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Sarah Lucy Cooper

Birmingham City University, Centre for American Legal Studies

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THE COLLISION OF LAW AND SCIENCE: AMERICAN COURT RESPONSES TO DEVELOPMENTS IN FORENSIC SCIENCE

*Sarah Lucy Cooper**

Introduction

In 2013, our scientific and technological capabilities continue to exceed all expectations. The capacity of DNA¹ evidence to identify specific sources consistently and with a

*Sarah Lucy Cooper is a Senior Lecturer in Law at Birmingham City University's Centre for American Legal Studies in the UK, and a Fellow at the Arizona Justice at Arizona State University. I would like to thank my two research assistants, Alice Storey and Daniel Gough who always do a superb job. I would also like to thank Dr. Jon Yorke, Dr. Haydn Davies, Professor Meryl Thomas, Professor Alex Kendall, Dr. Anne Richardson-Oakes, Professor Carrie Sperling, Professor Carolyn Hoyle, Professor Lissa Griffin, Paul Cooper, Christine Cooper, and Terri Smith for reviewing and discussing the themes of this paper with me. Finally, I would like to thank the Academy of Criminal Justice Sciences for allowing me to share an earlier draft of this paper at its annual conference in NYC in March 2012.

1. Donald E. Shelton, *Twenty-First Century Forensic Science Challenges for Trial Judges in Criminal Cases: Where the "Polybutadiene" Meets the "Bitumen"*, 18 WIDENER L.J. 309, 320 (2009).

DNA is the molecular structure in all living things that contains genetic information. DNA evidence is very durable and can be extracted from the smallest of remains many years after a crime. Equally significant is its "polymorphism," meaning that, depending on the method used for its extraction, it is unique among humans and can identify the donor of the specimen with overwhelming accuracy. DNA testing can be extremely precise and can often demonstrate that only one person in billions could have been the source of the specimen evidence.

Id. (footnotes omitted).

high degree of certainty has been rigorously tested,² and it is widely accepted that a vast array of forensic sciences can engage in “individualization,” that is, identify the perpetrator of a crime “to the exclusion of all others.”³ With recent studies showing that jurors have an increased thirst for scientific evidence,⁴ these forensic sciences have rapidly re-shaped the criminal process.⁵ As such, television shows like *CSI* suggest forensic evidence is seamlessly and justifiably weaved into American courtrooms. In reality, however, the criminal justice system wrestles with scientific evidence, and its reliance on forensic science to identify criminals with absolute accuracy is troubling.

Recently, the ability of many forensic sciences to engage in individualization has been called in to question. There are a number of reasons for this. First, DNA evidence has become the gold-standard by which other forensic techniques are

2. See THE COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCI. CMTY., NAT'L RESEARCH COUNCIL OF THE NAT'L ACADS., STRENGTHENING THE FORENSIC SCIENCES IN THE UNITED STATES: A PATH FORWARD 7 (2009) [hereinafter NAS REPORT]. Although note that DNA evidence is not infallible. See Shelton, *supra* note 1, at 323-24.

Although DNA profiling is clearly scientifically superior to other forensic identification evidence, it is not—contrary to earlier pronouncements—infallible. DNA evidence and its underlying methodology are, of course, subject to human error. False positive DNA results have occurred and will undoubtedly continue to be part of the DNA testing landscape. Proffered evidence may still, as with other forensic science evidence, be the result of mistakes or contamination in its collection, testing, or interpretation. As the technology and methodology of DNA testing has progressed, it is the human errors that may present the biggest evidentiary challenges for trial judges.

Id. (footnotes omitted).

3. Michael J. Saks, *Merlin and Solomon: Lessons from the Law's Encounters with Forensic Identification Science*, 49 HASTINGS L.J. 1069, 1082, 1119 (1998) (quoting another source).

4. Donald E. Shelton, Young S. Kim & Gregg Barak, *A Study of Juror Expectations and Demands Concerning Scientific Evidence: Does the “CSI Effect” Exist?*, 9 VAND. J. ENT. & TECH. L. 331, 333 (2006).

5. See generally Shelton, *supra* note 1 (discussing the rapid development of emerging technologies and their tremendous impact on the justice system).

judged.⁶ Unlike many forensic sciences, prolific testing has led to DNA evidence having a quantifiable and miniscule error rate.⁷ Thus, DNA has raised the bar as to what is scientifically acceptable for identifying a source “to the exclusion of all others.” Second, DNA evidence has revealed a disturbing number of wrongful convictions. To date, 302 people have been exonerated by post-conviction DNA evidence in the United States,⁸ and in over fifty percent of those cases, invalidated or improper forensic evidence played a role in convicting the defendant.⁹ Thus, the methodologies of many forensic sciences have been exposed as unreliable. Third, in 2009, the National Academy of Sciences (“NAS”) produced a landmark report—*Strengthening Forensic Science in the United States: A Path Forward* (“NAS Report”)—which concluded that “[w]ith the exception of nuclear DNA analysis, . . . no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source.”¹⁰ Soon after the report was published, the United States Supreme Court acknowledged that many forensic sciences are subject to “[s]erious deficiencies.”¹¹

This paper considers how American courts have responded to developments in forensic science by focusing on four popular forensic science disciplines: (1) fingerprint identification (friction ridge analysis); (2) firearms identification (tool-mark analysis); (3) bite mark identification (forensic odontology); and (4) arson investigation (fire science). Part I briefly explores the relationship between law and science. Part II charts the development of the legal frameworks that govern the admissibility of expert evidence in America. Part III discusses the identification methods employed by these four disciplines

6. NAS REPORT, *supra* note 2, at 8.

7. *See id.* at 7.

8. *Facts on Post Conviction DNA Exonerations*, INNOCENCE PROJECT, http://www.innocenceproject.org/Content/Facts_on_PostConviction_DNA_Exonerations.php (last visited Jan. 20, 2013).

9. *Unreliable or Improper Forensic Science*, INNOCENCE PROJECT, <http://www.innocenceproject.org/understand/Unreliable-Limited-Science.php> (last visited Jan. 7, 2012).

10. NAS REPORT, *supra* note 2, at 7.

11. *Melendez-Diaz v. Massachusetts*, 557 U.S. 305, 319 (2009).

and provides examples of erroneous identifications. Part IV comments on the NAS Report findings that relate to these four disciplines. Part V critically surveys responses by criminal courts between 1999 and 2011 to various admissibility challenges raised with respect to these four disciplines. Part VI concludes that over recent years the fingerprint identification, firearms identification, bite mark identification, and arson investigation communities have attempted to improve the reliability of their disciplines, but have failed to use identification methods with solid scientific underpinnings. Despite this shortcoming, most courts fail to discern the difference between valid and invalid science, and are reluctant to corral exaggerated expert testimony in certain fields. However, the courts' failures are understandable. In sharp contrast to the storylines played out on popular television shows, forensic science does not always clarify legal ambiguities by leading straight to the culprit. In reality, law wrestles with science. This is largely because law and science have different cultures: law aims to stabilize society through predictability, whereas science embraces change to understand the natural world. Consequently, our understanding of forensic science frequently changes, but the law responds slowly, reluctantly, and often inconsistently.

I. The Relationship Between Law and Science

Science helps the law understand the world in which legal policy must operate.¹² Science provides the law with a plethora of facts, ranging from the parentage of a child and the side effects of prescription drugs, to the workings of the Earth's structures, atomic bombs and modern industry. Thus, it seems that law and science share a mutually convenient and benign relationship: lawyers look to science for certainty in the face of difficult legal questions, and science seemingly responds with an answer.¹³

12. DAVID L. FAIGMAN, *LEGAL ALCHEMY: THE USE AND MISUSE OF SCIENCE IN THE LAW* 26 (1999). Faigman argues that "without [science], legal policy is literally blinded." *Id.*

13. Alex R. Hess, Book Note, 9 *J. HIGH TECH. L.* 1 (2009) (reviewing ROBIN FELDMAN, *THE ROLE OF SCIENCE IN LAW* (2000)).

However, there are problems at the intersection of law and science. Law and science clash culturally because of their different approaches to the world. As David Faigman puts it, “[s]cience progresses while law builds slowly on precedent. Science assumes that humankind is determined by some combination of nature and nurture, while law assumes that humankind can transcend these influences and exercise free will. Science is a cooperative endeavor, while most legal institutions operate on an adversary model.”¹⁴ These differences may be superficial and stereotypical,¹⁵ but they are not illusory. For example, Michael Saks argues that the inclination of courts to simply cite supportive precedents has “interfered with the courts’ inquiries about . . . purported science.”¹⁶ Additionally, Robin Feldman points out that the law is “too slow to adapt to the changing information available through the advancements of science”¹⁷ Scholars also argue that the adversarial trial system compounds these problems by admitting evidence that does not adequately represent the relevant scientific field.¹⁸ This is because, ordinarily, scientists at the margins of their disciplines are selected to testify due to their willingness to express extreme views in their proponent’s favor.¹⁹

Although law and science take different approaches to the world, there are a number of reasons to believe that science can be a legitimate and reliable tool for the law. First, law and science arguably seek the same thing—the truth—and, as Faigman argues, law and science could “reconcile their cultural peculiarities in a common goal.”²⁰ That said, one must acknowledge the “important differences between the quest for truth in the courtroom and the quest for truth in the laboratory.”²¹ The law seeks proof, which is not always the same as the truth. As Susan Haack explains:

14. FAIGMAN, *supra* note 12, at 56.

15. *Id.*

16. Saks, *supra* note 3, at 1105.

17. Robin Feldman, *Historic Perspectives on Law & Science*, 2009 STAN. TECH. L. REV. 1, 4.

18. *See* FAIGMAN, *supra* note 12, at 54.

19. *Id.* at 54.

20. *Id.* at 56.

21. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 596-97 (1993).

[A] jury is asked to decide whether guilt or liability has been established to the desired degree of proof. This is a very special kind of inquiry into a very special kind of proposition, and is constrained not only by the demands of evidence, but also by considerations of principle and policy. . . . Moreover, the procedures of a trial are quite unlike those of ordinary scientific or historical inquiry²²

Second, law is inherently evolutionary and adaptive.²³ This means it at least has the capacity to evolve, ensuring more reliable scientific evidence enters the courtroom, despite some scholars' opinions that when the law borrows from science its adaptive quality "breaks down."²⁴ However, one area in which American law has shown its evolutionary and adaptive ability is the development of legal frameworks governing the admissibility of expert evidence. These developments will be considered in Part II.

II. The Admissibility of Expert Evidence in American Courtrooms

Anglo-American judges have summoned people with specialized knowledge to aid in the legal process since the thirteenth century.²⁵ The first rule identified for governing the admissibility of such evidence was the "commercial marketplace test."²⁶ Under this test, "expert" knowledge was

22. Susan Haack, *Inquiry and Advocacy, Fallibilism and Finality: Culture and Inference in Science and the Law*, 2 L. PROBABILITY & RISK 205, 206-07 (2003).

23. Feldman, *supra* note 17, at 5.

24. *Id.* at 103. Scholars argue legal rules and procedures hinder the courts' ability to evolve.

25. See Stephen Landsman, *Of Witches, Madmen, and Product Liability: An Historical Survey of the Use of Expert Testimony*, 13 BEHAV. SCI. & L. 131, 134 (1995).

26. The term "commercial market place test" was only recently coined. See generally David L. Faigman et al., *Check Your Crystal Ball at the Courthouse Door, Please: Exploring the Past, Understanding the Present, and Worrying about the Future of Scientific Evidence*, 15 CARDOZO L. REV. 1799, 1803-05 (1994) (discussing the history and development of the commercial

admissible if it had a commercial value and was beyond the knowledge of the fact-finder.²⁷ The problems with this regime²⁸ were exposed in 1923 when James Frye attempted to introduce into evidence the results of a systolic blood pressure deception test.²⁹ This attempt was problematic because although the matter was beyond the fact-finder's knowledge, the test had no market value outside of the courtroom.³⁰ Judge Van Orsdel resolved the conflict by enacting a new standard of admissibility, which demanded that a scientific principle or discovery be "sufficiently established to have *gained general acceptance in the particular field in which it belongs*."³¹

Frye shifted the burden of analyzing the reliability of a theory from the judge to the relevant expert community.³² Supposedly, this shift made any admissible testimony more credible.³³ Despite its shortcomings,³⁴ *Frye* was the dominant standard for determining the admissibility of expert evidence for over seventy years.³⁵

marketplace test).

27. Saks, *supra* note 3, at 1073-74.

28. The fact that an area of knowledge has a commercial value does not (and never has) automatically mean it is scientifically valid. *See, e.g., id.* at 1074:

The marketplace test had serious flaws, two of which concern us here. First, the marketplace test was incapable of distinguishing astrophysics from astrology. The market values both of them. Commercial value, then, is not a measure of scientific validity. A second problem was that some fields have little or no life in any commercial marketplace. Indeed, the fields that are the focus of this Article have little or no function outside of their possible courtroom utility. The courtroom is their marketplace.

Id. (footnotes omitted).

29. *See Frye v. United States*, 293 F. 1013, 1013 (D.C. Cir. 1923).

30. Sally Melnick, *An Aura of Reliability: An Argument in Favor of Daubert*, 1 FLA. COASTAL L.J. 489, 491 (2000).

31. *Frye*, 293 F. at 1014 (emphasis added).

32. *See Melnick, supra* note 30, at 491.

33. *Id.*; *see also United States v. Addison*, 498 F.2d 741, 743-44 (D.C. Cir. 1974) ("The requirement of general acceptance in the scientific community assures that those most qualified to assess the general validity of a scientific method will have the determinative voice").

34. *See, e.g., Melnick, supra* note 30, at 492-93.

35. Maryellen Ryan, Comment, *Ensuring Justice Prevails in the Wake of*

In 1993, after two decades of Congress's failure to clarify whether the 1975 Federal Rules of Evidence ("FRE") superseded *Frye*,³⁶ in particular FRE 702,³⁷ the United States Supreme Court granted certiorari in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* to clarify the matter.³⁸ In *Daubert*, the Supreme Court found that FRE 702 superseded *Frye*.³⁹ In so holding, the Justices charged the courts with ensuring the

Theresa Canavan's Case: *A Proposal for Reform*, 36 NEW ENG. L. REV. 479, 480 (2002). *But see* Saks, *supra* note 3, at 1076.

In actuality, the *Frye* corollary was so minor a variant that it went unnoticed for decades. Indeed, Judge Van Orsdel himself ignored [the *Frye* standard] in another landmark scientific evidence case he handed down on the very same day he issued the *Frye* opinion. *Frye* was not cited by a single other court, federal or state, for a decade. During the first quarter century after its publication, *Frye* was cited in only eight federal cases and five state cases. That amounts to one case every other year in the entire country. During its second quarter century, it was cited fifty-four times in federal cases and twenty-nine times in state cases. The *Frye* test really was "discovered" only in the past few decades. Consequently, in the 1980's *Frye* was being cited as much each year as it had been in its first fifty years added together.

Id. (footnotes omitted).

36. Craig M. Cooley & Gabriel S. Oberfield, *Increasing Forensic Evidence's Reliability and Minimizing Wrongful Convictions: Applying Daubert Isn't the Only Problem*, 43 TULSA L. REV. 285, 287 (2007); *see also* Stephen A. Saltzburg, *Questioning the Judicial Role in Expert Testimony in Complex and Non-Complex Cases*, 3 SEDONA CONF. J. 185, 186 (2002) ("The Advisory Committee's Note, accompanying Rule 702 indicates that the Committee knew that '[t]he rule is broadly phrased,' and that the Committee believed that there was no better test of admissibility than to ask whether the testimony could assist the trier of fact." (alteration in original)).

37. The wording of FED. R. EVID. 702 departed from *Frye*. *See Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923); FED. R. EVID. 702.

