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Scientific and Legal Developments in Fire and Arson Investigation Expertise in *Texas v. Willingham*

Rachel Dioso-Villa*

ABSTRACT

The forensic sciences, as a form of professional knowledge, are changing with new advancements in technology and continuing research and development. With the National Academy of Science's recent call for more research and testing of the forensic sciences, the criminal justice system is faced with the challenges of handling cases where convictions are based on outdated or discredited evidence. In light of technological advancements in the field, this article examines the evolution of fire- and arson-investigation knowledge over the course of a highly publicized capital murder case. The history of arson investigation is discussed, as is the legal admissibility of such expert testimony. Arson investigation expertise stems from non-scientific or experience-based origins, yet is conveyed in court as scientific fact. The article identifies the dangers of admitting such testimony into court without scrutiny. The lack of scientific validation of investigative methods, overreaching scientific claims based on case facts and witness statements, and fire investigators' susceptibility to contextual bias are discussed. The

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article raises questions as to whether and how the legal system has propagated the misuse of arson investigation testimony and how outdated understandings of evidence may impact the identification of future miscarriages of justice.

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I. INTRODUCTION

In 2009, the National Academy of Sciences (NAS) published a landmark report, *Strengthening Forensic Sciences in the United States: A Path Forward*, which highlighted the inadequacies of the forensic sciences and the dangers of its current use in court.¹ In it, they noted that with the exception of DNA testing, all other forensic disciplines, such as fingerprints, firearm identification, and hair evidence, lack scientific foundation to interpret and validate their methods

1. COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIENCE CMTY., NAT'L RESEARCH COUNCIL, *STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD* 5 (2009) [hereinafter *A PATH FORWARD*].

and claims.² They recommended that the field conduct more rigorous research and systematic scientific testing in which to ground their findings and to develop new methods of reliable and valid forensic investigation.³ This was not a new development. Prior to the NAS report, academic scholars had pointed out deficiencies in validation and scientific testing in such forensic disciplines as fingerprint identification,⁴ handwriting,⁵ toolmarks,⁶ and bullet lead analysis,⁷ to name a few.

Arson investigation expertise is another field that has received little attention by social scientists and legal scholars, although it is awarded considerable leeway in court when investigators testify as expert witnesses.⁸ Fire experts determine the cause and origin of fires, whether the fire was intentionally set or accidental, and they provide probative evidence in many criminal and civil cases.⁹ In light of research that has called into question the scientific validity of arson investigative methods and claims,¹⁰ this profession is now confronted with new challenges to its admission as expert evidence, and the criminal justice system may potentially face new claims of innocence in cases that employed outdated techniques.

This article provides a critical evaluation of arson investigation knowledge by examining the history and

2. *Id.* at 7 (“With the exception of nuclear DNA analysis, however, 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.”).

3. *Id.* at 8 (explaining that further research is needed to “establish the limits and measures of performance” of forensic methods).

4. See SIMON A. COLE, SUSPECT IDENTITIES: A HISTORY OF FINGERPRINTING AND CRIMINAL IDENTIFICATION 259–60 (2001); Jennifer Mnookin, *The Validity of Latent Fingerprint Identification: Confessions of a Fingerprinting Moderate*, 7 L. PROBABILITY & RISK 127, 128–30 (2008).

5. See D. Michael Risinger, *Defining the “Task at Hand”: Non-Science Forensic Science After Kumho Tire Co. v. Carmichael*, 57 WASH. & LEE L. REV. 767, 770 n.13 (2000) [hereinafter Risinger, *Defining*].

6. See Adina Schwartz, *A Systematic Challenge to the Reliability and Admissibility of Firearms and Toolmark Identification*, 6 COLUM. SCI. & TECH. L. REV. 1, 7–12 (2005).

7. See NAT’L RESEARCH COUNCIL, FORENSIC ANALYSIS: WEIGHING BULLET LEAD EVIDENCE 9–10 (2004).

8. See *infra* Part III.

9. See A PATH FORWARD, *supra* note 1, at 86 (“Forensic science experts and evidence are routinely used in the service of the criminal justice system.”).

10. See *infra* Part II.

transition of the profession from its non-scientific origins to its presentation as a scientifically-informed subject-matter expertise in court. I will examine the expert testimony of arson experts over the course of the Texas capital murder trial of Cameron Todd Willingham. The article highlights how testimony by fire investigators in this case contributed to the potential wrongful conviction of the defendant and demonstrates how legal and scientific changes in the field exposed the contentious nature of arson evidence as presented at trial. I will analyze the key forensic evidence that contributed to the defendant's conviction and expose limitations in the conduction of fire investigations and its presentation as scientific testimony. The article concludes by questioning the adequacy of post-conviction relief to detect and remedy such limitations on appeal or through habeas corpus and clemency petitions, as well as the effectiveness of post-execution investigations, such as those conducted by forensic science commissions, that have the capacity to acknowledge and address the use of discredited evidence within the forensic community.

II. FIRE AND ARSON INVESTIGATION—EXPERIENCE-BASED EXPERTISE

A. FIRE AND ARSON INVESTIGATION

A fire can consume combustible evidence due to its highly destructive nature, leaving fire investigators with the challenging task of determining its cause and origin based on the remaining debris.¹¹ Fire investigators may start their investigations upon arrival on site, or they may receive reports from the fire department several days after the fire has been extinguished to begin their investigations.¹² They may draw their conclusions based on several factors, including the analysis of debris through physical evidence, chemical testing,

11. Stephen M. Olenick et al., *The Behavior of Liquid Fuel on Carpet (Porous Media): A Case for the Inclusion of Science in Fire Investigation*, 46 FIRE TECH. 843, 843 (2010).

12. See NAT'L FIRE PROT. ASS'N ET AL., FIRE INVESTIGATOR: PRINCIPLES AND PRACTICE TO NFPA 921 AND 1033, at 138–39, 186–94 (3d ed. 2012) [hereinafter NFPA 921] (explaining the legal authority required to conduct a fire scene investigation and explaining the planning and preplanning process of fire scene investigations).

third-party reports and photographs, reports from medical professionals who treat victim injuries, and interviews with eyewitnesses and victims.¹³ Unlike other forensic sciences that attempt to match crime scene evidence with a unique source, such as fingerprints or DNA evidence, fire investigators interpret evidence and make conclusions as to whether the fire was accidental or intentionally set.¹⁴

The fields of fire investigation and fire protection engineering developed on parallel tracks that published separate texts, manuals, and guides for practitioners.¹⁵ On the one hand, fire protection engineers attempt to understand the physical processes of fire and how to control its growth and spread in different environments using different substances.¹⁶ This body of knowledge is continually evolving, due to the need to consider the effects of new materials, structures, and fuels and its reliance on mathematical equations, computer modeling, and the analysis of empirical data allow for the accommodation of new findings.¹⁷

On the other hand, fire fighters and police officers, whose primary objective was to determine whether the cause of a fire was accidental or incendiary, developed arson investigation. Fire investigators did not necessarily have scientific training,

13. See JOHN LENTINI, SCIENTIFIC PROTOCOLS FOR FIRE INVESTIGATION, 229–95 (2d ed. 2006) (detailing how forensic fire investigators evaluate sources of fire ignition). For additional overview of fire and arson investigation techniques and methods, see generally JOHN D. DEHAAN & DAVID J. ICOVE, KIRK'S FIRE INVESTIGATION (Pearson, 7th ed. 2012).

14. LENTINI, *supra* note 13, at xv (“Unlike . . . almost any other incident that requires investigation, a fire is unique in that the first major task, and often the most daunting one, is to determine whether a crime has been committed.”).

15. *Id.* at 10–13 (explaining the evolution of modern fire science).

16. See Pat O'Malley & Steven Hutchinson, *Genealogy of “Fire Prevention,”* in GOVERNANCE AND REGULATION IN SOCIAL LIFE: ESSAYS IN HONOUR OF W.G. CARSON 145, 154 (Augustine Brannigan & George Pavlich eds., 2007) (“Laboratories were largely staffed by engineers and focused on the investigation of specific fires, the testing of new equipment and the development of a generalizable knowledge of fire risks.”); see also Milosh T. Puchovsky, *Structural Fire Protection*, in 2 FIRE PROTECTION HANDBOOK, at 19-1, 19-3 to 19-126 (Arthur E. Cote et al. eds., 20th ed. 2008) (discussing building practices).

