THE SHIFTED PARADIGM: FORENSIC SCIENCE’S OVERDUE EVOLUTION FROM MAGIC TO LAW

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ABSTRACT

A decade ago, a controversial article in Science Magazine predicted a coming “paradigm shift” that would push forensic sciences toward fundamental change as the result of “[l]egal and scientific forces . . . converging to drive an emerging skepticism about the claims of the traditional forensic individualization sciences.”³ This article argues that the predicted paradigm shift has occurred. We support our thesis through a deconstruction of the jurisprudence of two of the forensic disciplines implicated in numerous wrongful convictions—forensic odontology (bite mark analysis) and forensic hair microscopy—and an examination of a confluence of unprecedented events currently altering the landscape of forensic sciences. The empirical evidence and data gathered here demonstrates that traditional forensic identification techniques, as well as

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the doctrines supporting them, are ultimately no more than a house of cards built on unvalidated hypotheses and unsubstantiated or non-existent data. Several far-reaching consequences result. Among those consequences are that state—and, to some extent, federal—jurisprudence that stands for the proposition that this type of evidence is admissible is objectively erroneous and must be reevaluated and effectively rejected as invalid precedent. The long-overdue paradigm shift presents a unique ethical challenge to criminal justice professionals, one that current professional ethics regimes fail to adequately capture, even though fundamental due process norms compel the conclusion that prosecutors, defense attorneys, forensic experts, and their respective governing bodies have an ethical, moral, and legal obligation to revisit affected cases and provide remedies. Put differently, the “path forward” for forensic sciences that the National Academy of Sciences identified in its seminal 2009 report must have a rear-view mirror.4

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When a federal magistrate judge recommended that the United States District Court for the Middle District of Pennsylvania exonerate Han Tak Lee for the murder by arson of his young daughter, he began his report this way: “Slow and painful has been man’s progress from magic to law.”

Lee’s daughter, the court explained, had perished “in a tragic cabin fire at a religious retreat,” and the State’s evidence:

was based, to a substantial degree, upon what was at the time undisputed scientific evidence concerning the source and origin of this fire, fire origin evidence which tended to show that the fire which consumed this cabin and took the life of . . . [the victim] was deliberately set by the defendant in a calculated fashion.

Lee had been wrongly imprisoned for twenty-five years, and the State’s conviction rested on the theory—elicited through expert testimony—that Lee “was especially cruel and calculating, dousing . . . [the] small cabin in Pennsylvania’s Pocono Mountains with more than 60 gallons of gasoline and heating fuel and setting at least eight fires, ending at the front door to block any chance of escape.”

When the court recommended that Lee be freed, however, it left no room for debate about either Lee’s innocence or the character of the evidence that had claimed a quarter century of his life. “Today,” the court wrote:

5 Han Tak Lee v. Tennis, No. 4:08-CV-1972, slip op. at 1, 1–2 (M.D. Pa. June 13, 2014) [hereinafter Han Tak Lee II]. As the court explained, “[t]his proverb, inscribed at the University of Pennsylvania Law School on the statue of Hseih-Chai, a mythological Chinese beast who was endowed with the faculty of discerning the guilty, is a fitting metaphor for both the progress of the law and the history of this case.” Id. at 1.

6 Id. at 2.

with the benefit of extraordinary progress in human knowledge regarding fire science over the past two decades it is now uncontested that this fire science evidence—which was a critical component in the quantum of proof that led to . . . [the] conviction—is invalid, and that much of what was presented to . . . [the] jury as science is now conceded to be little more than superstition.\(^8\)

_**Han Tak Lee**_ is an important case. This article argues that its primary importance rests not, however, in its innocence narrative, which is now, unfortunately, a familiar one.\(^9\) Nor does it rest even in the sub-narrative of its particular taxonomy: the set of wrongful convictions whose root cause is flawed forensic science.\(^10\) Instead, its significance derives from the court’s searing and ultimately dispositive critique of the forensic discipline that formed the core of the wrongful conviction—arson science—as well as of the false accord that has been granted to certain forensic disciplines in our criminal justice system over time. Despite their widespread acceptance by criminal courts, such disciplines are, in final analysis, mere “superstition.”\(^11\)

The judicial critique—which elevated scientific data above doctrinal dogma—was a long time in coming and necessarily calls into question the force and legitimacy of precedent as basis to introduce purportedly scientific evidence. It has been a decade since an article in _Science Magazine_ predicted what the authors termed the coming

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\(^{8}\) _Han Tak Lee II_, No. 4:08-CV-1972, slip op. at 1.