38. *Daubert v. Merrell Dow Pharm, Inc.*, 509 U.S. 579, 582-85 (1993). In that case, the Daubert family alleged that the prenatal drug ingested by the mother, and manufactured by Merrell Dow, caused serious birth defects in her two children. Merrell Dow proffered the testimony of a chemical exposure expert, who found the drug was not a risk factor for human birth defects, whereas the Daubert family presented eight experts who concluded the drug could cause birth defects. The lower courts sided with Merrell Dow after concluding the Dauberts' experts did not satisfy *Frye*'s "general acceptance" standard. *Id.*

39. *Id.* at 597-98.

relevance and reliability of expert testimony,⁴⁰ and directed lower court judges to examine the principles and methodology of proffered scientific evidence, not just acceptance in the relevant scientific community.⁴¹ To assist the lower courts, the Supreme Court created a flexible, factor-based approach to analyze the reliability of expert testimony. These factors include: (1) whether a method can or has been tested;⁴² (2) the known or potential rate of error;⁴³ (3) whether the methods have been subjected to peer review;⁴⁴ (4) whether there are standards controlling the technique's operation;⁴⁵ and (5) the general acceptance of the method within the relevant community.⁴⁶

A number of criticisms have been leveled at *Daubert*,⁴⁷ which remains the leading standard for the admissibility of expert evidence.⁴⁸ First, *Daubert* forces judges to become

40. *See id.* at 591-92.

41. *Id.* at 592-93.

42. *Id.* at 593.

43. *Id.* at 594.

44. *Id.* at 593-94.

45. *Id.* at 594.

46. *Id.*

47. Lower courts struggled to interpret *Daubert*, causing the Supreme Court to clarify its ruling in two subsequent cases. In *Gen. Elec. Co. v. Joiner*, 522 U.S. 136 (1997), the Court determined that an appellate court, reviewing a trial court's decision to admit or exclude expert testimony under *Daubert* should apply the "abuse of discretion" standard. In so holding, the Supreme Court limited the role of appellate courts in deciding whether to admit or exclude expert evidence, and emphasized that the main "gate-keeping" power remained with the trial judge. In *Kumho Tire v. Carmichael*, 526 U.S. 137 (1999), the Justices held that *Daubert* applied to all expert testimony, not just scientific testimony. This silenced claims that *Daubert* did not apply to the soft sciences. The Justices also held that trial courts may consider the five *Daubert* factors to the extent they are relevant. In other words, the Supreme Court did not endorse strict application of the *Daubert* factors.

48. Note that Congress amended Rule 702 in 2000 to codify the "*Daubert* Trilogy." FED. R. EVID. 702 now reads,

[i]f scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods,

“amateur scientists.”⁴⁹ Scholars argue that judges “do not think like scientists” and therefore do not have the capacity to ensure only reliable science enters the courtroom.⁵⁰ As Saks notes:

Just as legal training teaches one the intellectual skills to analyze legal problems, scientific training teaches one how to analyze empirical questions and proposed answers. This places judges in a weak position to know what questions need to be asked in order to test an empirical claim or how to evaluate the data offered in answer.⁵¹

Still, it is arguable that pre-existing mechanisms within the legal process can help judges overcome this criticism. For example, judges can use pre-trial conference authority to narrow the disputed scientific issues; conduct pre-trial hearings where the court can examine potential experts; and appoint independent experts, special masters, and specially trained law clerks.⁵² A less sympathetic view contends that because trial courts are the principal consumer of scientific expertise, judges should simply “learn to evaluate what they are getting for their dollar.”⁵³

A second criticism is that *Daubert*, and its progeny, significantly (and inappropriately) tip the delicate balance of power between judge and jury in favor of the judge when it comes to evaluating expert testimony.⁵⁴ If, however, one

and (3) the witness has applied the principles and methods reliably to the facts of the case.

STAFF OF H. COMM. ON THE JUDICIARY, 111TH CONG., FEDERAL RULES OF EVIDENCE 9 (Comm. Print 2010). Like *Daubert* and its progeny, Rule 702 forces courts to question the empirical underpinnings of all expert testimony and to exclude opinions that are “connected to existing data only by the *ipse dixit* of the expert.” *Kumho*, 526 U.S. at 157.

49. *Daubert*, 509 U.S. at 601 (Rehnquist, C.J., dissenting).

50. Saks, *supra* note 3, at 1136.

51. *Id.*

52. *Joiner*, 522 U.S. at 149-50 (Breyer, J., concurring).

53. FAIGMAN, *supra* note 12, at 64.

54. Ryan, *supra* note 35, at 491.

subscribes to the view that the juror population has succumbed to a “CSI Effect,”⁵⁵ this criticism is perhaps diluted. As Shelton describes:

It is widely perceived . . . that modern juries give a great deal of weight to scientific evidence. They complain that jurors today demand more from the prosecution in the way of scientific evidence and that they will wrongfully acquit defendants when such evidence is not presented. Most of the blame for these expectations is heaped on a single television show, *CSI* (and its spin-offs), to the degree that it has become known, both in the popular media and in legal circles, as the “CSI effect.”⁵⁶

In partial support of this view,⁵⁷ a study conducted by

55. Shelton, *supra* note 1, at 371.

56. *Id.*; see also Kimberlianne Podlas, “The CSI Effect”: Exposing the Media Myth, 16 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 429, 433 (2006).

The best-known definition states that CSI creates unreasonable expectations on the part of jurors, making it more difficult for prosecutors to obtain convictions. The second definition, which runs contrary to the first, refers to the way that CSI raises the stature of scientific evidence to virtual infallibility, thus making scientific evidence impenetrable.

Id.

57. It should be noted that, overall, Shelton’s study (and studies subsequent to it) found that jurors’ increased expectations and demands for scientific evidence are *not* related to watching *CSI* or similar television programs. Instead, Shelton found

[r]ather than any direct “CSI effect” from watching certain types of television programs . . . these juror expectations of and demands for scientific evidence are the result of broader changes in popular culture related to advancements in both technology and information distribution. Those broad and pervasive changes in technology lead jurors to expect that the prosecutor will obtain and present the scientific evidence that technology has made possible. These increased expectations and demands of jurors therefore could be more accurately referred to as the tech effect.

Shelton found that jurors “expect prosecutors to present scientific evidence and that, especially in cases where the rest of the evidence is circumstantial, they will demand scientific evidence before they will return a verdict of guilty.”⁵⁸ On the other hand, a study by Podlas returned data that denied “the existence of any negative effect of *CSI* on ‘not guilty’ verdicts. . . . If anything, the data hints that, if there is any effect of *CSI*, it is to exalt the infallibility of forensic evidence, favor the prosecution, or pre-dispose jurors toward findings of guilt.”⁵⁹

By inviting stakeholders in the criminal justice system to take a new look at old scientific evidence, *Daubert* has made many scientific evidence-related precedents vulnerable to reconsideration and reversal.⁶⁰ The identification methods employed by many forensic sciences, including fingerprint identification, firearms identification, bite mark identification, and arson investigation, are among the most vulnerable.⁶¹ Part III details the methods employed by these four disciplines, which are allegedly open to *Daubert* challenges.

Shelton, Kim & Barak, *supra* note 4, at 368.

58. Shelton, *supra* note 1, at 372.

59. Podlas, *supra* note 56, at 465 (emphasis added). Despite this result, Podlas advocates for stakeholders in the criminal justice system to tackle the concept of the *CSI* Effect.

Unfortunately, notwithstanding the evidence disputing a “*CSI* Effect,” if the public, the media, and the legal system do not accept or learn of this “proof,” accusations of the “*CSI* Effect” will continue. Ultimately, much like the unfounded tort crisis, *CSI* horror stories of justice denied may drive legal “reforms” when no reforms are needed or cause the issue to improperly enter trial arguments. Consequently, before the “*CSI* Effect” has time and media repetition to embed itself into the psyche of the public and members of the justice system, it should be exposed for what it is: nothing more than fiction.

Id.

60. Saks, *supra* note 3, at 1072.

61. *Id.* Note that some commentators were skeptical about *Daubert*'s likely impact on forensic science. See, e.g., Randolph Jonakait, *The Meaning of Daubert and What it Means for Forensic Science*, 15 *Cardozo L. Rev.* 2103 (1994).

III. Methods and Mistakes of Identification: Fingerprint Identification, Firearms Identification, Bite-Mark Identification, and Arson Investigation

A. *Fingerprint Identification*

When a person's hand (or foot) touches certain surfaces, the ridges on their skin leave a printed impression on the surface touched. For over a century, the practice of "matching" a crime scene print to an inked suspect print, known as friction ridge analysis, has gained universal acceptance.⁶² Proponents of fingerprint identification make three crucial claims: (1) every individual possesses a unique and permanent set of fingerprints;⁶³ (2) fingerprint examiners can identify the donor of a crime scene print ("latent print") "to the exclusion of all others;"⁶⁴ and (3) fingerprint identification is infallible and has a zero, or close to zero, error rate.⁶⁵ The most common method of fingerprint identification in the United States is the Analysis-Comparison-Evaluation-Verification ("ACE-V")

62. Saks, *supra* note 3, at 1101.

63. Nathan Benedict, *Fingerprints and the Daubert Standard for Admission of Scientific Evidence: Why Fingerprints Fail and a Proposed Remedy*, 46 ARIZ. L. REV. 519, 527 (2004).

64. Jacqueline McMurtrie, *Swirls and Whorls: Litigating Post-C conviction Claims of Fingerprint Misidentification After the NAS Report*, 2010 UTAH L. REV. 267, 273 ("The fingerprint literature suggests that examiners testify as follows: Q: How sure are you that those two prints were made by the same finger? A: Absolutely sure! I don't testify to probabilities.") (internal quotation marks omitted).

65. *Id.* at 273-74.

[T]he third premise of fingerprint identifications is one of "infallibility." Many in the latent fingerprint community also testify that the ACE-V comparison method has a "zero error rate." They claim that when the method is used by well-trained and experienced examiners, no errors are ever made, so that the method itself is error free. Thus, the claim is that erroneous identifications are only made by poorly trained or inexperienced practitioners. In other words, the "methodological" (sometimes called "scientific") error rate is zero while the "practitioner" (sometimes called "human") error rate is unknown.

Id. (footnotes omitted).

method.⁶⁶ To conduct an examination using this method, the fingerprint examiner needs a latent print and a known print (“suspect print”).⁶⁷

“The *analysis* phase relies on a ‘qualitative and quantitative’ assessment of friction ridge detail at three levels of granularity: (1) ridge flow . . .; (2) individual ridge examination . . .; and (3) . . . [an] examination of pores.”⁶⁸ The latent print is analyzed first, followed by the suspect print.⁶⁹ “The *comparison* phase involves a side-by-side observation” of both the latent print and the suspect print.⁷⁰ The examiner observes the “friction ridge detail to determine if the details match in similarity, sequence, and spatial relationship.”⁷¹ No set number of similarities (i.e., “points”) are indicative of a “match.”⁷² The *evaluation* phase “requires the examiner to form a conclusion about the prints”: (1) the prints may match (“individualization” or “identification”); (2) the prints may not match (“exclusion”); or (3) the results may be inconclusive.⁷³ The *comparison* and *evaluation* phases both require the examiner to exercise independent judgment, which is based on

66. See *Commonwealth v. Patterson*, 840 N.E.2d 12, 14 n.2 (Mass. 2005).

67. *United States v. Aman*, 748 F. Supp. 2d 531, 539 (E.D. Va. 2010).

68. *Id.* “The first level of detail can be used to exclude but not identify, a print, while a combination of the second and third levels of detail may allow for either identification or exclusion. If either . . . print is unsuitable for examination, the analysis ends.” *Id.*

69. *Id.*

70. *Id.*

71. *Id.* “[D]ifferences in the fingerprints do not necessarily end the analysis; rather, the examiner must determine whether the dissimilarity is explainable given pressure differences, surface texture, print medium (e.g., ink, sweat, or blood), and other expected variations.” *Id.*

72. *Id.*

No set number of similarities—sometimes known as “points”—indicates a “match,” since it is both the quantity and quality of similarities that allow for identification. Likewise, the number of explained dissimilarities—that is, dissimilarities believed to be the result of expected variations—is not dispositive either for or against finding a match.

Id.

73. *Id.*

individual training and experience.⁷⁴ In the final phase, *verification*, “a second examiner is provided the same prints and checks the work of the first examiner.”⁷⁵

However, fingerprint identification is not error-free. The most high profile example of a debunked fingerprint “match” is in the case of Brandon Mayfield.⁷⁶ In March 2004, the Madrid bombings killed 192 people and injured thousands.⁷⁷ A bag of detonators found near the explosion site contained a fingerprint.⁷⁸ Three FBI examiners concluded that the print was an “[one hundred] percent positive identification” of Brandon Mayfield, an Oregon attorney.⁷⁹ After two weeks in prison, Mayfield was released due to an erroneous identification.⁸⁰ An Algerian suspect’s DNA was found in an inculpatory area,⁸¹ and his prints closely “matched” those found on the bag of detonators at the explosion site.⁸²

B. *Firearms Identification*

American courts have admitted firearms identification evidence for over eighty years.⁸³ Investigators regularly seek to identify a particular gun as the source of suspect ammunition.⁸⁴ When the hard metal of an internal part of a gun connects with the softer metal of the ammunition, the gun

74. *Id.*

75. *Id.* Notably, the second examiner is aware of the first examiner's conclusion.

76. Professor Simon Cole has labeled the Mayfield error as “probably the most highly publicized fingerprint error ever exposed.” Simon A. Cole, *More than Zero: Accounting for Error in Latent Fingerprint Identification*, 95 J. CRIM. L. & CRIMINOLOGY 985, 985 (2005).

77. Elaine Sciolino, *Bombings in Madrid: The Attack; 10 Bombs Shatter Trains in Madrid, Killing 192*, N.Y. TIMES, Mar. 12, 2004, at A1.

78. Cooley & Oberfield, *supra* note 36, at 325.

79. *Id.* (internal quotation marks omitted).

80. Susan Schmidt, *Oregon Lawyer's Status Remains Murky*, WASH. POST, May 22, 2004, at A2.

81. Tomas Alex Tizon et al., *Critics Galvanized by Oregon Lawyer's Case*, L.A. TIMES, May 22, 2004, at A13.

82. *See* Schmidt, *supra* note 80.

83. *See* 4 DAVID L. FAIGMAN ET AL., MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY § 35:1, at 642-43 (2011-2012 ed. 2011).

84. Shelton, *supra* note 1, at 335.

makes a “tool-mark” on the ammunition.⁸⁵ Tool-marks can be divided into class, sub-class, and individual characteristics.⁸⁶ Class characteristics are the distinctively designed features of a class of tools, and are present on every tool in that class.⁸⁷ Individual characteristics are unique to a particular tool, and consist of random, microscopic imperfections and irregularities on the tool’s surface.⁸⁸ Sub-class characteristics straddle the line between class and individual characteristics.⁸⁹ These characteristics arise when manufacturing processes create batches of tools that are similar to each other, but that are distinct from other tools of the same class.⁹⁰ Firearms identification is premised on the notion that a weapon leaves unique tool-marks on the ammunition it fires, and those marks are reproduced each time the weapon is discharged.⁹¹ Thus, many firearms examiners believe they have the ability to conclude that a particular gun fired a particular bullet to the “exclusion of all other[s]”⁹²

However, examiners can be very conflicted in their views of the same evidence. For example, during a 1989 investigation of several prostitution-related murders, Rickey Ross, a Sheriff’s Deputy, was arrested for soliciting and accompanying a prostitute.⁹³ In three of the murder cases, the offender shot the prostitutes with a handgun.⁹⁴ Two police officers concluded that

85. When a gun is fired, two distinct types of tool-marks may be created: striations and impressions. Striations are similar to small scratches, and are most often produced on the bullet as it passes through the gun barrel. Impressions usually resemble dimples or craters, and are typically produced on the cartridge as it comes into contact with the various internal parts of the firing chamber (e.g. the firing pin, breach face, extractor, and ejector). Adina Schwartz, *Challenging Firearms and Toolmark Identification—Part One*, CHAMPION MAG., Oct. 2008, at 10, 12.

86. *Id.*

87. *Id.*

88. *Id.*

89. *See id.*

90. *Id.* Sub-class characteristics cannot be said to be individual characteristics because they are shared by more than one tool. Nor can they be said to be class characteristics because they are not shared by every tool in that class.

