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Using Forensic Ballistics In The Courtroom

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Using Forensic Ballistics In The Courtroom

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I. Introduction

When discussing Forensic Ballistics it is important to understand what it is and what it isn't. Today the term forensic ballistic does not mean the use of scientific knowledge or methods suitable to a court of law in solving crimes concerning the movement of objects (such as bullets or rockets) that are shot or forced to move forward through the air, it is about identifying a weapon to a bullet or shell casing from a crime scene to put the bad guy in prison.^{1,2} Due to the popularity of criminal investigation shows the average American could probably explain that forensic ballistic examiners link evidence such as shell casings or bullets using key features of shell casings and bullets to link specimens to a particular weapon and if necessary testify in court, however television's portrayal of forensic ballistics contributes to a general misunderstanding of its limits. Calvin Goddard coined the use of the term Forensic Ballistics in 1925 in his paper using that title, however the paper discussed use of a comparison microscope to match shell casings and bullets to a specific gun.³

Prior a discussion on the current view courts take regarding the admissibility of Forensic Ballistic experts testimony concerning the identification of a particular weapon the following knowledge will provide the basics.

The field of forensic science recognizes four types of "ballistics"; Internal ballistics refers to the forces, pressure, and ignition that operate on the bullet while still inside the firearm; External ballistics, describes the flight of a bullet between the firearm muzzle and its impact at target; Terminal ballistics describe the mechanics of impact on

¹ <http://www.merriam-webster.com/dictionary/ballistics> (Last visited April 18, 2014)

² <http://www.merriam-webster.com/dictionary/forensic> (Last visited April 18, 2014)

³ Section III contains a discussion about the first uses of the Forensic Ballistics to prove police officers where innocent of a murder.

both the projectile and the target; and Forensic ballistics which is the analysis of bullet and cartridge case evidence and the use of that evidence to link specimens to each other and to particular weapons.⁴ While this paper will attempt to use the term Forensic Ballistics exclusively at times the term ballistics will be used for short hand. In the world of forensic science a “toolmark” refers to any mark left on an object by coming into contact with another, typically harder, object.⁵ Expert criminal laboratory technicians examine shell casings and bullets to match identifying marks to a particular weapon under the assumption that guns leave individually indefinable marks and if necessary will testify to in court.

The technique of firearm identification involves the expert examining the marks created on a bullet or shell casings (projectiles). The bullet and shell casing come from the cartridge, which is made up of four main parts: the bullet, the case, the powder, and the primer. The case is the covering that holds all of the cartridge components together. The bullet itself is the projectile propelled from the weapon. The powder sits behind the bullet and is exploded during firing. The primer is the component at the rear of the case that starts the reaction when the cartridge is fired.⁶ The examiner uses a comparison microscope or other magnification technology to view unique striae left on the projectile.

⁴ Rinker, R.A. (2004). *Understanding Firearm Ballistics (Fifth Edition)*. Clarksville, IN: Mulberry House Publishing.

⁵ See National Research Council, *Strengthening Forensic Science in the United States: A Path Forward 150* (2009) (Strengthening Forensic Science).

⁶ When a gun is fired, some of the gun's features are transferred to the shell casings, creating patterns of striae (scratch marks) as the cartridge casing leaves the gun. The gases produced when the primer explodes and gunpowder burns cause the casing to expand in all directions; as a result, markings from the breech face of the gun are imprinted to some degree onto the casing. In addition, in the process of igniting, the firing pin creates an imprint on the cartridge case. On semiautomatic firearms, a metal spring called the “extractor” can also leave individualized markings. There are also chamber marks on fired casings, left by the sides of the firing chamber as the casing slides through the gun. *United States v. Green*, 405 F. Supp. 2d 104, 110 (D. Mass. 2005)

When a bullet is fired the examiner looks for the marks created by the machined metal on the barrel, breach block, extractor, or firing pin on the projectile when the gun is fired.⁷

After examining the projectile the expert can make: an “identification” of the components, concluding that they came from the same source, an “elimination” of the components, concluding that they did not come from the same source, or “inconclusive,” meaning that there is not enough evidence to identify whether the components either do or do not come from the same source. In the parlance of firearm examiners, if there is sufficient agreement to make identification, a firearm examiner often states that the chance that another firearm could have made the mark is a “practical impossibility.”

The examiner faces the challenge of identifying both class and individual characteristics on the other. Class characteristics are “design features, they're what the manufacturer intends before the first piece of metal is processed.”⁸ Presumably, class characteristics narrow the identification to a given manufacturer, but not to an individual gun. Thousands of firearms may share the same class characteristics.⁹ Sub-class characteristics are markings that temporarily become part of the manufacturing process and therefore create a marking on perhaps hundreds of weapons in a given production run, though they are not a permanent feature of the design.¹⁰ In effect, sub-class characteristics indicate an imperfection in the method used to produce a limited number of firearms.¹¹ In contrast, the individual characteristics are “imparted from the actual

⁷ BALLISTIC IMAGING 32

⁸ United States v. Green, 405 F. Supp. 2d 104, 110-13 (D. Mass. 2005)

⁹ (Daubert Hr'g Tr. 16-17, Nov. 2, 2005.)

¹⁰ (Daubert Hr'g Tr. 23-24, Oct. 5, 2005.)

¹¹ (Daubert Hr'g Tr. 22-23, Nov. 2, 2005.)

piece, the actual tool” during production.¹² Finally, the examiner's task is further complicated by the facts that accidental characteristics may be found in shell casings fired from the same gun and individual gun's markings change over time; marks present at one period may not be there at another.