\(^{11}\) _Han Tak Lee II_, No. 4:08-CV-1972, slip op. at 1.
“paradigm shift”\textsuperscript{12}—forensic science’s evolution away from magic and toward law—the so-called “shot heard round the forensic science community.”\textsuperscript{13} Based on a historical assessment of the jurisprudence concerning two forensic assays—bite mark identification and hair microscopy—as well as their underlying empirical evidence and data, this article presents a new, parallel narrative: the failure of courts and litigants to distinguish between magic and science in the first instance, and the judicial system’s continuing reflexive reliance on deeply flawed, scientifically invalid precedent to support the admissibility of false and misleading evidence.

Consider, for example, the relationship between the 1985 Wisconsin conviction of Robert Lee Stinson for the murder of his elderly neighbor and the 1992 Mississippi conviction of Levon Brooks for the sexual assault and murder of a three-year old girl. The only direct evidence against Stinson was the bite mark testimony of two board-certified “Diplomates” of the American Board of Forensic Odontology (ABFO). One expert concluded that bite marks on the victim “had to have been made by teeth identical”\textsuperscript{14} to Stinson’s, and that there was “no margin for error”\textsuperscript{15} in his conclusion. The other expert concurred, testifying the bite mark evidence was “high quality”\textsuperscript{16} and “overwhelming.”\textsuperscript{17} In Brooks’ case, the State also presented the testimony of a board-certified forensic odontologist, who, utilizing a purportedly path-breaking new forensic technique, testified that the only


\textsuperscript{15} Transcript of Record at 83, State v. Stinson, 397 N.W.2d 136 (Wis. Ct. App. 1984) (No. 86-0002-CR).

\textsuperscript{16} \textit{Stinson}, 397 N.W.2d at 138.

direct evidence linking Brooks to the crime—a series of bite marks on the victim—matched Brooks’ teeth in such a way that “it could be no one but Levon Brooks that bit this girl’s arm.” Stinson and Brooks were both exonerated after DNA testing proved that they were not the perpetrators—Stinson in 2009 and Brooks in 2008.

Apart from sharing the same type of incriminating forensic evidence, Stinson and Brooks would appear to have little in common: the convictions are separated by nearly a decade; the crimes occurred on opposite sides of the country in jurisdictions that applied different standards to evaluate and admit expert testimony from two different experts. But a comparison of the underlying data tells a different story altogether: that the cases are actually strikingly similar, even co-dependent. In fact, each depended on the other for the failures of justice that occurred, both at trial and during the years-long, protracted struggle that Stinson and Brooks endured while seeking to prove their innocence.

In reviewing Brooks’ conviction—and, more specifically, the propriety of admitting the bite mark evidence—the Mississippi Supreme Court simply adopted a blanket rule in favor of the admission of bite mark testimony, but noted that “it is certainly open to defense counsel to attack the qualifications of the expert, the methods and data used to compare the bite marks to persons other than the defendant, and the factual and logical bases of the expert's opinions. Also, where such expert testimony is allowed by the trial court, it should be open to the defendant to present evidence challenging the reliability of bite-mark comparisons.”

