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# "Shifted Science" Revisited: Percolation Delays and the Persistence of Wrongful Convictions Based on Outdated Science

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# “SHIFTED SCIENCE” REVISITED: PERCOLATION DELAYS AND THE PERSISTENCE OF WRONGFUL CONVICTIONS BASED ON OUTDATED SCIENCE

CAITLIN M. PLUMMER & IMRAN J. SYED\*

## ABSTRACT

We previously wrote about the phenomenon of convictions based on science that is credible at the time of trial, but later comes to be repudiated.<sup>1</sup> Such post-conviction shifts in science were most obvious and reprehensible in the very old cases, the example being a 1986 arson prosecution, whose scientific underpinnings are exposed in a post-conviction motion filed in 2011. Immediately upon completing that article, we came to realize that it told only half the story. We seek in this Article to build on that foundational idea of “shifted science” by discussing at length a harder question: the perception, percolation and continued evolution of shifts in science. We address here cases that arise on the cusp of a shift, identify the process of the shift in various forensic science disciplines and analyze how difficult it can be to perceive and address a shift in science, even when it occurs concurrently with, or even some time prior to, trial. Taking a step-by-step route through the process of significant shifts in several different forensic disciplines, we hope to clarify the many stages involved in these shifts and the important consequences of misperceiving shifts in science as they occur. Finally, we also lay a foundation for a later piece addressing the difficult question of legal avenues for relief in shifted science cases that arise on the cusp of a revolution, such as those we address here.

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For any insights that happen to find their way into this piece, we are greatly indebted to Prof. David A. Moran, Justice Bridget M. McCormack, Michael A. McKenzie, John J. Lentini, David M. Smith and the many members of the Innocence Network who have encouraged and helped us over the years. We are also very grateful to our students, whose hard work and remarkable talents have enabled us to litigate the cases that inform our academic work. Finally, we dedicate this piece to our many clients, whose resolve and patience know no bounds.

<sup>1</sup> Caitlin Plummer & Imran Syed, “*Shifted Science*” and *Post-Conviction Relief*, 8 STAN. J. C.R. & C.L. 259 (2012).

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#### INTRODUCTION

“*Slow and painful has been man’s progress from magic to law.*”<sup>2</sup>

##### *A. Background: The Enigma of Shifting Science*

In science, “[i]t is a truism that ‘error is inherent in research, and [scientific] validity is always conditional.’”<sup>3</sup> But such “conditional validity” and “inherent error” are highly unpalatable to the legal system, that zealot of consistency and finality.<sup>4</sup> The issue is especially salient in criminal cases, where so much is on the line that any reasonable person may favor accuracy, yet the law’s insistence on finality still reigns.<sup>5</sup>

<sup>2</sup> Han Tak Lee v. Tennis, No. 4:08-CV-1972, 2014 WL 3894306, at \*1 (M.D. Pa. June 13, 2014) (quoting proverb inscribed on a statue at the University of Pennsylvania Law School).

<sup>3</sup> George J. Annas, *Scientific Evidence in the Courtroom: The Death of the Frye Rule*, 330 NEW ENGL. J. MED. 1018, 1020 (1994) (quoting A.S. Relman & M. Angell, *How Good Is Peer Review?*, 321 NEW ENGL. J. MED. 827 (1989)).

<sup>4</sup> See, e.g., *Herrera v. Collins*, 506 U.S. 390, 417 (1993) (noting that “need for finality” in legal proceedings demands an “extraordinarily high” threshold for those seeking collateral review of their criminal convictions based on actual innocence).

<sup>5</sup> See ALAN M. DERSHOWITZ, *TAKING THE STAND: MY LIFE IN THE LAW* 274 (2013) (lamenting that “anachronistic rules of finality . . . shut the courtroom doors to new scientific

Judge Richard Posner of the Seventh Circuit Court of Appeals recognized the problem better than most in the odd detour he took in *Jackson v. Pollion*.<sup>6</sup> In what was to be a routine opinion affirming denial of an inmate’s § 1983 civil rights action, Judge Posner dove headlong into a discussion on the regrettably troubled relationship between law and science.<sup>7</sup> Quoting in turn five of the most significant jurists in American history (Judge Learned Hand, Judge Henry Friendly, Justice Felix Frankfurter, Chief Justice William Rehnquist, and Justice Antonin Scalia), Posner established beyond refute his contention: There is “a widespread, and increasingly troublesome, discomfort among lawyers and judges confronted by a scientific or other technological issue.”<sup>8</sup> Posner also went on to correctly state why the disconnect ought to be disconcerting: “[I]t’s increasingly concerning, because of the extraordinary rate of scientific and other technological advances that figure increasingly in litigation.”<sup>9</sup>

But, in the end, even Judge Posner’s apt observation tells only half the story. It cannot be denied, of course, that *new* technological advances and scientific knowledge make a world of difference in legal proceedings. Indeed, we have previously written about this very issue, analyzing how shifts in scientific thought and consensus affect the justice of criminal convictions, which may well be based on outdated science, that occurred before the shift.<sup>10</sup> But at the time we too limited ourselves to only telling half the story—for *new* technological and scientific advances are not the only thing the law is slow to recognize. Rather, the law is astonishingly inept at understanding, incorporating, and learning from even those shifts in scientific thinking that occurred years, perhaps even decades, before.

#### *B. The Process of the Shift—and What Comes After*

We seek in this Article to complete the circle by elaborating on the problem of shifted science that is yet to be widely recognized in the legal community, even where the “new” consensus is old news in the relevant scientific community. The practical question this Article addresses is: How might a defendant, convicted on the basis of science that was flawed, *and the flaws could have been known at the time of his conviction*, recognize the issues in his case and frame them properly in preparation for seeking post-conviction relief?

Our focus here is on the percolation of knowledge of scientific advances, first within the scientific communities themselves and then, much later, within our legal system. It is easy enough to grasp that changes in scientific understanding and theory take some time to be accepted within the scientific community, and even longer to be perceived by the largely unscientific legal community. But there is much more gravity to that simple truth than our legal system has so far accounted for. This

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developments that can both free the wrongly convicted and apprehend the guilty who remain at large”).

<sup>6</sup> 733 F.3d 786 (7th Cir. 2013).

<sup>7</sup> *Id.* at 787.

<sup>8</sup> *Id.* at 787-88.

<sup>9</sup> *Id.* at 788.

<sup>10</sup> *See generally* Plummer & Syed, *supra* note 1.

Article is an attempt to document and explain the full scope of that unfortunate reality, as it has played out across a select few forensic science disciplines.

The following four parts of this Article pull examples of the “shifted-but-not-yet-understood” issue from four separate forensic disciplines. Each of these examples addresses what we call the “Percolation Problem,” where shifts in science take years to percolate down into the average courtroom—and the delay causes unjust convictions to continue for years after the science is recognized as flawed. Describing shifts pulled from the fields of fire science, comparative bullet lead analysis, and the medical diagnosis that was for years referred to as “Shaken Baby Syndrome,” this Article outlines some of the problems arising from delays in percolation of new scientific ideas into the local legal communities where criminal convictions occur. In so doing, this Article lays a framework for recognizing where particular cases fall within the percolation delay, which informs how prayers for relief may be structured.

The tiny incremental steps in the journey of shifts in science are usually long forgotten by the time the end product is achieved. Nevertheless, we find that understanding the process of the shift is essential to appreciating the dynamism of science, which in turn is essential for fashioning a legal system that understands the materiality of shifts in science and accounts for them in the post-conviction avenues it makes available. In the four parts that follow, we undertake a far deeper review of the process of the shift than in our previous work. Because, when it comes to seeking relief based on late percolating shifts in science, the devil is in the details of when certain science changed, and when practitioners within the relevant scientific fields, lawyers, courts, and most importantly, defendants, could or should have become aware of the changes.

Finally, how one actually obtains relief based on shifts in science is, of course, the all-important underlying question of the research and analysis we have undertaken. Yet, because we intend to focus here on the process of the shift, recognizing it and realizing where a particular case might fall within it, we make only minimal discussion of legal remedies in this Article. Such a discussion, to be more than merely cursory regurgitation of existing understanding, demands a full article in itself—one we have forthcoming.

#### I. FIRE SCIENCE—PHYSICAL MARKERS ATTRIBUTED TO ARSON

Andrew Babick was convicted in November 1996 of arson and felony murder for a house fire that occurred in September 1995 in Battle Creek, Michigan.<sup>11</sup> The question of whether and how his case is affected by the fire science revolution ushered in with the 1992 advent the National Fire Protection Association’s (“NFPA”) *NFPA 921: Guide for Fire & Explosion Investigations*<sup>12</sup> is a complex one, and it seemed almost impossible to resolve when initially brought before us.<sup>13</sup>

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<sup>11</sup> *People v. Babick*, No. 207638, 1999 WL 33437948, at \*1, 5 (Mich. Ct. App. Aug. 13, 1999).

<sup>12</sup> NAT’L FIRE PROTECTION ASS’N, *NFPA 921: GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS* (1st ed. 1992) [hereinafter *NFPA 921*].

<sup>13</sup> The authors worked on Babick’s case at the Michigan Innocence Clinic at the University of Michigan Law School. *Michigan Innocence Clinic Secures New Trial in Arson-Murder Case*, U. MICH. L. SCH. NEWS (Nov. 7, 2014), <https://www.law.umich.edu/newsandinfo/features/Pages/Michigan-Innocence-Clinic-Secures-New-Trial-in-Arson->

Resolved it was, and in a manner most fortunate for Babick,<sup>14</sup> but let us start at the beginning.

*A. Deadly House Fire<sup>15</sup>*

On the evening of September 8, 1995, Babick visited a drug house to purchase crack cocaine.<sup>16</sup> After returning a second time to make another purchase, he was told that the dealer was not there, so Babick waited on the porch for the dealer to return.<sup>17</sup> During that time, he smoked a cigarette and fell asleep on the couch on the porch.<sup>18</sup> Waking up shortly afterward, Babick could not find his cigarette.<sup>19</sup> Seeing that the dealer had still not returned, Babick ambled home.<sup>20</sup>

A fire consumed the drug house shortly after Babick's departure.<sup>21</sup> Two adults escaped from the burning home, but two children died.<sup>22</sup> Babick was arrested and charged with felony murder for intentionally setting the fire, allegedly because he was angry with the dealer.<sup>23</sup>

No one saw Babick set the fire.<sup>24</sup> He had no traces of gasoline on him,<sup>25</sup> and there was no explanation given of how he had acquired or transported gasoline.<sup>26</sup> There

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Murder-Case.aspx.

<sup>14</sup> Trace Christenson, *Andrew Babick Wins New Trial in '95 Arson-Murder*, BATTLE CREEK ENQUIRER (Nov. 7, 2014), <http://www.battlecreekenquirer.com/story/news/local/2014/11/07/andrew-babick-wins-new-trial-arson-murder/18647607>.

<sup>15</sup> Throughout the discussion of the Babick case, we cite mostly to the trial transcripts of the Babick case (on file with the authors) because, knowing the case as we do, we deem the evidence actually presented to the jury to be the best true statement of the record of the case, as opposed to haphazard summarizations made by the various courts on appeal. However, because trial transcripts are not readily available to the reader, where possible, we do also include secondary citations to appellate opinions.

<sup>16</sup> Transcript of Jury Trial Vol. 3 at 66, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT3]; Transcript of Jury Trial Vol. 5 at 21, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT5]; *see also* Babick v. Berghuis, 620 F.3d 571, 574 (6th Cir. 2010).

<sup>17</sup> Transcript of Jury Trial Vol. 4 at 51-52, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT4]; *see also* Babick, 620 F.3d at 574.

<sup>18</sup> Babick TT4, *supra* note 17, at 52, 56; *see also* Babick, 620 F.3d at 574.

<sup>19</sup> Babick TT5, *supra* note 16, at 49; *see also* Babick v. Berghuis, No. 1:03-cv-20, 2008 WL 282166, at \*66 (W.D. Mich. Jan. 29, 2008).

<sup>20</sup> Babick TT4, *supra* note 17, at 56; *see also* Babick, 2008 WL 282166, at \*2.

<sup>21</sup> Babick TT3, *supra* note 16, at 73-74; *see also* Babick, 620 F.3d at 574.

<sup>22</sup> Babick TT3, *supra* note 16, at 73-75; *see also* Babick, 620 F.3d at 574.

<sup>23</sup> Transcript of Jury Trial Vol. 6 at 18, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT6] ("So he sat there long enough to stew about it, smoking his cigarette, finally decided, oh, hell with it, so he grabbed gas can right in front of him at the barbecue and started pouring."); *id.* at 22; *id.* at 91-93 (trial court instructing jury on specific charges); *see also* Babick, 620 F.3d at 574-75.

<sup>24</sup> Babick TT6, *supra* note 23, at 5-34 (prosecutor summarizing all of the evidence presented against Babick, which includes no mention of anyone seeing him set the fire).

was no explanation for how he got into the house, and why no one in the house heard him, despite the allegation that he spread gasoline only a few feet away from the inhabitants.<sup>27</sup> Babick insisted he did not set the fire.<sup>28</sup> Nevertheless, the State concluded that he broke into the house, poured gasoline throughout, and ignited it.<sup>29</sup> And the State had no trouble convincing the jury about that version of events,<sup>30</sup> because “science” was on its side.

At trial the State’s case consisted of two vital lines of scientific argument. The first was based on the physical markers present at the fire scene, testified to by two fire investigators, Wayne Etue and Joan Tuttle.<sup>31</sup> They stated that present in the house were “liquid pour patterns” on the floor, suspicious “even burning” on the stairs, an abundance of “low burning” and “deep burning” into the carpet, and evidence of especially intense, extremely high temperature burning.<sup>32</sup> The experts testified that all of these things were unmistakable markers of arson.<sup>33</sup> Specifically, they said that the evidence showed that someone had walked into the house, poured gasoline in various places, including the living room, stairs and upstairs landing, and then ignited the accelerant.<sup>34</sup> Indeed, reading what was then often called the

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<sup>25</sup> Babick TT5, *supra* note 16, at 61-63, 67-69 (chemist affirming that all clothing and shoes taken from Babick tested negative for accelerants in the lab; one pair of shoes indicated a possible positive, but the chemist indicated that was due to contamination in her lab).