91. *See* Shelton, *supra* note 1, at 335-36.

92. Schwartz, *supra* note 85, at 14.

93. Cooley & Oberfield, *supra* note 36, at 338-39.

94. *Id.* at 339.

Ross's firearm and "no other weapon" could have discharged the fatal bullets.⁹⁵ Ross was charged with murdering three prostitutes, but was later released when three other experts concluded that the evidence "overwhelmingly exclude[d]" Ross's firearm as the offending weapon.⁹⁶

In 1998, the Association of Firearms and Toolmark Examiners ("AFTE")⁹⁷ developed a protocol detailing when an examiner may reach a certain conclusion ("AFTE Protocol").⁹⁸ Presently, the AFTE Protocol is the industry standard by which examiners conduct their examinations. Under the AFTE Protocol, an examiner may make one of the following four conclusions: (1) identification, (2) inconclusive, (3) elimination, or (4) unsuitable for comparison.⁹⁹ To make an "identification" (i.e., a "match"), there must be "sufficient agreement" between the tool-marks present on ammunition found at a crime scene and a test cartridge fired from a suspect weapon.¹⁰⁰

95. *Id.* at 338.

96. *Id.* at 339 (alteration in original) (internal quotation marks omitted).

97. The AFTE is an international organization of firearms and toolmark examiners and is the leading professional organization in the field.

98. Ass'n of Firearms & Toolmark Exam'rs, *Theory of Identification as It Relates to Toolmarks*, 30 ASS'N FIREARMS & TOOLMARK EXAMINERS J., no. 1, Winter 1998, at 86. The AFTE Protocol is meant to be a practical application of the AFTE's Theory of Identification.

99. *Id.* at 86-87. These conclusions apply to the identification of a weapon as a whole, not simply to the individual marks an examiner may be comparing. That is, the AFTE's protocol does not anticipate conclusions that, for instance, the firing pin marks are Identifications, the breach face marks are Inconclusive, and the ejector marks are Eliminations. Such a schizophrenic application of the protocol would be of no use to a jury. Rather, the protocol anticipates that the *combination* of the marks examined will cumulatively reveal which conclusion the examiner may reach regarding the weapon itself. A conclusion is "Inconclusive" (e.g. a particular weapon may, or may not, have made a particular mark) when there is: "[s]ome agreement of individual characteristics and all discernable class characteristics, but insufficient for identification," *Id.* at 87; or "[a]greement of all discernable class characteristics without agreement or disagreement of individual characteristics due to an absence, insufficiency, or lack of reproducibility," *Id.*; or "[a]greement of all discernible class characteristics and disagreement of individual characteristics, but insufficient for elimination." *Id.* An "elimination" (i.e., a particular weapon did not make a particular mark) is made when there is "[s]ignificant disagreement of discernable class characteristics and/or individual characteristics." *Id.* Finally, where the marks presented are "unsuitable for comparison," the examiner must make no conclusion. *Id.*

100. The AFTE Theory of Identification allows an examiner to conclude

C. Bite Mark Identification

Bite-mark identification is a specialized subset within the broader discipline of forensic odontology.¹⁰¹ In a criminal case, forensic odontologists “compare a suspect’s dentition with a latent mark left in the victim’s flesh, or in some edible substance found at the scene of the crime,” to determine whether the two samples “match.”¹⁰² “The basic premise underlying bite mark forensic evidence is that human dentition is unique”¹⁰³ Thus, bite mark evidence is considered a method of individualization. Since 1980, nearly all American states have admitted bite mark evidence.¹⁰⁴

The American Board of Forensic Odontology (“ABFO”) developed “the first standardized guidelines for the collection and analysis of bite mark evidence.”¹⁰⁵ According to these guidelines, “[t]he standard comparison technique . . . is to match a photograph or model of the bite mark to a template of the suspect’s dentition through an overlay technique at the same scale.”¹⁰⁶ “The ABFO has created a scoring guide to evaluate the strength of the comparison. Points are awarded

that a particular tool made a particular mark when there is “sufficient agreement” between the tool and the mark. “Sufficient agreement” exists when “the agreement is of a quantity and quality that the likelihood another tool could have made the mark is so remote as to be considered a practical impossibility.” AFTE Criteria for Identification Committee, *Theory of Identification, Range of Striae Comparison Reports and Modified Glossary Definitions – an AFTE Criteria for Identification Committee Report*, 24 ASS’N FIREARMS & TOOLMARK EXAMINERS J. no. 2, April 1992, at 336-40.

101. Saks, *supra* note 3, at 1119.

102. *Id.*

103. Shelton, *supra* note 1, at 346. Many courts have accepted the basic concept of dental uniqueness. See Erica Beecher-Monas, *Reality Bites: The Illusion of Science in Bite-Mark Evidence*, 30 CARDOZO L. REV. 1369, 1372 (2008).

104. See 5 DAVID L. FAIGMAN ET AL., MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY § 37:4, at 6 (2011-2012 ed. 2011).

105. Steven Weigler, *Bite Mark Evidence: Forensic Odontology and the Law*, 2 HEALTH MATRIX 303, 307 (1992). “In its statement of purpose, [ABFO] noted that ‘careful use of these guidelines in bite mark analysis will enhance the quality of the investigation and the conclusions.’” *Id.* at 307-08. The guidelines advise experts in relation to “the description of the bite mark, collection of the evidence from the victim, collection of the evidence from the suspect, and the analysis of the evidence.” *Id.*

106. *Id.* at 309 (footnotes omitted).

for various matches in gross dental anatomy, tooth position, and intradental features.”¹⁰⁷

ABFO guidelines do not protect all criminal defendants. In 1991, Ray Krone was convicted of murdering a bartender who was found with a bite mark on her breast. Prior to trial, a FBI odontologist told investigators that it “could not have been clearer” that Krone was not the donor of the bite mark.¹⁰⁸ However, at trial, the state’s expert testified that there was a “definite match” between Krone’s teeth and the bite mark.¹⁰⁹ The state’s expert also misstated some relevant statistics while testifying: “the possibilities of two teeth being in the same position, it would be 150 times 150, whatever that is. Maybe 1200 or something like that.”¹¹⁰ In 2002, DNA evidence exonerated Krone and identified the real culprit.¹¹¹

107. *Id.* (footnotes omitted).

A 1986 study published in the *Journal of Forensic Sciences* reports a high degree of reliability associated with the use of the scoring guide. However, in 1988, the authors of the 1986 study seemed to recant their initial optimism when they stated: Subsequent discussion and review has led the authors to the conclusion that much more work and consideration will be needed before a stable and accurate index is developed that can be widely applied. . . . [T]he authors' present recommendation is that all odontologists await the results of further research before relying on precise point counts in evidentiary proceedings.

The scoring guidelines are merely a guide and should not be relied upon exclusively. *Id.* (alteration in original) (footnotes omitted).

108. BRANDON L. GARRETT, *CONVICTING THE INNOCENT: WHERE CRIMINAL PROSECUTIONS GO WRONG* 103-05 (1st ed. 2011) (quoting Robert Nelson, *About Face*, PHX. NEW TIMES, Apr. 21, 2005, <http://www.phoenixnewtimes.com/2005-04-21/feature/about-face/>).

109. *Id.* at 104 (internal quotation marks omitted).

110. *Id.* at 103 (internal quotation marks omitted).

111. *Id.* at 103-04.

D. *Arson Investigation*

There are two types of fires: accidental fires and incendiary fires.¹¹² The latter are treated as arson.¹¹³ Arson prosecutions often depend on whether the prosecution can show the presence of a chemical accelerant at the scene of the fire.¹¹⁴ Fire investigators use chemical tests and their training and experience to identify alleged physical hallmarks of arson.¹¹⁵ These hallmarks include pour patterns, “spider-web” glass, brown stains on the floor, and “V” shaped soot marks.¹¹⁶ Fire investigators often testify to observing these hallmarks in arson cases.¹¹⁷

This practice has its limitations, however. In 1987, Ernest Willis was sentenced to death for purposely setting a fire that resulted in two deaths. The prosecution’s case rested primarily on arson experts who testified to identifying a number of arson hallmarks at the crime scene.¹¹⁸ Willis maintained that he was innocent.¹¹⁹ No accelerant was detected on Willis’s clothes, and prosecutors “never produced any evidence regarding the type of accelerant used to start the fire”¹²⁰ In August 2004, the district court, taking into account expert evidence discrediting the validity of the arson hallmarks, granted Willis’s writ of habeas corpus.¹²¹ The state declined to appeal or retry Willis, and Willis was freed from death row in October 2004.¹²²

112. See Bruce L. Ottley, *Beyond the Crime Laboratory: The Admissibility of Unconfirmed Forensic Evidence in Arson Cases*, 36 NEW ENG. J. ON CRIM. & CIV. CONFINEMENT 263, 269 (2010).

113. *Id.*

114. *Id.* at 266.

115. David Grann, *Trial By Fire—Did Texas Execute an Innocent Man?*, THE NEW YORKER, Sept. 7, 2009, available at http://www.newyorker.com/reporting/2009/09/07/090907fa_fact_grann.

116. *Id.*

117. See *Id.*

118. It was said that burn patterns and the degree of burning indicated that a flammable liquid was poured on the floor of the house. See Cooley & Oberfield, *supra* note 36, at 329–31.

119. *Willis v. Texas*, 785 S.W.2d 378, 380 (Tex. Crim. App. 1989), *overruled by Estrada v. Texas*, 313 S.W.3d 274 (Tex. Crim. App. 2010).

120. *Id.* at 330 (internal quotation marks omitted).

121. *Id.*

122. *Id.* at 331.

The National Fire Protection Agency (“NFPA”) produced a guide for fire and explosion Investigations (“NFPA 921”).¹²³ NFPA 921 recommends that investigators use the well-known “scientific method” of generating and testing hypotheses to determine the cause of a fire.¹²⁴ The NFPA 921 guide details how fire patterns, burn damage, and other evidence can be used to explain the cause and origin of a fire, but it also requires investigators to exclude nine non-arson causes for certain fires before reaching a conclusion that the fire was incendiary.¹²⁵

The methods employed in the fields of fingerprint identification, firearms identification, bite mark identification, and arson investigation all assist the criminal justice process by providing expert knowledge capable of identifying the perpetrator of a crime to the exclusion of all others. DNA exonerations and questionable prosecutions expose the flaws of these disciplines: they are not underpinned by the scientific method; they have unknown error-rates; they rely heavily on subjective and experience-based evaluations, which can widely diverge; they allow for overstated conclusions; and they are governed by inadequate standards. These weaknesses fuelled the school of thought that these disciplines are inadmissible under *Daubert*.¹²⁶ This school of thought intensified when the NAS produced its 2009 report, *Strengthening Forensic Science in the United States: A Path Forward*. The report’s findings will be considered in Part IV.

123. NFPA 921 is a three-hundred-page manual originally published in 1992 and updated periodically thereafter. As the manual itself explains, NFPA 921 was developed by the Technical Committee on Fire Investigations, which includes dozens of fire investigators from local, state, and national agencies. As the list of committee members suggests, and as confirmed by Robbins's own testimony, NFPA 921 has been peer-reviewed and is generally accepted in the community of fire investigators. The NFPA 921 has been widely disseminated in the field of fire investigation. *United States v. Aman*, 748 F. Supp. 2d 531, 535 (E.D. Va. 2010).

124. This methodology consists of seven steps: “(1) identify the problem; (2) define the problem; (3) collect data; (4) analyze the data; (5) develop a hypothesis; (6) test the hypothesis; and (7) following any repeated rounds of refining and testing the hypothesis, select the final conclusion.” *Id.* at 535.

125. *Id.* at 535-36.

126. Jennifer L. Mnookin et al., *The Need for a Research Culture in the Forensic Sciences*, 58 UCLA L. REV. 725, 726-27 (2011).

IV. The Findings of the National Academy of Sciences:
*Strengthening Forensic Science in the United States: A Path
Forward* (2009)

Congress recognized the need for significant improvements in the forensic science system, and in 2005 commissioned the National Academy of Sciences to explore these problems. The purpose of the Academy, one of the world's premier sources of independent, expert advice on scientific issues, was to report on the past, present, and future use of forensic science in America.¹²⁷ The Academy spent two years collaborating with legal and scientific scholars and practitioners.¹²⁸ It heard over eighty witnesses during sixteen days of testimony.¹²⁹ The Academy issued a report containing its findings in 2009.

The report was billed as a “blockbuster” that [would overhaul] the legal landscape regarding forensic evidence,¹³⁰ addressed the veracity of numerous forensic disciplines, and made many eye-opening findings. The report concluded that the forensic science system had “serious problems,”¹³¹ faced many challenges,¹³² and was accountable for multiple wrongful

127. NAS REPORT, *supra* note 2, at xix.

128. *Id.* at xix-xx.

129. *Id.* at 2.

130. McMurtrie, *supra* note 64, at 267.

131. NAS REPORT, *supra* note 2, at xx.

In considering the testimony and evidence that was presented to the committee, what surprised us the most was the consistency of the message that we heard: The forensic science system, encompassing both research and practice, has serious problems that can only be addressed by a national commitment to overhaul the current structure that supports the forensic science community in this country. This can only be done with effective leadership at the highest levels of both federal and state governments, pursuant to national standards, and with a significant infusion of federal funds.

Id.

132. *Id.* at 4-5. These challenges range from the lack of mandatory standardization, certification, and accreditation to problems associated with the interpretation of forensic evidence, to the need for research to establish limits and measures of performance. *Id.* at 6.

convictions.¹³³ On the basis of the evidence before it, the NAS concluded, *inter alia*, that (1) “with the exception of nuclear DNA analysis . . . no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source”¹³⁴ and (2) the existing legal framework governing the admissibility of forensic evidence in the United States was inadequate for resolving the problems identified.¹³⁵ Additionally, the report made some specific findings regarding fingerprint identification, firearms identification, bite mark identification, and arson investigation.

A. *Fingerprint Identification*

The NAS Report acknowledged that “friction ridge analysis has served as a valuable tool, both to identify the guilty and to exclude the innocent,” and gave some support to the discipline’s

133. *Id.* at 4.

Those advances [DNA evidence testing], however, also have revealed that, in some cases, substantive information and testimony based on faulty forensic science analyses may have contributed to wrongful convictions of innocent people. This fact has demonstrated the potential danger of giving undue weight to evidence and testimony derived from imperfect testing and analysis. Moreover, imprecise or exaggerated expert testimony has sometimes contributed to the admission of erroneous or misleading evidence.

Id.

134. *Id.* at 7.

135. *Id.* at 85.

The report finds that the existing legal regime—including the rules governing the admissibility of forensic evidence, the applicable standards governing appellate review of trial court decisions, the limitations of the adversary process, and judges and lawyers who often lack the scientific expertise necessary to comprehend and evaluate forensic evidence—is inadequate to the task of curing the documented ills of the forensic science disciplines.

Id.

ability to engage in individualization.¹³⁶ Due to the amount of detail available in friction ridges, NAS opined “[it’s] plausible that a careful comparison of two impressions can accurately discern whether or not they had a common source.”¹³⁷ The report agreed that some scientific evidence supports the presumption that friction ridge patterns are unique and remain unchanged throughout a lifetime.¹³⁸

However, the report also found that the discipline was not “properly” underpinned.¹³⁹ The NAS Report’s criticism spanned four areas. First, NAS found that ACE-V is not “specific enough to qualify as a validated method” because it “does not guard against bias; is too broad to ensure repeatability and transparency; and does not guarantee that two analysts following it will obtain the same results.”¹⁴⁰ Thus, following ACE-V did not mean that one was “proceeding in a scientific manner or producing reliable results.”¹⁴¹ Second, NAS thought examiners needed to better document their analysis.¹⁴² Third, NAS opined that claims of a zero error-rate are clearly “unrealistic.”¹⁴³ Fourth, NAS determined that more research is needed into ridge patterns and distribution, discriminating values and items that affect the quality of latent prints.¹⁴⁴

136. *Id.* at 142.