In today's world Forensic Ballistics experts gather shell casings and bullets collected at crime scenes or by test firing guns found at crime scenes to collect shell casings and bullets to create Ballistic Images, which are uploaded to crime databases in an effort to match other crimes with matching ballistics. Criminal laboratory technicians use the Ballistic Image databases to match evidence collected in other crimes. In 1997 the Bureau of Alcohol, Tobacco, and Firearms was authorized to create a National Integrated Ballistic Information Network (NIBIN). This database only maintains records on ballistics recovered from crime scenes. The States of New York and Maryland started a Reference Ballistic Image Database (RBID) in 2001 and 2002, which include images from test-fired rounds of most new and imported handguns. In concept, the state RBID systems would permit bullet or cartridge case evidence recovered at crime scenes to link a firearm's point of sale. Currently information about a firearm is only available if the gun itself is recovered at the crime scene and is put through a full tracing process. The usefulness of this information is debatable given the Maryland State Police Forensic Sciences Division request that the Maryland- Integrated Ballistics Identification System (MD-IBIS) Program be suspended, the law be repealed and Laboratory Technicians associated with the program be moved to the DNA Database Unit.¹³ It is perhaps this last statement in the Forensic Sciences Division report that demonstrates a genuine question

¹² (Daubert Hr'g Tr. 15-16, Oct. 5, 2005.)

¹³ <http://cdm266901.cdmhost.com/cdm/ref/collection/p266901coll7/id/3434>

as to specific testifying experts in the area and their possible lack of specialized knowledge necessary to satisfy the Federal Rules of Evidence requirements. Under Federal Rule of Evidence 702(Rule 702), the witness must be qualified as an expert by knowledge, skill, experience, training, or education.¹⁴ The expert must demonstrate the following four factors to the courts satisfaction; scientific, technical, or other specialized knowledge that will help the trier of fact to understand the evidence or to determine a fact in issue; the testimony is based on sufficient facts or data; the testimony is the product of reliable principles and methods; and the expert has reliably applied the principles and methods to the facts of the case.¹⁵

The theory underpinning forensic ballistics is that all firearms possess distinctive features that in turn impart distinctive markings or “toolmarks” onto projectiles and cartridge casings when the weapon is fired. Using a microscope, firearms examiners compare toolmarks found on spent projectiles and cartridge casings to determine whether they were fired from a particular weapon, generally by comparing projectiles and cartridge casings found at the scene of a crime or in an autopsy with ones test-fired from a seized weapon.¹⁶

Although Forensic Ballistics is currently allowed in the courtroom through the testimony of qualified government and occasionally academic experts recently judges are examining the underpinnings of the science and questioning the precision of identification in the testimony. This has resulted in rulings, which limit the once accepted

¹⁴ Fed. R. Evid. 702

¹⁵ *Id.*

¹⁶ *Com. v. Pytou Heang*, 458 Mass. 827, 837-38, 942 N.E.2d 927, 938 (2011)Strengthening Forensic Science, *supra* at 150–151; *Ballistic Imaging*, *supra* at 11–86; *Theory of Identification as it Relates to Toolmarks*, 30 *AFTE J.* 86, 86–88 (1998) (*Theory of Identification I*).

“a match to the exclusion of all other weapons in the world” testimony of experts. Forensic Ballistics experts use markings on shell casings or bullets to determine the match to a particular weapon. Once the evidence chain of custody is proven a court is concerned with matching of markings to prove the identification of a weapon associated with the suspect. Under this second question the court primarily questions of the expert’s experience in the field or certifications earned to ensure the expert meets the requirements of Rule 702. Currently forensic ballistics testimony is allowed if the court is satisfied with the evidence and the qualifications of the expert. The history of gun identification and current state of forensic ballistics will provide a glimpse into the world of forensic ballistics allowing one to better understand the complexity of the issue.

II. The Use of Forensic Ballistics in the Courtroom

The current admissibility of forensic evidence was articulated by a Massachusetts Court’s four factors:

1. When the evidence and testimony will assist a jury in reaching a verdict by having the benefit of the opinion, as well as the information needed to evaluate the limitations of such an opinion and the weight it deserves.¹⁷
2. **The defense counsel is furnished in discovery with the documentation needed to prepare an effective cross-examination or sufficient data to repeat the expert’s identification in an attempt to rebut the government’s expert witness.**¹⁸
3. The jury is provided necessary background concerning the theory and methodology of forensic ballistics.¹⁹
4. Where an opinion matching a particular firearm to recovered projectiles or cartridge casings, if necessary is limited to a “reasonable degree of ballistic certainty”.²⁰

¹⁷ Com. v. Pytou Heang, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011)

¹⁸ Id.

¹⁹ Id.

While these factors represent one circuit's current acceptance of forensic ballistic evidence the following cases will provide a short history on challenges to the science. The changing or at least limiting reliance on forensic ballistics experts in the courtroom is from the gatekeeping power given judges by Rule 702 and the raising chorus of scientists and academics questioning the scientific rigor underpinning forensic ballistics and journals questioning the science behind the idea that each gun has a unique fingerprint.