<sup>26</sup> *See Babick*, 620 F.3d at 584 (Merritt, J., dissenting) (quoting county prosecutor’s letter admitting, “[T]here is no evidence that connects Mr. Babick to accelerants. The only evidence that shows he had contact with accelerants in his footwear and this is weak evidence at best. There is no evidence nor explanation of where the charcoal lighter fluids or kerosenes came from.”).

<sup>27</sup> Babick TT6, *supra* note 23, at 38, 41, 44-46. Additionally, the state court of appeals, undertaking what it called a “thorough” review of the case against Babick, outlined in its opinion all the evidence of guilt presented against Babick. *People v. Babick*, No. 207638, 1999 WL 33437948, at \*5-6 (Mich. Ct. App. Aug. 13, 1999). The evidence did not include any eyewitnesses or explanations for how the gasoline was acquired and transported, or how Babick gained entry into the house and allegedly spread the gasoline without being noticed.

<sup>28</sup> Babick TT6, *supra* note 23, at 54; *see also Babick v. Berghuis*, No. 1:03-CV-20, 2008 WL 282166, at \*8 (W.D. Mich. Jan. 29, 2008) (“[P]etitioner vehemently denied having started the fire . . .”).

<sup>29</sup> Babick TT6, *supra* note 23, at 8, 17-20.

<sup>30</sup> Transcript of Jury Trial Vol. 7 at 9-12, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT7].

<sup>31</sup> Transcript of Jury Trial Vol. 1 at 196, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT1]; Transcript of Jury Trial Vol. 2 at 46, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996) [hereinafter Babick TT2]; *see also Babick*, 1999 WL 33437948, at \*5.

<sup>32</sup> Babick TT1, *supra* note 31, at 208-19; Babick TT2, *supra* note 31, at 8-13, 52-59, 62-64; *see also Babick v. Berghuis*, 620 F.3d 571, 581-82 (6th Cir. 2010) (Merritt, J., dissenting); *Babick*, 2008 WL 282166, at \*25-26.

<sup>33</sup> Babick TT2, *supra* note 31, at 9, 52-54.

<sup>34</sup> *See supra* note 31.

"fingerprint of arson,"<sup>35</sup> the two experts claimed even to be able to read and follow the particular pour trail left by Babick as he spread the gasoline through the house.<sup>36</sup>

The second line of scientific argument was based on the alerts given at the scene by an accelerant-detection canine.<sup>37</sup> The dog's handler, Jeff Austin, testified that the dog alerted in various places throughout the house, and that her alerts were direct evidence that an accelerant was used in those locations.<sup>38</sup> Austin went so far as to say that his dog was "100% correct every time"<sup>39</sup> and her nose was 1,000 times more sensitive than laboratory equipment used to detect gasoline.<sup>40</sup> The latter statement was necessary because lab testing failed to detect the presence of gasoline on any of the debris samples taken from inside the house.<sup>41</sup> The prosecutor asked the jury to overlook that fact, stating, "a dog's nose on a trained dog is a mystical thing . . . a thousand times more sensitive than the lab equipment."<sup>42</sup>

In light of that dynamic duo of scientific implication and insinuation, Babick's defense team faced a severe uphill battle. Given that juries often attribute a "mystic infallibility" to scientific evidence presented in court,<sup>43</sup> a defendant's options are inevitably limited when confronted with a situation where (not just one but) two lines of scientific argument, and multiple scientific experts, heavy handedly negate any possibility of innocence or mitigation.<sup>44</sup> Babick maintained his innocence, but because the experts seemed to decisively conclude that the fire was arson, his attorney did not even bother with a "not-arson" defense, and tried instead to just point the finger at possible alternative arsonists.<sup>45</sup>

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<sup>35</sup> See, e.g., INNOCENCE PROJECT, INNOCENCE NETWORK EXONERATIONS 7 (2012), [http://www.innocenceproject.org/files/imported/innocence\\_network\\_2012.pdf](http://www.innocenceproject.org/files/imported/innocence_network_2012.pdf) (stating in the case of David Lee Gavitt that the scientific evidence known as the "fingerprint of arson" are outdated indicators of arson that no scientific basis); see also Babick TT1, *supra* note 31, at 219 (Tuttle speaking of "characteristic footprint from accelerant . . .").

<sup>36</sup> Babick TT2, *supra* note 31, at 27-28, 52, 54.

<sup>37</sup> Babick TT4, *supra* note 17, at 85-89; see also Babick, 2008 WL 282166, at \*31, \*50.

<sup>38</sup> See *supra* note 37.

<sup>39</sup> Babick TT4, *supra* note 17, at 81.

<sup>40</sup> Babick v. Berghuis, 620 F.3d 571, 580 (6th Cir. 2010) (Merritt, J., dissenting); see also Babick TT4, *supra* note 17, at 84 ("Lab equipment used to check fire debris will detect parts per million and the canine can detect parts per billion. So that's how much more sensitive she is than the equipment.").

<sup>41</sup> Babick, 620 F.3d at 580-81 (Merritt, J., dissenting).

<sup>42</sup> Babick TT6, *supra* note 23, at 19-20.

<sup>43</sup> United States v. Addison, 498 F.2d 741, 744 (D.C. Cir. 1974).

<sup>44</sup> E.g., United States v. Hebshie, 754 F. Supp. 2d 89, 113 (D. Mass. 2010) ("Just because the testimony has been admitted sends the jury the message that the opinions are entitled to some weight.") (citing N.J. Schweitzer & Michael J. Saks, *The Gatekeeper Effect*, 15 PSYCHOL. PUB. POL'Y & L. 1, 12 (2009) ("[J]urors assume that judges review scientific evidence before it is presented to them, and that any evidence used in a trial must be above some threshold of quality. Because of these assumptions, jurors seem to be less critical of scientific evidence used in trials and are more persuaded by it.")).

<sup>45</sup> Babick v. Berghuis, No. 1:03-CV-20, 2008 WL 282166, at \*8 (W.D. Mich. Jan. 29, 2008) ("[T]he record does not support the conclusion that [Babick]'s trial counsel pursued a



The strategy failed. Babick was convicted<sup>46</sup> and sentenced in December 1996 to life in prison without the possibility of parole<sup>47</sup>—the most severe punishment permitted in Michigan, given that the state outlawed the death penalty nearly two centuries ago.<sup>48</sup> His direct appeal was denied by the state court of appeals in 1999,<sup>49</sup> and higher courts denied his applications and petitions for relief.<sup>50</sup> As far as the law was concerned, Babick’s story was over.

But science was already working on a sequel.

### *B. A Revolution in the Backdrop*

Unbeknownst to Babick or his defense counsel was the fact that the very sort of evidence the State was using to convict him was being invalidated even as his trial proceeded. Since the late 1980s, a select group of fire investigators had begun to question the conventional wisdom that went into the diagnosis of arson in cases like Babick’s.<sup>51</sup> Did intense low burning necessarily mean the fire was fueled by a liquid accelerant such as gasoline? Were those patterns on the floor only present when accelerants had been poured? And did canines really have some mystical ability to sniff out accelerants where even lab tests failed to detect them? Slowly, and sometimes by sheer happenstance,<sup>52</sup> the answers began to be revealed—and they were shocking.

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theory of accident at trial. Instead, the record indicates that counsel pursued only the theory that her client was not the perpetrator . . .”).

<sup>46</sup> Babick TT7, *supra* note 23, at 9-10.

<sup>47</sup> Transcript of Sentencing at 18, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 1996).

<sup>48</sup> MICH. CONST. art. IV, § 46 convention cmt. (“[O]ur state has not had the death penalty since 1846.”). Ironically, perhaps, Michigan outlawed the death penalty specifically out of the fear that an innocent person might be executed. *See* Eugene G. Wagner, *Michigan and Capital Punishment*, MICH. B.J., Sept. 2002, at 39 (noting that shortly before banning capital punishment in 1846, “in about 1840, Michiganians learned that the Canadians had hanged an innocent man three years before just across the river in what is now Windsor, the true culprit later having made a death-bed confession of his guilt.”).

<sup>49</sup> *People v. Babick*, No. 207638, 1999 WL 33437948, at \*1 (Mich. Ct. App. Aug. 13, 1999).

<sup>50</sup> *Babick v. Berghuis*, 563 U.S. 948 (2011); *Babick v. Berghuis*, 620 F.3d 571 (6th Cir. 2010); *Babick v. Berghuis*, No. 1:03-CV-20, 2008 WL 282166 (W.D. Mich. Jan. 29, 2008); *People v. Babick*, 610 N.W.2d 916 (Mich. 2000); *People v. Babick*, 614 N.W.2d 588 (Mich. 2000).

<sup>51</sup> JOHN J. LENTINI, *SCIENTIFIC PROTOCOLS IN FIRE INVESTIGATION* 13 (2d ed. 2013) [hereinafter LENTINI, *SCIENTIFIC PROTOCOLS*].

<sup>52</sup> *See, e.g., id.* at 483 (“The lines of demarcation seen in a 1992 test fire in Tucson, Arizona . . . gave pause to the author and his colleagues conducting the test. No efforts were made to produce the pattern (later used in NFPA 921), but it looked to all present like something resembling a flammable liquid pour pattern had been created.”); *see also* John Lentini, *Fire Expert: How I Nearly Sent a Man to the Electric Chair*, ABC NEWS (May 6, 2010), <http://abcnews.go.com/2020/john-lentini-fire-arson-investigation/story?id=10562869&singlePage=true> (explaining that the prevalence of flashover, and its significant impact on compartment fires, was discovered accidentally by Lentini in his attempt to prove a defendant’s guilt in a 1992 Jacksonville, Florida, case).

1. Roots of Revolution<sup>53</sup>

The story of the revolution in fire science is best told by John J. Lentini, who was among its chief catalysts<sup>54</sup> and is certainly its most recognized documenter.<sup>55</sup> In his book *Scientific Protocols in Fire Investigation* Lentini notes that as a profession, “[f]ire investigation developed on a parallel track” from advances in fire science, and “until the mid-1980s, very little of the newly discovered knowledge about the behavior of fire was passed on to fire investigators.”<sup>56</sup>

While investigators in the field may have remained largely oblivious, “[t]he early-1980s were years of decisive change” in the understanding of fire behavior.<sup>57</sup>

For the first time, computers were able to come to grips with the complexities of simultaneously modeling fluid dynamics, heat transfer, mass loss, and chemistry. . . . As cheaper and faster computers became generally available, more individuals had the ability to learn how to model fires. In addition to the computational advances, there were technological advances in the study and measurement of real fires.

....

In 1984, the National Fire Protection Association (NFPA) released *Countdown to Disaster*, a 16-minute videotape of a test fire that mimicked the behavior of an ordinary residential fire involving an upholstered chair. The spectacular flashover that occurred is still used to illustrate how compartment fires behave in a manner entirely beyond the comprehension of anyone who has not personally witnessed the phenomenon. *Countdown to Disaster* destroyed the simple “heat rises” concept that many fire

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<sup>53</sup> We previously avoided a wholesale analysis of the specifics of when and how the actual shift in fire science occurred, and chose instead to just briefly describe its results. See Plummer & Syed, *supra* note 1, at 271-75. However, it is necessary to have a fuller discussion here because the intricacies of the advanced subset of the shifted science conundrum that we engage in in this Article demand a more searching analysis of the subtleties of the science and the path of its advancements. If we avoided such discussions here (and in upcoming subsections below), we would be making the very mistake for which Judge Posner chided the legal profession in *Jackson*.

<sup>54</sup> See, e.g., Steve Kroft, *Arizona’s Pioneer Hotel Fire Re-examined*, 60 MINUTES (Mar. 31, 2013) at 10:04, <http://www.cbsnews.com/videos/arizonas-pioneer-hotel-fire-re-examined> (“[Lentini] has conducted more than 2,000 fire investigations, and has been at the center of the most important developments in fire investigations over the past 30 years.”).

<sup>55</sup> E.g., LENTINI, *SCIENTIFIC PROTOCOLS*, *supra* note 51; John J. Lentini, *The Evolution of Fire Investigation and Its Impact on Arson Cases*, 27 CRIM. JUST., Spring 2012, at 12, [http://www.americanbar.org/content/dam/aba/publications/criminal\\_justice\\_magazine/sp12\\_fire\\_investigation.authcheckdam.pdf](http://www.americanbar.org/content/dam/aba/publications/criminal_justice_magazine/sp12_fire_investigation.authcheckdam.pdf); John J. Lentini, *A Calculated Arson*, FIRE & ARSON INVESTIGATOR, Apr. 1999, at 20; John J. Lentini et al., *Unconventional Wisdom: The Lessons of Oakland*, FIRE & ARSON INVESTIGATOR, June 1993, at 18; John J. Lentini et al., *Baseline Characteristics of Residential Structures Which Have Burned To Completion: The Oakland Experience*, 28 FIRE TECH. 195 (1992).

<sup>56</sup> LENTINI, *SCIENTIFIC PROTOCOLS*, *supra* note 51, at 10.