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19 See Robert Lee Stinson, supra note 17.
21 The governing standard for expert opinion admissibility in Stinson’s case was that “evidence given by a qualified expert is admissible irrespective of the underlying scientific theory . . . [as long as the] expert scientific testimony [is] relevant . . . and the expert [is] qualified [so that] scientific or specialized knowledge will assist the trier of fact to determine a fact in issue . . . .” Stinson, 397 N.W.2d at 140–41 (citing State v. Walstad, 351 N.W.2d 469 (Wis. 1984)). In Brooks v. State, the Mississippi Supreme Court simply adopted a blanket rule in favor of the admission of bite mark testimony, but noted that “[i]t is certainly open to defense counsel to attack the qualifications of the expert, the methods and data used to compare the bite marks to persons other than the defendant, and the factual and logical bases of the expert's opinions. Also, where such expert testimony is allowed by the trial court, it should be open to the defendant to present evidence challenging the reliability of bite-mark comparisons.” Brooks v. State, 748 So. 2d 736, 739 (Miss. 1999) (quoting Howard v. State, 701 So. 2d 274, 288 (Miss. 1997) (No. 94-DP-00524-SCT)) (emphasis in original).
Court relied upon the reasoning in *Stinson* and other similar precedent, to not only find no error in the admission of the evidence and affirm the conviction, but also to issue a blanket pronouncement that “bite-mark identification is admissible in Mississippi” in an effort to preclude further challenges. Nevertheless—in spite of both the exonerations of Stinson and Brooks and the overwhelming proof that the bite mark evidence presented in *Brooks* was spurious—*State v. Brooks* and *Stinson*, continue to stand as reliable authority for the wholesale admissibility of this branch of forensic science in Mississippi and Wisconsin state courts.

This kind of self-serving, court-facilitated pseudo-jurisprudence not only facilitates trial courts’ wholesale admission of flawed evidence, but also insulates such decisions from appellate review, no matter how legally indefensible and intellectually dishonest. Post-conviction courts, moreover, typically avoid any rigorous analysis of a discipline’s validity or of the propriety of a trial court’s admissibility decision by invoking procedural bars. In Han Tak Lee’s case, for example, post-conviction courts’ review was primarily focused not on the analysis of fire science, but, instead, on procedural hurdles that Lee’s request for post-conviction relief were required to overcome in state and federal *habeas corpus* litigation. After the Pennsylvania Superior Court declined to address the

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22 *Brooks*, 748 So. 2d at 746 (Smith, J., concurring).
23 *Id.* at 739.
24 In a companion case, Kennedy Brewer was exonerated a few weeks before Brooks. See *Levon Brooks*, supra note 20. Bite mark evidence testimony from the same state expert had also led to Brewer’s conviction, and, like Brooks’ exoneration, was debunked as a result. See *id.*; Coburn Dukehart, *Flawed Autopsies Send Two Innocent Men to Jail*, NPR, http://www.npr.org/2011/06/01/133401716/flawed-autopsies-send-two-innocent-men-to-jail (last visited Feb. 13, 2016). Post-conviction DNA testing identified the true perpetrator, who had murdered the victims in each case. See *Kennedy Brewer*, INNOCENCE PROJECT, http://www.innocenceproject.org/cases-false-imprisonment/kennedy-brewer (last visited Oct. 9, 2015); *Levon Brooks*, supra note 20.
25 See *infra* note 144 and accompanying text.
scientific legitimacy of the fire science, Lee was denied review because his “claim of newly discovered evidence [that the fire evidence was not based on sound science] is not cognizable under § 2254 [state remedies in federal court] because claims of actual innocence based on newly discovered evidence are never grounds for federal habeas relief absent an independent constitutional violation.”

Han Tak Lee, like Brooks and Stinson, has been resolved. But the scientifically invalid evidence and erroneous jurisprudence that led to those convictions continues to frustrate the truth-seeking mission of the criminal justice system, precluding legitimate claims of innocence in dozens—perhaps hundreds—of other similarly situated cases, including capital convictions. The jurisprudence connecting Han Tak Lee, Brooks,

27 See Han Tak Lee I, No. 4:08-CV-1972, slip op. at 1.
29 Han Tak Lee I, No. 4:08-CV-1972, slip op. at 5. The court cited Herrera v. Collins, 506 U.S. 390, 400 (1993) for the following proposition:

Claims of actual innocence based on newly discovered evidence have never been held to state a ground for federal habeas relief absent an independent constitutional violation occurring in the underlying state criminal proceeding. . . . “This rule is grounded in the principle that federal habeas courts sit to ensure that individuals are not imprisoned in violation of the Constitution-not to correct errors of fact.”

See Han Tak Lee II, No. 4:08-CV-1972, slip op. at 5 (quoting Herrera, 506 U.S. 390, 400 (1993)).