17. Thomas R. May, *Fire Pattern Analysis, Junk Science, Old Wives Tales, and Ipse Dixit: Emerging Forensic 3D Imaging Technologies to the Rescue?*, 16 RICH. J.L. & TECH. 1, 1–2 (2010). For further discussion of fire science, see generally DOUGAL DRYSDALE, AN INTRODUCTION TO FIRE DYNAMICS (2d ed. 1998) and O'Malley & Hutchinson, *supra* note 16, at 154–55.

nor was it necessary for them to hold a higher educational degree beyond a high school diploma.¹⁸ As a result, theories and heuristics about the ways in which fires behave developed out of the collective experience of fire investigators within the community through their field investigations.¹⁹ Mentors passed down this experiential knowledge to their apprentices without experimental or scientific testing to validate their claims.²⁰ For example, fire investigators relied on various assumptions such as the belief that naturally set or accidental fires had one cause and origin; therefore, fires with multiple origins would be indicative of arson, and accelerant-induced fires burned faster and at higher temperatures than naturally burning fires.²¹ Texts and guidelines authored by leading fire investigators perpetuated these beliefs and furthered their widespread use.²²

There is considerable variability in procedures and training between state, region, county, police and fire departments, and among fire investigators themselves.²³ Moreover, there is no consistent standard across courts or jurisdictions that require that fire experts be certified investigators. Attempts to standardize field practices remain controversial among fire investigators, since the field's knowledge base and tenets were born out of individual and anecdotal experience about fires and how to conduct

18. See LENTINI, *supra* note 13, at xv; David L. Faigman et al., *The Legal Response to Expert Testimony on Fires and Explosions*, in SCIENCE IN THE LAW: FORENSIC SCIENCE ISSUES 339, 344 (David L. Faigman et al. eds., 2002).

19. See John J. Lentini, *The Scientific Basis of Expert Testimony on Fires, Arsons, and Explosions*, in SCIENCE IN THE LAW: FORENSIC SCIENCE ISSUES, *supra* note 18, at 355, 380–81.

20. See LENTINI, *supra* note 13, at 11–12; see also Michael J. Saks & David L. Faigman, *Failed Forensics: How Forensic Science Lost Its Way and How It Might Yet Find It*, 4 ANN. REV. L. & SOC. SCI. 149, 157–58 (2008); Marc Price Wolf, *Habeas Relief From Bad Science: Does Federal Habeas Corpus Provide Relief for Prisoners Possibly Convicted on Misunderstood Fire Science*, 10 MINN. J. L. SCI. & TECH. 213, 217 (2009).

21. See JOHN F. BOUDREAU ET AL., ARSON AND ARSON INVESTIGATION: SURVEY AND ASSESSMENT 35, 60 (1977); LENTINI, *supra* note 13 at 513; DEHAAN & ICOVE, *supra* note 13, at 678.

22. See, e.g., DEHAAN & ICOVE, *supra* note 13, at 678; U.S. DEP'T OF COMMERCE, FIRE INVESTIGATION HANDBOOK 6 (Francis L. Brannigan et al. eds. 1980); Wolf, *supra* note 20, at 220–25.

23. See generally FED. EMERGENCY MGMT. AGENCY & U.S. FIRE ADMIN., FIRE/ARSON INVESTIGATION TRAINING RESOURCE CATALOG 145–60 (1993) (describing the different accreditation requirements for different fire investigation programs).

investigations.²⁴ This is perpetuated by the fact that there are no formal training or specialized courses required to conduct fire investigations; rather, investigators should “remain current with investigation methodology, fire protection technology, and code requirements by attending workshops and seminars, and/or through professional publications and journals.”²⁵ The NAS highlighted the absence of such a standard in their report and recommended that all forensic disciplines standardize training requirements for their examiners.²⁶

B. ARSON INDICATORS

The use of arson indicators in fire investigation was left largely undisputed until the 1980s when technological advancements improved the measurement of heat transfer and the chemical properties of fires through the use of computer modeling and advances in the study of fluid dynamics.²⁷ The National Fire Protection Association (NFPA), one of the leading associations for fire investigators in the United States, conducted controlled test fires to evaluate basic assumptions and heuristics about incendiary fires.²⁸ Their results challenged existing theories of fire behavior that texts and training materials had endorsed over the years. For example, it was previously believed that fires that burned abnormally fast due to the aid of accelerants experienced a moment of “flashover,” where all materials in an enclosed room simultaneously combusted.²⁹ Controlled test burns later revealed that accidental fires set in small, enclosed spaces produced the same artifacts of “flashover” and therefore could not solely be interpreted as evidence of arson.³⁰ In 1991, fire investigators treated the Oakland California firestorm that destroyed thousands of houses and hundreds of apartments as a natural

24. See *infra* Section VII.

25. NFPA 921, *supra* note 12, at 415. The National Fire Protection Association (NFPA) is one of the leading associations for arson investigators in the United States. *About NFPA*, NFPA, <http://www.nfpa.org/categoryList.asp?categoryID=143> (last visited Apr. 22, 2013).

26. See Chapter 5, specifically the section about the “Analysis of Explosives Evidence and Fire Debris.” A PATH FORWARD, *supra* note 1, at 5–34.

27. See LENTINI, *supra* note 13, at 110–113.

28. See NFPA 921, *supra* note 12, at 44.

29. LENTINI, *supra* note 13, at 501–03.

30. See NFPA 921, *supra* note 12, at 37 (describing the factors that lead to flashover); see also Wolf, *supra* note 20, at 223.

field experiment, since the fires had a known natural cause.³¹ The investigators' conclusions, after sifting through the debris of the destroyed homes, again, challenged the validity of many of the widely accepted beliefs of arson taught at the time, since they found the same burn patterns in these homes.³²

Despite these new findings, fire investigation texts were slow to reflect these changes and fire investigators did not systematically or immediately alter or update their investigative techniques.³³ *Fire Investigator: Principles and Practice to NFPA 921 and 1033 (NFPA 921)* explicitly outlined that arson indicators should not be solely relied upon to determine whether or not the fire was incendiary.³⁴ The guide did not explicitly invalidate the use of arson indicators; rather, it stated that fire investigators could no longer rely on these indicators exclusively in determining arson since they were indistinguishable in natural and incendiary fires. Newer editions of fire investigation texts soon followed suit and referred to these indicators as "myths" or "misconceptions," implying that the current fire investigation community should, at the very least, exercise caution when making determinations of arson based on such indicators.³⁵

With these developments in the late 1980s and early 1990s, it is debatable as to whether the fire community readily adopted such advancements. In 2009, NAS stated that the forensic sciences, in general, needed standardized reporting of their findings and testimony; fire and arson investigation was no exception to its recommendations. NAS stated:

By contrast [to the analysis of explosives], much more research is needed on the natural variability of burn patterns and damage characteristics and how they are affected by the presence of various accelerants. 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

31. See John Lentini et al., *Unconventional Wisdom: The Lessons of Oakland*, FIRE & ARSON INVESTIGATOR, June 1993, at 18, 18.

32. For example, the theory that fires started by accelerants burn hotter than those accidentally set meant that finding melted copper and steel would be evidence of arson, since these metals had high melting points. However, fire investigators found melted copper and steel in the Oakland houses, despite the fact that the fires were not the result of arson. *Id.* at 19.

33. See A PATH FORWARD, *supra* note 1, at 127.

34. See NFPA 921, *supra* note 12, at 298, 302.

35. See DEHAAN & ICOVE, *supra* note 13, at 687–91; see also LENTINI, *supra* note 13, at 473–74.

committee [by John Lentini, Scientific Fire Analysis, L.L.C.], many of the rules of thumb that are 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.³⁶

In its evaluation of the existing fire and arson investigation techniques, NAS specifically referred to arson indicators as “rules of thumb” and acknowledged that there is contradictory evidence to challenge its validity. They recommended validation studies with experimental designs to test the burn patterns in different conditions in an attempt to put the field on “more solid scientific footing.” Arson indicators do not conclusively prove that an accelerant was used or that the fire was incendiary, and the determination that a fire is arson based solely on these indicators would arguably be misleading to a jury and potentially erroneous.

III. ADMITTING FIRE AND ARSON EVIDENCE AS EXPERT TESTIMONY

The admission of fire expertise in U.S. courts is not necessarily guaranteed, nor does the process result in a consistent or predictable outcome. The courts initially resisted admitting fire testimony, since they believed that expertise lay within the scope of common experience and that it invaded the jury’s decision-making process.³⁷ In the 1960s, fire investigators were admitted to testify in court as expert witnesses with admissibility decisions tending to rest on the investigators’ qualifications and experience, rather than the reliability or validity of the knowledge, methods, or expertise on which investigators based their conclusions.³⁸

In 1993, the case of *Daubert v. Merrell Dow Pharmaceuticals, Inc.* changed the landscape of legal

36. A PATH FORWARD, *supra* note 1, at 173 (footnotes omitted). Alligatoring is the blistering of wood that produces a pattern that indicates that there was a “rapidly developing fire. See U.S. DEP’T OF COMMERCE, *supra* note 22, at 6. For elaboration on how specific char patterns refers to the depth of burning in the wood to determine the length of time the wood burned see LENTINI, *supra* note 13, at 474–78.