<sup>57</sup> *Id.* at 11.

investigators used (and some, unfortunately, still use) to determine the origin of fires.<sup>58</sup>

## 2. The Forging of NFPA 921: A New Way of Doing Things

Noting “the perception of a profession plagued by misconceptions,” the Standards Council of the NFPA formed a Technical Committee on Fire Investigations in 1985.<sup>59</sup> “After 7 years, the first edition of NFPA 921, *Guide for Fire and Explosion Investigations*, was released.”<sup>60</sup> Intended to “assist in improving the fire investigation process and the quality of information on fires resulting from the fire investigation process,”<sup>61</sup> NFPA 921 “is currently updated every 3 or 4 years” and “is the single most important treatise ever published in the field of fire investigation.”<sup>62</sup>

The exact changes to the fire investigation profession wrought by NFPA 921 were truly substantial. Nearly all of them were based on a new understanding of the phenomenon called flashover, which NFPA 921 describes as:

A transition phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space, resulting in full room involvement or total involvement of the compartment or enclosed space.<sup>63</sup>

. . . .

This transition is generally characterized as the transition from “a fire in a room” to “a room on fire.”<sup>64</sup>

With flashover revealed as a prominent player in potentially every compartment fire, fire scientists began to note that many of the physical artifacts previously thought to only occur in arson fires could actually occur in innocent fires that have reached flashover.<sup>65</sup> NFPA 921 noted that physical markers—such as alligating of wood,<sup>66</sup> crazed glass,<sup>67</sup> depth and location of char,<sup>68</sup> lines of demarcation in the burn

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<sup>58</sup> *Id.*

<sup>59</sup> *Id.* at 13.

<sup>60</sup> *Id.*

<sup>61</sup> *Id.* (quoting NAT’L FIRE PROT. ASS’N, NFPA 921: GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS 1 (7th ed. 2011)).

<sup>62</sup> *Id.*

<sup>63</sup> NAT’L FIRE PROT. ASS’N, NFPA 921: GUIDE FOR FIRE AND EXPLOSION INVESTIGATIONS § 3.3.78 (7th ed. 2011).

<sup>64</sup> *Id.* at § 5.10.4.1.

<sup>65</sup> JOHN D. DEHAAN & DAVID J. ICOVE, KIRK’S FIRE INVESTIGATION 270 (7th ed. 2012) (“Such a burn by itself does not mean that a fire is incendiary in origin . . . . Something normal to the room may have caused it to burn in this fashion, such as combustible floor coverings, post-flashover burning, falldown or collapse. Each possible hypothesis has to be tested and eliminated.”).

<sup>66</sup> LENTINI, SCIENTIFIC PROTOCOLS, *supra* note 51, at 474.

<sup>67</sup> *Id.* at 478.

patterns,<sup>69</sup> sagged furniture springs,<sup>70</sup> spalled concrete,<sup>71</sup> low burning and holes in the floor,<sup>72</sup> and time and temperature of the fire<sup>73</sup>—were vastly misunderstood prior to the understanding of flashover.<sup>74</sup> Previously, the presence of one or more of these markers would have led to a quick conclusion that the fire was arson, but flashover deepened the narrative. Given that the same physical markers could be present in both accidental and arson fires, investigators needed more than just those physical markers to make a call of arson.<sup>75</sup> Forced to reconcile with the basics of good police investigation—such as evaluation of motive, means, opportunity, personality and context—the fire investigation profession became more discerning over time, as knowledge of NFPA 921 and its requirements percolated down into every corner of the field.

It is to that all-important, but often-ignored, period of percolation that we now turn our attention.

### 3. Delayed Percolation: Spreading the Word, Holdouts and Relapses

As Lentini notes, the advancements in scientific knowledge codified in the initial and successive editions of NFPA 921, were not immediately or universally accepted and implemented: “To say that the early editions of NFPA 921 were not universally embraced by the fire investigation community would be a serious understatement.”<sup>76</sup>

As with any new standard, NFPA 921 aroused the ire of those accustomed to working to their own subjective criteria. In 1999, these individuals organized a write-in campaign that urged the NFPA to delete any reference to science in the document. Part of the driving force behind this campaign was the 11th Circuit Court decision called *Michigan Millers Mutual v. Benfield*. In that case, the appeals court upheld the exclusion of an investigator’s testimony and held that because the investigator stated that he was knowledgeable in fire science, the admissibility of his testimony was subject to *Daubert* challenge. This ruling sent shudders through the world of fire investigation. Certain leaders of the fire investigation community began urging fire investigators to avoid any mention of the word “science” and thus avoid the *Daubert* challenge that it might bring. An *amicus curiae* brief was filed on behalf of the International Association of Arson Investigators, which argued that “Cause and origin investigations, by their very nature, are ‘less scientific’

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<sup>68</sup> *Id.* at 481.

<sup>69</sup> *Id.* at 482.

<sup>70</sup> *Id.* at 489.

<sup>71</sup> *Id.* at 490.

<sup>72</sup> *Id.* at 498.

<sup>73</sup> *Id.* at 501.

<sup>74</sup> *Id.* at 474.

<sup>75</sup> See DEHAAN & ICOVE, *supra* note 65, at 269-70.

<sup>76</sup> LENTINI, SCIENTIFIC PROTOCOLS, *supra* note 51, at 13.

than envisioned by *Daubert*,” essentially asking that the Court “grandfather” the folly that “traditional” methods represented.<sup>77</sup>

The United States Supreme Court, in *Kumho Tire v. Carmichael*, declined the invitation by the old school to deem that certain types of expert testimony lie outside the scope of *Daubert*.<sup>78</sup> Instead, the Court “held unanimously that *Daubert* applied to all expert testimony, and Rule 702 made no relevant distinction between ‘scientific knowledge’ and ‘technical’ or ‘other specialized’ knowledge.”<sup>79</sup> Despite the Supreme Court’s authoritative declaration, the old school of fire investigation did not give up: “[M]ore than a hundred comments were submitted to the NFPA for the 2001 edition, protesting the Technical Committee’s decision to continue to recommend the use of the scientific method.”<sup>80</sup>

Thus, since the initial understanding of flashover emerged in the 1980s and even since the initial edition of NFPA 921 was released in 1992, much confusion, disagreement, and outright insubordination remained. Like Lentini, David M. Smith—a fire scientist with more than forty years of experience, who has been a member of the NFPA Technical Committee on Fire Investigations since 1992<sup>81</sup>—witnessed many of the percolation delays first hand. Smith notes that even after the initial publication of NFPA 921, “it would be many years—in some cases, up to a decade or more—before knowledge of NFPA 921 would percolate down to the relevant investigative communities in various parts of the country.”<sup>82</sup>

Law enforcement officials in particular attempted to hold out from NFPA 921:

As a member of the NFPA 921 technical committee at that time, I received and reviewed countless comments from members of the Michigan State Police and Fire Marshal’s Bureau. Most involved a request to simply withdraw or cancel the document since it was contrary to the methods they used and taught. Other comments from the Michigan State Fire Marshal and the Michigan State Police challenged supposed “misconceptions” in NFPA 921, but failed to provide any documentation or testing to support their objections.<sup>83</sup>

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<sup>77</sup> *Id.* (citing *Michigan Millers Mut. Ins. Corp. v. Benfield*, 140 F.3d 915 (11th Cir. 1998); *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993); Burke, P.W., *Amicus curiae* Brief Filed on Behalf of the International Association of Arson Investigators in *Michigan Millers*).

<sup>78</sup> 526 U.S. 137 (1999).

<sup>79</sup> LENTINI, SCIENTIFIC PROTOCOLS, *supra* note 51, at 13-14.

<sup>80</sup> *Id.* at 14.

<sup>81</sup> David M. Smith, ASSOCIATED FIRE CONSULTANTS, <http://assocfire.com/david-m-smith> (last visited Mar. 16, 2016).

<sup>82</sup> Affidavit of David M. Smith at ¶ 27, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. June 17, 2013) (on file with authors) (citing LENTINI, SCIENTIFIC PROTOCOLS, *supra* note 51, at 15 (noting that NFPA 921 did not become “generally accepted” by the fire investigation community until the year 2000)).

<sup>83</sup> *Id.* at ¶ 29.

That law enforcement officials in particular resisted the change is important because law enforcement agencies, like the state police and fire marshal, are generally the ones who hold local trainings and teach fire investigation concepts and methods to other investigators, prosecutors and defense attorneys.<sup>84</sup> Therefore, as law enforcement agencies held out, there would logically be an even more pronounced delay in percolation of NFPA 921 teachings. As Smith notes,

Only since the early 2000's has the scientific method embodied in NFPA 921 come to be generally accepted by the relevant scientific community. Specifically, the execution of Cameron Todd Willingham in 2004 was the first major event that exposed the old myths of the fire investigation profession to the general public. Only after that point did non-scientists really begin to appreciate the importance of the decisive shift in methodology and paradigm that the fire investigation profession was undergoing.<sup>85</sup>

The period between 1992 (when NFPA 921 was first released and officially debunked myths about the physical markers of arson, such as those used to convict Babick) and 2004 (when knowledge of the scientific shift had percolated enough to begin reaching those outside of the relevant scientific community) was thus a dangerous no-man's land: The old ways persisted, the new ways existed, and the average defendant and attorney remained oblivious to the differences.

It was in that no man's land that Andrew Babick's case arose. But that was not even the only scientific albatross his defense faced. There was a second significant scientific shift that would have changed the very paradigm upon which the State built its case against Babick: Accelerant detecting canines.

## II. A PARALLEL REVOLUTION IN FIRE SCIENCE: CANINE-ACCELERANT ALERTS

### A. *"Dog said it. I believe it. That settles it."*<sup>86</sup>

As if arising during the transition stage of the percolation of NFPA 921 did not create enough of a challenge for Babick's defense, there was also the matter of shifting consensus on canine hydrocarbon alerts. This shift occurred separately from the shift in scientific consensus on physical markers of arson: in fact, canine evidence was not mentioned at all in the 1992 or 1995 editions of NFPA 921.<sup>87</sup>

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<sup>84</sup> For example, Babick's trial attorney testified at the 2014 evidentiary hearing that, prior to her representation of Babick, she had been trained in fire science by the Michigan State Police Fire Marshal Division, and that training had given her no knowledge of NFPA 921. Transcript of Video Evidentiary Hearing at 6-8, 42-43, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. 2014) (on file with authors).

<sup>85</sup> Smith, *supra* note 82, at ¶ 33.

<sup>86</sup> LENTINI, SCIENTIFIC PROTOCOLS, *supra* note 51, at 526 (describing the traditional attitude of canine handlers toward canine accelerant alerts).

<sup>87</sup> The 1995 edition of NFPA 921 did seemingly anticipate the coming shift in accelerant-detection canine evidence, noting on an introductory page that: "The committee is continuing its work, and future editions will include information on . . . the use of canines in the detection of accelerants." NAT'L FIRE PROT. ASS'N, NFPA 921: GUIDE FOR FIRE AND EXPLOSIONS INVESTIGATIONS I (2d ed. 1995). Other than that passage, however, there was not another mention of canines in the entire 1995 edition of NFPA 921.

Instead, as the 1995 edition of NFPA 921 went to print, the official position of the relevant scientific community on canine accelerant alerts was what it had been for a decade or more: trained dogs have a mystical ability to detect accelerants at fire scenes, even where lab testing fails to show anything.<sup>88</sup>

Indeed, in 1995, the then-latest edition of the leading fire investigation treatise *Kirk's Fire Investigation* advised that canine alerts, even without lab confirmation, can be "accepted as proof of the presence of accelerants."<sup>89</sup> Babick's attorney at his November 1996 trial thus had no real way to contest the prosecution's claim that gasoline was present on the debris samples taken from the house. Even though lab testing failed to confirm the canine accelerant alerts, the State could, and certainly did, argue that there was gasoline present in the debris at the fire scene.<sup>90</sup>

However, a major change in science was occurring at virtually the exact same time as Babick's trial.

### *B. Seeds of Change: State of Georgia v. Weldon Wayne Carr*

An April 7, 1993, fire at the home of Georgia millionaire Weldon Wayne Carr was perhaps the single most crucial event that led to the exposure of considerable flaws in traditional beliefs about canine accelerant alerts and the move toward reform.<sup>91</sup> Carr was immediately suspected of arson and arrested days later.<sup>92</sup> The prosecutor on the case, Nancy Grace, brought to the table an unflinching assumption of Carr's guilt, and a dogged determination to see him convicted.<sup>93</sup> Had Carr been the average indigent defendant, his case may well have gone the Babick route of conviction and decades of incarceration. However, Carr had the resources to fund the retention of top-notch experts and attorneys,<sup>94</sup> and was able to litigate his defense to

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<sup>88</sup> See, e.g., *supra* notes 38-40 and accompanying text. In another context, the Illinois Supreme Court, a bit ahead of its time, noted the practice of attributing "superstitious awe" to the alleged capabilities of a dog's nose. *People v. Cruz*, 643 N.E.2d 636, 662 (1994) (internal citations omitted).

<sup>89</sup> JOHN D. DEHAAN, *KIRK'S FIRE INVESTIGATION* 135 (3d ed. 1991).

<sup>90</sup> Babick TT6, *supra* note 23, at 18 (With respect to accelerant, prosecutor argued, "[w]ho cares where it came from? We know it was there.").

<sup>91</sup> See, e.g., LENTINI, *SCIENTIFIC PROTOCOLS*, *supra* note 51, at 518-34.

<sup>92</sup> *Id.* at 519.

<sup>93</sup> See *id.* (noting that when the state crime lab failed to find presence of accelerants in chemical testing of fire debris, Grace went to the trouble of commissioning a private lab to do new tests); *id.* at 529 (noting that the Georgia Supreme Court held that Grace violated Carr's Fourth Amendment rights and likely committed prosecutorial misconduct warranting a reversal of the conviction).