Prior to 2006 forensic ballistics had been accepted in criminal cases for decades. The case of *United States v. Foster* (Foster) in 2004 represents the mindset of courts prior to a pair of decisions from Massachusetts in 2006 and a 2008 national academy of sciences report.²¹ The Court ruled forensic evidence is generally admissible including a footnote referencing a 1935 ballistics textbook.²² The Federal Bureau of Investigation (FBI) expert's testimony connected a .25 caliber and a .40 caliber cartridge with two separate shootings and murders. The defendants in Foster challenged the government's

²⁰ *Id.* The Courts acknowledges differing conclusions concerning the research regarding forensic ballistics. The Second Circuit, ballistics expert to offer opinion only that "firearms match was 'more likely than not'." *United States v. Glynn*, 578 F.Supp.2d 567, 574–575 (S.D.N.Y.2008); The Eleventh Circuit, forensic ballistics expert to offer opinion of match "to a 100% degree of certainty." *United States v. Natson* 469 F.Supp.2d 1253, 1261–1262 (M.D.Ga.2007); The First Circuit, forensic ballistics expert to testify only to expert's actual observations, and refusing to permit expert to offer opinion that particular firearm was source of recovered shell casings. *United States v. Green*, 405 F.Supp.2d 104, 124 (D.Mass.2005)

The Court described a "reasonable degree of ballistic certainty" as a general rule on quality of the evidence on which the opinion rests in a particular case given it's own current understanding of the scientific rigor underpinning forensic ballistics.

²¹ *United States v. Monteiro*, 407 F. Supp. 2d 351, 374 (D. Mass. 2006)

In *United States v. Green*, The case of the .308 Hi Point pistol

²² Ballistics evidence has been accepted in criminal cases for many years. The first comprehensive textbook of ballistics, *Firearms Investigation. Identification and Evidence*, was published by Major Julian S. Hatcher in 1935. *United States v. Foster*, 300 F. Supp. 2d 375, 377 (D. Md. 2004)

use of forensic ballistics expert under Rule 702 in charges for multiple murders. The Court found the testimony admissible finding the “imprimatur of a strong general acceptance, not only in the expert community, but in the courts as well.” The FBI expert established to the court's satisfaction the general reliability of the science of ballistics, including comparisons of spent cartridge casings even where there is no “known” weapon recovered.²³ In Concluding, the court notes the defendant’s access to the casings an option of putting on a rebuttal witness to offer a contrary opinion of the evidence.

In *United States v. Monteiro*, the government was charging defendants with RICO prosecution and sought to include expert testimony matching cartridge cases from scenes of various shooting to a 9mm gun.²⁴ Before admitting the expert testimony the Court sought to qualify the government’s expert a Boston City Police Officer under responsibility as gatekeeper under Rule 702 ensuring he meet the “knowledge, skill, experience, training, or education” requirement. Finding that the expert lacked formal scientific training, certification or membership in any professional organizations, reads no literature in the field, and had not undertaken any proficiency testing at the time he performed the tests at issue in the case the court proceed to qualify the expert on the basis of experience. To accept an expert witness relying solely or primarily on experience, the court must be satisfied by the expert; explaining how the experience leads to the conclusion reached, why the experience form a sufficient basis for the opinion, and how the experience is reliably applied to the facts. Absent these requirements the trial court's

²³ Helpful guidance is provided by the Fourth Circuit's decision in *United States v. Crisp*, 324 F.3d 261 (4th Cir.2003), rejecting a Daubert challenge to testimony concerning fingerprint and handwriting analysis. As stated in *Crisp*, “the touchstones for admissibility under Daubert are two: reliability and relevancy.”

²⁴ *United States v. Monteiro*, 407 F. Supp. 2d 351, 355-56 (D. Mass. 2006)

gatekeeping function becomes simply “taking the expert's word for it.”²⁵ Here, the expert’s experience consisted of on the job training by an experienced examiner in firearms identification, attending various armorer schools, and conducting hundreds of examinations of firearms using a comparison microscope.²⁶ The government forensic ballistic witness qualified as an expert under Rule 702 experience based his hundred examinations (the standard in the field) with the department and his passage of a nationally administered proficiency test in July 2005.²⁷ It should be noted this “experience” overcame the expert’s lack of a bachelor’s degree with science courses, which the court quoted a American Society of Crime Laboratory Directors manual listing it as a “desirable” qualification for firearms examiners.²⁸

Even if the expert qualified under Rule 702 the government had a burden of proof that in this particular case the expert’s methodology was reliable. The Court noted guidelines of the Association of Firearm and Tool Mark Examiners requiring examiners to document identifications by notes, sketches, or photographs.²⁹ Here, the government expert acknowledged his failure to make sketches or take photographs and his notes contain no description of what process led to his conclusions and seems to acknowledge that current standards would require more description of his examination.³⁰ Also, the

²⁵ United States v. Monteiro, 407 F. Supp. 2d 351, 366 (D. Mass. 2006)

²⁶ xaminer in firearms identification and attended various armorer schools. (Daubert Hr'g Tr. 33, Oct. 28, 2005.) He has conducted hundreds of examinations of firearms using a comparison microscope. (Id. at 140.)To be sure, Sgt. Weddleton's scientific and academic credentials are underwhelming.

²⁷ (Daubert Hr'g Tr. 95, Oct. 27, 2005.) Although enough to qualify him as an expert.

²⁸ Furthermore, the government lists a bachelor's degree with science courses as a “desirable” qualification for firearm examiners, it does not list it as “essential.”, Laboratory *374 Accreditation Board Manual, 29 (1997) (Ex. 49).D. Documentation21

²⁹ (Daubert Hr'g Tr. 43-4, Sept. 16, 2005.)