137. *Id.*

138. *Id.* at 143-44.

139. *Id.* at 144.

140. *Id.* at 142.

141. *Id.*

142. *Id.* at 143 (“Better documentation is needed of each step in the ACE-V process or its equivalent. At the very least, sufficient documentation is needed to reconstruct the analysis, if necessary.”).

143. *Id.*

144. *Id.* at 144-45. The NAS Report acknowledged that “additional research is also needed into ridge flow and crease pattern distribution on the hands and feet . . . , [and] more research is needed regarding the discriminating value of the various ridge formations and clusters of ridge formations.” *Id.* at 144.

B. Firearms Identification

The NAS Report found that class characteristics can be “helpful in narrowing the pool of tools that may have left a distinctive mark,”¹⁴⁵ and that individual characteristics “might, in some cases, be distinctive enough to suggest one particular source.”¹⁴⁶ However, overall, the report concluded that “the scientific knowledge base for tool mark and firearms analysis is fairly limited.”¹⁴⁷ In order to make the process of individualization more precise and repeatable, the report concluded “additional studies should be performed.”¹⁴⁸ It further concluded that the AFTE Protocol was not defined in a sufficiently precise way for examiners to follow, particularly in relation to when an examiner can “match” two samples.¹⁴⁹ The report berated the protocol, stating “[t]his AFTE document, which is the best guidance available for the field of tool mark identification, does not even consider, let alone address, questions regarding variability, reliability, repeatability, or the

145. *Id.* at 154.

146. *Id.*

147. *Id.* at 155.

148. *Id.* at 154. Some studies have been performed to consider the degree of similarity that can be found between marks made by different tools and the variability in marks made by individual tool.

149. *Id.* at 155.

As noted above, AFTE has adopted a theory of identification, but it does not provide a specific protocol. It says that an examiner may offer an opinion that a specific tool or firearm was the source of a specific set of tool-marks...when ‘sufficient agreement’ exists in the pattern of two sets of marks.

Id. The standards define agreement as significant

when it exceeds the best agreement demonstrated between tool marks known to have been produced by different tools and is consistent with the agreement demonstrated by tool marks known to have been produced by the same tool. The meaning of “exceeds the best agreement” and “consistent with” are not specified, and the examiner is expected to draw on his or her own experience.

Id. (internal quotation marks omitted).

number of correlations needed to achieve a given degree of confidence.”¹⁵⁰

C. *Bite Mark Identification*

The NAS Report found that “it is reasonable to assume that the process [bite mark identification] can sometimes reliably exclude suspects.”¹⁵¹ However, the report firmly rejected the notion that experts can identify a person, by their bite mark, “to the exclusion of all others.”¹⁵² The NAS found that there is no scientific basis for such claims¹⁵³ and was concerned by the controversial nature of bite mark identification,¹⁵⁴ the high rate of false-positive results,¹⁵⁵ and the fact that “experts diverge widely in their evaluations of the same bite-mark evidence.”¹⁵⁶ The report acknowledged that the ABFO guidelines attempt to standardize experts’ analysis, but criticized the guidelines for not offering scientific criteria for determining when a bite mark can be related to a person’s dentition and with what degree of probability.¹⁵⁷

D. *Arson Analysis*

The NAS Report found that conclusions by fire investigators that a particular fire was arson, on the basis of rules of thumb, are not well founded.¹⁵⁸ The report stated:

Despite the paucity of research, some arson investigators continue to make determinations about whether or not a particular fire was set. However, according to testimony presented to the committee, many of the rules of thumb that are

150. *Id.*

151. *Id.* at 176.

152. *Id.*

153. *Id.*

154. *Id.* at 173.

155. *Id.* at 174.

156. *Id.* at 176.

157. *Id.*

158. *Id.* at 173.

typically assumed to indicate that an accelerant was used (e.g., “alligatoring” of wood, specific char patterns) have been shown not to be true. Experiments should be designed to put arson investigations on a more solid scientific footing.¹⁵⁹

To help tackle the various shortcomings of forensic science, the NAS Report made thirteen recommendations, which included the creation of an entirely “new, strong, and independent” federal agency – The National Institute of Forensic Science (“NFIS”).¹⁶⁰ NFIS would objectively oversee and regulate the practices of forensic science to ensure the development of rigorous research to determine the capabilities and the limits of forensic science.¹⁶¹ NFIS would have “no ties to the past,”¹⁶² but “the authority and resources to implement a fresh agenda designed to address the problems” identified in the 2009 NAS Report.¹⁶³

The Academy recommended that one area NFIS should focus upon is “developing programs to improve understanding of the forensic science disciplines and their limitations within legal systems.”¹⁶⁴ Whether this envisions NFIS playing a role in improving the existing legal frameworks that govern the admissibility of forensic evidence, is unclear. One thing that is clear, however, is that American courts need help in evaluating forensic science. Despite the fact that (1) *Daubert* demands courts to ensure that forensic evidence rests on a reliable foundation, (2) scores of DNA exonerations have exposed the unreliability of various other forensic disciplines and examiners, and (3) the NAS has confirmed that the forensic science system has serious problems, many American courts are still failing to discern the differences between valid and invalid science. Despite the fact that our understanding of forensic science is changing, the law is responding slowly,

159. *Id.* (footnotes omitted).

160. *Id.* at 18, 19-33.

161. *Id.* 19-22.

162. *Id.* at 18.

163. *Id.*

164. *Id.* at 19-20 (Recommendation 1(h)).

reluctantly and often inconsistently. A snapshot of cases involving fingerprint identification, firearms identification, bite mark identification, and arson investigation, between 2000 and 2011, support this view. These cases are critically evaluated in Part V.

V. A Critical Survey of American Criminal Court Responses to Legal Challenges Concerning Fingerprint Identification, Firearms Identification, Bite Mark Identification, and Arson Investigation Between 2000 and 2011

A. *Fingerprint Identification*

In 2002, Judge Pollak of the United States District Court for the Eastern District of Pennsylvania surprised the American criminal justice system. In *United States v. Llera Plaza (Llera Plaza I)*, after a *Daubert* review, Judge Pollak held that “no expert witness for any party will be permitted to testify that, in the opinion of the witness, a particular latent print is—or is not—the print of a particular person.”¹⁶⁵ Judge Pollak’s ruling was the first “successful” defense challenge to fingerprint identification evidence.¹⁶⁶ However, as Lawson explains, “Judge Pollak’s ruling was not radical. Pollak appears to be the first judge to fully analyze the scientific validity of fingerprints under the true tenets of the *Daubert-Kumho* standard. . . . [T]he expert’s ultimate conclusion regarding identity . . . lacked scientific validity.”¹⁶⁷

Llera Plaza I was short-lived, however. Weeks later, Judge Pollak reversed his decision.¹⁶⁸ The reversal (*Llera Plaza II*) was based on Judge Pollak’s finding that the FBI’s ACE–V process was “essentially indistinguishable” from that of

165. *United States v. Llera Plaza (Llera Plaza I)*, Nos. 98-cr-362-10, 98-cr-362-11, 98-cr-362-12, 2002 WL 27305 (E.D. Pa. Jan. 7, 2002), *vacated and superseded*, 188 F. Supp. 2d 549 (E.D. Pa. 2002).

166. Tamara F. Lawson, *Can Fingerprints Lie?: Re-Weighing Fingerprint Evidence in Criminal Jury Trials*, 31 AM. J. CRIM. L. 1, 34-35 (2003).

167. *Id.* at 36.

168. *United States v. Llera Plaza (Llera Plaza II)*, 188 F. Supp. 2d 549 (E.D. Pa. 2002) (vacating and superseding the prior decision upon reconsideration).

England's New Scotland Yard.¹⁶⁹ Judge Pollak bowed to precedent, stating "to postpone present in-court utilization of this 'bedrock forensic identifier' pending such research would be to make the best the enemy of the good."¹⁷⁰

Soon after *Llera Plaza I* and *Llera Plaza II*, the Fourth Circuit Court of Appeals considered *United States v. Crisp*.¹⁷¹ Crisp was convicted of a bank robbery based in part on expert testimony that his right palm had produced a print recovered from a confession note.¹⁷² Crisp challenged the admission of the testimony under *Daubert*.¹⁷³ The majority rejected Crisp's claims. They found that precedent favored admission¹⁷⁴; the principles underlying fingerprint identification bore the "imprimatur of a strong general acceptance;"¹⁷⁵ the discipline had adequate standards controlling its operation because "fingerprint analysts are held to a consistent 'points and characteristics' approach to identification,"¹⁷⁶ and examiners undergo proficiency tests;¹⁷⁷ and there was testimony that the discipline had an "essentially zero" error-rate.¹⁷⁸ The majority conceded that "further research . . . and the development of even more consistent professional standards is desirable," but found, "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence."¹⁷⁹ Notably, however, studies have rejected the idea that cross-examination cures "shaky" evidence:

169. *Id.* at 575-76.

170. *Id.* at 572.

171. *United States v. Crisp*, 324 F.3d 261 (4th Cir. 2003).

172. *Id.* at 265.

173. *Id.*

174. *Id.* at 268.

175. *Id.*

176. *Id.* at 269.

177. *Id.*

178. *Id.*

179. *Id.* at 269-70 (quoting *Daubert v. Merrell Dow Pharm. Inc.*, 509 U.S. 579, 596 (1993)) (alteration in original).

For example, in mock jury studies about the effectiveness of cross-examination, it apparently made little difference whether the defense challenged the expert testimony; whether the defense pointed out in cross examination that the expert's conclusions were inconsistent with prior research and that the expert had not followed standard methodology; whether the defense not only cross-examined the prosecution expert, but also put on its own expert. Although the jurors discussed the expert evidence in their deliberations, and although there was a strong correlation between the prosecution expert's testimony and the jury's verdict preferences, the results did not vary among the first three conditions.¹⁸⁰

In his dissent, Judge Michael was also cautious about the power of cross-examination, stating that "adversarial testing simply means that the defense lawyer cross-examines the government's expert. That, I concede, is important, but it only goes part way. In most criminal cases . . . the defendant does not have access to an independent expert who could review the analyses and conclusions of the prosecution's expert."¹⁸¹ This view is shared by Saks: "The maldistribution of forensic scientists so favors the prosecution that the defense has little access to any, which prevents the adversary process from working, as intended, to expose error."¹⁸²

Judge Michael found that the fingerprint evidence (in Crisp's case) failed *Daubert* review.¹⁸³ He found that there was no record of testing on the reliability of fingerprint identification,¹⁸⁴ that peer review in the fingerprint community did not "prompt critique or reanalysis by other scientists,"¹⁸⁵ and that the error-rate provided to the court was based on

180. Beecher-Monas, *supra* note 103, at 1407 (footnotes omitted).

181. *Crisp*, 324 F.3d at 273 (Michael, J., dissenting).

182. Saks, *supra* note 3, at 1093.

183. *Crisp*, 324 F.3d at 272 (Michael, J., dissenting).

184. *Id.* at 273-74.

185. *Id.* at 274.

assumption and not scientific studies.¹⁸⁶ Judge Michael also found that the discipline's controlling standards were not universal.¹⁸⁷ He was troubled by examiners' subjective approach to determining a match between a latent print and a suspect print,¹⁸⁸ and the lack of clarity with regards to whether proficiency tests represented real life conditions.¹⁸⁹ Because the fingerprint examination community had not been sufficiently challenged internally or externally, Judge Michael opined that the technique was not generally accepted in the scientific community.¹⁹⁰ With regard to precedent, Judge Michael concluded, "[t]he history of fingerprint identification and the dogged certainty of its examiners are insufficient to show that the technique is reliable."¹⁹¹ As such, Judge Michael's dissent added to the courts' recent unease about the reliability of fingerprint evidence.

In 2004, Byron Mitchell challenged the admission of fingerprint evidence that connected him to getaway car used in a robbery. In *United States v. Mitchell (Mitchell I)*,¹⁹² the United States Court of Appeals for the Third Circuit found that fingerprint evidence passed "*Daubert* muster,"¹⁹³ but applied a different approach to *Llera Plaza II* and *Crisp*. First, the court focused on the notion that the premises of fingerprint identification were "testable," not whether they were actually underpinned by scientific testing.¹⁹⁴ The court was persuaded that the reliability of fingerprint evidence had been tested by one hundred years of experience.¹⁹⁵ Second, the court considered peer review in the context of whether the "verification" step of ACE-V constitutes effective peer review, as well as publication. The court heard evidence that "verification" was not always anonymous and that fingerprint examiners had "developed an 'occupational norm of unanimity'

186. *Id.*

187. *Id.* at 275.

188. *Id.*

189. *Id.* at 274-75.

190. *Id.* at 276.

191. *Id.* at 278.

192. *United States v. Mitchell*, 365 F.3d 215 (3d Cir. 2004).

193. *Id.* at 219.

194. *Id.* at 235-38.

195. *Id.* at 238.

that strongly discouraged the verifying examiner from challenging the identification made by the initial examiner.”¹⁹⁶ With that in mind, the court found “[l]ooking at the entire picture, the ACE–V verification step may not be peer review in its best form, but, on balance, the peer review factor does favor admission.”¹⁹⁷ The court found that the “publication facet of peer review is not a strong factor, and neither reinforces nor detracts from our conclusion that the peer review factor favors admission.”¹⁹⁸ Third, the court found that despite the fact an “error rate [had] not been precisely quantified . . . the absence of significant numbers of false positives in practice,” and the absence of false positives in two recent surveys meant the discipline’s error rate “strongly” favored admission.¹⁹⁹ Unlike past cases, however, the court found that the discipline was lacking with regards to controlling standards.²⁰⁰ The court opined that the ACE–V method was “insubstantial” in comparison to the “elaborate and exhaustively refined standards found in many scientific and technical disciplines.”²⁰¹

196. *Id.* at 238-39.

197. *Id.* at 239.

198. *Id.*

199. *Id.* at 241.

We therefore accept that the error rate has been sufficiently identified to count this factor as strongly favoring admission of the evidence. The error rate has not been precisely quantified, but the various methods of estimating the error rate all suggest that it is very low. This follows from three pieces of evidence we identify above as favoring the government: (1) the absence of significant numbers of false positives in practice (despite the enormous incentive to discover them), (2) the absence of false positives in the FBI's state agency survey, and (3) the statistical computations based on the 50/50 experiment.

Id.

200. *Id.*

201. *Id.* The court also found the discipline to be “generally accepted.”

Thus we consider as one factor in the *Daubert* analysis whether fingerprint identification is generally accepted within the forensic identification community. The answer is yes, as demonstrated by the results of the FBI's survey of state agencies. . . . Mitchell's only argument with respect to this factor is that there is no *scientific* community that

In 2005, a Superior Court in Massachusetts found that the ACE-V method was “sufficiently reliable to admit expert opinion testimony regarding” a fingerprint match.²⁰² Despite this typical ruling, the case of *Commonwealth v. Patterson*, shows a court restricting the acceptance of fingerprint identification evidence. In *Patterson*, an examiner used the ACE-V method “to determine that four latent impressions found on the victim’s vehicle were left by [the defendant].”²⁰³ The examiner could not match any single latent impression to its “allegedly corresponding finger,” so based his testimony on the “cumulative similarities between the impressions and their corresponding fingers. The examiner opined that the four impressions could be analyzed collectively because they were simultaneous impressions, that is, impressions of multiple fingers made by the same hand at the same time.”²⁰⁴ The court held that application of ACE-V to simultaneous impressions did not satisfy *Daubert*, stating:

the Commonwealth needed to establish more than the general reliability of latent fingerprint identification. It needed to establish that the theory, process, and method of latent fingerprint identification could be applied reliably to simultaneous impressions not capable of being individually matched to any of the fingers that supposedly made them.²⁰⁵

generally accepts fingerprint identification. But the scientific/nonscientific distinction is irrelevant after *Kumho Tire*, and accordingly we reject the argument. We also note that the Court of Appeals for the Fourth Circuit . . . relied heavily on general acceptance to support the admission of fingerprint identification evidence. See *United States v. Crisp*, 324 F.3d 261 (4th Cir. 2003). We likewise conclude that this factor weighs in favor of admitting the evidence.