<sup>94</sup> See *id.* at 519 (noting that Carr retained leading defense attorney Jack Martin, who hired I.J. Kranats and Ralph Newell, two of the preeminent fire experts in the country). Indeed, Carr had the further resources to fund his attorney's consultation with experienced fire litigator Michael McKenzie (to whom the authors owe their own education in fire science) and McKenzie's retention of John Lentini. *Id.* This sort of dream team is hardly one that the average criminal defendant can hope for, and yet, even with it, Carr's freedom was nearly lost, and retained only after an epic struggle through the Georgia courts spanning many years. See *id.* at 518-33.

the fullest extent possible, questioning assumptions about canine evidence that had not been questioned seriously before.<sup>95</sup>

In so doing, Carr's legal team brought about a whole other revolution in fire science, parallel to the one embodied by the 1992 release of NFPA 921. At Carr's April-May 1994 trial, "the judge ruled that [Lentini] was not qualified to testify about the accelerant detection canines because [he] was not an accelerant detection canine handler. The evidence of the 12 [unconfirmed canine] alerts was put before the jury."<sup>96</sup> After Carr's conviction at trial, Lentini worked to convince the International Association of Arson Investigators ("IAAI") to officially denounce the validity and use of unconfirmed canine alerts, which the IAAI did in a late-1994 position paper.<sup>97</sup> An important first step toward full shift in scientific consensus, the IAAI's position paper was prelude to the NFPA 921 Technical Committee's own first official comment on the use of unconfirmed canine alerts.<sup>98</sup> Although,

[t]he 1995 edition of NFPA 921 was already put to bed, . . . the Committee members felt that if they were to wait until 1998 to publish guidance on the proper use of accelerant detection canines, the case law that accumulated in the interim would render the Committee's guidance ineffective.<sup>99</sup>

A decision was thus made to issue an interim amendment to NFPA 921.<sup>100</sup>

### C. Changing of the Science

That tentative interim amendment ("TIA") was released on October 21, 1996—a mere two weeks before the trial of Andrew Babick in Battle Creek, Michigan. The TIA stated: "In order for the presence or absence of an ignitable liquid to be scientifically confirmed in a sample, that sample should be analyzed by a laboratory . . . Any canine alert not confirmed by laboratory analysis should not be considered validated."<sup>101</sup> The NFPA's response was owed to newly emerging research that indicated that while dogs undoubtedly have sensitive noses, it is impossible for them

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<sup>95</sup> See *id.* at 520, 523, 526, 529.

<sup>96</sup> *Id.* at 521.

<sup>97</sup> *Id.* at 523.

<sup>98</sup> *Id.* at 526.

<sup>99</sup> *Id.*

<sup>100</sup> *Id.* To complete the story of Weldon Wayne Carr, the Georgia Supreme Court reversed his conviction on March 10, 1997, citing, among other things, to the impropriety of admitting unconfirmed canine alerts. *Carr v. State*, 482 S.E.2d 314, 317-18 (Ga. 1997). Although the State expressed an intention to retry him, more than six years passed without the case being brought back to trial, and eventually, the case against Carr was dismissed by the court on May 19, 2003. *State v. Carr*, 598 S.E.2d 468 (Ga. 2004). Carr was officially exonerated in June of 2004, more than ten years after his initial conviction at trial. See *Weldon Wayne Carr*, NAT'L REGISTRY EXONERATIONS (July 3, 2012), <http://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3936>.

<sup>101</sup> Affidavit of Craig Balliet at ¶¶ 15-16, *People v. Babick*, No. 96-2562FC (Mich. Cir. Ct. Jan. 7, 2014) (quoting Tentative Interim Amendment to 1995 Edition of NFPA 921) (on file with authors).



to convey to their handlers exactly what substance they are alerting to.<sup>102</sup> Given that fire scenes are a great source of hydrocarbons even outside of poured accelerants—due to the burning/melting of plastics, vinyls, and other synthetics—canine alerts cannot alone account for the conclusion that gasoline is present at a fire scene.<sup>103</sup>

Around 1996, following the lead of the IAAI and the NFPA, the rest of the relevant scientific community came around on this point. The 1996 edition of *Kirk's Fire Investigation* (released in November 1996, almost simultaneous to Babick's trial) reversed course from its prior edition word-for-word. The 1991 edition of *Kirk's*, partaking in the traditional leap to attribute mystical qualities to canines, had advised: "Dogs [are] trained to detect one drop of gasoline or kerosene . . . . As with drug-detection dogs, their positive signals can be used as probable cause for searches and recovery or even accepted as proof of the presence of accelerants."<sup>104</sup> By 1996, the IAAI and NFPA's positions had changed the paradigm. Indeed, following up on a 1994 position paper, the IAAI again denounced the use of canine alerts that fail confirmation by lab testing in July 1995—this time for a wider scientific audience—in a lengthy letter published in the *Journal of Forensic Sciences*.<sup>105</sup> One of the principal signers of that letter was John DeHaan, then a co-chair of the IAAI Forensic Science Committee.<sup>106</sup> Unsurprisingly then, given that DeHaan is also the credited author of *Kirk's Fire Investigation*, the next edition of *Kirk's* (released in November 1996), reversed course entirely:

As with drug-detection dogs, [accelerant-detection canine] alerts can be used as probable cause to search a person or take a sample from a fire scene, but their positive indications should not be accepted as proof of the presence of accelerants. Dogs cannot discriminate between gasoline used as an accelerant and volatile traces of carpet adhesives or insecticide sprays.<sup>107</sup>

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<sup>102</sup> *Id.* at ¶ 16 ("The canine olfactory system is believed capable of detecting gasoline at concentrations below those normally cited for laboratory methods. The detection limit, however, is not the sole criterion, or even the most important criterion for any forensic technique. Specificity, the ability to distinguish between ignitable liquids and background materials, is even more important than sensitivity for detection of any ignitable liquid residues . . . . Current research does not indicate which individual chemical compounds contained in ignitable liquids may be produced from the burning of common synthetic materials.").

<sup>103</sup> Affidavit of David M. Smith, *supra* note 82, at ¶ 65 (emphasis added).

<sup>104</sup> DEHAAN, *supra* note 89, at 135 (emphasis added).

<sup>105</sup> See IAAI Forensic Science Committee, Letters to the Editor, *IAAI Forensic Sciences Committee Position on the Use of Accelerant Detection Canines*, 40 J. FORENSIC SCI. 532, 532-34 (1995) ("Extremely low levels of such ignitable liquid vapors are normal to our environment. A canine is not capable of discriminating between these intrinsic vapors and deliberately added ignitable liquid vapors . . . . Any [canine] alert or indication not confirmed by laboratory analysis must be considered a false positive or unconfirmed indication . . . . If the forensic laboratory examination of the sample is negative for the presence of identifiable ignitable liquids, any positive indication by the canine for that sample *must* be deemed as *not relevant*."); see also LENTINI, SCIENTIFIC PROTOCOLS, *supra* note 51, at 523 (discussing the 1994 position paper by IAAI upon which the 1995 letter was based).

<sup>106</sup> See IAAI Forensic Science Committee, *supra* note 105.

<sup>107</sup> JOHN D. DEHAAN, *KIRK'S FIRE INVESTIGATION* 178 (4th ed. 1997) (emphasis added).

*D. Courts, Percolation and Holdouts*

As the leading scientific groups began to recognize the shift in science concerning canine alerts, courts slowly started to take notice as well. Although courts had routinely held unconfirmed canine alerts admissible as substantive evidence of the presence of accelerants even as late as 1993 and 1994,<sup>108</sup> the scientific shift began its initial permeation by 1995.

Perhaps the first major case to recognize the inklings of a scientific shift was the Illinois case of *People v. Acri*.<sup>109</sup> In hindsight, *Acri*, which was decided in January of 1996, is hardly groundbreaking. The court took no sides at all, and instead simply declined to have the disagreement in the relevant scientific community regarding uncorroborated alerts aired out in the courtroom, erring on the safe side of keeping the evidence out.<sup>110</sup> The disagreement at that time, as *Acri* noted, was between "[o]ne faction, led by the IAAI," which is comprised of "chemists and other professionals who are not dog handlers," and "[o]thers, composed mainly of dog handlers and led by the [Canine Accelerant Detection Association ("CADA")]."<sup>111</sup> CADA's position was especially significant, given that it was a professional organization in the relevant field that gave individual canine handlers an ostensibly credible path to ignoring the IAAI and NFPA's burgeoning opposition to the use of unconfirmed canine alerts.<sup>112</sup>

Not long after *Acri*, however, came the Georgia Supreme Court's definitive opinion in *State v. Carr*. Decided in March of 1997 (less than three months after Babick was sentenced to life in prison without the possibility of parole), *Carr* constituted a braver, wholesale engagement with the then-thorny issue of unconfirmed canine alerts.<sup>113</sup> And, even in hindsight, *Carr* was a groundbreaking opinion. Its holding on the relevant issue is worth repeating because it remains essentially the scientifically accepted position today:

While the use of trained dogs can be a valuable part of investigative procedures and can provide important elements of probable cause to search, dog alerts to accelerants have not been shown, neither at the trial of this case nor in any Georgia appellate decision, to have the scientific

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<sup>108</sup> See, e.g., *State v. Buller*, 517 N.W.2d 711, 714 (Iowa 1994) (holding that a canine's seventy-five percent laboratory confirmation rate was accurate enough to admit an unconfirmed alert); see also *Reisch v. State*, No. 426, 1992, 1993 WL 227264, at \*2 (Del. 1993) (holding canine alerts were admissible without laboratory confirmation); *State v. Acevedo*, No. A189691T4, at \*9-10 (N.J. Super. Ct. App. Div. Jan. 18, 1994) (holding that the canine handler's testimony of his dog's accuracy was generally accepted by the profession). We thank our former student Emma Lawton for providing the research that informs this footnote, and large parts of the text in this section.

<sup>109</sup> 662 N.E.2d 115 (Ill. App. Ct. 1996).

<sup>110</sup> *Id.* at 117 (noting disagreement in relevant scientific community about the acceptability of unconfirmed canine alerts, and barring courtroom use of unconfirmed alerts solely because of that disagreement).

<sup>111</sup> *Id.*

<sup>112</sup> *Id.* at 116 (canine handler noting that he disagrees with the IAAI's position on unconfirmed alerts because CADA, "of which he is a member," disagrees with IAAI).

<sup>113</sup> *Carr v. State*, 482 S.E.2d 314 (Ga. 1997).

reliability necessary to permit their use as substantive evidence of the presence of accelerants. The trial court's ruling to the contrary was error.<sup>114</sup>

Therefore, courts started to come around merely weeks after Babick's conviction and sentencing. Unfortunately, the wisdom of *Carr* and even the hapless accuracy of *Acri* were rare exceptions in those days. And, as in the matter of the physical markers of arson, plenty of holdouts remained in the canine handler profession, and they sought admission of egregious, unverifiable canine alerts even years after *Carr*.<sup>115</sup>

Perhaps the most famous case involving junk canine evidence that arose during this period of percolation is the 2006 federal prosecution of a Massachusetts man named James Hebshie. Ten years after the NFPA's and *Kirk's Fire Investigation's* recognition of the problems surrounding canine evidence, *United States v. Hebshie* resulted in a significant habeas opinion repudiating canine evidence.<sup>116</sup> In that case, canine handler Douglas Lynch presented alerts given by his dog, Billy, though they were not properly confirmed or contextualized for the jury.<sup>117</sup> As federal judge Nancy Gertner described in granting Hebshie's petition for writ of habeas corpus,

It is not an understatement to say that Lynch, the dog handler, was permitted to testify to an almost mystical account of Billy's powers and her unique olfactory capabilities. He presented unsubstantiated claims about the dog's accuracy. He was allowed to go on at great length about his emotional relationship with the dog and his entirely subjective ability to interpret her face, what she thought, intended, and the "strength" of the alert she gave in this case. Finally, Lynch was permitted to testify that the dog did not alert to anything else on the premises, as if the dog had been allowed to range widely on the fire scene (*she was not*), and as if the dog's failure to alert had evidential value (*it does not*).<sup>118</sup>

Moreover, the court found that proper investigation by trial counsel would have revealed the problems with the dog testimony and, more likely than not, trial counsel could have succeeded in having the canine evidence suppressed.<sup>119</sup> And had such

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<sup>114</sup> *Id.* at 318 (internal citations omitted).

<sup>115</sup> One especially appalling example is *Farm Bureau Mutual Insurance Co. of Arkansas, Inc. v. Foote*, 14 S.W.3d 512 (Ark. 2000), where a canine handler sought to testify that "a dog's nose can detect 300 parts per billion, while the laboratory tests detect 100 parts per million." *Id.* at 519.

<sup>116</sup> *United States v. Hebshie*, 754 F. Supp. 2d 89, 91-95 (D. Mass. 2010).

<sup>117</sup> *Id.* at 93 (noting that the building that burned was a convenience store, and it would have logically contained several "light petroleum distillates," yet further testing was not conducted to discover the source or probativeness of the canine's alerts, and no explanation was given to the jury about the likelihood that any alerts by the canine could have been owed to innocent sources).

<sup>118</sup> *Id.* at 93-94.

<sup>119</sup> *Id.* at 93 ("The most significant problems should have been abundantly clear" to trial counsel, and had counsel properly objected and challenged the proffered testimony, exclusion, or at least strict limitation, "was more than a 'reasonable probability.' It was likely.").

evidence been suppressed, a different outcome would have been likely at trial.<sup>120</sup> Implicitly, then, *Hebshie* is significant because it marks an era where not only have unconfirmed canine alerts been repudiated, but also, that repudiation has sunk in enough that a reasonable defense attorney is expected to be aware of it in order to meet the *Strickland* standard of providing constitutionally sufficient assistance of counsel to a defendant.<sup>121</sup>

In the world of fire science, the prevailing fact of life is that holdouts die out: Wrongful convictions based on previously repudiated science become less likely as the years go by. Such has been the case in the realm of canine accelerant alerts, though the percolation has taken an alarmingly long time in some places.<sup>122</sup> It is for that reason that the 2012 declaration by CADA, perhaps the last of the official organizational holdouts, is so significant. Although CADA had previously butted heads with the IAAI to argue that unconfirmed canine alerts could be used as affirmative evidence of accelerants being present,<sup>123</sup> CADA reversed course entirely in 2012. In no uncertain terms, it proclaimed:

The Canine Accelerant Detection Association (CADA) does not support, nor do we recommend, Accelerant Detection Canine Handlers testifying in criminal or civil court to the presence of an ignitable liquid without having received confirmation through laboratory analysis. . . . [N]o Prosecutor, Attorney or ADC Handler should ever testify or encourage testimony that an ignitable liquid is present without confirmation through laboratory analysis.<sup>124</sup>

CADA's declaration was, one would hope, the closing of the book on unconfirmed canine alerts. The process of percolation is thus finally complete—nearly twenty years after it began.