37. *E.g.*, *State v. Watson*, 65 Me. 74, 76–77 (1876); *Neal v. Mo. Pac. Ry. Co.*, 153 N.W. 492, 493 (Neb. 1915); *New York v. Grutz*, 105 N.E. 843, 846–47 (N.Y. 1914); *cf. Sawyer v. State*, 132 So. 188, 193–94 (Fla. 1931).

38. Faigman et al., *supra* note 18, at 341–43.

admissibility of expert evidence in the United States.³⁹ The U.S. Supreme Court made trial judges “gatekeepers” to determine the relevancy of the expert evidence and provided them with guidelines to evaluate the reliability of the scientific theory and techniques.⁴⁰ To assist in evaluating the reliability of the evidence, the *Daubert* guidelines required that the evidence or methods are accepted by the scientific community to which it belongs, the science in question has peer-reviewed publications, a known low error rate, and a falsifiable and testable methodology.⁴¹ By specifying factors to evaluate the reliability of a particular science, *Daubert* was perceived as a more demanding standard than the previous admission standard of *Frye v. United States*⁴² that called for the scientific community to accept an expert’s methods and techniques.⁴³

Consistent with its historical roots as a skill-based expertise, fire and arson investigation experts attempted to evade scrutiny under the new *Daubert* standards, by claiming that their knowledge was not scientific. In the case of *Michigan Millers Mutual Insurance Co. v. Benfield*, the trial court judge excluded the insurance company’s arson expert’s testimony on the basis that it did not meet *Daubert*’s reliability criteria.⁴⁴ *Michigan Millers* argued for the application of a lesser standard for experience-based expertise. In support of this position, the International Association of Arson Investigators (IAAI) put forth an amicus curiae brief arguing that arson investigation was an experience-based expertise and was not a novel or scientific technique—therefore, *Daubert* should not

39. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 589 (1993).

40. *Id.* at 592–93.

41. *Id.* at 593–94.

42. *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

43. See *Weisgram v. Marley Co.*, 528 U.S. 440, 445, 455 (2000) (“Since *Daubert*, . . . parties relying on expert evidence have had notice of the exacting standards of reliability such evidence must meet.”); see also Gary Edmond & David Mercer, *Experts and Expertise in Legal and Regulatory Settings*, in *EXPERTISE IN REGULATION AND LAW* 1, 20–21 (Gary Edmond ed., 2004); Adina Schwartz, *A “Dogma of Empiricism” Revisited: Daubert v. Merrell Dow Pharmaceuticals, Inc. and the Need to Resurrect the Philosophical Insight of Frye v. United States*, 10 HARV. J.L. & TECH. 149, 154 (1997); Margaret A. Berger, *What Has a Decade of Daubert Wrought?*, 95 AM. J. PUB. HEALTH S59, S60 (2005).

44. *Mich. Millers Mut. Ins. Corp. v. Benfield*, 140 F.3d 915, 920 (11th Cir. 1998).

apply.⁴⁵ The appellate court in *Michigan Millers* upheld the trial court ruling that fire investigation expertise should be subject to scrutiny under the *Daubert* standards. Similar concerns were raised before the U.S. Supreme Court in *Kumho Tire Co. v. Carmichael* objecting to such investigative work's scientific classification;⁴⁶ however, the U.S. Supreme Court disregarded the IAAI's assertion and ruled that all scientific and skill- or experience-based expert evidence must be evaluated by the same admissibility criteria, thereby closing any further avenues that might be used to evade *Daubert*.⁴⁷ In addition, the Supreme Court's new ruling excused trial judges from the onus of differentiating between scientific and nonscientific evidence.⁴⁸

In the fallout of *Daubert* and *Kumho*, gradual pressure changed the field of forensic science to elucidate scientifically rigorous criteria through the creation of scientific and technical working groups within the different forensic disciplines.⁴⁹ This proved challenging for those forensic sciences whose foundations were built on the experience and skill of their analysts and practitioners.⁵⁰ Socio-legal scholars currently claim that many of the forensic sciences that are routinely admitted into court today are admitted without adequate supporting evidence to meet the *Daubert* standards;⁵¹ this includes handwriting,⁵² toolmarks,⁵³ and fingerprints.⁵⁴ As

45. Brief for International Ass'n of Arson Investigators as Amicus Curiae Supporting Appellants at 13–14, *Mich. Millers Mut. Ins. Corp. v. Benfield*, 140 F.3d 915 (1998) (No. 97-2138).

46. *Kumho Tire v. Carmichael*, 526 U.S. 137, 146 (1999). The IAAI filed a brief on behalf of Carmichael. *Id.* at 140.

47. *Id.* at 147, 151.

48. *See id.* at 147.

49. *See* A PATH FORWARD, *supra* note 1, at 39–53, 85–110.

50. *Id.*

51. *See* Jennifer L. Groscup et al., *The Effects of Daubert on the Admissibility of Expert Testimony in State and Federal Criminal Cases*, 8 PSYCHOL. PUB. POL'Y & L. 339, 363 (2002) (“The more interesting finding is the striking absence of any significant relationships between the four *Daubert* criteria and decisions to admit or exclude expert evidence.”).

52. *E.g.*, D. Michael Risinger, *Handwriting Identification*, in SCIENCE IN THE LAW: FORENSIC SCIENCE ISSUES, *supra* note 18, at 113, 121–39 [hereinafter Risinger, *Handwriting*]; *see also* Risinger, *Defining*, *supra* note 5, at 780–81 (noting a court's rejection of handwriting identification as science within the meaning of *Merrell Dow Pharm., Inc.*).

53. *See* Schwartz, *supra* note 6, at 31–32 (discussing reliability of toolmark identification).

54. *See* Simon A. Cole, *More than Zero: Accounting for Error in Latent*

such, many of the forensic sciences, including fire investigation, can be described as a subjective process that is often based on an examiner's judgment and experience.⁵⁵ There is a lack of a scientific foundation for many of the methods used in fire investigation and a lack of data and empirical evidence to which fire investigators can refer due to the field's reliance on practical knowledge.⁵⁶ Despite this, in response to *Daubert*, *Kumho* and the NAS report, fire investigators have expressed the need for the field to move toward the scientific validation of its methods and claims.⁵⁷

Fingerprint Identification, 95 J. CRIM. L. & CRIMINOLOGY 985, 986–88 (2005) (discussing possible errors with fingerprint evidence and the *Daubert* standard); Simon A. Cole, *Grandfathering Evidence: Fingerprint Admissibility Rulings from Jennings to Llera Plaza and Back Again*, 41 AM. CRIM. L. REV. 1189, 1197–1200 (2004); Mnookin, *supra* note 4, at 128–29; *see also* Itiel E. Dror & David Charlton, *Why Experts Make Errors*, 56 J. FORENSIC IDENTIFICATION 600, 600–04 (2006) (categorizing types of error). Many of these techniques and methodologies do not stem from the traditional hard sciences. As Professor Michael Saks notes, forensic identification sciences attempt to accomplish something that no other scientific field attempts to do—establish links between crime scene evidence to known exemplars. *See* Michael J. Saks, *Banishing Ipse Dixit: The Impact of Kumho Tire on Forensic Identification Science*, 57 WASH. & LEE L. REV. 879, 882 (2000). For example, in handwriting identification, document examiners attempt to determine who the author of a given written specimen is by comparing it to a known sample. It involves the visual scrutiny of written text based on the expert's experience. Document examiners face specific problems in making such determinations, such as whether individuals write uniquely from others and whether there is variation in any given individual's writing. *See* Risinger, *Handwriting*, *supra* note 52, at 121–22 (noting that specialization is often overlooked by the courts); *see also* Margaret A. Berger, *Expert Testimony in Criminal Proceedings: Questions Daubert Does Not Answer*, 33 SETON HALL L. REV. 1125, 1137–38 (2003); Mark P. Denbeaux & D. Michael Risinger, *Kumho Tire and Expert Reliability: How the Question You Ask Gives the Answer You Get*, 34 SETON HALL L. REV. 15, 60 (2003); D. Michael Risinger, *Navigating Expert Reliability: Are Criminal Standards of Certainty Being Left on the Dock?*, 64 ALB. L. REV. 99, 141 (2000) (comparing handwriting to bite mark analysis).