Id. (citation omitted).

202. *Commonwealth v. Patterson*, 840 N.E.2d 12, 15 (Mass. 2005).

203. *Id.* at 14.

204. *Id.* at 14-15.

205. *Id.* at 15.

It should be noted, however, that the court emphasized that the traditional method of fingerprint identification satisfied *Daubert*.²⁰⁶

Llera Plaza I and II, Crisp, Mitchell I, and Patterson demonstrate that American courts, to differing degrees and on the basis of different approaches to *Daubert*, had some concerns about the practice of fingerprint identification prior to the release of the NAS Report in February 2009. The impact of the NAS Report is considered in the following cases.

In December 2009, Brian Rose challenged the admissibility of fingerprint evidence that allegedly linked him to a fatal carjacking. In *United States v. Rose*,²⁰⁷ a federal court in Maryland ruled that precedent,²⁰⁸ the general acceptance of the ACE-V method in the fingerprint community,²⁰⁹ and the lack of evidence to contradict the conclusion that misidentifications were extremely rare all favored the admission of the fingerprint evidence.²¹⁰ The court acknowledged the NAS Report's use of a study that found there was no "available scientific evidence of the validity of the ACE-V method."²¹¹ However, the court emphasized that "the report itself did not conclude that fingerprint evidence was unreliable such as to render it inadmissible,"²¹² and its authors did not intend to answer the "question whether forensic evidence in a particular case is admissible under applicable law."²¹³

In *United States v. Baines*,²¹⁴ the United States Tenth Circuit Court of Appeals made no mention of the NAS Report when upholding a decision to admit evidence that a "thumb print found on some of the contraband . . . was a match to Baines' [sic] print."²¹⁵ In so holding, the court took yet another approach to *Daubert*. Somewhat like the court in *Mitchell I*, the

206. *Id.* at 32-33.

207. *United States v. Rose*, 672 F. Supp. 2d 723 (D. Md. 2009).

208. *Id.* at 725.

209. *Id.* at 726

210. *Id.*

211. *Id.* at 725 (internal quotation marks omitted).

212. *Id.*

213. *Id.* (quoting Hon. Harry T. Edwards, Statement before U.S. Senate Judiciary Committee (Mar. 18, 2009)).

214. *United States v. Baines*, 573 F.3d 979 (10th Cir. 2009).

215. *Id.* at 980.

Tenth Circuit found that:

[W]hile . . . this record does not show that [fingerprint identification] has been subject to testing that would meet all of the standards of science, it would be unrealistic in the extreme for us to ignore the countervailing evidence. Fingerprint identification has been used extensively by law enforcement agencies all over the world for almost a century.²¹⁶

However like Judge Michael in *Crisp*, the court acknowledged that proficiency tests had been heavily criticized. On that basis, the court opined that the testing factor did not weigh “powerfully” in favor of admission.²¹⁷ Unlike the *Mitchell I* court, the *Baines* court found that peer review did not favor admissibility because “the verification stage of the ACE-V process is not the independent peer review of true science.”²¹⁸ Benedict agrees with this assessment, stating that the process of more than one fingerprint examiner performing the identification process

is not the meaning of peer review under *Daubert*, or as used by scientists generally. Rather, the term refers to a formal submission of research to a scientific journal, whose editorial board of fellow scientists carefully examines it. It is not merely a second opinion rendered by another examiner . . . [that] does little to put a scientific gloss on the first opinion.²¹⁹

Like most other courts, the Tenth Circuit accepted that the discipline had a very low error rate, which “strongly” favored admission.²²⁰ The court put significant emphasis on the state’s

216. *Id.* at 990.

217. *Id.*

218. *Id.*

219. Benedict, *supra* note 63, at 530 (alteration in original) (footnotes omitted) (internal quotation marks omitted).

220. *Baines*, 573 F.3d at 991.

testimony that the discipline had an error rate of one in every eleven million cases, which was unchallenged by the defense.²²¹ In tackling the criticisms aimed at proficiency tests, the court acknowledged that “[v]ery few mistakes are reported in testing that trainees must complete before progressing to actual casework.”²²² The court acknowledged the possibility of erroneous identifications and that “[d]efense attorneys rarely have the resources to hire independent experts for trial,” but found “even allowing for the likelihood that the actual error rate . . . may be higher than reflected[,] . . . the known error rate remains impressively low.”²²³ Applying *Mitchell I*, however, the court found the “controlling standards” factor did not favor admission, as ACE-V “is a procedural standard but not a substantive one. Critical steps in the process depend on the subjective judgment of the analyst.”²²⁴ The court relied on precedent to determine that fingerprint identification had an “overwhelming” acceptance in the courts (and other professional bodies), which favored admission.²²⁵

The Supreme Court of Massachusetts considered the NAS Report in more detail in *Commonwealth v. Gambora* in 2010.²²⁶ After being convicted of murder and other related offenses, Gambora used the NAS Report to challenge evidence that matched his fingerprints to latent prints found on a door. The court acknowledged, in considerable depth, the concerns raised about the reliability of fingerprint identification in the NAS

221. *Id.* at 990-91.

222. *Id.* at 990.

223. *Id.* at 991.

224. *Id.* Notably, the Tenth Circuit made this finding *arguendo* because the factor was not critical to its decision.

225. *Id.* at 991-92. In closing, the court echoed the thoughts of

Judge Pollak, who said regarding the desirability of research to provide the scrutiny and independent verification of the scientific method to aid in assessing the reliability of fingerprint evidence, that such efforts would be “all to the good. But to postpone present in-court utilization of this ‘bedrock forensic identifier’ pending such research would be to make the best the enemy of the good.”

Id. at 992 (quoting *United States v. Llera Plaza*, 188 F. Supp. 2d 549, 572 (E.D. Pa. 2002)).

226. *Commonwealth v. Gambora*, 933 N.E.2d 50 (Mass. 2010).

Report. However, the court emphasized that the NAS Report had not argued for, and did not result in, the wholesale exclusion of fingerprint evidence.²²⁷ The court admitted the evidence.²²⁸

Despite being a typical ruling, *Gambora* made two important impacts. First, it highlighted that some of the NAS Report's conclusions are confusing. The court stated

[a]s our discussion of the NAS Report reflects, there is tension in the report between its assessments that, on the one hand it seems plausible that a careful comparison of two impressions can accurately discern whether or not they had a common source, but that on the other, merely following the steps of ACE-V does not imply that one is proceeding in a scientific manner or producing reliable results.²²⁹

The court felt unable to resolve this tension in *Gambora*.²³⁰ Second, *Gambora* represents the first restriction on fingerprint identification evidence as a direct consequence of the NAS Report. The court said

based on the NAS Report, we can say this much at the present time: Testimony to the effect that a latent print matches, or is "individualized" to, a known print, if it is to be offered, should be presented as an opinion, not a fact, and opinions expressing absolute certainty about, or the infallibility of, an "individualization" of a print should be avoided.²³¹

227. *Id.* at 58.

228. It is important to note that the *Gambora* decision was somewhat molded by the fact the Defendant testified at trial that he put his hand on the door in question. Furthermore, substantial other evidence connected the defendant to the scene of the robbery and homicide. *Id.* at 61.

229. *Id.* at 61 n.21 (citation omitted) (internal quotation marks omitted).

230. *Id.* at 61 n.22

231. *Id.* However it should be noted that the court also concluded that "nothing in this [*Gambora*] opinion should be read to suggest that the existence of the NAS Report alone will require [*Daubert*] hearings as to the

Notably, shortly before the *Gambora* decision, the International Association for Identification (“IAI”)—the primary professional association for those engaged in forensic identification practices—also advocated for examiners to refrain from declaring individualizations. Resolution 2010-18 resolves, *inter alia*, that “[e]xaminers shall only use mathematically based models that have been accepted as valid by the IAI in partnership with the relevant scientific community and in which they have been trained to competency.”²³²

Weeks after *Gambora*, Ajmal Aman moved to exclude fingerprint evidence that allegedly linked him to an arson fire. In *United States v. Aman*,²³³ a United States District Court in Virginia opined that “[t]he absence of a known error rate, the lack of population studies, and the involvement of examiner judgment all raise important questions about the rigorousness of friction ridge analysis.”²³⁴ The court acknowledged the NAS Report’s concern that the discipline had not been subjected to population studies to demonstrate its precision,²³⁵ and noted

general reliability of fingerprint identifications.” *Id.*

232. Int’l Ass’n of Identification [IAI], *Resolution 2010-18*, ¶ 7 (July 16, 2010).

It is the responsibility of forensic experts to offer a clear and unambiguous presentation of their conclusions. Friction ridge skin impressions can display varying levels of commonality (pattern type, ridge flow) in appearance with other impressions which do not derive from the same source. Friction ridge skin impressions can share class characteristics (pattern type, ridge flow) and any associations based on these criteria require, ethically and professionally, that the examiner clearly state any limitations of their conclusions. The use of mathematically based models to assess the associative value of the evidence may provide a scientifically sound basis for supporting the examiner’s opinion. Examiners shall only use mathematically based models that have been accepted as valid by the IAI in partnership with the relevant scientific community and in which they have been trained to competency.

Id. at ¶¶ 4-7.

233. 748 F. Supp. 2d 531 (E.D. Va. 2010).

234. *Id.* at 541.

235. *Id.* at 540.

that “while fingerprint experts sometimes use terms like ‘absolute’ and ‘positive’ to describe the confidence of their matches, the NRC has recognized that a zero-percent error rate is ‘not scientifically plausible.’”²³⁶ The court agreed that further testing and study would enhance the precision and reviewability of fingerprint examiners’ work,²³⁷ but, relying on *Crisp*, ruled that Aman’s challenge was appropriate for cross-examination and not grounds for exclusion.²³⁸

In June 2011, Donny Love challenged the admission of fingerprint evidence that allegedly connected him to the 2008 bombing of a federal courthouse in San Diego. In *United States v. Love*,²³⁹ a United States District Court in California recognized that the NAS Report criticized some aspects of fingerprint analysis, but denied Love’s challenge. In so holding, the court used yet a different overall approach to *Daubert*. The court based its conclusion, in part, on precedent²⁴⁰ and on evidence that “the forensic science community generally . . . ha[s] beg[an] to take appropriate steps to respond to [the] criticism [contained in the NAS Report]”²⁴¹ With regards to error rate, the court picked up on a “May 2011 study of the performance of 169 fingerprint examiners [which] revealed a total of six false positives among 4,083 comparisons of non-

236. *Id.*

237. *Id.* at 541.

238. *Id.* at 540 n.9. The *Aman* court relied on the *Crisp* court’s view that:

[T]he district court heard testimony to the effect that the expert community has consistently vouched for the reliability of the fingerprinting identification technique over the course of decades The district court also heard evidence from which it was entitled to find the existence of professional standards controlling the technique’s operation. Those standards provide adequate assurance of consistency among fingerprint analyses. Finally, the court heard testimony that fingerprint identification has an exceedingly low rate of error, and the court was likewise within its discretion in crediting that evidence.

United States v. Crisp, 324 F.3d 261, 269 (4th Cir. 2003).

239. *United States v. Love*, No. 10-cr-2418 (MMM), 2011 WL 2173644 (S.D. Cal. June 1, 2011).

240. *Id.* at *8.

241. *Id.*

matching fingerprints for an overall false positive rate of 0.1%.”²⁴²

In response to the Defendant’s comments about Brandon Mayfield’s case, the court said “one confirmed misidentification is in no way inconsistent with an exceedingly low rate of error. . . . Of course, any misidentification is troublesome. Without more foundation, however, this statement does not translate into a quantifiable error rate.”²⁴³ With regards to controlling standards, the court acknowledged that the standards used in fingerprint analysis were insubstantial compared to those employed by scientific disciplines, citing *Mitchell I*.²⁴⁴ Unlike *Mitchell I* (and *Baines*), however, the *Love* court found that the procedural nature of the ACE-V method (in this case, in the context of the FBI) and the stringent qualification process for FBI Agents favored admission.²⁴⁵

It was in its consideration of general acceptance that the *Love* court departed from precedent, finding it only weakly supported admission.²⁴⁶ The court agreed that the NAS Report demonstrated “some hesitancy in accepting latent fingerprint analysis on the part of the broader scientific community.”²⁴⁷ However, the court did not reject “general acceptance” entirely because “forensic science and law enforcement communities strongly support the use of friction ridge analysis.”²⁴⁸ The court concluded that “[f]riction ridge analysis is not foolproof, but it is also far removed from the types of ‘junk science’ that must be excluded under . . . *Daubert*[] and *Kumho*.”²⁴⁹ This is contrary to one scholar’s view that the “gold standard” of fingerprinting identification may be more akin to “fool’s gold.”²⁵⁰

242. *Id.* at *5 (internal quotation marks omitted).

243. *Id.*

244. *Id.* at *6.

245. *Id.* at *6-7.

246. *Id.* at *7.

247. *Id.*

248. *Id.*

249. *Id.* at *8.

250. Brooke G. Malcom, Comment, *Convictions Predicated on DNA Evidence Alone: How Reliable Evidence Became Infallible*, 38 CUMB. L. REV. 313, 328 (2008).

In August 2011, after being convicted of first-degree murder, Edward Mitchell challenged the fingerprint evidence against him. In *Illinois v. Mitchell (Mitchell II)*,²⁵¹ the majority of the Illinois Appellate Court found that (1) the trial court did not err by admitting expert testimony that failed to account for five of the thirteen points allegedly found between Mitchell's print and the suspect print; and (2) the trial court did not err by failing to conduct an admissibility hearing concerning the methodology used by the relevant fingerprint expert.²⁵² The court made no substantive mention of the NAS report's findings,²⁵³ but in his dissent, Judge Gordon appeared to follow the NAS Report's findings in that he berated the experts involved for not making notes of their processes and conclusions.²⁵⁴

Shortly after *Mitchell II*, *United States v. Gutierrez-Castro*²⁵⁵ came before the United States District Court in New Mexico. In that case, Gutierrez-Castro was accused of "re-entry of an illegal alien" and the state wanted to introduce the testimony of James McNutt.²⁵⁶ McNutt would testify that suspect prints belonged to Gutierrez-Castro.²⁵⁷ In *Gutierrez-Castro*, the Court used the NAS Report in a very narrow sense. Gutierrez-Castro argued that, while McNutt was a certified fingerprint examiner and that he had completed several classes on fingerprint analysis, the NAS Report "indicate[d] that certification may not be a valid indication of knowledge or ability."²⁵⁸ Gutierrez-Castro argued there was no standardized or approved method of certification; hence McNutt was not qualified to offer expert testimony about fingerprint analysis.

251. *People v. Mitchell (Mitchell II)*, 353 Ill. Dec. 369 (App. Ct. Aug. 5, 2011).

252. *Id.* at 373-76.

253. The NAS Report's description of the ACE-V method was mentioned. *Id.* at 386 (Gordon, J., dissenting).

254. *Id.* at 382 (Gordon, J., dissenting).

255. *United States v. Gutierrez-Castro*, 805 F. Supp. 2d 1218 (D.N.M. 2011).

256. *Id.* at 1221-22.

257. *Id.* at 1220.

258. *Id.* at 1228.

Without engaging the NAS Report,²⁵⁹ the court rejected Gutierrez-Castro's argument, seemingly siding with the state's argument that "McNutt ha[d] undergone demanding training culminating in" regular proficiency tests.²⁶⁰ Like other courts, the *Gutierrez-Castro* court was not deterred by concerns that most proficiency tests do not reflect real-life conditions. Interestingly, the court gave permission for McNutt to testify, but would *not* allow: (1) the state to offer him as an expert witness in the jury's presence; (2) the trial court to certify McNutt as an expert witness in the jury's presence; and (3) allow the jury instructions to refer to McNutt as an expert.²⁶¹

The *Gutierrez-Castro* decision arguably responds to the idea that jurors are easily seduced by people described as *experts* and as a consequence pay little attention to the veracity of the discipline they are tasked with judging.²⁶² In the context of fingerprint identification, for example, studies have found that a vast majority of jurors agree that fingerprint identification is a "science"²⁶³ and that fingerprints are the most reliable means of identification.²⁶⁴ In *United States v. Watkins*, Eric Watkins challenged a decision to admit fingerprint evidence that linked him to, inter alia, an armed robbery.²⁶⁵ Specifically, Watkins challenged the state's expert who claimed that when ACE-V "is used properly by a competent examiner, the error rate for identification is zero."²⁶⁶

259. Although the court noted that McNutt had acknowledged that the NAS Report calls into question ACE-V methodology. *Id.* at 1233.