### III. COMPARATIVE BULLET LEAD ANALYSIS

As the old maxim goes, if something seems too good to be true, it probably is. That simple common sense rule applies perfectly to the phenomenon of Comparative Bullet Lead Analysis ("CBLA").<sup>125</sup>

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<sup>120</sup> *Id.* at 127 ("Indeed, to say that the exclusion of either the accelerant laboratory analysis or the canine evidence would have undermined this verdict and grievously prejudiced *Hebshie*, is an understatement. There would have been no case at all.").

<sup>121</sup> *See Strickland v. Washington*, 466 U.S. 668, 687-88 (1984) (holding that "[w]hen a convicted defendant complains of the ineffectiveness of counsel's assistance, the defendant must show that counsel's representation fell below an objective standard of reasonableness.").

<sup>122</sup> *See, e.g., People v. Jackson*, No. 272776, 2008 WL 2037805, at \*2 (Mich. Ct. App. May 13, 2008) (holding that canine alert is admissible as substantive evidence even in the absence of laboratory confirmation).

<sup>123</sup> *See, e.g., People v. Acri*, 662 N.E.2d 115, 116 (Ill. App. Ct. 1996) (noting CADA's disagreement with the IAAI).

<sup>124</sup> *CADA's Position on "Testifying to Negative Samples,"* CANINE ACCELERANT DETECTION ASS'N (Sept. 2012), <http://cadafiredogs.com/wp-content/uploads/2012/01/CADAS-Position-on-Testifying-to-Negative-Samples.pdf>.

<sup>125</sup> This technique is alternatively known as Compositional Analysis of Bullet Lead or CABL. *See* NAT'L RESEARCH COUNCIL, FORENSIC ANALYSIS: WEIGHING BULLET LEAD

### A. The CBLA Proposition

On an annual basis there are a staggering number of criminal offenses committed involving firearms. Of those, murder is probably the most heinous, and in the United States most murders are committed with firearms. Consequently, there is a social imperative in the United States to efficiently investigate and effectively prosecute offenses in which firearms are used, particularly homicides.<sup>126</sup>

For a significant time period, starting in about the 1960s, and continuing into the 2000s,<sup>127</sup> law enforcement had in its arsenal a unique technology to aid in meeting the “social imperative” of investigating and prosecuting crimes of gun violence: CBLA.

The theoretical underpinning of CBLA has to do with the process of bullet making, the metals used in that process, and the source of those metals.<sup>128</sup> Very roughly speaking, bullets are made from melted scraps of lead, and each batch of melted lead (consisting primarily of used automotive batteries<sup>129</sup>) contains trace amounts of other elements, including arsenic, antimony, tin, cadmium, bismuth, copper, and silver.<sup>130</sup> The premise of CBLA analysis is that the exact percentages of these trace metals in each batch of bullet lead are unique, and therefore, to a significant extent, it will be possible to trace the source of the bullet in question and put that information to probative use in a criminal case.<sup>131</sup> “Many times the [expert] witnesses have even concluded that the [crime scene] bullets came *from the same box of bullets*” found at the suspect’s house.<sup>132</sup>

CBLA analysis has three phases, succinctly described in an article by William Tobin, a former FBI metallurgist and the man most responsible for subjecting the CBLA technique to close scientific scrutiny in the late 1990s<sup>133</sup>—scrutiny that CBLA ultimately could not survive:

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EVIDENCE 1 (2004) [hereinafter NRC REPORT].

<sup>126</sup> Edward J. Imwinkelried & William A. Tobin, *Comparative Bullet Lead Analysis (CBLA) Evidence: Valid Inference or Ipse Dixit?*, 28 OKLA. CITY U. L. REV. 43, 43 (2003) (citations omitted).

<sup>127</sup> William A. Tobin, *Comparative Bullet Lead Analysis: A Case Study in Flawed Forensics*, CHAMPION, July 28, 2004, at 15-17.

<sup>128</sup> See Imwinkelried & Tobin, *supra* note 126, at 46.

<sup>129</sup> *Id.* at 46.

<sup>130</sup> Paul C. Giannelli, *Comparative Bullet Lead Analysis: A Retrospective*, 47 CRIM. LAW BULL. 306 (2011).

<sup>131</sup> *Id.*

<sup>132</sup> Tobin, *supra* note 127, at 13.

<sup>133</sup> See, e.g., Steve Kroft, *Evidence of Injustice: FBI’s Bullet Lead Analysis Used Flawed Science to Convict Hundreds of Defendants*, 60 MINUTES (Nov. 16, 2007) at 3:02-3:28, <http://www.cbsnews.com/news/evidence-of-injustice> (noting that the CBLA paradigm “went unchallenged for 40 years, until Tobin retired in 1998 and decided to do his own study—discovering that the basic premise had never actually been scientifically tested”).

1. **Analytical Phase**, where the elemental composition of bullets is ascertained through lab testing, a process that for many years required a nuclear reactor, but since 1995 has been accomplished through another, more readily duplicable technique.
2. **Grouping Phase**, where "the elemental composition numbers generated during the [first phase] are 'grouped' according to similarity of compositional presence (amount). Compositions similar to a crime scene bullet(s) are put in one group and considered "*analytically indistinguishable*"; compositions considered dissimilar are placed in different groups and considered "analytically distinguishable."
3. **Inference Phase**, where an expert judges the "alleged probative significance of finding 'analytically indistinguishable' (similar) compositions in both crime scene and 'known' bullet samples."<sup>134</sup>

#### *B. Shifts in the Science Underlying the CBLA Proposition*

As scientists reviewing the technique in recent years have concluded, potential problems arise at each phase of the CBLA proposition.

##### 1. Problems at Phase One

Even in phase one, which critics of CBLA regard as the most scientifically credible phase,<sup>135</sup> there is the issue of replicability and verifiability. While the scientific method requires that findings be verifiable and results be replicable,<sup>136</sup> for more than twenty-five years such double-checking of phase one of the CBLA proposition could only be done by those with access to a nuclear reactor.<sup>137</sup> While the shift to a more modern and accurate technique that does not require a nuclear reactor<sup>138</sup> began to address this basic problem of scientific credibility, "[t]here are practical constraints . . ."<sup>139</sup>

Cadmium is almost always absent . . . . Similarly, tin is not present in a significant proportion of samples analyzed. "Bismuth is almost always in a very narrow range of compositions . . . . Silver is almost always in a very narrow range between 20 and 30 ppm." When the analyst encounters these problems with respect to those four elements in the testing of a

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<sup>134</sup> Tobin, *supra* note 127, at 13.

<sup>135</sup> *Id.* ("In our challenge to CBLA practice, we generally assume the competent conduct of the first phase of the examinations (analytical chemistry).").

<sup>136</sup> Bob Grant, *Science's Reproducibility Problem*, SCIENTIST (Dec. 18, 2012), <http://www.the-scientist.com/?articles.view/articleNo/33719/title/Science-s-Reproducibility-Problem> ("The gold standard for science is reproducibility. Ideally, research results are only worthy of attention, publication, and citation if independent researchers can replicate them using a particular study's methods and materials."); *see also* NRC REPORT, *supra* note 125, at 9 (noting that some of the published data pertaining to CBLA "lack specified assessments of reproducibility and repeatability").

<sup>137</sup> Tobin, *supra* note 127, at 13.

<sup>138</sup> *Id.*; *see also* Imwinkelried & Tobin, *supra* note 126, at 48.

<sup>139</sup> Imwinkelried & Tobin, *supra* note 126, at 49.

given sample, in effect the analyst is forced to rely on three elements to characterize the sample . . . .<sup>140</sup>

Such reliance on percentages of only antimony, arsenic, and tin increases the potential for mis-analysis at this first stage of CBLA.<sup>141</sup>

## 2. Problems at Phase Two

In the second phase, where “the expert attempts to group the measurements of the individual samples to determine whether the compositions of the two samples ‘match’ or are ‘analytically indistinguishable,’”<sup>142</sup> the potential for error and misdiagnosis is greater.<sup>143</sup> While some courts applying *Daubert* previously failed to even reach this issue, holding that the scientific acceptability of the underlying technique was enough to satisfy *Daubert*,<sup>144</sup> the Supreme Court of Kentucky, in what is perhaps the definitive court opinion on the shift in CBLA science,<sup>145</sup> concluded that courts must proceed to evaluating the second (and third) phases of the CBLA hypothesis.<sup>146</sup> The court based its reasoning on the holdings of *Daubert* and its direct progeny, which note that the inferences that an expert makes may be flawed, even if the underlying methodology is above board.<sup>147</sup>

The basic goal of the second stage is to determine whether or not two bullets (presumably one from the crime scene and one found in the suspect’s possession) are “analytically indistinguishable” in terms of their metallic compositions.<sup>148</sup> A significant problem arises:

Anyone familiar with the limitations of the ability of even precise instruments to make measurements realizes that when an expert uses the expression, “analytically indistinguishable,” the expert is not saying that there is a perfect match in elemental composition. Rather, he or she is

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<sup>140</sup> *Id.* (quoting William A. Tobin & Wayne Duerfeldt, *How Probative Is Comparative Bullet Lead Analysis?*, 17 CRIM. JUST. 26, 33 (2002)).

<sup>141</sup> *Id.* at 48-49 (noting that Gulf General Atomic, which pioneered the used of CBLA under a contract with the United States Atomic Energy Commission, deemed reliance solely on points of similarity in percentages of these three elements to be “inadequate”); *see also* NRC REPORT, *supra* note 125, at 20 (noting that not all of the seven elements used by the FBI in its CBLA process are have significant “discriminating capabilities,” and, in particular, tin and cadmium are nearly useless).

<sup>142</sup> Imwinkelried & Tobin, *supra* note 126, at 50.

<sup>143</sup> *Id.*

<sup>144</sup> *E.g.*, *Ragland v. Commonwealth*, 191 S.W.3d 569, 577 (Ky. 2006) (discussing lower court opinion).

<sup>145</sup> For example, in the textbook *Wrongful Convictions: Cases and Materials*, *Ragland* is the second case included in the chapter on “Evidentiary Standards and Science,” preceded only by *Daubert* itself. *See* JUSTIN BROOKS, *WRONGFUL CONVICTIONS: CASES AND MATERIALS* 304 (2011).

<sup>146</sup> *Ragland*, 191 S.W.3d at 577-78.

<sup>147</sup> *Id.* at 578 (citing *Gen. Elec. Co. v. Joiner*, 522 U.S. 136 (1997)).

<sup>148</sup> Imwinkelried & Tobin, *supra* note 126, at 49.

asserting that although there are differences, the differences detected fall within the precision limits of the particular measuring technique.<sup>149</sup>

While the mathematical route to a finding of "analytically indistinguishable" may be above reproach, the data being put in to the equation is flawed.<sup>150</sup> The first reason is the impreciseness of measurement noted by Imwinkelried and Tobin.<sup>151</sup> Beyond just that, however, elemental composition could vary in different parts of the same bullet.<sup>152</sup> Nevertheless, in CBLA analysis, the analyst simply takes three samples at random from the bullet, making no confirmation that what he obtained was in fact a sample representative of the metallic composition of the whole bullet.<sup>153</sup>

### 3. Problems at Phase Three

Despite those shortcomings of the first and second stages of inference, however, critics of CBLA take much more issue with the "unjustifiable extrapolation" that characterizes the third phase:<sup>154</sup>

It is the third phase of the practice, the inference phase, that is most objectionable and, unfortunately, the most directly incriminating. In this phase, the expert witness has most frequently concluded that, because the crime scene and known bullets are allegedly "analytically indistinguishable" (compositionally similar), the bullets have a common origin as to "molten source." In the courtroom, the expert witness states that the compared bullets "were made by the same manufacturer, on the same day, from the same molten source of lead," and often that the bullets "originated from the same box of bullets." . . . The witnesses have asserted as universal assumptions that all bullets from the same molten source have the same composition, and that all bullets from different molten sources have different compositions.<sup>155</sup>

The assumptions required to make the extrapolation in question were never seriously tested prior to 2000, and once they were tested, they proved to be quite questionable.<sup>156</sup>

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<sup>149</sup> *Id.*

<sup>150</sup> *Id.*

<sup>151</sup> *Id.*

<sup>152</sup> NRC REPORT, *supra* note 125, at 29, 30 (noting that measurements of elemental composition of a bullet "could have differed . . . had we used different fragments of the same bullet for measurement of the overall average, since even an individual bullet may not be completely homogenous in its composition . . .").

<sup>153</sup> Tobin, *supra* note 127, at 13; *see also* NRC REPORT, *supra* note 125, at 1 (noting three samples are taken from each bullet); *id.* at 30 (noting that taking three different samples from the same bullet could yield different compositional readings because "even an individual bullet may not be completely homogenous in its composition").

<sup>154</sup> *See, e.g.*, Tobin, *supra* note 127, at 14.

<sup>155</sup> *Id.* at 13.

<sup>156</sup> *Id.* (noting "there have never been any comprehensive and meaningful studies of the hypotheses and assumptions of CBLA"); *see also* Ragland v. Commonwealth, 191 S.W.3d 569, 578-79 (Ky. 2006).