55. David L. Faigman, *Anecdotal Forensics, Phrenology, and Other Abject Lessons from the History of Science*, 59 HASTINGS L.J. 979, 979 (2008) (“Indeed, the forensic identification sciences that have little or no research basis . . . depend largely on the subjective judgment of practitioners . . .”); *see also* Saks & Faigman, *supra* note 20, at 156.

56. *See* Daniel Madrzykowski, *State-of-the-Art Research is the Future of Fire Investigation*, SIU AWARENESS, Mar. 2001, at 18, 19; *see also* FIRE PROT. RESEARCH FOUND., RECOMMENDATIONS OF THE RESEARCH ADVISORY COUNCIL ON POST-FIRE ANALYSIS 5–6 (2002) (“Improved methodologies for origin and cause determination would also provide greater confidence, and possibly greater quality, in statistics on fire problems.”).

57. LENTINI, *supra* note 13, at 13–15; Vincent Brannigan & Jose Torero,

IV. FIRE AND ARSON EXPERT TESTIMONY

A. *TEXAS V. WILLINGHAM*—CASE STUDY

In 1992, Cameron Todd Willingham was convicted for setting fire to his home and killing his three children. Twelve years later, the State of Texas executed him by lethal injection. The state's key evidence came from two fire investigators who testified that the fire was intentionally set. The indicators of arson included a sample taken from the front porch floorboard that tested positive for petroleum-based chemicals; burn patterns on the floor in the home where a liquid accelerant was believed to have been poured and ignited; broken glass patterns; and melted aluminum believed to be caused by abnormally high temperatures associated with fires fueled by accelerants.⁵⁸ The fire experts' investigative techniques and their reliance on the interpretation of arson indicators and burn patterns were not based on scientific testing, but on heuristics consistent with practices employed in the 1980s and, in some cases, still relied upon today.⁵⁹

B. EXPERIENCE-BASED EXPERT TESTIMONY

Since Willingham's execution in 2004, scholars, politicians, the media, and social justice organizations have expressed interest in the case in light of research in fire investigation uncovered before his execution.⁶⁰ Although there is no way to

The Expert's New Clothes: Arson "Science" After Kumho Tire, FIRE CHIEF (July 1, 1999), http://firechief.com/mag/firefighting_experts_new_clothes; Madrzykowski, *supra* note 56, at 19.

58. See ARSON REVIEW COMM., REPORT ON THE PEER REVIEW OF THE EXPERT TESTIMONY IN THE CASES OF *STATE OF TEXAS V. CAMERON TODD WILLINGHAM* AND *STATE OF TEXAS V. ERNEST RAY WILLIS* 10–13 (2006), available at <http://www.innocenceproject.org/docs/ArsonReviewReport.pdf> (discussing the methodology of investigative techniques used in *Willingham*); see also CRAIG L. BEYLER, ANALYSIS OF THE FIRE INVESTIGATION METHODS AND PROCEDURES USED IN THE CRIMINAL ARSON CASES AGAINST ERNEST RAY WILLIS AND CAMERON TODD WILLINGHAM 41–42 (2009).

59. A PATH FORWARD, *supra* note 1, at 170–73; May, *supra* note 17, at 2–3.

60. See Steve Mills & Maurice Possley, *Man Executed on Disproved Forensics: Fire That Killed His 3 Children Could Have Been Accidental*, CHI. TRIB., (Dec. 9, 2004), <http://www.chicagotribune.com/news/nationworld/chi-0412090169dec09,0,7443588,full.story>; Paul C. Giannelli, *The Execution of Cameron Todd Willingham: Junk Science, an Innocent Man, and the Politics of Death* 2 (Case W. Reserve Univ. Sch. of Law, Working Paper No. 2011-18, 2011); see also Craig M. Cooley & Gabriel S. Oberfield, *Increasing Forensic Evidence's Reliability and Minimizing Wrongful Convictions: Applying*

definitively prove Willingham's innocence, since intention cannot be deduced without having been present at the start of the fire, new research calls into question the evidence that convicted him.⁶¹ If Willingham's innocence were demonstrated, this would mark the first occasion in which a U.S. government body acknowledges that they executed an innocent person.⁶²

In *Texas v. Willingham*, the Assistant Fire Chief of Corsicana, Douglas Fogg, and Deputy Fire Marshal from the State Fire Marshal's Office (SFMO), Manuel Vasquez, investigated the fire scene and declared it an arson.⁶³ In his investigation, Fogg employed a common investigative technique of drawing a determination of arson by eliminating accidental or natural causes of the fire (i.e., electrical shorts and gas leaks) and noted unusual burn characteristics, such as puddle configurations and pour patterns.⁶⁴ Similarly, Vasquez identified over twenty indicators of arson that have, since the trial, been highly disputed and subsequently found as not necessarily indicative of arson.⁶⁵ At trial, he testified:

The fire is telling me this. The fire tells a story. I am just the interpreter. I am looking at the fire, and I am interpreting the fire. That is what I know. That is what I do best. And the fire does not lie. It tells me the truth.⁶⁶

Fogg and Vasquez's expert testimonies conclusively determined that the fire was incendiary and that Willingham had set fire to his home with the intention to kill his children.⁶⁷ The jury found Willingham guilty of three counts of capital murder and sentenced him to death.⁶⁸

Daubert *Isn't the Only Problem*, 43 TULSA L. REV. 285, 331-32 (2008) (describing briefly the effects and commission that arose out of Willingham's case).

61. Report of Dr. Gerald Hurst at 3-6, *Ex parte Willingham*, No. 24,4679(B) (Tex. Crim. App. Feb. 13, 2004).

62. David Grann, *Trial By Fire: Did Texas Execute an Innocent Man?*, NEW YORKER (Sept. 7, 2009), http://www.newyorker.com/reporting/2009/09/07/090907fa_fact_grann?printable=true¤tPage=all.

63. Statement of Facts Volume XI at 224-58, *Texas v. Willingham*, No. 24-467 (Tex. Dist. Ct. Aug. 18, 1992).

64. *Id.* at 256-57.

65. Report of Dr. Gerald Hurst, *supra* note 61, at 3-6; *see also* BEYLER, *supra* note 58, at 47-50 (describing faults in Vasquez's testimony).

66. Statement of Facts Volume XI, *supra* note 63, at 244.

67. *Id.* at 168, 258.

68. *See* Giannelli, *supra* note 60, at 2.

In Vasquez's explanation to the jury of his assertion of arson, there is little science involved:

Heat rises. In the winter time when you are going to the bathroom and if you don't have any carpet on the rug and you are barefooted, and you step on that cold floor, that floor is colder than the ceiling. It always is. Like right now, this floor is colder than this ceiling here.

So when I found that the floor is hotter than the ceiling, that's backwards, upside down. It shouldn't be like that. The only reason that the floor is hotter is because there was an accelerant. That's the difference. Man made it hotter or woman or whatever. Human being[s] made it hotter.⁶⁹

Vasquez explained fire investigation and fire dynamics as logical and common sense, such that jurors themselves could evaluate with their senses and experiences to arrive at the same conclusions. Similarly, Vasquez testified that burn patterns on the floor indicated the pouring of an accelerant and igniting it:

Burn trailers [are] like a trailer, you know, like a little path, a burnt path. A pour pattern, which is a pattern like somebody put some liquid on the floor . . . then it creates a puddle. Liquid creates puddles. When it rains, you get puddles. When the baby drops it's [sic] milk, you create puddles. If you ever drop a coke, you create puddles. All this area has that, has the burn trailer pour patterns and configurations.⁷⁰

Again, Vasquez explained fire dynamics as predictable and logical outcomes that jurors could imagine and evaluate for themselves. In this way, jurors need not solely rely on the expert opinions that the fire was intentionally set, but they could evaluate the evidence to draw their own opinions of the fire. In this account, Vasquez' explanation lacked any scientific basis for his conclusions and did not allude to scientific testing.

He reported melted aluminum on the porch, which the fire investigation community at the time believed could only occur at high temperatures that could not be reached without the use of an accelerant. He testified,

And aluminum melts at 1200 degrees normal. Wood fire does not exceed 800 degrees. So to me, when aluminum melts, it shows me that it has had a lot of intense heat Therefore, the only thing that can cause that to react is an accelerant. You know, it makes the fire hotter. It's not [a] normal fire.⁷¹

Here, he separated normal fires from abnormal fires, which he implied are incendiary fires that use accelerants. He offered no

69. Statement of Facts Volume XI, *supra* note 63, at 256.

70. *Id.* at 238.

71. *Id.* at 249.

alternative explanation as to why the aluminum melted or why or how the fire may have reached high temperatures.