³⁰ notes so the question is whether his notes provide adequate documentation of the identification. (Daubert Hr'g Tr. 65, 72, Oct. 28, 2005.) The three reports of identifications in this case, entered as Exhibits 38, 40, and 41, contain no description of

expert failed to have a second independent qualified examiner from his lab review the work or conclusions in accordance with the generally accepted standard in the field.³¹ The Court stated, “Until the basis for the identification is described in such a way that the procedure performed is reproducible and verifiable, it is inadmissible under Rule 702.”³² Besides the expert’s examination falling short of the mark in both documentation and peer review, in this particular case the gun was found in a state of disrepair and prior to test-firing the gun to match cartridge cases the government’s expert replaced a number of parts. In conclusion the court rules even with all the shortcomings the above forensic ballistic evidence will be allowed if the expert along with a second independent qualified examiner perform new examinations.³³ It is also important to note the defendants did not provide rebuttal expert testimony.

Subsequently, In *United States v. Green* (Green), the government expert was to testify the .308 Hi Point pistol (Hi Point) found in defendant’s front yard matched the shell casings connected to two shootings “to the exclusion of every other firearm in the world” as part of RICO charges.³⁴ The expert’s examination of the evidence was not

what led Sgt. Weddleton to his conclusions. Indeed, all the reports indicate is that there was a “positive ID.” Even Sgt. Weddleton seems to acknowledge that current standards would require more description of his examination than he provided in this case. (*Daubert Hr’g Tr.* 78, Oct. 28, 2005.)

³¹ (*Daubert Hr’g Tr.* 73, Oct. 28, 2005.).

³² (*Id.* at 374.)

³³ *United States v. Monteiro*, 407 F. Supp. 2d 351, 374 (D. Mass. 2006)

³⁴ On September 9, 2000, Boston police detectives collected eight spent .380 caliber shell casings on the sidewalk opposite 249 Harvard Street in Boston. On September 16, 2000, following the shooting of Richard Green, detectives collected six spent .380 caliber shell casings at 870 Blue Hill Avenue in Boston. More than a year later, on September 20, 2001, detectives found a loaded Hi Point, .380 caliber pistol [“Hi Point pistol”] in the front yard at 6 Esmond Street in Boston.

The government seeks to introduce ballistics testimony from Sergeant Detective James O’Shea [“O’Shea”] of the Boston Police Department. O’Shea examined the evidence and concluded that all of the shell casings came from the same weapon, and further, that the weapon was the Hi Point pistol found in front of 6 Esmond Street. Indeed, O’Shea declared that this match could be made “to the exclusion of every other firearm in the world.” (*Daubert Hr’g Tr.* 20, 60, Oct. 5, 2005.)

initially recorded in any manner either by notes, measurements, photographs, or drawn diagrams.³⁵ During examination the expert admitted his examination did not follow any known protocols for toolmark examination. He qualified as an expert under 702 based on “hundreds” of examinations. Unlike the previous cases the defendants in *Green* offered expert testimony possessing an advanced degree in material science but had limited experience in ballistics primarily from gun manufacturer armorer courses and no laboratory.³⁶ Although the government expert’s examination of the evidence the primary issue concerned the Hi Point because it is one of the cheapest guns made making the softer steel more susceptible to wear over time than other firearms.³⁷ The breech face on the .308 Hi Point at issue was relatively smooth making additional challenges in identifying class characteristics on the weapon.³⁸ Examining the casings consisted of the expert comparing the evidence from two shootings and test firing the Hi Point found by law enforcement in the front yard of defendants. The expert also examined test-fired casings to four other Hi Points in the possession of the department but he did not compare casings of other inexpensive guns.³⁹ Ultimately the court allowed the testimony but prevented the government expert from stating the match was “to the exclusion of every other firearm in the world.”

In *United States v. Glynn* (*Glynn*), the court found that ballistics testimony was accepted without question for many decades in United States federal courts but new scrutiny in light of the judicial gatekeeping of reliable evidence and a recent scientific

³⁵ *United States v. Green*, 405 F. Supp. 2d 104, 108 (D. Mass. 2005)

³⁶ *United States v. Green*, 405 F. Supp. 2d 104, 108 (D. Mass. 2005)

³⁷ *United States v. Green*, 405 F. Supp. 2d 104, 111-13 (D. Mass. 2005) (*Daubert* Hr’g Tr. 75, Oct. 5, 2005.)

³⁸ (*Daubert* Hr’g Tr. 75, Oct. 5, 2005.) (*Daubert* Hr’g Tr. 23-25, Nov. 2, 2005.)

³⁹ *United States v. Green*, 405 F. Supp. 2d 104, 111-13 (D. Mass. 2005) (*Daubert* Hr’g Tr. 66, Nov. 2, 2005), *United States v. Green*, 405 F. Supp. 2d 104, 115 (D. Mass. 2005)

journal.⁴⁰ The defendant in Glynn faced a new trial after murder charges had deadlocked the jury resulting in a mistrial. As part of the case the government expert testified the murder weapon matched casings from two prior shootings. The discussion allowed the testimony but the judge had serious questions about the scientific assumptions related to forensic ballistic evidence.⁴¹ After questioning the science the court ruled the expert could only state a firearms match was “more likely than not” and was not allowed to say ballistics was a science or his conclusions were reached with any degree of certainty.⁴²

The use of defendant’s rebuttal expert witness was restricted in *United States v. Taylor* (Taylor) because the court believes an expert critic tended to confuse rather than assist the jury. The government sought to offer forensic ballistic expert testimony from a Bureau of Alcohol, Tobacco, Firearms, and Explosives examiner (ATF expert) as part of conspiracy charges against multiple defendants.⁴³ Defendants proffered their own expert and academic who has researched and written on the subject of firearms identification.⁴⁴ The ATF expert provided the government’s critic of the Defendant’s expert published writings stating they were based primarily on secondary sources, took some studies out of context almost to the point of misleading, and lack of any experience examining firearms (testifying she had never even fired a gun).⁴⁵ The court reviewed the Third and Eleventh Circuit’s prior rulings concerning a notorious Professor’s testimony as “there is no such thing as a handwriting expert” expert. The Third Circuit allowed this Professor to testify as to reliability of experts in the field although was not qualified according to the court to

⁴⁰ *United States v. Glynn*, 578 F. Supp. 2d 567, 569-70 (S.D.N.Y. 2008)

⁴¹ is found in section five.