For example, it was assumed that “the source from which the fragment or sample originated is compositionally uniform or homogeneous.”<sup>157</sup> In other words, it was assumed that each batch of molten lead, which is in the range of 100-125 tons and could yield as many as 54 million bullets, was itself homogenous in its elemental makeup.<sup>158</sup> That assumption, it turns out, could not survive a real world analysis. As the 2004 National Research Council Report on CBLA noted, homogeneity should not be assumed, and really, the evidence seems to prove a lack of it.<sup>159</sup>

Second, even assuming compositional uniformity, for that compositional uniformity to have any meaning, another assumption is needed: “[T]hat the composition of each molten source is unique or individual.”<sup>160</sup> If multiple batches could have identical composition, then it would not be possible to narrow down the source of a particular bullet to a particular batch of melted lead. For this reason “[CBLA] also assumes that each lead source has a unique composition. [However,] [p]ublished data have shown that two lead sources prepared twelve years apart had compositions that were analytically indistinguishable.”<sup>161</sup>

### *C. Implications of the Problems with the CBLA Proposition*

The lack of validity in both assumptions that are central to phase three CBLA analysis (not to mention the additional problems that arise at phases one and two) means that the testimony often given in court cases by supposed experts in CBLA lacks credibility, and may have led to many manifest injustices.<sup>162</sup> For example, experts have often testified that a compositional match means the bullets came from the same box of ammunition.<sup>163</sup> Such testimony is powerful and convenient, and it led in part to the capital conviction and subsequent execution in Texas of James Earhart.<sup>164</sup>

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<sup>157</sup> Tobin, *supra* note 127, at 13.

<sup>158</sup> Imwinkelried & Tobin, *supra* note 126, at 67.

<sup>159</sup> NRC REPORT, *supra* note 125, at 79 (“It is generally assumed that the composition of a given melt is constant and homogeneous from the beginning to the end of the pour if nothing is added to the pot during the pour . . . . It should be noted that during a pour material may be added to the original melt, thus producing time-varying compositional changes . . . . In the case of at least one manufacturer, billets are not poured from a vat that has a constant composition; instead, while the vat is being poured, molten lead from another pot is continuously added to maintain the level of molten lead in the vat being poured. Thus, compositional changes can occur during casting . . . . [Research] also showed occasional distinct concentration changes in some elements as samples were extracted from the beginning, middle, and end of the pour.”) (internal citations omitted).

<sup>160</sup> Tobin, *supra* note 127, at 16.

<sup>161</sup> NRC REPORT, *supra* note 125, at 9 (internal citation omitted).

<sup>162</sup> See, e.g., Kroft *supra* note 133.

<sup>163</sup> See Gianelli, *supra* note 130, at 310 (quoting expert John Riley’s trial testimony in *State v. Earhart*, where Riley said “from my 21 years experience of doing bullet lead analysis and doing research on boxes of ammunition down through the years I can determine if bullets came from the same box of ammunition”); see also NRC REPORT, *supra* note 125, at 91-92 (citing several cases where experts have testified that compositionally indistinguishable bullets, in turn, could/would/probably did come from the same box of ammunition).

<sup>164</sup> Gianelli, *supra* note 130 (citing *Earhart v. State*, 823 S.W.2d 607, 614 (Tex. Crim. App.

However, in light of the comprehensive analysis of the 2004 NRC Report, and even the pre-2004 publications from experts and scholars such as Tobin, there is simply no basis to draw such conclusions. Given that millions of bullets come from each batch of melted lead, it is senseless to attempt to trace any two given bullets back to the same box. Even if it is assumed that each batch of lead is internally homogenous as well as compositionally unique from every other batch (and both of these assumptions have been debunked, as noted above), each box of bullets contains twenty bullets,<sup>165</sup> whereas a single lead melt can produce up to 54 million bullets.<sup>166</sup> These millions of bullets made from a single pour would, under the CBLA hypothesis, all be compositionally indistinguishable—hardly traceable to the same box.

An additional problem arises from the “clustering” of bullets from the same batch, which tend to go to the same geographic area.<sup>167</sup> Not only can analytically indistinguishable bullets not be traced to the same box, but also, it is likely that similar branded and caliber bullets sold during a given time in a given geographic region are analytically indistinguishable. Thus, any box of similar ammunition in the given region where the crime occurred is *disproportionately more likely* to contain bullets that are analytically indistinguishable from the bullets used in a crime in that local area.<sup>168</sup>

All in all, the potential for wrongful arrest and prosecution of innocent individuals is quite high, if law enforcement officials take the CBLA hypotheses on their face, and without regard to the bounty of research from the past ten to fifteen years indicating that CBLA is a technique too flawed to be considered science at all.

#### *D. Percolation Delays and the Prolonged Death of CBLA*

The validity of the CBLA proposition, accepted since the 1960s, was only rarely questioned before 2002. One such rare occasion was in 1991, when, “at the International Symposium on the Forensic Aspects of Trace Evidence, hosted by the FBI, various experts in the field ‘cautioned that the variability (of the elemental mix) within a production run . . . has not been addressed in a comprehensive study.’”<sup>169</sup> However, the 1991 study was essentially ignored, as CBLA continued to be conducted by the FBI and used in courts against defendants throughout the 1990s and into the 2000s.<sup>170</sup>

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1991); and *Searchable Database of Executions*, DEATH PENALTY INFO. CTR., <http://www.deathpenaltyinfo.org/executions> (search for “Earhart” under “Execution Database”).

<sup>165</sup> *Ragland v. Commonwealth*, 191 S.W.3d 569, 576 (Ky. 2006).

<sup>166</sup> *Imwinkelried & Tobin*, *supra* note 126, at 67.

<sup>167</sup> *Id.* at 47.

<sup>168</sup> NRC REPORT, *supra* note 125, at 9 (“Although the major bullet manufacturers distribute their products nationally and even internationally, some regional distributors might receive and distribute many bullets from the same compositionally indistinguishable source. That would increase the probability of finding a match between a crime-scene bullet and a bullet in the possession of an innocent person.”).

<sup>169</sup> *Clemons v. State*, 896 A.2d 1059, 1076 (Md. 2006) (quoting *Imwinkelried & Tobin*, *supra* note 126, at 50)).

<sup>170</sup> *Gianelli*, *supra* note 130, at 307 (noting “[t]he technique was not seriously challenged

The 1991 study was an immense opportunity lost. While those within the relevant scientific community should have been put on notice about the unreliability of CBLA analysis, and pushed to examine its underlying paradigm, such progress would have to wait a few more years. In the meantime arose cases like that of James Earhart.<sup>171</sup>

Convicted in 1988 of capital murder in Texas, Earhart filed a habeas corpus petition in 1995.<sup>172</sup> In that habeas petition, he sought to question the validity of the CBLA evidence used against him through the procedural hook of a Sixth Amendment claim (arguing “trial counsel rendered ineffective assistance by failing to request an expert regarding analysis of bullet evidence”).<sup>173</sup> The State’s case against Earhart was entirely circumstantial, and CBLA evidence played a strong part in it.<sup>174</sup> Indeed the prosecution’s expert at the 1988 trial spoke of CBLA in as egregious a manner as imaginable, indicating that the bullet recovered from the victim was “analytically indistinguishable” from those found in Earhart’s possession, and that “analytically indistinguishable bullets are typically found within the same box of ammunition.”<sup>175</sup>

The United States Court of Appeals for the Fifth Circuit agreed that the CBLA evidence was central to the prosecution’s case.<sup>176</sup> In response to Earhart’s claim that trial counsel performed ineffectively in failing to obtain his own expert to challenge the CBLA evidence, the court went so far as to say “Texas law supports Earhart’s argument.”<sup>177</sup> However, given that the standard for ineffective assistance of counsel has two parts, deficient performance by the attorney and requisite prejudice caused to the defendant,<sup>178</sup> Earhart’s claim failed.<sup>179</sup> Even though trial counsel’s failure to obtain an expert may have been a bad choice (given the centrality of the CBLA evidence to the State’s case), the court held that it would not have made any difference, because there was no expert available to testify to prejudice anyway.<sup>180</sup>

Speaking haplessly to the very core of shifted science’s percolation problem, the Fifth Circuit wrote:

Earhart has not identified an expert witness available to testify on his behalf or the type of testimony such a witness would have provided

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until a retired FBI examiner, William Tobin, began questioning the procedure in scientific and legal journals and in court testimony as well” and citing to Tobin’s articles from 2002 and 2003, and courtroom testimony from 2005 and 2006).

<sup>171</sup> Earhart v. Johnson, 132 F.3d 1062 (5th Cir. 1998).

<sup>172</sup> *Id.* at 1064-65.

<sup>173</sup> *Id.* at 1065.

<sup>174</sup> *Id.* at 1067 (noting “the significant role the bullet evidence played in the prosecution’s case”).

<sup>175</sup> *Id.* at 1064.

<sup>176</sup> *Id.* at 1067.

<sup>177</sup> *Id.*

<sup>178</sup> *See, e.g.*, Strickland v. Washington, 466 U.S. 668, 691-92 (1984).

<sup>179</sup> Earhart, 132 F.3d at 1067.

<sup>180</sup> *Id.* at 1068.

beyond that elicited at trial. . . . In short, assuming defense counsel was deficient in failing to request an expert, Earhart has not established that this failure prejudiced his defense or otherwise rendered the outcome of his trial unreliable.<sup>181</sup>

Simply put, Earhart had a point, but the science just was not there yet, so Earhart was out of luck. He was executed on August 11, 1999.<sup>182</sup>

The tide started to turn in earnest on CBLA in 2002.<sup>183</sup> Two studies co-authored by Tobin that year,<sup>184</sup> helped bring the questions surrounding CBLA far enough into the light to actually compel the FBI to act. Due in large part to Tobin's advocacy, the "FBI asked the National Academy of Sciences (NAS) to review the technique. NAS appointed a committee of scientists, statisticians, and attorneys to conduct the review."<sup>185</sup> Even as the NAS committee was appointed and its work began, convictions continued on the basis of CBLA. The most important of these, as will be discussed later, was the March 2002 murder conviction of Shane Ragland in Kentucky.<sup>186</sup>

The result of the NAS Committee's work came out in 2004, in the form of a 214-page report entitled "Forensic Analysis: Weighing Bullet Lead Evidence."<sup>187</sup> That document contained conclusions that "undercut" the very premises that CBLA was built on.<sup>188</sup> The report addressed in detail the many potential problems at each analytical step of the CBLA calculus.<sup>189</sup>

The NAS report should have been the death knell to CBLA. The report had been commissioned by the FBI—one of only two agencies in America that were performing comparative bullet lead analysis—and its conclusions amounted essentially to: "The very basic foundations of the CBLA hypothesis are flawed." But the FBI was not ready to give in. Even as the NAS Committee proceeded about its work preparing the report, the FBI obstructed the process,<sup>190</sup> foreshadowing what would happen once the report was released: "The FBI's response to the NAS Report

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<sup>181</sup> *Id.*

<sup>182</sup> See *James Earhart*, TEX. EXECUTION INFO. CTR., <http://www.txexecutions.org/reports/184.asp> (last visited Mar. 14, 2016).

<sup>183</sup> See Gianelli, *supra* note 130, at 307 (noting that the CBLA "technique was not seriously challenged until a retired FBI examiner, William Tobin, began questioning the procedure in scientific and legal journals," with citations indicating that Tobin's publications started in 2002).

<sup>184</sup> *Id.* at 306 n.3.

<sup>185</sup> *Id.* at 307.

<sup>186</sup> *Ragland v. Commonwealth*, 191 S.W.3d 569, 578 (Ky. 2006).

<sup>187</sup> NRC REPORT, *supra* note 125.

<sup>188</sup> Gianelli, *supra* note 130, at 309.

<sup>189</sup> NRC REPORT, *supra* note 125, at 109-13.

<sup>190</sup> Gianelli, *supra* note 130, at 311-12 (citing "peculiarities," incomplete data, and high error rates to conclude: "In short, the NAS Committee, appointed at the behest of and funded by the FBI, was not provided with critical data that would have assisted it in evaluating the technique.").

was also disconcerting. The Bureau quickly put out a press release, obscuring the report's findings . . . . In effect, the FBI cherry-picked favorable statements from the report and downplayed the unfavorable crucial findings."<sup>191</sup>

While the FBI hemmed, hawed and held out, courts began to get the message: CBLA did not stand up to scientific scrutiny. In *United States v Mikos*,<sup>192</sup> Judge Ronald Guzman of the United States District Court for the Northern District of Illinois issued the first opinion applying the lessons of Tobin's mounting offensive against CBLA.<sup>193</sup> In *Mikos*, the court noted that the CBLA expert's "ultimate conclusion is based upon a series of determinations that lack scientific accuracy."<sup>194</sup> Noting both that "no one can say with any reasonable degree of scientific certainty what the probability or even the range of probabilities is" for a coincidental match of chemical compositions of bullets from different sources, and that "the record before us does not reflect that the samples were gathered in any approved scientific manner so as to be considered as representative of the bullet population as a whole,"<sup>195</sup> the court essentially barred step three of the CBLA analysis. While the State's expert would be allowed to say the crime scene bullets were analytically indistinguishable from bullets found in the suspect's possession, he would not be permitted to haphazardly opine as to the significance of this fact, as countless experts previously had been.<sup>196</sup>

Much like *Acri* in the realm of canine accelerant alerts, *Mikos* was an opinion that emerged on the cusp of a major scientific shift. While it came to the right conclusion, its analysis was not fully evolved. For that, our discussion shifts back to Shane Ragland, and the Kentucky Supreme Court's 2006 opinion in his case.<sup>197</sup> Aided by the fact that in 2005 the FBI had finally abandoned its own use of CBLA, *Ragland* took the *Mikos* rationale further and to a proper conclusion: Not only could no one say how common coincidental matches could be, but this uncertainty was a systemic error fatal not only in a single case, but rather fatal to the very premise of CBLA as a forensic tool.<sup>198</sup>

In what remains today the definitive opinion on the issue of the unreliability of CBLA, the Kentucky Supreme Court ended the era of uncertainty: CBLA no longer had a place in criminal convictions. Nearly a decade after Tobin first identified flaws in the very premise of CBLA,<sup>199</sup> the shift in consensus was complete in the relevant scientific community, the legal community, and had even begun to spill into the awareness of the public at large by 2007.<sup>200</sup>

<sup>191</sup> *Id.* at 313 (internal citations omitted).