260. *Id.* at 1228.

261. *Id.* The court held that the issues that the parties "bring out during McNutt's direct examination and cross-examination will go to the weight and credibility of McNutt's testimony." *Id.*

262. See Simon Cole, *Grandfathering Evidence: Fingerprint Admissibility Rulings From Jennings to Llera Plaza and Back Again*, 41 AM. CRIM. L. REV. 1189 (2004) (general proposition that jurors are easily seduced).

263. Charles Illsley, *Juries, Fingerprints, and the Expert Fingerprint Witness*, Address at the International Symposium on Latent Prints (July 7-11, 1987) (finding ninety-three percent of jurors agree that fingerprint identification is a science; only two percent disagree), available at http://www.nlada.org/forensics/for_lib/Documents/1056493657.7/Illsey.pdf.

264. *Id.* (finding that eighty-four percent of potential jurors agree that "fingerprints are the most reliable means of identifying a person," and only eight percent disagree).

265. 450 F. App'x 511, 512 (6th Cir. 2011).

266. *Id.* at 515 (internal quotation marks omitted).

In support, Watkins cited the NAS Report's conclusion that such claims were impractical.²⁶⁷ The Sixth Circuit rejected Watkins's argument on two grounds. First, the court said that it would not consider evidence, namely the NAS Report, which was not before the lower court.²⁶⁸ Second, the court reasoned that even "assuming *arguendo* that the ACE-V method is not error-free, the fact that the fingerprint examiner testified that it was [one hundred percent] accurate does not by itself mean that the district court erred in determining that the ACE-V method was scientifically valid."²⁶⁹ The court declined to hold that the "allegedly mistaken error-rate testimony negates the scientific validity of the ACE-V method given all the other factors that the district court was required to consider."²⁷⁰

The aforementioned cases demonstrate that between 2000 and 2011 American courts favored the admission of fingerprint identification evidence under *Daubert*. In doing so, these courts relied heavily on precedent to support their decisions and on the adversary system to weed out the fragilities of fingerprint analysis. These cases also demonstrate that American courts are taking inconsistent approaches to *Daubert*. These cases demonstrate that, in descending order of potency, the courts have been most critical of peer review, controlling standards, and testability. The courts are noting that these three areas are lacking in scientific underpinnings. Additionally, the cases illustrate that American courts are persuaded that fingerprint identification has a low error-rate and is generally accepted in the relevant fields.

The *Aman*, *Rose*, *Baines*, *Gambora*, *Castro*, *Mitchell II*, *Love*, and *Watkins* cases all demonstrate that courts are generally acknowledging the NAS Report since its publication. However, the courts are responding to the NAS Report's criticisms of fingerprint analysis to different degrees. Some courts have paid lip service to the report, whereas others have engaged in a more extensive evaluation of its findings. Overall, post-NAS Report courts have: (1) made decisions to restrict

267. *Id.*

268. *Id.*

269. *Id.*

270. *Id.* at 516.

testimony directly as a result of the NAS Report;²⁷¹ (2) been more critical of the ability of fingerprint evidence to satisfy *Daubert* than pre-NAS Report courts, while not going so far as to deny admission of fingerprint evidence because of the NAS Report's findings; (3) placed emphasis on the NAS Report's position that it did not intend to answer the question of whether forensic evidence in a particular case is admissible under applicable law;²⁷² (4) responded favorably to attempts by the forensic community to fill the gaps identified by the NAS Report;²⁷³ (5) highlighted areas of contradiction in the NAS Report's conclusions;²⁷⁴ and (6) relied on precedent and the adversary process to resolve and neutralize their concerns about the reliability of fingerprint evidence in the light of the NAS Report.²⁷⁵

B. *Firearms Identification*

In the early stages of the new millennium, American courts continued to fully embrace firearms identification evidence that matched suspect ammunition to a weapon linked with a defendant. In *United States v. Santiago*, Judge Marrero was quick to point out that the *Llera Plaza I* decision had no bearing on "ballistics" cases, and there was no precedent suggesting "the entire field of ballistics identification is unreliable."²⁷⁶ In *United States v. Hicks*, the United States Court of Appeals for the Fifth Circuit held that based on the widespread acceptance of firearms comparison testing, the existence of standards governing such testing, the discipline's negligible error rate (the court received testimony that the error rate was "zero or near to zero"), and the methodology

271. *E.g.*, *Commonwealth v. Gambora*, 933 N.E.2d 50, 58-60 (Mass. 2010).

272. *E.g.*, *United States v. Rose*, 672 F. Supp. 2d 723, 726 (D. Md. 2009); *id.* at 58.

273. *E.g.*, *United States v. Love*, No. 10-cr-2418 (MMM), 2011 WL 2173644, at *8 (S.D. Cal. June 1, 2011).

274. *E.g.*, *Gambora*, 933 N.E.2d at 59-60.

275. *E.g.*, *United States v. Crisp*, 324 F.3d 261, 267 (4th Cir. 2003); *United States v. Aman*, 748 F. Supp. 2d 531, 541-42 (E.D. Va. 2010).

276. *United States v. Santiago*, 199 F. Supp. 2d 101, 110-11 (S.D.N.Y. 2002).

employed by the state's ballistics expert, which allowed him to conclude that suspect casings were fired from a rifle found in Hicks's residence, was reliable.²⁷⁷ Both *Santiago* and *Hicks* afforded firearms identification scientific credit, while focusing on precedent and the experience of the examiner to support admission.

A conservative shift manifested in 2005, however. In *United States v. Green*,²⁷⁸ the state sought to admit expert testimony that Green's pistol could be matched, "to the exclusion of every other firearm in the world," to suspect shell casings in a racketeering prosecution.²⁷⁹ Judge Nancy Gertner of the United States District Court for the District of Massachusetts held that such a conclusion was extraordinary given the data and methods employed by the examiner.²⁸⁰

Judge Gertner detailed a long list of serious deficiencies in the field of firearms identification. She criticized the lack of guidelines available to distinguish between class and sub-class tool-mark characteristics,²⁸¹ the heavily subjective nature of declaring a match,²⁸² the potential for confirmatory bias to skew the examiners results ("the only weapon [the examiner] was shown was the suspect one: the only inquiry was whether the shell casings found earlier matched it"),²⁸³ and the examiner's failure to document his analysis and to follow procedure.²⁸⁴ She also vociferously disagreed with the

277. *United States v. Hicks*, 389 F.3d 514, 526 (5th Cir. 2004).

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

279. *Id.* at 107 (citation omitted) (internal quotation marks omitted).

280. *Id.* at 107.

281. *Id.* at 110-13.

282. *Id.* at 114.

283. *Id.* at 107.

It was, in effect, an evidentiary "show-up," not what scientists would regard as a "blind" test. He was not asked to try to match the casings to the other test-fired Hi Point weapons in police custody, or any other gun for that matter, an examination more equivalent to an evidentiary "line-up." His work was reviewed by another officer, who did the same thing—checked his conclusions under the same conditions—another evidentiary "show-up."

Id. at 108.

284. *Id.* at 114-15.

applicable precedents, as “every single court post-*Daubert* has admitted this testimony.”²⁸⁵ Despite all this, Judge Gertner reluctantly admitted the expert testimony. However, her decision was qualified:

[N]otwithstanding my serious reservations, I feel compelled to allow [the state’s expert] to testify about his observations of the shell casings . . . , and about his comparison of those casings to the suspect . . . weapon. . . . However, . . . O’Shea may only describe and explain the ways in which the earlier casings are similar to the shell casings test-fired from the . . . pistol. . . . I will not allow him to conclude that the shell casings come from a specific . . . pistol . . . to the exclusion of every other firearm in the world. That conclusion—that there is a definitive match—stretches well beyond O’Shea’s data and

285. *Id.* at 108.

I reluctantly come to the above conclusion because of my confidence that any other decision will be rejected by appellate courts, in light of precedents across the country, regardless of the findings I have made. While I recognize that the *Daubert-Kumho* standard does not require the illusory perfection of a television show (CSI, this wasn’t), when liberty hangs in the balance—and, in the case of the defendants facing the death penalty, life itself—the standards should be higher than were met in this case, and than have been imposed across the country. The more courts admit this type of toolmark evidence without requiring documentation, proficiency testing, or evidence of reliability, the more sloppy practices will endure; we should require more.

Id. at 109 (footnote omitted).

This reliance on long-standing use of ballistics evidence in the courts is troubling. It runs the risk of “grandfathering in irrationality,” without reexamining it in the light of *Kumho* and *Daubert*. It arguably ignores the mandate of *Daubert*, especially where the courts are relying on pre-*Daubert* acceptance of a given scientific technique.

Id. at 123.

methodology.²⁸⁶

The same court considered a similar challenge weeks later in *United States v. Monteiro*.²⁸⁷ Monteiro sought to exclude expert testimony that suspect cartridge cases matched firearms linked to him.²⁸⁸ The court rejected Monteiro's challenge, finding that the underlying scientific principle of individualization in firearm identification was valid.²⁸⁹ The court found that "the existence of the requirements of peer review and documentation ensure sufficient testability and reproducibility to ensure that the results of the technique are reliable."²⁹⁰ Despite the subjective judgment involved in making an identification, the defendant could conduct her own testing, proffer her own experts and use cross examination to test the evidence.²⁹¹ In considering peer review, the court found that although "there appears to be a disagreement in the peer reviewed literature as to the reliability of the AFTE method of identification, consensus is not necessary."²⁹² With regards to error rate, the court concluded that the known error rate is "not unacceptably high."²⁹³ The court was troubled that there were no universal standards for declaring a match, but found that it was not fatal because documentation and peer review helped maintain standards.²⁹⁴ Moreover, the examiner's specialized training and experience favored admission.²⁹⁵

Despite this, *Monteiro* added to the more conservative approach taken in *Green*. Although the court admitted the testimony, again its decision was qualified:

286. *Id.* at 108-09 (footnote omitted).

287. 407 F. Supp. 2d 351 (D. Mass. 2006).

288. *Id.* at 354.

289. *Id.* at 355.

290. *Id.* at 369.

291. *Id.*

292. *Id.* at 367.

293. *Id.* at 368.

294. *Id.* at 371.

295. *Id.*

One important caveat: during the testimony at the hearing, the examiners testified to the effect that they could be [one hundred] percent sure of a match. Because an examiner's bottom line opinion as to an identification is largely a subjective one, there is no reliable statistical or scientific methodology which will currently permit the expert to testify that it is a "match" to an absolute certainty, or to an arbitrary degree of statistical certainty. Allowing the firearms examiner to testify to *a reasonable degree of ballistic certainty* permits the expert to offer her findings, but does not allow her to say more than is currently justified by the prevailing methodology.²⁹⁶

As Schwartz explains, the *Green* and *Monteiro* decisions "took major steps towards recognizing the systemic scientific problems and excluding firearms and tool mark identifications."²⁹⁷ Subsequent cases, however, demonstrate inconsistent results.

In the 2007 case of *United States v. Natson*,²⁹⁸ the court ignored *Green* and *Monteiro*. In *Natson*, a firearm examiner opined that the tool-marks present on a suspect cartridge were an exact match to those produced by Natson's gun.²⁹⁹ The court found that the examiner's opinion was "based upon a scientifically valid methodology."³⁰⁰ That methodology was tested, subjected to peer review, had an ascertainable error rate, and was generally accepted in the scientific community.³⁰¹

On the other hand, *United States v. Diaz*³⁰² followed *Monteiro*. In that case, the court found that claims of individualization, in the firearms identification field, were not

296. *Id.* at 372 (emphasis added).

297. Schwartz, *supra* note 85, at 10.

298. 469 F. Supp. 2d 1253 (M.D. Ga. 2007).

299. *Id.* at 1254.

300. *Id.* at 1261.

301. *Id.*

302. *United States v. Diaz*, No. 05-cr-00167 (WHA), 2007 WL 485967 (N.D. Cal. Feb. 12, 2007).

supported.³⁰³ Thus, the court only allowed the examiners to “testify that a match has been made to a reasonable degree of certainty in the ballistics field.”³⁰⁴ An examiner’s “keen practiced eye for discerning the extent of matching patterns” outweighed any concerns about the subjective nature of making an identification.³⁰⁵

In 2008, in *United States v. Glynn*,³⁰⁶ the United States District Court for the Southern District of New York took a different approach to *Green*, *Monteiro*, *Natson* and *Diaz*. At trial, the state sought to introduce expert testimony that “to a reasonable degree of ballistic certainty” suspect ammunition came from firearms linked to Glynn.³⁰⁷ Glynn moved to exclude the testimony, arguing the discipline was not based on sufficiently reliable methods.³⁰⁸ The court concluded that firearms identification “not only lacks the rigor of science but suffers from greater uncertainty than many other kinds of forensic evidence.”³⁰⁹ However, while the “subjectivity and vagueness [involved in firearms identification] might suggest that [it] involves little more than a hunch, such a characterization would be unfair.”³¹⁰ This is because the court found that the methodology of firearms identification had garnered “sufficient empirical support as to warrant its admissibility.”³¹¹ The court admitted the testimony, but was conscious that:

The problem is how to admit it into evidence without giving the jury the impression—always a risk where forensic evidence is concerned—that it has greater reliability than its imperfect methodology permits. The problem is compounded by the tendency of ballistics experts

303. *Id.* at *1.

304. *Id.* at *1 (internal quotation marks omitted).

305. *Id.*

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

307. *Id.* at 568.

308. *Id.*

309. *Id.* at 574.

310. *Id.* at 572.

311. *Id.* at 574.

. . . to make assertions that their matches are certain beyond all doubt, that the error rate of their methodology is “zero,” and other such pretensions. Although effective cross-examination may mitigate some of these dangers . . . when it comes to expert testimony, cross-examination is inherently handicapped by the jury’s own lack of background knowledge, so that the Court must play a greater role, not only in excluding unreliable testimony, but also in alerting the jury to the limitations of what is presented.³¹²

The court concluded that allowing the examiner to testify that he had matched ammunition to a particular gun “to a reasonable degree of ballistic certainty” would “seriously mislead the jury as to the nature of the expertise involved.”³¹³ To resolve this problem, the court: (1) limited the examiner to testifying that a firearms match was more likely than not; (2) prevented the expert from testifying that he reached his conclusions to any degree of certainty; and (3) prevented the expert from testifying that ballistics was a science.³¹⁴

In October 2009, eight months after the publication of the NAS Report, *United States v. Taylor*³¹⁵ was decided by the United States District Court for the District of New Mexico. Taylor had moved to exclude evidence that his rifle could be matched to suspect ammunition in a racketeering prosecution.³¹⁶ The court factored an earlier report from the NAS—*Ballistic Imaging, Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database* (“Ballistic Imaging Report”)³¹⁷—in to its *Daubert*

312. *Id.*

313. *Id.*

314. *Id.* at *13-14.

315. *United States v. Taylor*, 663 F. Supp. 2d 1170 (D.N.M. 2009).

316. *Id.* at 1172.