⁴² *United States v. Glynn*, 578 F. Supp. 2d 567 (S.D.N.Y. 2008)

⁴³ *United States v. Taylor*, 704 F. Supp. 2d 1192, 1194 (D.N.M. 2009)

⁴⁴ *United States v. Taylor*, 704 F. Supp. 2d 1192, 1193 (D.N.M. 2009)

⁴⁵ *United States v. Taylor*, 704 F. Supp. 2d 1192, 1199-200 (D.N.M. 2009)

be an expert in the field on handwriting himself.⁴⁶ Alternatively, the Eleventh Circuit's excluded the Professors testimony focusing on the complete lack of experience in handwriting analysis. The court found he did not possess an acceptable degree of knowledge, provided no assistance to the jury, and was not a qualified expert in the field.⁴⁷ After reviewing the aforementioned cases the Taylor court held the defendant's expert testimony would confuse instead of assisting the jury and most significantly the expert was not sufficiently reliable to gain admissibility under Rule 702 or Daubert.⁴⁸ Taylor's decision highlights the concern with the court's focus on "whether this particular evidence matches this specific gun" risks missing the point; whether or not the "art" of forensic ballistics is reliable.

While the courts in Green and Monteiro grappled with the science behind ballistic evidence the Second Circuit in Taylor focused on the match of the specific evidence to glossing over the issue raised by the defendants and their expert, "As a whole is the art/science of microscopic pattern matching based on false assumptions. Other courts have determined the testimony of experts is unreliable and therefore limit the statistical certainty an expert can claim for the origin of the ballistic marks.

In *United States v. St Gerrard*, testimony by the government expert included a statement that it would be practically impossible for the markings on the casings to have come from anything except defendants AK-47.⁴⁹ The case involved a shooting on a military base in Germany where defendant was alleged to have shot at another soldier. Although the court found the government's expert qualified to give expert testimony

⁴⁶ *United States v. Velasquez*, 64 F.3d 844, 851 (3d Cir.1995)

⁴⁷ *United States v. Paul*, 175 F.3d 906 (11th Cir.1999)

⁴⁸ *United States v. Taylor*, 704 F. Supp. 2d 1192, 1199 (D.N.M. 2009)

⁴⁹ *United States v. St. Gerrard*, US Army Trial Judiciary, 5th Judicial Cir., Germany (7 June 2010)

under Rule 702, it determined the possible error rates involved in the examination of toolmarks, the recent National Academy Science Report and held the expert's testimony to be unreliable. However the expert was still able to testify but was prevented from claiming the statistical certainty of "practically impossible" under Daubert.⁵⁰ In discussing the NAS Report the court concluded ballistic identification to be a subjective process lacking quantitative standards, grounded in a limited testing, and not demonstrating scientific principles establishing toolmark origins to any specific certainty. The unreliability of the testimony would have unfairly prejudiced the defendant.

While courts retain discretion under Rule 702 and Daubert, the next case outlines how structured the admissibility of forensic evidence today is which could in fact protect the status quo by limiting the use of rebuttal evidence to criticize the science behind pattern matching.

The court in *Commonwealth v. Pytou Heang* (Pytou) articulated four factors in order to determine the admissibility of forensic ballistic expert testimony. First, the evidence and testimony must assist a jury in reaching a verdict by having the benefit of the opinion, as well as the information needed to evaluate the limitations of such an opinion and the weight it deserves.⁵¹ Second, in discovery defense counsel must be furnished with documentation necessary to prepare an effective cross-examination or sufficient data to repeat the expert's identification in an attempt to rebut the government's expert witness.⁵² Third, provide the jury necessary background concerning the theory and

⁵⁰ reliability and relevancy." *United States v. Foster*, 300 F. Supp. 2d 375, 376 (D. Md. 2004)

⁵¹ *Com. v. Pytou Heang*, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011)

⁵² *Id.*

methodology of forensic ballistics.⁵³ Fourth, if necessary limit the opinion matching a particular firearm to recovered projectiles or cartridge casings to a “reasonable degree of ballistic certainty”.⁵⁴ Examining the use of government and rebuttal experts through these four factors will highlight the advances made and the difficulty in further challenges.

In *Pytou*, the defendant was convicted of two murders in a jury trial.⁵⁵ The government expert presented forensic ballistic evidence connecting 3 bullets and cartridge casings to a nine-millimeter gun in the possession of the defendant however expert stated, the match could not exclude every other nine millimeter weapon with similar barrel characteristics.⁵⁶

First, the court believed the nature of the testimony in *Pytou* would assist the jury reaching a verdict by providing information necessary to evaluate and weigh the evidence properly.⁵⁷ This first step ensures the testimony will not confuse the jury. Here, the expert limited his own testimony concerning the match of the evidence so as not to lead the jury to give improper weight to the evidence. It remains to be seen if a rebuttal expert under this factor would be admissible, In *Glynn* the defendant expert was allowed to

⁵³ *Id.*

⁵⁴ *Id.* The Courts acknowledges differing conclusions concerning the research regarding forensic ballistics. The Second Circuit, ballistics expert to offer opinion only that “firearms match was ‘more likely than not’”. *United States v. Glynn*, 578 F.Supp.2d 567, 574–575 (S.D.N.Y.2008); The Eleventh Circuit, forensic ballistics expert to offer opinion of match “to a 100% degree of certainty.” *United States v. Natson* 469 F.Supp.2d 1253, 1261–1262 (M.D.Ga.2007); The First Circuit, forensic ballistics expert to testify only to expert's actual observations, and refusing to permit expert to offer opinion that particular firearm was source of recovered shell casings. *United States v. Green*, 405 F.Supp.2d 104, 124 (D.Mass.2005)

The Court described a “reasonable degree of ballistic certainty” as a general rule on quality of the evidence on which the opinion rests in a particular case given it’s own current understanding of the scientific rigor underpinning forensic ballistics.