<sup>192</sup> No. 02 CR 137, 2003 WL 22922197 (N.D. Ill. Dec. 9, 2003).

<sup>193</sup> Gianelli, *supra* note 130, at 310 n.31 (indicating *Mikos* was first such opinion).

<sup>194</sup> *Mikos*, 2003 WL 22922197, at \*3.

<sup>195</sup> *Id.* at \*4.

<sup>196</sup> *Id.* at \*6.

<sup>197</sup> *Ragland v. Commonwealth*, 191 S.W.3d 569 (Ky. 2006).

<sup>198</sup> *Id.* at 579-80.

<sup>199</sup> *See* Kroft, *supra* note 133, at 3:02-3:28.

<sup>200</sup> *See, e.g.*, John Solomon, *FBI's Forensic Test Full of Holes*, WASH. POST (Nov. 18, 2007), <http://www.washingtonpost.com/wp-dyn/content/article/2007/11/17/AR2007111701681.html>.

## IV. SHAKEN BABY SYNDROME—SCIENCE STILL SHIFTING

Like the other fields discussed above, the science surrounding so-called “Shaken Baby Syndrome” (SBS)—a medicolegal diagnosis of child abuse typically based on three specific symptoms—has developed, *shifted*, significantly in the last several decades. However, the SBS landscape makes a straightforward application of the concept of shifted science more difficult than the other fields described above.

Unlike fire science or comparative bullet lead analysis—where nearly all of the relevant scientific community has denounced the old ways—the debate is far from over in the realm of SBS. Instead, scholars, scientists and practitioners across a wide continuum of the medical field continue to disagree about the viability of the SBS diagnosis, and its exact applications.<sup>201</sup> Still, undeniable changes have occurred—with some penetrating more deeply than others. One thing is certain: the SBS diagnosis has been the subject of increasingly intense scrutiny and the landscape looks much different than it did when the diagnosis first emerged. Thus, SBS lends itself as an interesting study of shifting science, where the historical percolation delays described above for other fields are actually still playing out.

A. *The Beginning—“Good Shakings” in Northern England*

In its purest form, the SBS Hypothesis<sup>202</sup> posits that intentional child abuse in infants and young children, can be reliably diagnosed from a finding of three symptoms: (1) encephalopathy (brain injury—usually brain swelling); (2) subdural hematoma (bleeding on the surface of the brain) and; (3) retinal hemorrhage (bleeding behind the eyes).<sup>203</sup> These three symptoms are often referred to as the diagnostic “triad.”<sup>204</sup>

Dr. Norman Guthkelch is often credited as being the inventor of the SBS hypothesis.<sup>205</sup> Working as a pediatric neurosurgeon working in northern England in the early 1970s, Dr. Guthkelch noticed a curious trend of injuries to children: “They had blood on the surface of the brain but no external signs of violence to the head.”<sup>206</sup> He came to attribute such injuries to the local practice of giving a child “a good shaking” as a form of discipline, as opposed to hitting the child.<sup>207</sup>

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<sup>201</sup> See, e.g., Debbie Cenziper, *Shaken Science: A Disputed Diagnosis Imprisons Parents*, WASH. POST (Mar. 20, 2015), [http://www.washingtonpost.com/graphics/investigations/shaken-baby-syndrome/?wpisrc=al\\_alert](http://www.washingtonpost.com/graphics/investigations/shaken-baby-syndrome/?wpisrc=al_alert).

<sup>202</sup> SBS critics note that the word “hypothesis” is intentional and appropriate, noting the lack of testing necessary to call SBS a “theory” or really anything but a hypothesis: “It’s actually just a hypothesis, and I use that word intentionally.” Keith Findley et al., *Examining Shaken Baby Syndrome Convictions in Light of New Medical Scientific Research*, 37 OKLA. CITY U. L. REV. 219, 222 (2012).

<sup>203</sup> DEBORAH TUEKHEIMER, *FLAWED CONVICTIONS: “SHAKEN BABY SYNDROME” AND THE INERTIA OF JUSTICE* 5 (2014).

<sup>204</sup> *Id.*

<sup>205</sup> Joseph Shapiro, *Rethinking Shaken Baby Syndrome*, NAT’L PUBLIC RADIO (June 29, 2011), <http://www.npr.org/2011/06/29/137471992/rethinking-shaken-baby-syndrome>.

<sup>206</sup> Cenziper, *supra* note 201, at Part II, § 2.

<sup>207</sup> *Id.*

In 1971, Guthkelch wrote a paper titled *Infantile Subdural Hematoma and its Relationship to Whiplash Injuries* where he proposed that shaking alone could cause a subdural hematoma in an infant, as the result of ruptured bridging veins that drain blood from the brain.<sup>208</sup> The next year, pediatric radiologist John Caffey coined the term “whiplash shaken infant syndrome,” to describe injuries similar to those Guthkelch had observed in England.<sup>209</sup> Caffey wrote that this method of abuse is “practiced in all levels of society, by a wide variety of persons, in a wide variety of ways, for a wide variety of motives.”<sup>210</sup> Moreover, he wrote, “the infantile head is especially vulnerable to whiplash injuries owing to a combination of the normal relatively heavy head and weak neck muscles.”<sup>211</sup>

Despite these landmark publications, Professor Deborah Tuerkheimer describes the late 1970s and 1980s as a “time of relative quiescence” for the SBS diagnosis: “While researchers continued to explore the subject, the impact of SBS outside the medical community was marginal . . . [and] the relationship between SBS and crime was slow to develop.”<sup>212</sup> Indeed, the term “Shaken Baby Syndrome” did not come into general usage until the 1980s.<sup>213</sup>

Moving slowly at first, diagnoses of SBS, and prosecutions based on it, began to rise steadily over the years. The first appeal of a conviction based on the SBS hypothesis came in 1984, and fewer than fifteen such appeals were reported in the next five years.<sup>214</sup> However, that number would grow substantially in the years that

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<sup>208</sup> A.N. Guthkelch, *Infantile Subdural Haematoma and Its Relationship to Whiplash Injuries*, BRITISH MED. J., May 1971, at 430; see also Carole Jenny, *Foreword*, ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN xi (2007) (describing Guthkelch’s article as “the first clear reference in the world’s medical literature to shaking as a means of inducing head injury in infants and small children”).

<sup>209</sup> Cenziper, *supra* note 201, at Part II, § 2.

<sup>210</sup> John Caffey, *On the Theory and Practice of Shaking Infants*, 124 AM. J. DISEASES CHILD. 161, 168 (1972).

<sup>211</sup> *Id.*

<sup>212</sup> TUERKHEIMER, *supra* note 203, at 2.

<sup>213</sup> LORI FRASIER ET AL., ABUSIVE HEAD TRAUMA IN INFANTS AND CHILDREN 2 (2007).

<sup>214</sup> TUERKHEIMER, *supra* note 203, at 2. The testimony of a coroner in a 1984 case, provides a classic example of the type of testimony given in SBS cases, particularly those from the early years:

Q. Doctor, did you have an occasion to determine and qualify the type of force which you believe that would have had to have been used on that child in order to have it sustain the type of injuries which you viewed?

A. I think on a baby there is no question that there is violent force.

Q. Now, Doctor, did you also reach an opinion, based upon a reasonable medical certainty as to the cause of death of Patricia Schneider?

A. Yes.

Q. And what was that opinion, sir?

A. Brain death.

Q. And Doctor, was that as a result of the shaking?

A. Yes, ma'am.

Q. And your examination of the other organs of the child and your visual examination, was that child, Patricia Schneider, prior to December 12, 1983, otherwise a very healthy little baby?

followed, with more than 200 appellate decisions between 1990 and 2000, and more than 800 between 2000 and 2010.<sup>215</sup> While recognizing that review of appellate decisions is not a perfect way to measure the number of prosecutions, Tuerkheimer notes that the data suggests "that the total volume of prosecutions has been on a sharply upward trajectory since 1990."<sup>216</sup> She estimates that currently, approximately 200 defendants are being convicted based on the SBS hypothesis annually.<sup>217</sup> The National Center on Shaken Baby Syndrome asserts that 1,300 children are diagnosed with SBS each year in the United States.<sup>218</sup>

### *B. Challenges and Changes—Pathognomonic No More*

Challenges to the SBS hypothesis started to emerge in the late 1980s when researchers delved into the biomechanics underlying the hypothesis. In 1987, Duhaime et al. published a report of a study designed to test the hypothesis on a biomechanical level.<sup>219</sup> The study concluded that, "the shaken baby syndrome, at least in its most severe acute form, is not usually caused by shaking alone. Although shaking may, in fact, be a part of the process, it is more likely that such infants suffer blunt impact."<sup>220</sup> Based on her findings from this and other biomechanical studies, Duhaime wrote that "'Shaken Baby [S]yndrome' is a misnomer, implying a mechanism of injury which does not account mechanically for the radiographic or pathological findings."<sup>221</sup>

Perhaps related to the development of evidence-based medicine in the late 1990s,<sup>222</sup> the late 1990s and early 2000s saw the onset of increased doubt and debate about the validity of SBS. In a 2003 study, Dr. Mark Donohoe noted:

The issue of the evidence for SBS appears analogous to an inverted pyramid, with a small database (most of it poor-quality original research, retrospective in nature, and without appropriate control groups) spread to a broad body of somewhat divergent opinions. One may need reminding that repeated opinions based on poor-quality data cannot improve the

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A. Absolutely.

State v. Schneider, No. L-84-214, 1984 WL 3719, at \*2 (Ohio Ct. App. Dec. 21, 1984).

<sup>215</sup> TUERKHEIMER, *supra* note 201, at 2.

<sup>216</sup> *Id.*

<sup>217</sup> *Id.* at 10.

<sup>218</sup> *SBS Statistics*, NAT'L CENTER ON SHAKEN BABY SYNDROME, <http://dontshake.org/sbs.php?topNavID=3&subNavID=27> (last visited June 22, 2015).

<sup>219</sup> Ann-Christine Duhaime et al., *The Shaken Baby Syndrome: A Clinical, Pathological, and Biomechanical Study*, 66 J. NEUROSURGERY 409 (1987).

<sup>220</sup> *Id.* at 414.

<sup>221</sup> Ann-Christine Duhaime et al., "Shaken Baby Syndrome: A Misnomer?," 4 J. PEDIATRICS NEUROSCI. 77, 85 (1988).

<sup>222</sup> Jeffrey A. Claridge & Timothy C. Fabian, *History and Development of Evidence-Based Medicine*, 29 WORLD J. SURGERY 547 (2005).



quality of evidence . . . . There exist major gaps in the medical literature about SBS.<sup>223</sup>

Donohoe also noted the circular nature of much of the research: “Many of the authors repeated the logical flaw that if [retinal hemorrhages] and [subdural hematomas] are nearly always seen in SBS, the presence of [retinal hemorrhage] and [subdural hematoma] ‘prove’ that a baby was shaken intentionally.”<sup>224</sup> This logical fallacy is tantamount to asserting “because most doctors are smart, most smart people are doctors.”<sup>225</sup> Overall, Donohoe concluded that “the data available in the medical literature by the end of 1998 [was] inadequate to support *any* standard case definitions, or *any* standards for diagnostic assessment.”<sup>226</sup> Even supporters of the SBS diagnosis admit there are problems with circularity in the relevant studies.<sup>227</sup>

The basis of the scientific challenge to the SBS diagnosis is that symptoms traditionally relied on are not pathognomonic for abuse—meaning they can occur as the result of other natural or accidental causes.<sup>228</sup> Even this point is not seriously contested today, as supporters of the diagnosis readily admit it: “[T]here is a clear, strong, and highly statistically significant association between SDHs [subdural hematomas] and RHs [retinal hemorrhages] with trauma. However, the mere presence along of SDHs and RHs does not establish a diagnosis of AHT [abusive head trauma].”<sup>229</sup>

Others have questioned the significance of retinal hemorrhages to the SBS diagnosis, stating that the diagnostic relationship is “not supported by the objective scientific evidence . . . . Until good evidence is available, we urge caution in interpreting eye findings out of context.”<sup>230</sup> Again, the supporters of SBS acknowledge that retinal hemorrhages can have a multitude of causes other than abuse, while maintaining there is a “significant statistical association of severe RHs and AHT.”<sup>231</sup>

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<sup>223</sup> Mark Donohoe, *Evidence-Based Medicine and Shaken Baby Syndrome*, 24 AM. J. FORENSIC MED. & PATHOLOGY 239, 241 (2003).

<sup>224</sup> *Id.*

<sup>225</sup> See Keith A. Findley et al., *Shaken Baby Syndrome, Abusive Head Trauma, and Actual Innocence: Getting It Right*, 12 HOUS. J. HEALTH L. & POL’Y 209, 287 (2012).

<sup>226</sup> Donohoe, *supra* note 223, at 241.

<sup>227</sup> See, e.g., Sandeep Narang, *A Daubert Analysis of Abusive Head Trauma/Shaken Baby Syndrome*, 11 HOUS. J. HEALTH L. & POL’Y 505, 562 (2011) (“[S]ome circularity is inevitable, because we are unwilling to experimentally shake infants, and even reliably confessed accounts have some doubt.”).

<sup>228</sup> *Id.* at 562-63.

<sup>229</sup> *Id.* at 571; see also Carole Jenny, Presentation, 2011 New York City Abusive Head Trauma/Shaken Baby Syndrome Training Conference: The Mechanics: Distinguishing AHT/SBS from Accidents and Other Medical Conditions, slide 33 (Sept. 23, 2011), [www.queensda.org/SBSConference/SBC2011.html](http://www.queensda.org/SBSConference/SBC2011.html) (“No trained pediatricians think that subdural hemorrhage, retinal hemorrhage, and encephalopathy equals abuse. The ‘triad’ is a myth!”).

