

Fire Investigation: Historical Perspective and Recent Developments

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ABSTRACT: As a forensic science, fire investigation involves a wide variety of disciplines and thus attracts an equally wide variety of practitioners. These range from fire protection engineers who may only occasionally engage in forensic work to law enforcement officers, laboratory chemists, metallurgists, and materials engineers. This breadth of practice has resulted in a checkered history, which only relatively recently has given science a full-throated embrace. Because of the stakes involved, fires provide a rich source of material for litigation, both civil and criminal. This conceptual review provides a brief history from the standpoint of a practitioner who has witnessed and sometimes precipitated the changes that have taken place since 1974. Highlights include the debunking of many misconceptions about fire behavior and a general (though not always uninterrupted) movement toward making fire investigation more scientifically accurate through the development of best practices.

KEYWORDS: Arson, Cameron Todd Willingham, fire investigation, ignitable liquid residues (ILR), Lime Street fire, NFPA, Oakland fire, standards.

INTRODUCTION

As a forensic science discipline, fire investigation is one of the broadest, in that it encompasses so many different academic and investigative fields. Fire investigators, if they are to understand their role properly, need to be conversant in chemistry, physics, fluid dynamics, fire dynamics, developments in data collection and analysis, and the use of science to answer questions of interest to the legal system. To say that fire investigation has undergone dramatic changes in the last few decades would be a major understatement. It becomes difficult to identify a place to start, as change has been stretched out over so many years and seems to be accelerating.

A wide-ranging and richly annotated review of the discipline was released in 2017 by the American Association for the Advancement of Science (AAAS), entitled "Forensic Science Assessments: A Quality and Gap Analysis. Report 1: Fire Investigation" [1]. This gap analysis was intended to be applied to 10 forensic disciplines, but only two have been released so far: fire investigation and latent fingerprint examination. The Fire Investigation Report and its "plain language" summary may be found at: <https://www.aaas.org/resources/fire-investigation>.

I. FIRE SCENE INVESTIGATION WENT OFF THE RAILS EARLY ON

To put the changes in fire investigation science into historical perspective, a convenient starting point is the 1977 report by the Law Enforcement Assistance Administration (LEAA), the predecessor to the National Institute of Justice (NIJ), entitled "Arson and Arson

Investigation: Survey and Assessment" [3]. The 144-page study may be found at: <https://www.ncjrs.gov/pdffiles1/Digitization/147389/CJRS.pdf>.

In that assessment, the authors described several well-known "burn indicators" but stated, "Although burn indicators are widely used to establish the causes of fires, they have received little or no scientific testing." The study authors recommended "that a program of carefully planned scientific experiments be conducted to establish the reliability of currently used burn indicators" and "a handbook based on the results of the testing program should be prepared for field use by arson investigators".

Three years later, the handbook called for in the 1977 report was published by the most respected scientific and engineering body on the planet, the US National Bureau of Standards (NBS; National Institute of Standards and Technology, or NIST, since 1988) [4]. Unfortunately, the scientific studies recommended in the survey had not been conducted. The NBS handbook editors were advised by two members of the National Fire Academy staff, and in Chapter 1 they repeated most of the myths that have been used to incorrectly determine that a fire burned faster or hotter than normal. The text refers to "hot" fires and a "rapid buildup of heat", which were generally interpreted by investigators as indicative of the use of liquid accelerants.

The indicators that could allegedly be used to determine whether a fire was a "slowly developing" one or a "rapidly developing" one were listed as follows [4]:

- **Alligatoring of wood.** Slow fires produce relatively flat alligatoring. Fast fires produced humpback, shiny alligatoring.
- **Spalling of concrete.** An indication of intense high-heat fire.
- **Fire patterns.** A wide-angle or diffuse V pattern generally