⁵⁵ *Com. v. Pytou Heang*, 458 Mass. 827, 828-29, 942 N.E.2d 927, 932 (2011)

⁵⁶ *Com. v. Pytou Heang*, 458 Mass. 827, 835, 942 N.E.2d 927, 936 (2011)

⁵⁷ *Com. v. Pytou Heang*, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011)

testify while in Taylor rebuttal expert testimony was not allowed at trial and confusion of the jury was stated as one reason.

Second, in discovery defense counsel must be furnished with documentation necessary to prepare an effective cross-examination or sufficient data to repeat the expert's identification in an attempt to rebut the government's expert witness.⁵⁸ The basis for this step is in both ensuring the defense is able to see the evidence convicting them but also requires the government expert to follow standards in the field.⁵⁹ In this case the government provided adequate documentation concerning the expert's examination of the forensic ballistic evidence. Although important the documentation in this factor case only be used by the defense in hopes a independent qualified examiner can contradict the government expert's match. Whether forensic science is scientifically reliable is not part of this factor.

Third, the forensic ballistics expert should explain to the jury necessary background concerning the theory and methodology in forensic ballistics.⁶⁰ Lurking underneath the surface of this step is the courts desire for the jury to understand what the expert is testifying about. Unfortunately a prolonged discussion about class, subclass and individual characteristics risk elevating the expert.⁶¹ Here, the expert informed the jury about identifying toolmark characteristics and explained the scientific limits of firearms matching. However during testimony the government's expert stated it was a practical

⁵⁸ Id.

⁵⁹ Com. v. Pytou Heang, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011) United States vs. Monteiro, U.S. Dist. Ct. Criminal No. 03-10329-PBS (D.Mass. Nov. 28, 2005) (AFTE guidelines require examiners to document identifications by notes, sketches, or photographs, and barring expert forensic ballistics testimony until adequate documentation is provided).

⁶⁰ Id.

⁶¹ Com. v. Pytou Heang, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011)

impossibility that another weapon fired the projectiles.⁶² The next factor addresses potential overstatements by experts.

Fourth and finally, the opinion of the expert if necessary should be limited. The examination of forensic ballistics sometimes results in a less than 100% match and in these cases the court must limit the expert's testimony.⁶³ An expert that states their opinion to a "reasonable degree of ballistic certainty" is stating a scientific degree of precision or statistical certainty where none is present.⁶⁴ The phrase "reasonable degree of scientific certainty" should also be avoided because it suggests that forensic ballistics is a science, where it is clearly as much an art as a science.⁶⁵ As discussed above, the expert's testimony here was limited from saying the match could exclude every other 9 millimeter firearm with six lands and six grooves and a right-hand twist. However on redirect examination the expert stated it was practically impossible for the projectiles here to be from another firearm.⁶⁶ The potential for an expert to circumvent a court's limits raises concerns as to whether the weight of a forensic ballistics expert can in fact be limited in a manner which allows the jury to distinguish differences in scientific certainty.

In conclusion, the problem of forensic ballistic evidence is that although there is no question that there are many marks on shell casings, from all of these sources—production process, firing pin, breech face, etc. But even assuming that some of these marks are unique to the gun in question, the issue is their significance, how the examiner

⁶² *Com. v. Pytou Heang*, 458 Mass. 827, 846, 942 N.E.2d 927, 944 (2011)

⁶³ *Com. v. Pytou Heang*, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011)

⁶⁴ *Com. v. Pytou Heang*, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011) *Ballistic Imaging*, *supra* at 82

⁶⁵ *Com. v. Pytou Heang*, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011) **See *Ballistic Imaging*, *supra* at 54–56.**

⁶⁶ *Com. v. Pytou Heang*, 458 Mass. 827, 846, 942 N.E.2d 927, 944 (2011)

can distinguish one from another, which to discount and which to focus on, how qualified he is to do so, and how reliable his examination is.⁶⁷

III. History of Forensic Ballistics

Forensic ballistic evidence has been used in criminal cases since the early 1920's however the use of this evidence is only now beginning to be challenged. After reviewing the history of this evidence one question remains unanswered, was forensic science created because the science underpinning its use was solid or if it was simply necessary to combat the evils in civilized society.