<sup>230</sup> Patrick Lantz et al., *Perimacular Retinal Folds from Childhood Head Trauma*, 328 BMJ 754, 756 (2004).

<sup>231</sup> Narang, *supra* note 227, at 558.

Other researchers have described witnessed falls that produced classic SBS findings, meaning "[a] history by the caretaker that the child may have fallen cannot be dismissed."<sup>232</sup> Supporters of the SBS hypothesis counter by citing research finding that the risk of death from a short fall is less than one in one million children.<sup>233</sup>

The position papers of the American Academy of Pediatrics ("AAP") frame the development nicely. In 2001, the AAP wrote that, "data regarding the nature and frequency of head trauma consistently support the need for a presumption of child abuse when a child younger than 1 year has an intracranial injury."<sup>234</sup> However, in 2009 the AAP revised its position in accordance with the growing medical research. It acknowledged that "the mechanisms and resultant injuries of accidental and abusive head injury overlap" and that "there is no single or simple test to determine the accuracy of the diagnosis."<sup>235</sup> Moreover, the 2009 statement removed language advocating the "presumption of child abuse."<sup>236</sup>

In short, a substantial debate continues about the validity of SBS hypothesis, in light of new research and the repudiation of the idea that the triad is pathognomonic of abuse. While a new consensus has yet to be reached, this debate is itself significant.<sup>237</sup> And though the debate rages on, it is key to note that the battle lines have changed. Indeed, even those in the relevant scientific community who still support the reliability of the SBS hypothesis have modified their positions in significant ways. For example, in 2009, the AAP also recommended a change in terminology, urging that: "Pediatricians should use the term 'abusive head trauma' rather than a term that implies a single injury mechanism, such as shaken baby syndrome, in their diagnosis and medical communications."<sup>238</sup> Thus, at the very least, supporters of SBS have conceded that the symptoms associated with SBS may not always (or ever) be caused by shaking alone.<sup>239</sup>

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<sup>232</sup> John Plunkett, *Fatal Pediatric Head Injuries Caused by Short-Distance Falls*, 22 AM. J. FOREIGN MED. & PATHOLOGY 1, 10 (2001).

<sup>233</sup> David L. Chadwick et al., *Annual Risk of Death Resulting from Short Falls Among Young Children: Less Than 1 in 1 Million*, 121 PEDIATRICS 1213 (2008).

<sup>234</sup> American Academy of Pediatrics Committee on Child Abuse and Neglect, *Shaken Baby Syndrome: Rotational Cranial Injuries—Technical Report*, 108 PEDIATRICS 206, 206 (2001).

<sup>235</sup> Cindy W. Christian et al., *Abusive Head Trauma in Infants and Children*, 123 PEDIATRICS 1409, 1410 (2009).

<sup>236</sup> *Id.*

<sup>237</sup> See, e.g., *State v. Edmunds*, 746 N.W.2d 590, 599 (Wis. Ct. App. 2008) ("[I]t is the emergence of a legitimate and significant dispute within the medical community as to the cause of those injuries that constitutes newly discovered evidence.").

<sup>238</sup> Christian et al., *supra* note 235, at 1411.

<sup>239</sup> Chris N. Morison & Robert A. Minns, *The Biomechanics of Shaking*, in SHAKING AND OTHER NON-ACCIDENTAL HEAD INJURIES IN CHILDREN 113 (Robert A. Minns & J. Keith Brown eds., 2006) ("The medico-legal community is still painfully aware of a lack of conclusive evidence either for or against the capacity for SBS to be caused by shaking alone. In fact, specialists in the diagnosis and treatment of SBS find contradiction between the currently accepted publications which seem to prove the necessity of impact to cause such severe injuries, and their own clinical observations and investigations which seem to produce

*C. The Existing Landscape—Percolation in Progress*

Unlike the old methodologies in the realm of fire science or comparative bullet lead analysis, one cannot make a blanket claim that SBS hypothesis has been wholly repudiated by the relevant community. Indeed, as addressed earlier, a fierce debate continues, with experts championing both sides.<sup>240</sup> Nevertheless, it is undeniable that there has been a shift. Recent years have seen increased challenges to the validity of the SBS hypothesis,<sup>241</sup> and even some supporters now acknowledge that the classic SBS symptoms can have non-abusive causes.<sup>242</sup>

For his part, Norman Guthkelch, the British doctor who is considered the father of the SBS hypothesis, has his own concerns about the way in which the diagnosis has developed. In a 2011 interview with National Public Radio, Guthkelch, then ninety-five years old, expressed grave doubts over how far the SBS hypothesis had been carried by law enforcement: “I don't think that the famous triad, however well some people think it's defined, can ever be so well-defined that you can say that and nothing else cause it—that meaning shaking.”<sup>243</sup>

Court opinions on the issue, for the most part, are split, as is to be expected for a science that is still shifting. Some, starting with the landmark *Edmunds* opinion in 2008, have recognized the debate within the scientific community as reason enough to subject the SBS hypothesis to further scrutiny than it endured at trial, and have therefore granted new trials where the jury may be apprised of the controversy.<sup>244</sup>

Indeed in 2014, federal district Judge Matthew Kennelly of the Northern District of Illinois went further than simply acknowledging a debate.<sup>245</sup> He used perhaps the strongest language to date in granting habeas relief to Jennifer Del Prete, who had been convicted of first-degree murder in 2005 based on the SBS hypothesis.<sup>246</sup> In a ninety-seven-page opinion, summarizing in depth the testimony from eleven forensic experts presented in the post-conviction stage of the case alone, Judge Kennelly considered, in light of “the new evidence together with the evidence presented at Del Prete's trial . . . whether any reasonable juror who heard all of it could find Del Prete guilty beyond a reasonable doubt.”<sup>247</sup> The judge concluded: “The answer to that question is a rather resounding no,”<sup>248</sup> and went on to note that the SBS hypothesis is arguably “more an article of faith than a proposition of science.”<sup>249</sup>

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many occurrences of SBS symptoms in which they themselves are convinced that there was no impact.”).

<sup>240</sup> See, e.g., Cenziper, *supra* note 201.

<sup>241</sup> See *supra* notes 236-38 and accompanying text.

<sup>242</sup> See, e.g., *supra* notes 223, 224, 227 and accompanying text.

<sup>243</sup> Shapiro, *supra* note 205.

<sup>244</sup> *State v. Edmunds*, 746 N.W.2d 590, 599 (Wis. Ct. App. 2007); see also *People v. Ackley*, 870 N.W.2d 858 (Mich. 2015); *State v. Louis*, 798 N.W.2d 319 (Wis. 2011).

<sup>245</sup> *Del Prete v. Thompson*, 10 F. Supp. 3d 907 (N.D. Ill. 2014).

<sup>246</sup> *Id.* at 909.

<sup>247</sup> *Id.* at 955.

<sup>248</sup> *Id.*

<sup>249</sup> *Id.* at 957 n.10.

Still, other courts continue to endorse the SBS hypothesis, particularly in deciding whether the underlying science is sufficiently reliable to be admissible under various standards.<sup>250</sup> Thus, while a clear trend—starting with *Edmunds* in 2008—has emerged in courts questioning Shaken Baby Syndrome/abusive head trauma in various ways, it has not been universal, and prosecutions based on the SBS hypothesis continue.<sup>251</sup>

The United States Supreme Court briefly passed on the issue of the validity of the SBS hypothesis recently as well, in the case of *Cavazos v. Smith*.<sup>252</sup> Shirley Ree Smith was convicted of killing her seven-week-old grandson in 1996 based on the SBS hypothesis.<sup>253</sup> While it upheld the conviction because the specific claim being litigated did not allow consideration of new evidence,<sup>254</sup> the majority wrote, "[d]oubts about whether Smith is in fact guilty are understandable."<sup>255</sup> Justice Ginsburg's dissent examined the considerable scientific evidence that has accumulated since Smith went to trial and concluded, "[w]hat is now known about SBS hypotheses seems to me worthy of considerable weight in the discretionary decision whether to take up this tragic case."<sup>256</sup> Justice Ginsburg's dissent is notable

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<sup>250</sup> See, e.g., *Flick v. Warren*, 465 F. App'x 461, 465 (6th Cir. 2012) (finding defense counsel was not ineffective for failing to request a *Daubert* hearing because even if he had, "he likely would have failed to unseat the prevailing scientific consensus" surrounding SBS); *Johnson v. State*, 933 So. 2d 568, 570 (Fla. Dist. Ct. App. 2006) (finding no scientific admissibility hearing was necessary prior to admission of SBS/AHT expert testimony because the underlying scientific principles were generally accepted); *State v. Leibhart*, 662 N.W.2d 618, 628 (Neb. 2003) (finding SBS/AHT was sufficiently reliable under *Daubert*).

<sup>251</sup> See, e.g., Tim Chitwood, *Murder Trial: Defense Expert Dismisses "Shaken Baby Syndrome,"* LEDGER-ENQUIRER (July 22, 2015), <http://www.ledger-enquirer.com/news/local/crime/article29482249.html>; Jordan Travis, *Testimony Wraps Up in Joshua Tough Trial,* ALPENA NEWS (Apr. 30, 2015), <http://www.thealpennews.com/page/content.detail/id/541592/Testimony-wraps-up-in-Joshua-Tough-trial.html?nav=5004>; Lisa Roose-Church, *Brighton Dad Sentenced to Jail in Controversial Baby Abuse Case,* DETROIT FREE PRESS (Mar. 20, 2015), <http://www.freep.com/story/news/local/michigan/2015/03/20/brighton-father-sentenced-abuse/25073129>; Jameson Cook, *DiMambro Convicted of Beating Damian to Death,* MACOMB DAILY (June 11, 2014), <http://www.sourcenewspapers.com/articles/2014/06/11/news/doc53985ebd73e94691810881.txt>; Vincent Marshall, *Prosecution Rests with Pediatrician Testimony,* DODGE CITY DAILY GLOBE (Aug. 17, 2015), <http://www.dodgeglobe.com/article/20150817/NEWS/150819524>; Lou Whitmire, *Murder Trial in Baby's Death to Begin Thursday,* MANSFIELD NEWS J. (Aug. 10, 2015), <http://www.mansfieldnewsjournal.com/story/news/local/2015/08/10/shaken-baby-syndrome-murder-trial-preview/31407379>.

<sup>252</sup> 132 S. Ct. 2, 7 (2011) (per curiam).

<sup>253</sup> *Id.* at 4.

<sup>254</sup> Smith's federal claim arose under the sufficiency of evidence standard of *Jackson v. Virginia*, 443 U.S. 307 (1979). *Smith*, 132 S. Ct. at 3. As such, reviewing courts are bound to consider only the evidence actually presented to the jury, and not how a jury may react to new evidence. *Id.* at 7 n.\*.

<sup>255</sup> *Id.* at 7.

<sup>256</sup> *Id.* at 11, 12 (Ginsburg, J., dissenting) (arguing that the Supreme Court should have denied certiorari and let stand the lower court decision granting relief instead of "ignor[ing] Smith's plight . . . to teach the Ninth Circuit a lesson").

because it implies that doubts about the SBS hypothesis have reached the ears of our highest court, meaning further scrutiny of the traditional SBS prosecution is likely in the coming years. Few platforms can as swiftly spread the knowledge of a shift in science than an opinion emerging from the United States Supreme Court, even if it is a dissent.<sup>257</sup>

As the debate continues, it has now transformed into one about where the line is to be drawn, as opposed to whether a line is to be drawn at all. That is a significant shift, and we anticipate further evolution in the SBS hypothesis in the years to come. As the shift transpires around us, and yet prosecutions of SBS cases continue, the percolation problem described historically in the realms of fire science and comparative bullet lead analysis is all-too current and consequential for SBS defendants. Our discussion of the shift in the SBS hypothesis, and its percolation, must end here, though the last chapter of this story is yet to be written.

#### CONCLUSION

The percolation problem of shifts in science is an elusive phenomenon, one that has not attracted enough attention to date, even with increased conversation on the importance, and traditional flaws, of many forensic science methods. Yet it is also a dangerous force when it comes to criminal convictions and appeals from those convictions. Defendants like Andrew Babick, Weldon Wayne Carr, Shane Ragland, James Earhart, and Jennifer Del Prete, and their monumentally varying fates, are proof of the significance of the percolation nuances we describe here.

To truly understand when a shift in science became known, and when it reasonably could have been discovered—questions of utmost importance in post-conviction litigation—requires close study of an area of science, and corresponding court opinions, over a period of years. In this Article, we took such close study of the percolation of four significant forensic science shifts, in the hopes of laying out a playbook of evaluation for lawyers, courts and defendants who find themselves grappling with such cases, in these and other forensic realms. Understanding where a certain case falls along the timeline of the shift in science is the first and most important step to any meaningful possibility of relief. Once that understanding is obtained, only then does the discussion shift to potential legal avenues for relief. We will take up that thorny subject in an upcoming article.

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<sup>257</sup> Justice Ginsburg's dissent had a significant impact specifically in Smith's case. California Governor Jerry Brown granted clemency in April 2012 in a move observers thought to be spurred by the Supreme Court's denial of relief. See Emily Bazelon, *Jerry Brown Shows Mercy to Shirley Ree Smith*, SLATE (Apr. 6, 2012), [http://www.slate.com/articles/news\\_and\\_politics/crime/2012/04/jerry\\_brown\\_pardons\\_shirley\\_ree\\_smith\\_in\\_an\\_old\\_sad\\_shaken\\_baby\\_case\\_.html](http://www.slate.com/articles/news_and_politics/crime/2012/04/jerry_brown_pardons_shirley_ree_smith_in_an_old_sad_shaken_baby_case_.html) (noting "calls for clemency for Smith began" after the Supreme Court decision).