15. Grann D: Trial by fire; *The New Yorker*; September 7, 2009; <https://www.newyorker.com/magazine/2009/09/07/trial-by-fire> (Accessed October 1, 2018).
16. International Association of Arson Investigators: Certified Fire Investigator (IAAI-CFI®) website; <https://www.firearson.com/Training-Credentials/Certifications-Designations/Certified-Fire-Investigator-IAAICFI/Default.aspx> (Accessed October 10, 2018).
17. *Kumho Tire Co. v. Carmichael* (97-1709); 526 U.S. 137 (1999) 131 F. 3d 1433.
18. Lentini JJ: Persistence of floor coating solvents; *J Forensic Sci* 46:1470; 2001.
19. Lentini JJ: Personal communication.
20. Lentini JJ: *Scientific Protocols for Fire Investigation*, 3rd ed; CRC Press: Boca Raton, FL; p 11; 2018.
21. Lentini JJ, Smith DM, Henderson RW: Baseline characteristics of residential structures which have burned to completion: The Oakland experience; *Fire Technology* 28:195; 1997.
22. *Michigan Millers Mutual Insurance Company v. Janelle R. Benfield*; 140 F.3d 915 (11th Cir. 1998).
23. Mims S, Bailey J Jr: *Incendiary: The Willingham Case*; 2011; www.incendiarymovie.com (Accessed October 9, 2018).
24. National Fire Protection Association: *Guide For Fire and Explosion Investigations* (NFPA 921); National Fire Protection Association: Quincy, MA; 1992.
25. National Fire Protection Association: *Standard for Professional Qualifications for Fire Investigator* (NFPA 1033); National Fire Protection Association: Quincy, MA, 2009.
26. National Fire Protection Association: Standards Council minute item 17-12-38; National Fire Protection Association: Quincy, MA; December 2017.
27. National Fire Protection Association: Standards Council minute item 79-39; National Fire Protection Association: Quincy, MA; August 1979.
28. National Fire Protection Association: Standards Council minute item 81-14; National Fire Protection Association: Quincy, MA; October 1985.
29. National Research Council: *Strengthening Forensic Science in the United States: A Path Forward*; The National Academies Press: Washington, DC; 2009; <http://www.nap.edu/catalog/12589.html> (Accessed October 1, 2018).
30. Nightmare on Lime Street: How a ghastly Jacksonville fire forever changed arson science in America; *Folio Weekly* February 23–March 1, 2010; <https://globalwrong.files.wordpress.com/2013/01/nightmare-on-lime-street1.pdf> (Accessed October 1, 2018).
31. Organization of Scientific Area Committees for Forensic Science: OSAC Approved Standards; National Institute of Standards and Technology: Gaithersburg, MD; <https://www.nist.gov/topics/forensic-science/organization-scientific-area-committees-osac/osac-registry/o-ac-approved> (Accessed October 25, 2018).
32. Technical Working Group of Fire and Arson Scene Investigation: *Fire and Arson Scene Evidence: A Guide for Public Safety Personnel* (NJC181584); National Institute of Justice: Washington, DC; p 5; 2000; <https://www.ncjrs.gov/pdffile1/nij/181584.pdf> (Accessed October 1, 2018).
33. Texas Forensic Science Commission: *Willingham/Willis Investigation*; April 15, 2011; <http://fsc.state.tx.us/documents/FINALWILLINGHAMREPORT0418113.44pm.pdf> (Accessed October 10, 2018).



ABOUT THE AUTHOR

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John Lentini studied natural sciences at New College (Sarasota, FL), earning a bachelor's degree in 1973. He is the president and principal investigator at Scientific Fire Analysis, LLC (www.firescientist.com), an independent consulting firm in Islamorada, FL.

Mr. Lentini began his career in the Georgia Bureau of Investigation Division of Forensic Sciences (Decatur, GA) where he analyzed all kinds of trace evidence, and specialized in fire debris analysis. He entered the private sector in 1978 offering both fire scene inspections and laboratory analysis of fire debris, serving as the manager of fire investigations at Applied Technical Services (Marietta, GA) through 2006, when he opened his current consultancy. Mr. Lentini has been very active in standards development organizations, including both the National Fire Protection Association (Quincy, MA) and ASTM International (West Conshohocken, PA). His research has resulted in significant contributions to the literature in both fire debris analysis and interpretation of fire scene artifacts.

Mr. Lentini is certified by the American Board of Criminalistics (General Criminalistics) and by the International Association of Arson Investigators (Certified Fire Investigator). He is the author of *Scientific Protocols for Fire Investigation*, now in its third edition (CRC Press: Boca Raton, FL; 2018). In addition to offering training and fire litigation consulting, he is active in many professional organizations, including the American Academy of Forensic Sciences, and is a charter member of the Organization of Scientific Area Committees for Forensic Science's Subcommittee on Fire and Explosion Investigations (<https://www.nist.gov/topics/forensic-science/fire-and-explosion-investigation-subcommittee>).