[123].

> It thus appears that this is a technical subject, and in order to give an expert opinion thereon, the witness should have made a *special* study of the subject and have suitable instruments and equipment to make proper tests. In so saying we do not mean to accept or approve of any particular theory or test, but merely to illustrate the crudeness of an attempt by the parties, without any special knowledge of ballistics and with only an ordinary magnifying glass . . . the witnesses in this case were not qualified to give such opinions and conclusions . . . the admission of such . . . was prejudicial . . .[124]

With civil trials the standards do not change. It is permissible to have an expert show homicide rather than suicide in an action to collect double indemnity on the deceased's insurance policy. The Alabama court held it error when the witness was not allowed to attempt to qualify. The appellate court stated that either party had the right to call expert witnesses, and the failure of the trial court to allow such was an abuse of discretion[125]. Where the expert admitted the period of testing would last several days, the Idaho appellate court approved the denial of the expert's qualification, on the ground the defendant was entitled to a speedy trial without the delay requested by the expert[126]. This particular case is of some doubt because of the age of the case, 1894. The better view would be to allow the defendant a fair trial, rather than a speedy one.

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122 Burchette v. State, 74.

123 Rowe v. State, —Fla.—, 163 So. 22 (1935).

124 Jack v. Commonwealth, 222 Ky. 546, 550, 1 S.W.2d 961, 964 (1928).

125 Sovereign Camp w. w. v. Gunn, 224 Ala. 444, 140 So. 400 (1932).

126 State v. Hendel, 4 Idaho 88, 35 Pac. 836 (1894).

Where the defendant claimed surprise after being informed that the expert had traced the fatal bullet to the defendant's weapon, the appellate court said that there was no error in the refusal of the lower court to grant a new trial. When you have lost your case through your testimony, there are no longer grounds for a new trial, and can never be an abuse of discretion[127].

The types of tests allowed are also within the discretion of the trial court[128]. The courts have frequently stated that the test of abuse is: are the tests performed similar to what appeared to have taken place[129]. Where a change in conditions is involved, it is proper to ask the expert what effect the changes would have on the tests[130].

> Experiments of this nature are frequently received in homicide cases, and uniformly received into evidence. The purpose of the experiments in this case were to determine the spread or pattern of the shot when the gun was fired at various distances from the target. There was no reason to think that the spread . . . of the shot would be different when the gun was fired at the time of the tragedy than when the experiments were made . . . if the testimony respecting these experiments was competent there is no reason to exclude the targets (blotting paper) . . .[131]

Some states insist that all portions of the experiments be exact with the conditions of the homicide, including the target[132]. It is interesting to note, where bullets are involved, the courts do not care how the test bullet is recovered.

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127 Evans v. Commonwealth, 81.

128 State v. Smith, 49 Conn. 376 (1881); McKenna v. People, 65; State v. Vuckovich, 116; Ferrell v. Commonwealth, 84.

129 State v. Smith, 128.

130 Commonwealth v. Best, 92.

131 State v. Criger, —Kan.—, 98 P.2d 135 (1940).

132 State v. Bass, 186 La. 139, 171 So. 829 (1937).

> We see no other way the jury could have learned so intelligently how a gun barrel would have marked a lead bullet fired through it, a question of much importance in this case. Not only was it the best evidence obtainable, but the sources of error suggested were trifling. The photographs were arranged to bring out the similarities . . . the jury could correct this fault[133].

The court does not have the right to comment on the expert's opinion in a manner suggestive of going to the credibility of the witness, once the expert has been qualified by the court[134].

EVIDENCE AND THE EXPERT WITNESS

Certain problems arise in addition to the expert's opinion. These pertain to the more usual rules of evidence, rather than the more specialized rules governing the opinion. These issues arise in the concealing of evidence; the "tracing" of the test "item" to the expert; the admission of the test "item" into evidence; and other related issues.

In *United States ex rel Almedia* v. *Baldi*[135], the question was raised whether unfavorable opinions of the state's experts could be withheld during the trial. The defendant had been convicted of killing a police officer. The bullet found in the body was of .38 caliber, while Almedia's weapon was a .45 caliber automatic. On appeal the United States Supreme Court held this to be a suppression of the evidence, sufficient to warrant a new trial. It would seem that where the expert's opinion is contrary to that desired, the opinion still must be entered into the evidence. To supress the evidence is a denial of "due process of law" within the meaning of the Fourteenth Amendment.

Perhaps the greatest problem occurs with the tracing of the weapon into the hands of the defendant. Certainly the

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133 Commonwealth v. Best, 92.

134 Dobry v. State, 100.

135 U. S. ex rel Almedia v. Baldi, 195 F.2d (3rd Cir. 1952) 815.

expert cannot testify as to WHO fired the weapon. He may testify *only* that it was fired and the bullet it fired killed the deceased. Where the defendant has admitted the ownership of the weapon and firing it, the problem is easier[136]. Circumstantial evidence plus the positive identification by the expert are sufficient to warrant a jury's finding of guilty[137].