As further evidence of arson, Vasquez testified that the fires started in the bedroom hallway and front porch, concluding that “[m]ultiple areas of origin indicate—especially if there is no connecting path, that they were intentionally set by human hands.”⁷² In order to draw such a conclusion, Vasquez would need to clearly demonstrate that the fires were isolated and had no connecting paths, which he did not explain to the jury and which other fire experts contested in post-conviction analyses of the evidence.⁷³

Fogg and Vasquez chemically analyzed over a dozen samples taken from “suspicious” areas of the house that showed severe burning and where the fire investigators hypothesized were the origins of the fires using gas chromatography with mass spectrometry (GC-MS).⁷⁴ All samples, with the exception of the front porch taken from the barbecue area, tested negative for any traces of an accelerant. Vasquez explained the chemical results:

A[:] And so there won't be any—anything left; it will burn up. The only thing left is a burn pattern. Because the fire, itself, leaves the evidence of what was there. Although the evidence—the liquid is burned, the evidence, by the fire left there, is that there was a liquid there.

Q[:] Similar to a fingerprint?

A[:] Yes, sir.

...

A[:] . . . [T]he fire leaves the burn patterns. You can't—you can't alter the burn patterns. You cannot pollute the fire scene. You can try, but you can't.⁷⁵

Here, he argued that the lack of GC-MS evidence of an accelerant should not be interpreted as evidence of its absence. Vasquez stressed that burn patterns disclose what GC-MS

72. *Id.* at 255.

73. Report of Dr. Gerald Hurst, *supra* note 61, at 4; ARSON REVIEW COMM., *supra* note 58, at 11–12.

74. Gas chromatography-mass spectrometry (GC-MS) is a laboratory method that is used to identify and test the presence of different substances within a given sample. For an overview, see M. H. Mach, *Gas Chromatography-Mass Spectrometry of Simulated Arson Residue Using Gasoline as an Accelerant*, 22 J. FORENSIC SCI. 348, 354–56 (1977).

75. Statement of Facts Volume XII at 50–52, *Texas v. Willingham*, No. 24,467 (Tex. Dist. Ct. Aug. 21, 1992).

testing could not necessarily detect due to the fire's consumption of the accelerant.⁷⁶ He likened burn patterns to fingerprints, which implied a fixed, unique, and unchangeable property that created a persuasive and powerful argument for arson. The danger in these statements is that they bolster the importance of arson indicators and diminish the need or significance of GC-MS testing. GC-MS testing can also be persuasive evidence that a fire started due to natural or accidental causes, especially if analysts, who are unaware of the investigative facts of the case, conduct the testing. Despite its utility, GC-MS testing is not always required in an investigation, and when performed, it is not always reported; rather, fire investigators may draw conclusions solely on the basis of their observations without chemical testing.⁷⁷

V. INVESTIGATIVE FACTS AND SCIENTIFIC ANALYSIS

A. EXTRA-LEGAL FACTORS

Unlike other forensic disciplines, fire investigators conduct the investigation and collect and evaluate burn patterns and debris alongside reports by the police, fire fighters, other fire investigators, and medical professionals; they conduct interviews with eyewitnesses, victims, and the defendant who may disclose information on a potential motive for arson (e.g., bankruptcy evasion, revenge, vandalism).⁷⁸ These extra-legal factors or investigative facts may be incorporated into the investigators' fire scene analysis and his determination of arson. For example, Vasquez reviewed Fogg's investigation report prior to commencing his examination and based his conclusion in part on external factors independent from his inspection of the physical evidence:

Q[:] Based on your experience, your training, your investigation, examination of the scene, do you have an opinion as to whether this particular fire was arson or [incendiary] in nature?

...

76. *Id.*

77. See DEHAAN & ICOVE, *supra* note 13, at 566, 573; see also NFPA 921, *supra* note 12, at 218–23 (outlining the methods that a fire investigator would use to document evidence).

78. See ROBERT E. CARTER, ARSON INVESTIGATION 209–33 (1978); DEHAAN & ICOVE, *supra* note 13, at 254–55, 316–21; HARVEY M. FRENCH, THE ANATOMY OF ARSON 45–50, 59 (1979); JOHN J. O'CONNOR, PRACTICAL FIRE AND ARSON INVESTIGATION 257–69 (1987).

A[:] It's a set fire. It's an incen[di]ary fire, and consequently is a crime of arson.

Q[:] What led you to believe this fire was incen[di]ary?

A[:] Besides what I've already said [about an investigation of the fire debris], I've talked to the occupant of the house, and I let him talk and he told me a story of pure fabrication.

[The Defense raised an objection on the basis that the conclusions are hearsay. The Court overrules the Defense's objection.]

...

Q[:] Deputy Vasquez, on your investigation and examination of this, did you interview witnesses, including the occupants of this house?

A[:] Yes, sir.

Q[:] Why?

A[:] If I am going to have a complete investigation, I have to have all the information I can possibly get.

...

Q[:] . . . You investigated the scene, examined the fire scene. Based on your experience and training and interviews that you conducted of, say, witnesses and the occupants of the house, do you have an opinion as to whether it's incen[di]ary or arson?

A[:] Yes, sir.

Q[:] And how did you arrive at that decision?

A[:] From what I have already reiterated and explained on the diagram and on the photographs and the interview with the defendant.

...

[Defense raises objections on the basis of hearsay. Court overrules objection.]

A[:] I listened to him. I never questioned him. I never asked him any questions. He just talked and he talked, and all he did was lie.⁷⁹

Here, Vasquez argued that he required as much information as possible about the offender and the events surrounding the fire, in order to conduct the investigation. The argument is that by collecting as much of the factual context of a case as possible, the fire investigator or forensic analyst avoids performing redundant or harmful tests, and this arguably allows them to give more accurate judgments consistent with what actually happened in the crime.⁸⁰ This is problematic, since information

79. Statement of Facts Volume XI, *supra* note 63, at 258–60.

80. For a discussion, see the section, “The Role of Forensic Scientists in Criminal Investigations” in William C. Thompson, *What Role Should Investigative Facts Play in the Evaluation of Scientific Evidence?* 4–8 (Univ. of Irvine Sch. of Law, Paper No. 2010-25, 2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1694722.

gathered over the course of the investigation can be subjective and may incorporate the investigator's theories on the events or motives of the fire, as would be the case in a police investigation.⁸¹ These investigative facts are not necessarily disclosed to juries. If left unquestioned during direct- or cross-examination, juries may mistakenly interpret fire investigation as a scientific expertise, as it is purported, without the awareness that it has incorporated subjective and non-scientific information into its conclusions.

B. CONTEXTUAL BIAS

In a similar vein, another drawback of conducting the investigation and knowing the extra-legal information, such as beliefs about the suspect's guilt, is that forensic examiners may be unknowingly influenced by this information, with an impact on their opinions and testimony.⁸² For example, Vasquez's interview with Willingham and his evaluation of the eyewitness testimony may have biased his examination of the fire debris, burn patterns, and interpretation of the GC-MS testing results. By ruling out natural or accidental causes of the fire, the fire investigator is vulnerable to contextual bias that may impact which ones he eliminates. In all likelihood, there may be many alternative theories of the fire that cannot or may not be pursued in the investigation.⁸³ This is particularly problematic, since contextual bias occurs on a subconscious level and cannot be controlled by willpower.⁸⁴

81. Whether a fire investigator has police powers during an investigation varies by state. See NFPA 921, *supra* note 12, at 138–39; see also INT'L ASS'N OF FIRE CHIEFS & NAT'L FIRE PROT. ASS'N, FUNDAMENTALS OF FIRE FIGHTER SKILLS 963 (2004).

82. For an extensive discussion of contextual bias in forensic expert evidence, see generally D. Michael Risinger et al., *The Daubert/Kumho Implications of Observer Effects in Forensic Science: Hidden Problems of Expectation and Suggestion*, 90 CALIF. L. REV. 1 (2002); Glen Whitman & Roger Koppl, *Rational Bias in Forensic Science*, 9 L. PROBABILITY & RISK 69, 70–71 (2010); Dror & Charlton, *supra* note 54, at 612.

83. For example, in severe fires, much of the evidence may be consumed, damaged, or missing. For a discussion of the limitations of applying *negative corpus* in fire investigation, see DENNIS W. SMITH, THE PITFALLS, PERILS AND REASONING FALLACIES OF DETERMINING THE FIRE CAUSE IN THE ABSENCE OF PROOF: THE NEGATIVE CORPUS METHODOLOGY 4–11 (2006), available at http://www.tedfordpond.com/wp-content/uploads/article_1181567640.pdf.