Unfortunately, this claim may be overstated as it relates to Willingham. See, e.g., Maurice Possley, Fresh Doubts over a Texas Execution: New Evidence Revives Concerns That a Man Was Wrongly Put to Death in 2004, WASH. POST (Aug. 3, 2014), http://www.washingtonpost.com/sf/national/2014/08/03/fresh-doubts-over-a-texas-execution/?hpid=z1.

With respect to death penalty cases alone, we have identified at least fifteen convictions where bite mark evidence not only played a key role in the prosecution, but where, as in Stinson and Brooks, the cases also mutually relied on each others’ flawed acceptance of the pseudo-science used to justify the conviction. See generally INNOCENCE PROJECT, STRATEGIC LITIGATION UNIT, DEATH PENALTY CONVICTIONS SUPPORTED BY BITE MARK EVIDENCE (2014) (on file with authors).
and Stinson to other, unresolved cases is not attenuated; it is direct and, as the evidence gathered here demonstrates, obvious. Howard v. State\textsuperscript{32} is a timely example. Howard is a pending death penalty case where the conviction rests almost exclusively on bite mark evidence.\textsuperscript{33} The Mississippi Supreme Court—in affirming Howard’s second conviction and refusing to grant him relief thus far\textsuperscript{34}—has relied on Brooks for substantive support of the discipline’s validity, even though the case is a notorious incident of wrongful convictions and the same forensic expert who testified falsely in Brooks also testified in Howard.\textsuperscript{35} Entirely absent from this appellate review is any discussion of the trial court’s failure to conduct a rigorous analysis of the discipline before allowing it to be proffered to a capital jury as scientific evidence of guilt, as required by relevant case law and evidentiary rules. Nor is there, in the court’s reliance on Brooks for support, any recognition that those other courts’ analysis was similarly deficient. Instead, the State of Mississippi continues to elevate procedural rules over scientific reality, arguing that Howard’s claims are “barred from consideration both by the successive petition bar”\textsuperscript{36} and “res judicata.”\textsuperscript{37} Thus far, the Mississippi Supreme Court has found those arguments persuasive.\textsuperscript{38}

\textsuperscript{32} 853 So. 2d 781 (Miss. 2003).
\textsuperscript{33} Id. at 784–85.
\textsuperscript{34} The Mississippi Supreme Court reversed Mr. Howard’s first conviction and remanded the case for a new trial, finding that Mr. Howard should not have been allowed to proceed pro se in light of his apparent mental condition and because it was a capital case. Howard v. State, 701 So. 2d 274, 288 (Miss. 1997).
\textsuperscript{35} See id. at 795–96; id. at 799–800 (McRae, J., dissenting).
\textsuperscript{37} Id.
INTRODUCTION

Against a backdrop of recent developments that reveal the gross shortcomings of previously accepted forensic techniques, our empirical evidence and data—derived in large part from our litigation, both nationally and in Mississippi—demonstrates that certain forensic science disciplines are significantly more problematic than previously thought. In fact, their deficiencies are far more egregious than the 2009 National Research Council of the National Academy of Sciences report’s (“NAS Report”) characterization of them as “imprecise or exaggerated” and the cause of “erroneous or misleading evidence” suggests. Although

39 The Innocence Project’s Strategic Litigation Unit uses litigation to challenge judicial reliance on evidence from unreliable forensic science disciplines and to reform the legal framework used to evaluate eyewitness identification evidence. See Strategic Litigation, INNOCENCE PROJECT, http://www.innocenceproject.org/free-innocent/strategic-litigation (last visited Oct. 9, 2015). The Strategic Litigation Unit employs multiple strategies to achieve this goal, including: the filing of amicus briefs in appropriate cases; consulting and supporting trial attorneys across the country; direct litigation on behalf of individuals at all stages of litigation; training attorneys and judges; and, effectuating change through legislation and policy. See id.

40 Mississippi has had an unusually high incidence of bite mark convictions—and post-conviction litigation concerning those convictions—because state prosecutors used one of its most aggressive practitioners, Dr. Michael West, for two decades, beginning in the mid-1980s. See Radley Balko, The Bite-Marks Men: Mississippi’s Criminal Forensics Disaster, SLATE (Feb. 20, 2008), http://www.slate.com/articles/news_and_politics/jurisprudence/2008/02/the_bitemarks_men.html.