Examining the history of the science of firearms identification highlights the absence of scientific basis in the assumption that all firearms leave uniquely identifiable marks. In order to view two projectiles at one time Cornel Calvin Goddard and Philip O. Gravelle invented the comparison microscope. Prior to the creation of the comparison microscope firearms experts had to remember identifying marks on each specimen. Of course the ability to view two bullets or cartridge casings allowed more accurate examination of the unique striae left on the bullet or cartridge case from the worn, machined metal of the barrel, breach block, extractor, or firing pin. Identification of projectiles and casings as a field in forensics is a direct result of the comparison microscope. Over the last eighty years the basic tools and techniques have remained unchanged which are to determine whether or not ammunition components were fired by

⁶⁷ United States v. Green, 405 F. Supp. 2d 104, 110-13 (D. Mass. 2005)

a single firearm based on unique and reproducible microscopic and class characteristics, or to reach a "no conclusion" result if insufficient marks are present.⁶⁸

On February 14th 1929, seven men were lined up and shoot with ninety rounds of ammunition inside a Chicago garage. This “massacre” during the day involving the killing of five North Sides shocked America.⁶⁹ Adding to the hysteria was the fact that witnesses had seen police officers in the area during the time of the shooting leading to the speculation of Chicago involvement in the murders.⁷⁰ At the request of a Chicago coroner Goddard traveled to Chicago to assist in the invention.⁷¹ Using a comparison microscope adapted for ballistics comparison Goddard absolved the Chicago Police Department’s participation in the St. Valentine's Day Massacre. Although this case is one of the most notorious in America’s gangland history it shows the increasing need for firearms to be identified and have wrongdoers convicted for their crimes.

IV. Certification of Forensic Ballistics Examiners

While it is possible for a expert to be qualified absent passing a nationwide certification test the court has been given discretion as a gatekeeper under Rule 702.

⁶⁸ John H. Dillon, Jr , Comparison Microscopy: The Origins of Firearms identification, A Practical Application of Forensic Science, Technology and Engineering to Case Linkage in Shooting Incidents Not Previously Related by Investigative personnel, BulletTRAX-3D, MatchPoint Plus and the Firearms Examiner, 2005.

⁶⁹ Rasmussen, Frederick N. "Baltimore native helped solve 1929 St. Valentine's Day Massacre," The Baltimore Sun, Sunday, February 13, 2011.
http://articles.baltimoresun.com/2011-02-12/news/bs-md-backstory-st.-valentines-day-20110213_1_goddard-comparison-microscope-firearms

⁷⁰ Hoffman, Albert A., Jr. (2010). Some Historical Stories of Chicago. Xlibris. p. 188. ISBN 9781453539699.

<http://books.google.com/books?id=awdx10jLhAcC&pg=PA188&dq=%22john+may%22+moran&hl=en#v=onepage&q=%22john%20may%22%20moran&f=false>

⁷¹ O'Brien, John. "The St. Valentine's Day Massacre". Chicago Tribune. Retrieved 12 April 2013. <http://www.chicagotribune.com/news/politics/chi-chicagodays-valentinesmassacre-story,0,1233196.story>

Courts must review the admissibility of an expert in light of the “knowledge, skill, experience, training, or education” they possess. It is important to know that certification of forensic ballistics examiners does not change whether or not the scientific assumptions on which it is based are sound. Certification of forensic ballistics examiners into is one way courts can attempt to determine the reliability of the proposed testimony.

Courts are reluctant to exclude forensic ballistic evidence because of the precedent that has been set in courts across the country for decades. More recently the court in *Monteiro* found the expert lacked formal scientific training, certification or membership in any professional organizations, reads no literature in the field, and had not undertaken any proficiency testing but the expert was still qualified on his “hundreds” of prior examinations and his passage of a nationally administered proficiency test in July 2005.⁷² This expert seeking out and passing a proficiency test prior to trial demonstrates the fact that courts look for credentials with experts and a proficiency test is a credential.

The Association of Firearm and Tool Mark Examiners (AFTE), is the principal professional organization for firearms and toolmark examiners. The peer-reviewed journal published AFTE allows for the testing of scientific principles concerning forensic evidence from toolmarks, validating current technique of firearm identification.⁷³

The AFTE is one of many forensic ballistic evidence organizations offering a proficiency certification, which consists of a packet of ballistic ammunition containing a number of bullets and cartridges. The individual examiner reviews the specimens determining either identification, inconclusive, or elimination of the projectile as a match. While examining each specimen the tester is asked to document his or her findings.

⁷² (Daubert Hr'g Tr. 95, Oct. 27, 2005.) Although enough to qualify him as an expert.

⁷³ technique of firearm identification *United States v. Monteiro*, 407 F. Supp. 2d 351, 366 (D. Mass. 2006)

Ultimately the design of a proficiency test can only test an individuals ability to used verified firearms identification techniques and the ability one possess to use those techniques to match microscopic patterns unique to each weapon. The question remaining is the subjective nature inherent in forensic ballistic evidence identification.⁷⁴

Toolmark evidence and DNA evidence are markedly different in the crucial respect of subjectivity inherent in the analysis. Firearms identification ultimately comes down to a subjective assessment specifically, a subjective probability statement (although practitioners often render these as absolute statements). Firearms examiners observe concrete, objective phenomena. The difficulty is in developing a structural basis for evidence evaluation.⁷⁵

The Monteiro court stated the AFTE Theory of identification's critical problem no objective standard when deciding a particular mark is a subclass or individual characteristic.⁷⁶ The AFTE states caution should be made in distinguishing between the two characteristics.⁷⁷ The court seems to consider the focus placed by AFTE on the examiners training and experience in order to distinguish characteristics creates a serious problem concerning whether the testimony is reliable. The court concludes it has the discretion to allow subjective opinions if they are based on adequate experience and training.⁷⁸

Overcoming the current status of admissibility remains difficult based forensic examiner professional organizations, proficiency tests for certification and the status of

⁷⁴ Page 57 in Ballistic Imaging

⁷⁵ Page 50 in Ballistic Imaging

⁷⁶ United States v. Monteiro, 407 F. Supp. 2d 351, 371 (D. Mass. 2006)

⁷⁷ United States v. Monteiro, 407 F. Supp. 2d 351, 371 (D. Mass. 2006)

⁷⁸ United States v. Monteiro, 407 F. Supp. 2d 351, 374 (D. Mass. 2006)

law enforcement providing the testimony. When combined these factors establish “general acceptance in the field” standard which courts are reluctant to rule against.⁷⁹

V. Lingerin Issues about Forensic Ballistics and Conclusion

The scientific community has recently issued two articles where the scientific basis for identification using forensic ballistic evidence. The continued use of this evidence in light of the reports raises the question of whether forensic ballistics is used because of reliability or simply out of need.