84. See Thompson, *supra* note 80, at 10.

C. OVERREACHING CLAIMS

Another danger that is not unique to fire expertise is when forensic experts make “overclaims” as Professors Cole and Risinger suggest, drawing conclusions beyond the data and the methodology or exaggerating the probative value of the evidence.⁸⁵ For example, Vasquez testified as to the intention to set the fire based on the burn patterns:

A[:] . . . These pour pattern[s] indicate to me, sir, the intent of why the fire was set. And the intent was to prevent people from coming in through that place or delay this entrance of persons thereby creating a fire that would impede the entrance, a barrier, a fire barrier.⁸⁶

. . .

Q[:] Based upon your investigation and your examination of the scene and your conclusions, can you tell what the arsonist intended to do by setting this fire?

A[:] Yes.

Q[:] What is that?

A[:] The intent was to kill the little girls.⁸⁷

Here, Vasquez overreached his expertise and the extent of fire investigation techniques by interpreting the fire patterns as an indication of an individual’s intent to set the fire, with the assumption that the fire was arson and not accidental. This type of expert testimony can have a profound effect on the weight the jury places on the evidence, which can ultimately impact the final verdict. NAS highlighted the need to clarify and standardize the reporting of forensic evidence at trial, suggesting that experts state their conclusions in such a way that they reflect the limitations of the evidence;⁸⁸ however, the validity of the techniques or how experts draw conclusions from their investigative methods remains far from transparent.

According to the Federal Rules of Evidence section 702, expert witnesses are given a certain degree of latitude and are permitted to state their opinions based on their experience and knowledge beyond the scope of jury members.⁸⁹ In the case of

85. See Simon A. Cole, *Where the Rubber Meets the Road: Thinking about Expert Evidence as Expert Testimony*, 52 VILL. L. REV. 803, 817–38 (2007); Risinger, *Defining*, *supra* note 5, at 787–89.

86. Statement of Facts Volume XI, *supra* note 63, at 250–51.

87. Statement of Facts Volume XII, *supra* note 75, at 54.

88. The use of standardized terminology to describe the results of forensic testing is not common practice in the forensic sciences. See A PATH FORWARD, *supra* note 1, at 21.

89. FED. R. EVID. 702 (Committee Notes on Rules—2000 Amendment).

fire expertise, this has included opinions on the ultimate issue of the defendant's guilt or innocence, which should be the exclusive domain of the judge or jury. Vasquez testified that the fire was intentionally set and openly discredited Willingham's account of the events. Despite the defense's objections, the court permitted Vasquez to name Willingham as the person who set the fire:

Q[:] Based upon all your investigation and interviews and experience as a fire or arson investigator, do you have an opinion as to the person or persons who started this particular fire?

...

A[:] Yes, sir.

Q[:] What is that opinion?

A[:] The occupant, Mr. Willingham.⁹⁰

Vasquez was admitted as an expert witness to testify as to the cause and origin of the fire, yet the court gave him latitude to opine that the defendant intended to commit arson, that the fire was incendiary, and that the defendant was guilty. This testimony had the potential to contaminate the ultimate issue of the case that should have been left to the purview of the jury or judge. In this way, the fire expert became the final decision maker, and his position was further bolstered by the fact that he had access to all evidence in the case. The danger of this type of testimony lies in that its probative value is exaggerated, since the judge and jury may erroneously perceive the fire investigator as providing independent evidence from witness statements, rather than recognize that this extra-legal information was incorporated into the expert's initial investigation. In other words, the value of Vasquez's expert testimony as evidence was dependent on the accuracy of the witness statements. In effect, the judge and jury unknowingly double counted the weight of the witness evidence in making their decisions.⁹¹

90. Statement of Facts Volume XI, *supra* note 63, at 267–68.

91. For a discussion of “double counting” evidence, see Thompson, *supra* note 80, at 17.

VI. POST-CONVICTION INEFFICIENCIES TO DETECT AND CORRECT ERRORS

A. FAILED APPEALS, HABEAS CORPUS, PETITION, AND CLEMENCY PETITION

Appellate courts and habeas petitions are the legal safeguards that are in place to identify and remedy such incidents where outdated methods or misleading expert testimony are presented at trial. In Willingham's case, issues with the validity of the fire evidence were not raised on appeal or in the habeas petition. One month after a jury trial convicted Willingham and sentenced him to death in 1992, the NFPA published its guidelines, which questioned the validity and reliability of arson indicators. Despite this, Willingham's nine appeals of his conviction before the Texas State Court of Appeals did not raise the issue of the validity of the fire expert testimony.⁹²

In 2001, nine years after the publication of the *NFPA 921*, the U.S. District Court denied Willingham's habeas corpus petition.⁹³ Again, the petition failed to raise issue with the contested investigation techniques employed by the fire experts. Rather, it highlighted the appellate counsel's inefficiency to raise issue with Vasquez's testimony on the veracity of Willingham's account within the scope of his expert opinion, which the habeas court found permissible and affirmed the trial court's ruling.⁹⁴

Vasquez also testified as to the ultimate fact of the case of whether Willingham set the fire; however, the habeas court deemed the error as harmless and argued that it had no effect on the jury's guilty verdict, although overstepping the purview of the jury.⁹⁵ The court described Vasquez and Fogg's testimonies as "uncontroverted expert testimony . . . that an accelerant was used to start the fire intentionally"⁹⁶ and cited extrinsic factors related to Willingham's perceived

92. See *Willingham v. State*, 897 S.W.2d 351 (Tex. Crim. App. 1995); *Ex Parte Willingham*, No. 35,162-02 (Tex. Crim. App. 2004); *Ex Parte Willingham*, No. 35,162 (Tex. Crim. App. 1997).

93. *Willingham v. Johnson*, No. Civ. A. 3:98-CV-0409-L, 2001 WL 1677023, at *25 (N.D. Tex. Dec. 31, 2001).

94. *Id.* at *16-18.

95. *Id.* at *18.

96. *Id.*

inappropriate behavior as a grieving parent as circumstantial evidence: his “lack of concern or grief in the hospital after the fire,” his reported “carefree attitude one day after the fire,” and the fact that he asked investigators to help him locate his dartboard among the fire debris.⁹⁷ The court raised other evidence that supported the conviction and excused Vasquez’s testimony on the ultimate issue of guilt in the case. This is permissible, since the determination of harmless error is highly discretionary and flexible in that it allows the court to review all evidence placed before the jury while assuming the guilt of the defendant.⁹⁸ That is, rather than have the court determine whether the contested testimony contributed to the jury’s actual guilty verdict, it determines whether there is sufficient supporting evidence to excuse the guilty finding.⁹⁹ In this respect, harmless error undermines the very safeguards in place to protect the innocent from detection and the correction of miscarriages of justice that may have occurred at trial due to faulty or misleading evidence.¹⁰⁰

After Willingham exhausted all steps in the legal process to seek exoneration, he sought a petition for clemency to the Governor of Texas as a last resort.¹⁰¹ Granting clemency is an act of mercy that is at the discretion of one individual and it is meant as a failsafe to catch any errors in the justice system in which an innocent person may be executed.¹⁰² As a basis for the clemency petition, Pat Cox, one of Willingham’s cousins, enlisted Gerald Hurst, a recognized expert in fires and explosives, to review the evidence presented at trial.¹⁰³ He filed a report that identified “critical errors” with Fogg and Vasquez’s conclusions that the fire was incendiary.¹⁰⁴ He

97. *Id.*

98. For a detailed discussion of harmless error in cases of innocence, see Brandon L. Garrett, *Innocence, Harmless Error, and Federal Wrongful Conviction Law*, 2005 WIS. L. REV. 35, 57–63.

99. *Id.* at 57.

100. For a discussion on the use of habeas corpus petitions in trials that involved discredited evidence, such as the case with arson evidence, see Wolf, *supra* note 20, at 235–37.

101. Rachel Farris, *Dare Devils: Governor Rick Perry and the Texas Death Panel*, HUFFINGTON POST (Sept. 12, 2009, 07:33 PM), http://www.huffingtonpost.com/rachel-farris/dare-devils-governor-rick_b_284698.html.

102. See Austin Sarat, *Mercy, Clemency, and Capital Punishment: Two Accounts*, 3 OHIO ST. J. CRIM. L. 273, 274–76 (2005).