317. *Id.* at 1175-76. The Ballistics Imaging Report was focused on the feasibility of a national ballistics database. The Committee emphasized that its “report was not meant to be an overall assessment of firearms identification as a discipline.” *Id.* at 1176.

analysis. First, with regards to testing, the court acknowledged the Ballistic Imaging Report's findings that (1) "[t]he validity of the fundamental assumptions of uniqueness and reproducibility of firearms-related toolmarks has not yet been fully demonstrated"³¹⁸ and (2) "[a] significant amount of research would be needed to scientifically determine the degree to which firearms-related tool-marks are unique or even to qualitatively characterize the probability of uniqueness."³¹⁹ However, on the basis that numerous studies indicated that there is "some level of reproducibility,"³²⁰ and industry standards typically require an examiner to document his findings and have them double-checked by another examiner, the court found there was "at least some significant level of testability and reproducibility."³²¹ Second, in terms of peer review, the court found the existence of the *AFTE Journal* and two articles in the *Journal of Forensic Science*, both of which are peer-reviewed, "clearly weighs in favor of admissibility."³²² Third, the court found that the discipline's "error rate [was] quite low" on the basis of data from CTS testing carried out between 1978 and 1991.³²³

The *Taylor* court considered the 2009 NAS Report in the context of controlling standards. The court found that "[a]rguably the biggest obstacle facing any firearms examiner is that there is no such thing as a 'perfect match.'"³²⁴ The court partially attributed this to the circular nature of the AFTE

However, the Committee also recognized that the question of the feasibility of a national ballistics database was inextricably intertwined with the question of whether a particular set of tool marks can be shown to come from one weapon to the exclusion of all others, and thus the Committee felt compelled to point out the weaknesses in that theory.

Id. (internal quotation marks omitted).

318. *Id.* at 1175.

319. *Id.* at 1175-76.

320. *Id.* at 1176.

321. *Id.*

322. *Id.*

323. *Id.* at 1177. Data from CTS testing carried out between 1978 and 1991 suggest that the rate of false identification is less than one percent. *Id.*

324. *Id.*

Theory of Identification, which “does not provide any uniform numerical standard examiners can use to determine whether or not there is a match”³²⁵ Thus, much is left to the subjective eye of the examiner.³²⁶ The court acknowledged that the NAS Report had recognized this problem, but did not indicate whether such criticism did or did not favor admission of the expert testimony.³²⁷ However, it did find that the AFTE Theory was “generally accepted” because it was widely accepted (although not universally followed) by trained firearms examiners.³²⁸ Following *Monteiro* and *Diaz*, the *Taylor* court admitted the firearms evidence, but restricted the examiner to testifying that the ammunition came from Taylor’s rifle to within a “reasonable degree of certainty in the firearms examination field.”³²⁹ In so holding, the court noted that precedent favored admission, but accepted that a more conservative approach towards firearms identification had slowly begun to build.

In 2011, the decision in *Commonwealth v. Pytou Heang*³³⁰ caused further inconsistency. In that case, Pytou Heang alleged that the trial court had erred in allowing the state’s expert to testify that his AB-10 handgun had fired ammunition involved in the crime.³³¹ The court acknowledged that the accuracy, reliability and scientific basis of firearms identification had been critiqued in the Ballistics Imaging Report and the NAS Report.³³² Thus, the court found two main problems with firearms identification: (1) “there is little scientific proof supporting the theory that each firearm imparts ‘unique’ individual characteristic toolmarks on to [ammunition];” and

325. *Id.*

326. *Id.*

327. *Id.* at 1177-78. In addition to the issues surrounding the AFTE Protocol, the court noted an additional problem with firearms identification – confirmatory bias. The court acknowledged that it is typical practice for an examiner to be handed only one suspect weapon and the recovered ammunition, which creates “a potentially significant ‘observer effect’ whereby the examiner knows that he is testing a suspect weapon and may be predisposed to find a match.” *Id.* at 1179.

328. *Id.* at 1178.

329. *Id.* at 1180.

330. *Commonwealth v. Pytou Heang*, 942 N.E.2d 927 (Mass. 2011).

331. *Id.* at 937-38.

332. *Id.* at 938.

(2) the matching of individual characteristics is highly subjective.³³³ In light of these concerns, and to inject more reliability into the firearms identification process, the court designed a three-part approach that was to be taken by firearms examiners when testifying:

First, before trial, the examiner must adequately document the findings or observations that support the examiner's ultimate opinion, and this documentary evidence, whether in the form of measurements, notes, sketches, or photographs, shall be provided in discovery, so that defense counsel will have an adequate and informed basis to cross-examine the forensic ballistics expert at trial. . . .

Second, before an opinion is offered at trial, a forensic ballistics expert should explain to the jury the theories and methodologies underlying the field of forensic ballistics. . . .

Third, in the absence of special circumstances casting doubt on the reliability of an opinion . . . a forensic ballistics expert may present an expert's opinion of the toolmarks found on projectiles and cartridge casings. Where a qualified expert has identified sufficient individual characteristic toolmarks reasonably to offer an opinion that a particular firearm fired a projectile or cartridge casing recovered as evidence, the expert may offer that opinion to a reasonable degree of ballistic certainty.³³⁴

However, the court neither retroactively applied nor prospectively required this approach in *Pytou Heang's* case. Instead, the court denied the appeal and sanctioned the state's claim of individualization between the suspect ammunition and the defendant's AB-10 hand-gun.³³⁵ The court found that

333. *Id.* at 941.

334. *Id.* at 944-45 (citations omitted) (internal quotation marks omitted).

335. *Id.* at 944.

although the state's expert had testified that the suspect ammunition was "fired by that AB-10," and that in his opinion it was a "practical impossibility" that the ammunition came from any other AB-10 firearm, there was no prejudicial error.³³⁶ This was because the jury had been adequately informed of the limitations surrounding firearms identification throughout the entire proceedings.³³⁷

A number of American courts have changed their approach to the admissibility of firearms identification evidence between 2004 and 2011. All of the aforementioned cases (except *Santiago, Hicks, and Natson*) have moved firearms examiners away from making claims of individualization by restricting them to specific terminology and phrases, which allegedly reflect less absolute conclusions. Overall, courts have taken this approach because of concerns about the subjectivity of firearms identification and its lack of empirical underpinnings for claims of individualization. The impact this approach has on jurors is important to understand because numerous studies have shown that "jurors place special trust in expert[s]" and scientific evidence.³³⁸ Furthermore, studies have shown jurors to rate firearms examiners as among the most honest, competent and influential experts.³³⁹

Some scholars have labelled *Green, Monteiro, and Glynn* as "victories" for the defense and for the veracity of science.³⁴⁰ However, does restricting firearms examiners to phrases such as "to a reasonable degree of certainty" and "more likely than not" deter jurors from thinking there is a "match" between suspect ammunition and a known weapon? A recent study by Saks and McQuiston-Surrett suggests the answer is no.³⁴¹ In that study, both judges and jurors were found to be comfortable

336. *Id.*

337. *Id.*

338. Brandon Garrett & Peter Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 VA. L. REV. 1, 32 (2009).

339. Michael Saks & Roselle Wissler, *Legal and Psychological Bases of Expert Testimony, Surveys of the Law and of Jurors*, 2 BEHAV. SCI. & L. 435, 445 (1984).

340. Schwartz, *supra* note 85, at 10.

341. Dawn McQuiston-Surrett & Michael Saks, *Communicating Opinion Evidence in the Forensic Identification Sciences: Accuracy and Impact*, 59 HASTINGS L.J. 1159, 1188-89 (2008).

converting subjective probability evidence into findings of liability.³⁴² Moreover, does cross-examination and testimony about the shortcomings of firearms identification neutralize any exaggerated trust jurors place in experts? Again, the Saks and McQuiston-Surret study suggests the answer is no:

One might have expected an explication of the examination process, emphasizing the guesswork involved, would have a sobering effect on fact finders, but it appears instead to lead fact finders to be more impressed by the examination. Similarly, since most jurors begin with an exaggerated view of the nature and capabilities of forensic identification, one might expect that information explicitly informing fact finders about the limitations of the expertise would temper the jurors' inferences. Such information had little effect on jurors' judgments.³⁴³

Thus, there is reason to believe that the changes adopted by multiple courts between 2004 and 2011 in order to confront the weaknesses behind claims of individualization in this field, may not have the desired effect. This is perhaps unsurprising. As Schwartz argues, "The problems with firearms and toolmark examiners' testimony are not linguistic, however, but scientific: the requisite empirical and statistical foundations have not been laid for *either* absolute *or* probabilistic identification conclusions."³⁴⁴

C. *Bite Mark Identification*

In the past, forensic odontologists have been skeptical about their ability to engage in individualization.³⁴⁵ Despite these reservations, the majority of American courts have welcomed the admission of bite mark identification evidence

342. *Id.*

343. *Id.* at 1188.

344. Schwartz, *supra* note 85, at 14.

345. Saks, *supra* note 3, at 1119.

since the 1980s. In fact, Saks argues that the courts have “convinced” the forensic odontology community of their ability to identify a perpetrator “to the exclusion of all others.”³⁴⁶ A snapshot of cases decided between 1999 and 2011, demonstrate that despite what is now significant, external criticism of the discipline’s veracity, courts resist challenges to the admissibility of bite mark identification evidence and, at times, turn a blind eye to unsettling expert practices.

In *Brooks v. State*,³⁴⁷ Brooks had been convicted of capital murder based, in part, on the testimony of Dr. Michael West, who testified that two dentations present on the victim’s body had been made by Brooks.³⁴⁸ Brooks claimed that his trial court erred in admitting West’s testimony because he was not an expert in forensic odontology.³⁴⁹ The Supreme Court of Mississippi held that Brooks’s claim was procedurally barred, but because bite mark evidence was “controversial,” the court would address the issue’s merits.³⁵⁰ Despite concerns about West and the fact other experts found inconsistencies between the bite mark and Brooks’s teeth,³⁵¹ the majority took the chance to “state affirmatively that bite mark identification evidence is admissible in Mississippi.”³⁵² The court followed precedent, stating that because Brooks had the opportunity “to attack the qualifications of the expert, the methods and data used to compare the bite marks to persons other than the defendant, and the factual and logical bases of the expert’s opinions.”³⁵³ In addition, Brooks had presented his own experts.³⁵⁴

346. *Id.* at 1119-20.

347. *Brooks v. State*, 748 So. 2d 736 (Miss. 1999).

348. *Id.* at 739.

349. *Id.*

350. *Id.*

351. *Id.* at 740.

352. *Id.* at 739. Note that Justices Banks, Waller and Sullivan did not agree with this approach in their concurring judgment. *Id.* at 747 (Banks, J., concurring). Justice McRae did not agree with this approach in his dissenting judgment. *Id.* at 748 (McRae, J, dissenting).

353. *Id.* at 739 (quoting *Howard v. State*, 701 So. 2d 274, 288 (Miss. 1997)).

354. *Id.* at 740.

Despite this result, the *Brooks* case demonstrates some rumblings of disquiet about bite mark evidence in the courts before the eve of the new millennium, as Justice McRae filed a detailed dissent arguing:

The majority takes the opportunity to conclude once and for all that forensic odontology evidence is universally admissible . . . regardless of the quality of that evidence and regardless of the fact that the proponent of that evidence claims that two indentations are teeth marks unique to one person in the world. This is done despite the fact that the discipline is without any universal criteria or methodology. I dissent because, not only do I have qualms about proclaiming that bite-mark evidence is admissible to specifically identify a person and exclude everyone else, I also have reservations about Michael West's unmatched ability to conclude that no one other than the defendant could have produced the marks on the deceased especially where, as here, other experts are unwilling to testify that the marks could *only* be bite marks and not something else.³⁵⁵

Judge McRae's concerns were based on criticism about the reliability of bite mark evidence,³⁵⁶ the sore divide between expert opinions,³⁵⁷ and "West's propensity for testifying with a confidence seen in no other expert."³⁵⁸ Justice McRae detailed many concerns about West, including that he had materially misrepresented evidence and data, used methods not founded on scientific principles and claimed to have expertise in a vast array of identification disciplines.³⁵⁹ Justice McRae concluded that the majority's "apparent willingness to allow West to testify to anything and everything so long as the defense is

355. *Id.* at 747-48 (McRae, J., dissenting).

356. *Id.* at 748.

357. *Id.*

358. *Id.* at 749.

359. *Id.* at 749-50.

permitted to cross-examine him may be expedient for prosecutors but it is harmful to the criminal justice system.”³⁶⁰ Given the benefit of hindsight, Justice McRae made a very pertinent point—Brooks was exonerated by DNA evidence in 2008.³⁶¹

Prior to Brooks’s exoneration, the Mississippi Supreme Court relied on West’s testimony again in *Stubbs v. State*.³⁶² In that case, Stubbs was convicted of, inter alia, an aggravated assault and subsequently challenged the admission of bite mark evidence against her.³⁶³ At trial, West testified that the victim had bite marks on her hip and that Stubbs could not be excluded from being the donor.³⁶⁴ West concluded this after he had pressed the dental mold of Stubbs’s teeth on to the victim’s skin.³⁶⁵ Again, the court found that West was an expert in forensic odontology, and because the adversary system allowed Stubbs to attack West’s testimony, the trial court had not erred in admitting West’s evidence.³⁶⁶ In so holding, the court relied heavily on precedent.³⁶⁷ In June 2012, Stubbs’s aggravated assault conviction was vacated.³⁶⁸

In 2010, over one year after the publication of the NAS Report, the Court of Appeals of Kansas decided *State v. Lopez-Martinez*.³⁶⁹ In that case, a rape victim alleged that she had

360. *Id.* at 750 (footnote omitted).

361. *Levon Brooks Exonerated in Mississippi, Forensic Reforms Underway*, INNOCENCE PROJECT (Mar. 13, 2008), http://www.innocenceproject.org/Content/Levon_Brooks_Exonerated_in_Mississippi_Forensic_Reforms_Underway.php.

362. *Stubbs v. State*, 845 So. 2d 656 (Miss. 2003).

363. *Id.* at 657.

364. *Id.* at 662.

365. *Id.*

366. *Id.* at 669.

367. *Id.* In 2006, the same court followed suit in *Howard v. State* when reaffirming Eddie Howard’s death sentence. 945 So. 2d 326 (Miss. 2007). In that case, West had testified that to a “reasonable degree of certainty” Howard’s teeth matched a bite mark on the victim. *Id.* at 333. The court found Howard’s claims were procedurally barred and without merit. *Id.* at 371.

368. Caleb Bedillion, *Women Taste Freedom After Convictions Vacated*, THE DAILY LEADER, June 30, 2012, http://www.dailyleader.com/news/article_39b7af80-c20c-11e1-81a4-001a4bcf887a.html.

369. *State v. Lopez-Martinez*, No. 100, 643, 2010 WL 2545626 (Kan.

bitten her attacker on the shoulder.³⁷⁰ Lopez said the bite mark on his shoulder was given to him by a young relative when the two were roughhousing.³⁷¹ At trial, an expert testified that the victim's teeth matched the bite mark on Lopez, and Lopez was convicted.³⁷² On appeal, Lopez argued that there was no consensus with regards to the method or reliability of bite mark evidence and therefore the expert's testimony should have been inadmissible.³⁷³ In support, Lopez provided information about a 1999 study, which reported a sixty-three percent error rate in bite mark analyses.³⁷⁴ However, the court found this did not outweigh a clear 1980 precedent—*State v. Peoples*.³⁷⁵ In *Peoples*, the court had held that bite mark identification evidence was reliable and valuable to a jury.³⁷⁶ The *Lopez* court stated “we find no indication that our Supreme Court is departing from its holding in *Peoples*. Without such an indication, we are compelled to follow *Peoples*.”³⁷⁷

Despite this, *Lopez-Martinez* still represents a court feeling uneasy about not revisiting precedent in light of the criticism of bite mark identification. In his concurring judgment, Judge

App. June 11, 2010).

370. *Id.* at *1.

371. *Id.*

372. *Id.*

373. *Id.* at *2.

374. *Id.* (“Relying on articles in several periodicals, including a 2007 article in the New York Times regarding a 1999 study which reported a sixty-three percent rate of misidentifications in bite mark analyses, *Lopez-Martinez* argues that the reliability of bite mark evidence is now in serious doubt.”).

375. 605 P.2d 135 (Kan. 1980).

376. *Id.* at 132.