> We cannot pass independent judgment on these photographs any more than we can interpret X-rays . . . But a qualified expert has testified any given rifle will leave its own particular individual microscopic markings on any bullet passed through it . . . That firearm was found in the defendant's bedroom the morning after the homicide with a fresh smudge on it, and the defendant then said . . . no one had fired it but him. Nor did he explain at the trial why the rifle gave evidence of recent firing. Certainly the evidence in connection with the other facts was sufficient to take the case to the jury . . . the expert and the evidence worked together, not as one . . .[138]

A second problem is whether the fatal bullet must be introduced into evidence, or whether the expert's opinion takes the place of the fatal bullet. The minority view is that the fatal bullet is as much a part of the evidence as is the opinion[139]. The majority tend toward allowing the opinion without regard to entering the fatal bullet into evidence. Where the fatal bullet was not offered, a Connecticut court, took the position the opinion was enough[140]. Failure to introduce the bullet does not produce error, because the opinion takes the place of the bullet[141].

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136 People v. Richardson, 251 App. Div. 916, 297 N.Y.S. 514 (1937).

137 State v. Shawley, 77.

138 id. p. 124.

139 State v. Hendel, 126.

140 State v. Wojculewicz, —Conn.—, 101 A.2d 495 (1952).

141 id, p. 497.

Where the bullets are not entered into evidence and the expert shows the jury photographs supporting his opinion the photographs do not need to be introduced. Failure to introduce the photographs or the bullet does not give rise to a presumption that "higher" evidence would be adverse. The opinion is enough, the rest is surplus[142].

The problem of introducing the bullets into evidence often arises where the defendant has questioned the "chain of delivery", to the expert. On this basis the Federal Bureau of Investigation requires its agents to specially mark all items removed from the scene of the crime in a very individual manner, seal them individually with the same marking, and mail via Registered Mail to Washington, D. C.

It must be shown that the bullet tested was the bullet removed from the corpse, hence the "chain of delivery". Where the fatal bullet and the test bullet were not mailed but delivered by hand by "other" persons the court did not reverse, on the ground that no error was shown. For there to be error there must be more than a mere chance there was a "mix-up"[143]. All that must be shown is that the bullet is the same as the one removed from the deceased.

> . . . the record shows that the officer who found the bullets put his own distinguishing mark on them at the time they were found . . . at the time of the trial identified them . . . the ballistics expert testified . . . they were the same as were delivered . . . we find no error . . .[144]

Another problem arises when the test bullet is found in the earth or wall of a building. It must be shown that both the fatal and test bullets came from the same weapon, and the test bullet was seen fired from the weapon by a witness. Where

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142 People v. Buckowski, 37 Cal.2d 629, 233 P.2d 912 (1951); State v. Richetti, 342, Mo. 1015, 119 S.W.2d 330 (1938).

143 Musnun v. State, 250 Ala. 94, 33 So.2d 463 (1947); Kyser v. State, 250 Ala. 279, 33 So.2d 885 (1947).

144 People v. Dale, 116.

a witness could recall the defendant's firing a bullet into the ground some ten years before, this was sufficient to show "chain of delivery" upon proof of delivery to the expert[145].

A strange assortment of facts resulted in a conviction in *State* v. *Boccadoro*[146]. In this particular case the defendant was the chief suspect in a murder committed during a burglary. The common-law wife of the defendant testified to police officers that her husband had thrown his gun away after the homicide. The weapon was never recovered. When some of the stolen property of prior robberies was recovered from the defendant's house, one of the owners asked if his revolver had been recovered. It had been stolen at the same time as the recovered goods. It was not recovered from the stolen property in the defendant's house. The owner recalled firing several bullets into the ground during a July Fourth celebration the year before from the stolen weapon. The bullets were recovered from the ground, and matched the bullet taken from the deceased. The defendant confessed then to the homicide committed with the stolen weapon.

It would seem the better practice to always introduce both the test and fatal bullets into evidence, showing care, to show the identification of each, and the "chain of delivery" to the expert. If these items are regarded by the court as surplusage their introduction can do no harm. If regarded as necessary it is mandatory they be introduced.

Some courts require, where the expert is not required, but has made tests, that the test results be introduced into evidence. This occurs in the instances where the court determines that an expert is not required by the type of case-fact situation involved. A state allowing anyone to testify as to the distance required to produce powder burns, may allow the expert's tests into evidence and deny the admission of the expert's opinion on the basis that the jury is just as qualified as the expert[147].

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145 State v. McKeever, 110.

146 State v. Boccadoro, 105 N.J.L. 352, 144 Atl. 612 (1929).

147 Cooper v. State, —Okla.—, 67 P.2d 981 (1940).