103. See Mills & Possley, *supra* note 60.

104. See Report of Dr. Gerald Hurst, *supra* note 61, at 4–6.

emphasized that after Willingham's trial, advances in technology led the field of fire and arson investigators to question and contest each of the twenty arson indicators Fogg and Vasquez identified in the fire.¹⁰⁵ He cited the *NFPA 921* as a "landmark publication" that had become the "de facto standard of care for the fire investigation community."¹⁰⁶ The clemency petition requested a stay of execution and a ninety-day reprieve based on new evidence to allow Hurst to conduct a full investigation.¹⁰⁷ After exhausting all legal avenues for recourse, Governor Rick Perry and the Texas Board of Pardons and Paroles denied the petition.¹⁰⁸ Cameron Todd Willingham was executed after having served twelve years in prison on February 17, 2004.¹⁰⁹

B. FORENSIC SCIENCE COMMISSION INVESTIGATION

State-based forensic science and innocence commissions may re-investigate cases outside of the court system, which marks another means by which flawed evidence may be detected and corrected post-conviction. In 2008, the Texas Forensic Science Commission (TFSC) agreed to investigate the fire evidence in Willingham's case.¹¹⁰ While they would not rule on actual innocence, the TFSC's mandate is to investigate complaints of negligence or misconduct in criminal cases that involved forensic evidence, which could directly affect the practice and future of fire expertise.¹¹¹

In carrying out its investigation into Willingham's case, the TFSC sought an independent review from Craig Beyler, an experienced fire and explosives investigation expert, to examine the fire investigation evidence in relation to the existing standards of procedures at the time of the

105. *Id.* at 2.

106. *Id.*

107. See Letter from Maria Ramirez, Clemency Adm'r, to Walter Reaves, Jr. (Feb. 13, 2004), available at http://www.innocenceproject.org/docs/Willingham_foia.pdf.

108. See Mills & Possley, *supra* note 60.

109. See *id.*

110. See *The Texas Forensic Science Commission and the Willingham Case*, INNOCENCE PROJECT, http://www.innocenceproject.org/Content/The_Texas_Forensic_Science_Commission_and_the_Willingham_Case.php (last visited Mar. 2, 2013).

111. See *About Us*, TEX. FORENSIC SCI. COMMISSION, <http://www.fsc.state.tx.us/about/> (last visited Mar. 2, 2013).

investigation as well as the current standards.¹¹² Beyler offered several alternative explanations to the cause of the fire that Fogg and Vasquez did not eliminate in their investigations, such as an electrical fire caused by the appliances or the ceiling fans or the possibility that Willingham's eldest daughter accidentally set the fire with a cigarette lighter.¹¹³ He concluded that neither Fogg nor Vasquez's investigations, nor their testimonies, were compliant with existing standards of care at the time and do not comply with the existing standards as outlined in the *NFPA 921*.¹¹⁴

This point became moot in 2011, when the Attorney General, Greg Abbott, declared that the TFSC did not have jurisdiction to consider evidence in the *Willingham* case and could not pass a ruling on negligence or misconduct.¹¹⁵ By narrowly defining the TFSC's jurisdiction as only applying to cases heard after its establishment in 2005, it effectively stopped the investigation indefinitely and restricted the TFSC's power to hold the fire investigators in Willingham's case accountable for their actions or to enforce changes in the field to validate its methods and improve its practices.

VII. FIRE AND ARSON INVESTIGATION COMMUNITY

Prior to the Attorney General's dismissal of the TFSC's investigation of the *Willingham* case on the grounds of jurisdiction, the TFSC solicited responses to Beyler's report from the SFMO and the Corsicana Fire Department that carried out Willingham's investigation.¹¹⁶ Their correspondence highlighted the contentious nature of the field of fire and arson investigation where opinions based on experience, rather than science, are still highly valued and deemed part of acceptable practice within the community.¹¹⁷ This is, in part, due to the fact that fire investigation practices openly endorse the use of

112. See *The Texas Forensic Science Commission and the Willingham Case*, *supra* note 110.

113. BEYLER, *supra* note 58, at 45–46.

114. *Id.* at 51.

115. See Letter from Greg Abbott, Attorney Gen. of Tex., to Nizam Peerwani, Presiding Officer, Tex. Forensic Sci. Comm'n (July 29, 2011), available at <https://www.oag.state.tx.us/opinions/opinions/50abbott/op/2011/htm/ga-0866.htm>.

116. See Letter from Leigh Tomlin, Comm'n Coordinator, Tex. Forensic Sci. Comm'n, to State Fire Marshal's Office (Aug. 2, 2010) (on file with author).

117. See *id.*

witness interrogation and the analysis of human behavior along with investigating aspects of the fire.¹¹⁸ Subjective interpretation of fire patterns is required in fire investigation¹¹⁹ and discretion allows investigators to select from a myriad of extra-legal aspects of a case or artifacts of the fire on which to concentrate their investigations.¹²⁰ It is therefore not surprising that fire investigators may reach different conclusions about the same fire. In fact, reaching different conclusions based on “expertise” is an accepted outcome among fire investigators due to these varied investigative practices.¹²¹ While it might be expected that fire investigators agree with Beyler’s analysis of the fire evidence in light of new research and support by other fire experts,¹²² the subjective nature of the profession allows for contradicting opinions.

The Corsicana Fire Chief issued a twenty-one page rebuttal to Beyler’s report based on the trial transcripts, police reports, and media accounts of the case, but without access to the tapes, photographs, fire investigation reports, or any of the physical evidence available to Beyler on which he could base his conclusions.¹²³ The rebuttal defended Fogg and Vasquez’s testimony as valid and reliable based on a close reading of the witness testimonies at trial.¹²⁴ He acknowledged that arson indicators are not necessarily indicative of arson, but argued that since there are cases where accelerants are used that produced similar burn patterns,¹²⁵ Fogg and Vasquez’s reliance on arson indicators was justifiable.¹²⁶

The Corsicana Fire Chief stated, “[I]f [the fire] isn’t accidental, it is intentional”;¹²⁷ through the process of elimination of natural and accidental causes of a fire, one can

118. See Letter from Paul Maldonado, Tex. State Fire Marshall, to Tex. Forensic Sci. Comm’n (Aug. 20, 2010) (on file with author).

119. See Brannigan & Torero, *supra* note 57 (discussing the subjective nature of fire investigation).

120. See *supra* Part V.A (discussing the extra-legal aspects of fire investigation at length).

121. Brannigan & Torero, *supra* note 57.

122. See, e.g., ARSON REVIEW COMM., *supra* note 58, at 11–12.

123. Letter from Donald McMullan, Corsicana, Tex. Fire Chief, to Tex. Forensic Sci. Comm’n (Sept. 29, 2009) (on file with author).

124. *Id.*

125. *Id.*

126. *Id.*

127. *Id.*

draw the conclusion of arson. Many fire investigators believe they are permitted to use the process of elimination, or *negative corpus*, to rule out all known possible causes of the fire, if they suspect arson.¹²⁸ However, how to eliminate accidental causes in a systematic way and whether it is possible to eliminate all natural causes to draw a conclusion of arson is a contentious issue within the fire community.¹²⁹ Such an approach is dependent on the fire investigator's skill at ruling out any and all possible non-incendiary causes of fire that could have existed at the time.¹³⁰ This is not typically discussed and is left to the discretion of the investigator, as the Corsicana Fire Chief pointed out, "[W]hat constitutes 'elimination' is, to some degree, a matter of the investigator's judgment, which I believe should be based on reasonable scientific principles."¹³¹

The Fire Chief defended the overreaching claims fire experts testify to in court, such as Vasquez's testimony that "a fire does not lie" and the "fire tells a story," as a "colloquial way of expressing what physical facts can tell an experienced investigator about what happened during a particular fire."¹³² Again, the investigator's experience trumps scientific tests that may disprove arson, such as the negative chemical tests of accelerants in the debris. The investigator is given the benefit of the doubt that he used logical and even scientific assessments in making the determination of arson by virtue of his position and expertise.¹³³

The TFSC also requested an opinion from the SFMO, who stated that they supported Fogg and Vasquez's reports and conclusions in the case.¹³⁴ They disputed Beyler's evaluation of the evidence and expert testimony and stated that the fire investigators in Willingham's case used "principles that can be

128. LENTINI, *supra* note 13, at 127-29.

129. See generally DEHAAN & ICOVE, *supra* note 13, at 322 ("While some investigators treat negative corpus as a 'catchall,' it is a very difficult case to prove and should be relied upon only in the most special circumstances. Negative corpus cases are accepted in some jurisdictions and not in others . . .").

130. *Id.* (discussing the complexity of collecting enough data to exclude all other hypothesis except arson).

131. Letter from Donald McMullan, *supra* note 123.

132. *Id.*

133. See Brannigan & Torero, *supra* note 57 (arguing that fire investigation lacks a scientific process).

134. Letter from Paul Maldonado, *supra* note 118.

linked to *NFPA 921* standards subsequently put in place”¹³⁵ and highlighted the fact that the *NFPA 921* does not prohibit or preclude the use of arson indicators to determine an incendiary fire, rather, they indicate that this same physical evidence may be present in arson.¹³⁶ Part of the difficulty with applying the *NFPA 921* guidelines is that they are not standards or requirements for fire investigation and they are written with indeterminate language regarding the use of arson indicators.¹³⁷ Additionally, fire investigation routinely relies on extra-legal factors and the analysis of second-hand or third-party information,¹³⁸ which makes it that much more difficult to discern or predict conclusions by individual investigators.