[B]ite-mark identification by an expert witness is sufficiently reliable and can be a valuable aid to a jury in understanding and interpreting evidence in a criminal case. When the witness has the requisite skill and experience, and demonstrates the accuracy and reliability of his models, photographs, X-rays and supporting exhibits in bite mark identification, the trial court in exercise of its power of discretion may properly admit the opinion testimony of the expert witness.

Id.

377. *Lopez-Martinez*, 2010 WL 2545626, at *2.

Leben noted that the NAS Report, along with other sources, “found that the uniqueness of human teeth had not been scientifically established.”³⁷⁸ He concluded: “The *Peoples* decision was issued more than 30 years ago, which is a long time when considering the lifespan of a modern scientific method’s validity. . . . But reliance solely on past cases can be a problematic method for continued acceptance of scientific tests.”³⁷⁹

However, in a further display of reluctance to find bite mark evidence unreliable in the face of significant criticism, a federal court in Texas admitted bite mark evidence in a highly emotional case in 2011. In *United States v. Bourgeois*,³⁸⁰ the court refused to “brush aside the heart-wrenching testimony the jury heard” simply because the defendant proffered technical, scientific testimony that “[t]he bite-marks found on the victim cannot be traced to [him] with certainty any greater than guess work.”³⁸¹ The court’s judgment made no reference to the NAS Report.

The *Brooks*, *Stubbs*, *Howard*, *Lopez-Martinez* and *Bourgeois* cases generally support Beecher-Monas’s argument that:

When defense counsel do challenge bite-mark testimony, they are rarely successful. Courts simply decline to engage in any serious analysis of these challenges. By far the most widely used gate-keeping avoidance technique that judges employ is admitting bite-mark evidence because other courts have done so. Rather than engage in any analysis of the scientific principles on which the testimony is based, the data underlying the testimony, the methodology, error rate, or general acceptance by the scientific community, these courts skirt the

378. *Id.* at *4 (Leben, J., concurring).

379. *Id.*

380. *United States v. Bourgeois*, No. C-02-cr-216, 2011 WL 1930684 (S.D. Tex. May 19, 2011).

381. *Id.* at *95 (alterations in original) (internal quotation marks omitted).

entire issue³⁸²

The aforementioned cases also demonstrate that experts use a variety of terms to explain their conclusions. These range from declaring a “match” to probabilistic phrases such as “consistent with” and “reasonable scientific certainty.”³⁸³ Again, as discussed in relation to firearms identification, there is reason to believe that these phrases do not have the desired effect, that is, to deter jurors from thinking that there is a certain strength of connection between the defendant and suspect evidence.³⁸⁴

A further concern about the courts’ willingness to embrace bite mark analysis, and place reliance on ABFO guidelines, is that studies suggest that the terms used by bite mark examiners are not being interpreted by jurors in the way the ABFO intended. For example, under ABFO guidelines a “match” simply means there is “some concordance” or “some similarity” between two samples and the examiner does not intend to make an expression of specificity.³⁸⁵ Although a “match” is the weakest link an expert can make between a suspect bite mark and a defendant, a 2008 study found that people interpreted the word to indicate the strongest association between crime scene evidence and its source.³⁸⁶

D. *Arson Analysis*

For years, fire investigators have been testifying that physical signs such as pour patterns, “spider-web” glass, brown stains on floors, and “V” shaped soot marks indicate that a fire was incendiary. Investigators have picked up these alleged signs of arson through experience. Since 1990, however, scientific understanding about the behavior of both accidental and incendiary fires has advanced. In 1990, an elaborate experiment – the Lime Street Fire Experiment – was

382. Beecher-Monas, *supra* note 103, at 1395 (footnote omitted).

383. McQuiston-Surrett & Saks, *supra* note 341, at 1162.

384. *Id.* at 1162-63.

385. *Id.* at 1162 tbl.I.

386. *Id.* at 1163.

conducted.³⁸⁷ Without using an accelerant, investigators set fire to a couch in a house and watched as “flashover”—the point at which radiant heat causes a fire in a room to become a room on fire—occurred.³⁸⁸ In short, investigators found that the classic signs of arson, like pour patterns and “V” patterns, can also appear on their own, i.e., without accelerant, after flashover.³⁸⁹ Thus, the evidential foundations of many arson convictions have been undermined.³⁹⁰

In 2004, Alfred Albrecht Senior applied for post-conviction relief on the basis that advances in fire science constituted newly discovered evidence that proved his innocence.³⁹¹ Albrecht had been convicted of capital murder after the state produced evidence that he had used an accelerant to set a house fire that killed his wife, mother and daughter.³⁹² This evidence included the presence of burn patterns in the house and evidence of past threats from Albrecht to his wife.³⁹³

In *Albrecht*, the United States District Court for the Eastern District of Pennsylvania opined:

Petitioner has convincingly shown that the fire science evidence presented by the Commonwealth at his trial has since been discredited. . . . He presented evidence that modern fire science considers the Commonwealth’s trial evidence to be an unreliable basis upon which to conclude that a liquid accelerant *necessarily* was involved and that the fire could have been caused *only* by arson. In short, Petitioner’s expert testified that the fire science evidence in this case was as

387. JOHN J. LENTINI, THE LIME STREET FIRE: ANOTHER PERSPECTIVE 1 (1992), *available* *at* <http://www.firescientist.com/Documents/TheLimeStreetFire-AnotherPerspective.pdf>.

388. *Id.* at 2.

389. *Id.* at 3.

390. Grann, *supra* note 115.

391. *Albrecht v. Horn*, 314 F. Supp. 2d 451, 464 (E.D. Pa. 2004), *vacated on other grounds by*, 485 F.3d 103 (3d Cir. 2007).

392. *Id.* at 455-56.

393. *Id.* at 455-57.

consistent with an accidental fire—started in an upholstered chair in the living room as claimed by Petitioner—as with an accelerant fire intentionally started in either the kitchen or the living room.³⁹⁴

The court accepted that the fire could have been caused “*either intentionally or by accident,*” but still rejected Albrecht’s claim.³⁹⁵ The court reasoned that because circumstantial evidence existed, namely a gas can covered in soot with Albrecht’s fingerprints on it being found in Albrecht’s truck and reports of domestic abuse, there was sufficient evidence to support a rational inference that the fire was caused by arson.³⁹⁶ As the advances in science only supported the idea that the fire *might* have been accidental, and did not completely “foreclose the possibility that the fire was started by an arsonist using a liquid accelerant,” the court found that Albrecht’s situation did not merit relief.³⁹⁷

A similar approach was taken by the United States District Court for the Eastern District of New York in *Ferranti v. United States*.³⁹⁸ In that 2010 case, Ferranti had been convicted of a number of arson related crimes, after being charged with setting fire to his business – “Today’s Styles.”³⁹⁹ Fire investigators testified that burn patterns found at the scene suggested the fire was started by an accelerant and circumstantial evidence, including that the business was in financial turmoil, suggested Ferranti was the arsonist.⁴⁰⁰ Dr. Gerald Hurst testified on behalf of the defense, arguing “the prosecution’s case failed to establish the corpus of arson by contemporary scientific standards.”⁴⁰¹ The court was unshaken by the scientific advancements proffered by Ferranti:

394. *Id.* at 464-65.

395. *Id.*

396. *Id.* at 465-66.

397. *Id.* at 465.

398. *Ferranti v. United States*, No. 05-cv-5222 (ERK), 2010 WL 307445 (E.D.N.Y. Jan. 26, 2010).

399. *Id.* at *1.

400. *Id.* at *2.

401. *Id.* at *8.

Ferranti simply has not established that no reasonable fact finder would have found him . . . guilty of the underlying offense. Even assuming that Hurst's declaration is credible, at best it would neutralize the testimony of [the] Fire Marshals . . . that the irregular burn patterns were evidence of the presence of accelerants. Hurst declared that the irregular burn patterns seen here may result from post-ignition flashover, and as such, they were equally consistent with an accidental fire as they were with arson. What Hurst's declaration does not say, however, is that the fire was initiated by an electrical malfunction or some other accidental means. . . . Moreover, much of the other evidence submitted by Ferranti . . . which could have caused the burn patterns . . . serves only to neutralize the testimony of . . . Stickevers and Kelty [the Fire Marshals] regarding the burn patterns, but none of that evidence establishes that the fire was started accidentally.⁴⁰²

Albrecht and *Ferranti* suggest that courts are placing extremely high burdens on defendants applying for post-conviction relief. The courts in both of these cases demanded certainty of the defendant's innocence. As Keith Findley argues, "while the notion of 'innocence' does indeed mean factual innocence, in the sense that the defendant committed no crime—to demand certainty is to demand the impossible . . ."⁴⁰³

In *Green v. Koerner*,⁴⁰⁴ the United States District Court for the District of Kansas afforded greater weight to a defendant's behavior than advances in science.⁴⁰⁵ In that 2008 case, Debora Green appealed her conviction for the murders of her two

402. *Id.* at *12 (footnote omitted) (citation omitted).

403. Keith Findley, *Defining Innocence*, 74 ALB. L. REV. 1157, 1161 (2011).

404. No. 07-3262 (RDR), 2008 WL 2079469 (D. Kan. May 15, 2008).

405. *Id.* at *4-5.

children by setting their home on fire in 1996.⁴⁰⁶ The appeal was based on advances in fire science. The U.S. District Court denied the appeal, citing the Kansas Supreme Court's opinion that placed circumstantial evidence of her motive and demeanor over that of the scientific developments in arson.⁴⁰⁷ For example, the court gave more weight to Green's "casual and nonchalant" police interview⁴⁰⁸ and the presence of a book in her bedroom about children being killed in an intentionally set fire,⁴⁰⁹ than scientific advancements that called into question whether the fire was arson at all.⁴¹⁰

The case of *United States v Aman*⁴¹¹ suggests that the publication of the NAS Report has not changed the courts' reluctance to embrace scientific advancements in the field of arson investigation. In that case, Aman challenged the admissibility of the state fire investigator's evidence on that the basis that he did not use a reliable methodology, as required by *Daubert*.⁴¹² The fire investigator had followed procedures set out in the *National Fire Protection Agency's Guide for Fire and Explosion Investigations* 921 ("NFPA 921").⁴¹³

The United States District Court for the Eastern District of Virginia found that "[b]ecause the methodology described in NFPA 921 has been peer reviewed, is generally accepted in the field of fire investigation, and incorporates the classic scientific methodology of 'generating hypotheses and testing them to see if they can be falsified,'" it satisfied *Daubert*.⁴¹⁴ An error rate was not strictly required.⁴¹⁵ The court reasoned that the NAS

406. *Id.* at *1.

407. *State v. Green*, 153 P.3d 1216, 1227 (Kan. 2007).

408. *Id.* at 1220.

409. *Id.*

410. *Koerner*, 2008 WL 2079469, at *2.

411. *United States v. Aman*, 748 F. Supp. 2d 531 (E.D. Va. 2010).

412. *Id.* at 535.

413. *Id.*

414. *Id.* at 536 (quoting *Daubert v. Merrell Dow Pharm. Inc.*, 509 U.S. 579, 593 (1993)).

415. *Id.*

While a known error rate is also a factor to be considered in a *Daubert* analysis, a known error rate is not strictly required under *Daubert* (emphasizing that the *Daubert*

Report did not alter this conclusion. This was because (1) the NAS Report does not recommend barring fire investigators from testifying based on the NFPA 921 methodology;⁴¹⁶ and (2) the NAS Report does not bind federal courts.⁴¹⁷ Furthermore, Aman could challenge the methodology via cross-examination.⁴¹⁸

Between 2000 and 2011, defendants convicted of arson related crimes have used scientific advances to apply for post-conviction relief. Most defendants have argued that the new science equates to “newly discovered evidence” and/ or evidence of “actual innocence.” Cases decided in this period of time suggest that courts remain unpersuaded by arguments that these advances in fire analysis undermine the traditional hallmarks of arson investigation. It appears that courts prefer to take the word of experience-based investigators over those of scientists who have conducted empirical experiments.

VI. Conclusion

Law is a consumer of a broad spectrum of forensic sciences, including fingerprint identification, firearms identification, bite mark identification, and arson investigation. Over the last century, the law has, and continues to rely on these disciplines to help it answer important legal questions. Often, experts in these fields have testified that the methodologies of their discipline allow them to identify the perpetrator of a crime to the exclusion of all others. As such, these disciplines have become a mainstay of the American criminal justice system that reflects a smooth and mutually convenient relationship between law and science.

factors are not a “definitive checklist,” and that the inquiry envisioned by Rule 702 is . . . a flexible one). In all, analysis of the *Daubert* factors do not justify excluding Robbins'[s] methodology as unreliable.

Id. (alteration in original) (citations omitted) (internal quotation marks omitted).

416. *Id.* at 536.

417. *Id.*

418. *Id.*

However, since the arrival of DNA evidence in the late 1980s, the bar for what evidence is scientifically reliable has been raised. To date, 302 people have been exonerated by post-conviction DNA testing, and over half of these wrongful convictions can be attributed, in some way, to deficiencies and errors in forensic science. Furthermore, these serious deficiencies have been explored in detail and acknowledged by the National Academy of Sciences and United States Supreme Court respectively. Resultantly, a vast array of forensic sciences, including fingerprint identification, firearms identification, bite mark identification, and arson investigation, have been subject to mounting scientific and scholarly criticism. Critics argue that these disciplines are not underpinned by the scientific method, have unknown error-rates, rely heavily on subjective and experience based evaluations which can diverge widely, allow for overstated conclusions, and are governed by inadequate standards. As a consequence, between 1999 and 2011, the admissibility of evidence from each of these four disciplines has been increasingly challenged under *Daubert*. Defendants convicted of arson have also used advancements in fire science to make “newly discovered evidence” and “innocence” claims in post-conviction relief procedures.

A snapshot of criminal court responses to legal challenges concerning friction ridge analysis, tool-mark analysis, forensic odontology, and fire science between 1999 and 2011 allows us to make a number of general observations: (1) Despite significant criticism concerning the veracity of these four disciplines, the overwhelming majority of courts continue to admit such evidence. (2) In admitting such evidence, courts rely heavily on precedent to support their conclusions and on the adversary system’s ability to weed out unreliable practices and conclusions. (3) To different extents, courts are engaging the *Daubert* standard and the *Daubert* factors. However, numerous courts are taking inconsistent and, at times, contradictory approaches to applying *Daubert*. (4) Numerous courts have engaged, to differing degrees, with the criticism aimed at these four disciplines. In response to certain criticisms, and in order to inject more reliability into the evidence admitted, some courts have set out more precise

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procedures for testifying experts to follow, rejected untraditional evidence, and refused to allow experts to testify to matches between the defendant and suspect evidence. Whether these practices deter fact finders from incorrectly finding liability, however, is questionable. (5) To differing degrees, numerous courts have engaged the NAS Report across all four disciplines. To date, the NAS Report has not led any court to conclude that evidence from any of these four disciplines is inadmissible. Some court's discussions of the NAS Report suggest that the report contains some contradictory or confusing conclusions. To support their decisions to admit evidence, multiple courts have relied on the fact that the NAS Report does not intend to determine the admissibility of evidence in a particular case.

These general observations highlight the cultural differences between law and science. In short, although law and science both seek truth, they take different paths to find it, and, as many of the cases discussed in this article highlight, law's desire to seek the truth often comes in second behind its need to determine legal proof. Perhaps this is understandable because law must serve as a way of organizing societies by providing stability and predictability, whereas science is encouraged to embrace new ideas so that we can better understand the natural world. Science is not constrained in the many ways law is. Despite the growing criticism aimed at fingerprint identification, firearms identification, bite mark identification, and arson investigation, experts continue to use and testify to techniques that have never been scientifically validated. Moreover, judges seem ill-equipped to recognize the distinctions between valid and invalid forensic science. Law remains ill-equipped to incorporate changes in these disciplines because law is beholden to finality and predictability. Generally, judges seem to be unable to recognize invalidated methods or unwilling to banish long-accepted, but unsupported scientific assertions from the courtroom, perhaps through fear of upsetting the criminal justice system in unpredictable ways. As a consequence of these cultural clashes, when forensic science develops, as it inevitably does, law responds slowly, reluctantly, and often inconsistently.