The NAS 2008 report cautioned: Conclusions drawn in firearms identification should not be made to imply the presence of a firm statistical basis when none has been demonstrated. Specifically, examiners tend to cast their assessments in bold absolutes, commonly asserting that a match can be made “to the exclusion of all other firearms in the world.” Such comments cloak the inherently subjective assessment of matches with an extreme probability statement that has no firm grounding and unrealistically implies an error rate of zero.⁸⁰ Following the report, In *United States v. Glynn*, the court ruled that the expert could not use the term “reasonable scientific certainty” in testifying.⁸¹ Rather, the expert would be permitted to testify only that it was “more likely than not” that recovered bullets and cartridge cases came from a particular weapon, stating “based on the Daubert hearings whatever else ballistics identification analysis could be called, it could not fairly be called ‘science.’”⁸² The court added that the “problem is compounded by the tendency of ballistics experts . . . to make assertions that their matches are certain

⁷⁹ Page 68 in *Ballistic Imaging*

⁸⁰ . *Id.* at 82.

⁸¹ *United States v. Glynn*, 578 F. Supp. 2d 567 (S.D.N.Y. 2008)

⁸² *Id.* at 570.

beyond all doubt, that the error rate of their methodology is ‘zero,’ and other such pretensions.”⁸³

The 2009 NAS Report found that not enough is known about the variability’s among individual tools and guns, we are not able to specify how many points of similarity are necessary for a given level of confidence in the result. Sufficient studies have not been done to understand the reliability and repeatability of the methods. The committee agrees that class characteristics are helpful in narrowing the pool of tools that may have left a distinctive mark. Individual patterns from manufacture or from wear might, in some cases.⁸⁴ In a different passage, the report remarked “much forensic evidence ‘including firearm and toolmarks identifications’ is introduced in criminal trials without any meaningful scientific validation, determination of error rates, or reliability testing to explain the limits of the discipline.”⁸⁵

In 2011, the Massachusetts court explained the current acceptance of forensic evidence by stating:

“while the uniqueness of toolmarks has yet to be scientifically determined and while the process by which a firearms examiner declares a “match” remains inherently subjective, however that experience has demonstrated that firearms examiners can and consistently do compare such markings and reach opinions that can assist finders of fact.”⁸⁶

⁸³ Id. at 574.

⁸⁴ (National Research Council, National Academy of Sciences, *Strengthening Forensic Science in the United States: A Path Forward* 154 (2009)

⁸⁵ (Id. at 107-08.)

⁸⁶ *Com. v. Pytou Heang*, 458 Mass. 827, 846-50, 942 N.E.2d 927, 944-47 (2011)

The argument that forensic ballistic experts are admissibly because they have been in the past rings hollow and focuses on the matching of the evidence in a particular case instead of the scientific foundation of the opinion.⁸⁷

Ultimately the basis which allows forensic ballistic evidence in the courtroom will not be changed until the forces holding it in place realize that long accepted “scientific” evidence has a presumed admissibility difficult for the average defendant to overcome. In addition, the systems of peer-reviewed toolmark certification authorities, law enforcement agency resources, and the social need to solve crimes or convict the responsible individual pose separate hurdles for a zealous defendant wishing to oppose the use of forensic ballistic in his murder charge.

The current forensic ballistic expert engages in complex microscopic pattern-matching on the assumption that all guns leave a individualized set of marks that can be scientifically recorded and repeated. So long as the drawings, photos, and notes are adequate for a second examiner to review the findings will be sufficient and courts will allow the Government’s expert to testify. This becomes little more than a courtroom routine ensuring proper form of ballistic evidence resulting in the acceptance of highly persuasive testimony.

Today thousands of guns are made by hundreds of manufactures often designed with brand identifiers and made on assembly lines maintain a standard quality for each weapon create at least the possibility that all guns at all times do not leave individually identifiable markings on shell casings and bullets.

⁸⁷ United States v. Glynn, 578 F. Supp. 2d 567, 572-75 (S.D.N.Y. 2008)

The emphasis courts give to the experience of law enforcement experts who spend sometimes years in the field of ballistic examination even if entirely understandable creates a barrier for a defendant looking to rebut the evidence.

In the area of forensic ballistics a large study examining the science in the assumption every tool leaves a unique individualized mark identifiable by a experienced and trained expert needs to be undertaken. The reluctance courts have shown reluctance academic experts testifying in the field of forensic ballistics create a disadvantage to defendants hoping to rebut a government expert.⁸⁸ The remaining option for defendants is to find a group of committed individuals possessing the training, experience, certifications, and equipment who can offer contradictory testimony. This defense team fantasy could hope to qualify its own anti-criminal laboratory technicians use the Ballistic Image databases to match evidence collected in other crimes. Access to NIBIN or another large database of ballistic information could provide a way of demonstrating the existence of other matches “in the world.”⁸⁹ However this is unrealistic given the control proponents of the current state of forensic ballistics have on training, experience, and certification of forensic laboratories and experts.

⁸⁸ United States v. Taylor, 704 F. Supp. 2d 1192, 1194-96 (D.N.M. 2009)

⁸⁹ <http://www.atf.gov/publications/factsheets/factsheet-nibin.html>