VIII. FUTURE OF FIRE AND ARSON EXPERTISE

Incorporating investigative facts into scientific analysis, contextual bias, overreaching claims, and testifying to the ultimate issue of a case are serious problems that the legal system and forensic science community must contend with regarding the use of fire investigation expertise. Despite empirical evidence that discredits existing investigation methodologies and techniques, members of the fire community remain resistant to acknowledge or correct such errors, or adopt national standards and protocols.¹³⁹

Professor William Thompson suggested the division of labor and the creation of case managers to liaise between police investigators and forensic analysts in order to control for contextual bias:

[The ‘case manager model’] seeks to minimize both contextual ignorance and contextual bias through a separation of functions. Forensic scientists serve either as case managers or analysts. The role of case manager is to communicate with police officers and detectives, participate in decisions about what specimens to collect at crime scenes and how to test those specimens, and manage the flow of work to the laboratory. The role of the analyst is to perform analytic tests and comparisons on specimens submitted to the laboratory in accordance with the instructions of case managers.

135. *Id.*

136. *Id.*

137. *See* Brannigan & Torero, *supra* note 57.

138. *See supra* notes 9–10 and accompanying text.

139. *See generally* Thompson, *supra* note 80, at 3 (detailing the tension that exists as the increasing use of forensic evidence meets the scientific demand for empirical evidence).

This separation of function allows case managers to be fully informed of the investigative context . . . while [the] analyst remain[s] blind to the context and [is] thereby protected from contextual bias¹⁴⁰

This model may be incorporated in fire investigation techniques by making the investigator the case manager and requiring independent analysts to perform blind and mandatory GC-MS testing of samples without receiving any information about the specimens or the case. Under this model, physical evidence would be collected and documented meticulously, and analysts would be made aware of what samples to collect and what actions might lead to contamination.¹⁴¹ This would allow for the separation of the laboratory analysis from contextual information about the case gained during the investigation.

While the proposed model may control or limit contextual bias, it does not address the issue that arson experts incorporate investigative facts into their scientific conclusions. Incorporating extra-legal factors, such as interviews with witnesses and victims or reading medical reports and police reports, are routinely relied upon and endorsed in fire investigations.¹⁴² However, it is difficult to justify this practice when presented as scientific expertise in court.¹⁴³ Rather, fire experts could refrain from gathering extra-legal or contextual case information and determine the cause and origin of the fire and whether it was arson based solely on the analysis of the physical evidence and its chemical testing. There are few other forensic disciplines that endorse such a practice or have access to this type of information as fire investigators.¹⁴⁴ Removing all extra-legal information and basing conclusions solely on the physical evidence and chemical testing could eliminate such a problem.

The NAS report suggested that forensic scientists create a uniform terminology across the disciplines to describe findings

140. *Id.* at 6.

141. *See id.*; *see also* Simon A. Cole, *Acculturating Forensic Science: What is 'Scientific Culture', and How Can Forensic Science Adopt It?*, 38 *FORDHAM URB. L.J.* 435, 454–57 (2010).

142. *See supra* Part V.A (discussing the extra-legal aspects of fire investigation at length).

143. *See* Brannigan & Torero, *supra* note 57.

144. *Cf.* Saks & Faigman, *supra* note 20, at 150–51 (criticizing the unscientific aspects and methods of many of the subfields of forensic science).

and conclusions in court.¹⁴⁵ Such standardization would ensure that the statements convey conclusions about the evidence accurately and would eliminate overreaching claims in expert testimony.¹⁴⁶ However, before this can be accomplished, more research is needed to validate existing fire investigation methodology, such as eliminating natural and accidental causes to determine arson, and this research should be carried out with the utmost scrutiny by scientifically trained researchers.¹⁴⁷

IX. CONCLUSION

The *Willingham* case may be the first case in which a government body acknowledges the wrongful execution of an innocent person in the United States.¹⁴⁸ According to legal scholars, some forensic scientists, and media outlets, the fire evidence played a key role in Willingham's execution.¹⁴⁹ The discussion of fire evidence serves as an apt illustration of the paradigm shift in professional knowledge in the forensic sciences from experience-based to scientifically informed expertise in light of changing legal requirements of expert evidence. The analysis of the origins of fire expertise and the expert testimony in Willingham's case highlights the dangers courts face in accepting such evidence without scrutiny.¹⁵⁰ Specifically, fire experts present scientific conclusions that incorporate investigative facts; they may make overreaching claims that are unsupported by empirical evidence; they are subject to contextual bias due to a reliance on extra-legal information during their investigations; and courts have

145. See A PATH FORWARD, *supra* note 1, at 14–23, 109–10.

146. See *id.*

147. See, e.g., Cooley & Oberfield, *supra* note 60, at 286; see also Jennifer L. Mnookin et al., *The Need for a Research Culture in the Forensic Sciences*, 58 UCLA L. REV. 725, 744–53 (2011); Cole, *supra* note 141, at 463–70.

148. Grann, *supra* note 62.

149. See, e.g., Craig M. Cooley, *Nurturing Forensic Science: How Appropriate Funding and Government Oversight Can Further Strengthen the Forensic Community*, 17 TEX. WESLEYAN L. REV. 441, 442–43 (2011); Giannelli, *supra* note 60, at 3–8; Grann, *supra* note 62; Mills & Possley, *supra* note 60; Meghan J. Ryan, *Remedying Wrongful Execution*, 45 U. MICH. J.L. REFORM 261, 307 (2012); Roger Koppl, *The Social Construction of Expertise*, 47 SOCIETY 220, 223 (2010); see also Cooley & Oberfield, *supra* note 60, at 331–32.

150. See Cooley, *supra* note 149, at 442–43.

permitted them to testify to the ultimate issue of the case: the defendant's guilt. While the fire investigation profession has transitioned over the past twenty years with advancements in research, legal safeguards such as appeals, and habeas corpus and clemency petitions are ill equipped to detect such changes. External oversight bodies, including forensic science commissions, may not have jurisdiction to revisit innocence or enforce new standards, guidelines, or empirical research testing, and the forensic disciplines may be averse to taking responsibility and managing the consequences of having used outdated or discredited evidence in their investigations.

Advancements in DNA testing technology have brought to light a wave of wrongful convictions over the past few decades; with a push for more research and the empirical testing of forensic science techniques and claims, the criminal justice system and forensic science community may soon be faced with an influx of claims of innocence based on disproven evidence in other forensic disciplines. Unlike miscarriages of justice caused by serology or hair analyses whose samples can be retested using forensic DNA techniques to compare genetic information and provide conclusive evidence of innocence, in arson cases, proof of innocence cannot necessarily be established regardless of advancements in research and technology. The very determination that a fire is arson requires that there is evidence that it was intentionally set; while the presence of chemical accelerants could be interpreted as such evidence, there is no way to irrefutably prove intent. For example, common household items and floorboards may contain the same chemical trace elements as those found in accelerants that could be interpreted by investigators as indicative of arson if found at a fire site.¹⁵¹ Or chemical accelerants may be present in accidental or naturally caused fires and misinterpreted as indicators of arson. For example, a fire in a hardware store that stocks paints, varnishes and other highly flammable materials that could produce the same chemical results or burn patterns as an incendiary fire using similar accelerants. In both instances, there would be little evidence in which arson or innocence could be irrefutably proven to the same degree of certainty as forensic DNA testing. The problem therein lies with the inability to prove innocence in combination with a

151. John Lentini, *Persistence of Floor Coating Solvents*, 46 J. FORENSIC SCI. 1470, 1470–73 (2001).

forensic culture that lacks scientific rigor and validation of its investigative techniques and exhibits resistance to such advancements, with a judicial and penal culture that permits such evidence in criminal cases with little contention or effective safeguards to correct for errors.

If we consider the number of potentially innocent individuals that may be affected by outdated fire expertise, it is staggeringly high. According to the U.S. Fire Administration, between 1999 and 2008, there were an estimated 1.6 million fires annually, resulting in an average of 22,000 injuries and deaths each year, and totaling an estimated \$11.6 million in property loss and damage yearly.¹⁵² While only 0.3% of those annual fires (43,000) are classified as having been intentionally set,¹⁵³ there still remains the potential that thousands of arrests and convictions each year may have relied on overreaching testimony or evidence collected and interpreted using a defunct methodology.

152. *Fire Statistics*, U.S. FIRE ADMIN., www.usfa.dhs.gov/statistics/national/index.shtm (last updated Jan. 22, 2013).

153. *Id.*