41 NAS REPORT, supra note 4, at 4; see also WILLIAM J. STUNTZ, THE COLLAPSE OF AMERICAN CRIMINAL JUSTICE (2011); Craig M. Cooley & Gabrielle S. Oberfield, Increasing Forensic Evidence’s Reliability and Minimizing Wrongful Convictions: Applying Daubert Isn’t the Only Problem, 43 TULSA L. REV. 285 (2007); Keith A. Findley, Judicial Gatekeeping of Suspect Evidence: Due Process and Evidentiary Rules in the Age of Innocence, 47 GA. L. REV. 723 (2013); Sandra G. Thompson, Judicial Gatekeeping of Police-Generated Witness Testimony, 102 J. CRIM. L. & CRIMINOLOGY 329 (2012). Scholars have now by and large turned their attention away from critiquing this type of evidence—eyewitness identification, for example—and toward a new type of evidence—so-called “second generation” evidence, which includes database-driven techniques such as location tracking, biometrics, and digital forensics—to warn and argue
there exist scholarly critiques of the generalized shortcomings of this so-called “first generation” forensic evidence—particularly hair microscopy and bite marks, which are the focus here—our argument relies on empirical evidence, the historical record, and recent scientific and scholarly advancement.

More specifically, our thesis is situated on five bases: (1) the ever-increasing numbers of post-conviction exonerations, particularly those involving bite mark and hair microscopy evidence; (2) the publication and widespread acceptance of the NAS Report, including recent federal
legislative and policy initiatives which call for the realization of several of the Report’s core recommendations; 45 (3) the Federal Bureau of Investigation (FBI) and Department of Justice’s (DOJ) unprecedented audit of thousands of hair comparison cases, stemming from its admission that FBI analysts routinely proffered scientifically invalid testimony in these cases; 46 (4) state-level legislation amending habeas corpus statues in order to provide avenues of post-conviction review for petitioners whose convictions rest on discredited scientific evidence; 47 and, (5) our own data about bite mark identification and hair evidence, which provides abundant empirical support for the proposition that ethical and legal obligations should flow as a matter of course with regard to convictions based on such evidence.

Several far-reaching consequences logically and inevitably follow from the shifted paradigm thesis advanced here. Among these—each of which we address in turn—are: (a) the lack of scientific or evidentiary validity for certain types of pattern and identification techniques; (b) that, as a result of our empirical findings, state—and to some extent federal—jurisprudence which holds that this type of evidence is admissible is objectively erroneous and must be reevaluated and effectively rejected as invalid precedent; 48 and, (c) that the long-overdue awakening to scientific

45 See infra Part I.B.
47 See infra Part I.C.
48 There have been some isolated and sporadic efforts at the state level to address the problem we identify here. See, e.g., State v. Henderson, 27 A.3d 872 (N.J. 2011) (revising the standards for evaluating eyewitness identification testimony so that they more closely track social science findings on reliability); State v. Lawson, 291 P.3d 673, 685 (Or. 2012) (finding that “the scientific knowledge and empirical research concerning eyewitness perception and memory has progressed sufficiently to warrant taking judicial notice of . . . [them] in determining the effectiveness of our existing test for the admission of eyewitness identification evidence”).
reality presents a unique ethical challenge to the profession, one that current professional ethics fail to adequately capture, even though fundamental due process norms compel the conclusion that prosecutors, defense attorneys, experts, and their respective governing bodies have an ethical, moral, and legal duty to revisit convictions resting on discredited scientific evidence and provide effective remedies.

Part I sets forth the broad, contextual bases of our argument. Briefly discussed is the predominant incidence of flawed forensic science—specifically bite mark and hair microscopy evidence—as a leading cause of wrongful convictions. The discussion of the NAS Report’s findings in this Part centers on elements of the federal forensic reform agenda that are complementary to or, in certain instances, adoptive of suggestions contained in the Report. Also explored here are recent state efforts to address forensic malfeasance and discredited scientific evidence through legislation passed in direct response to post-conviction courts elevating procedural rules over the reality of scientific progress. In Parts II and III, we introduce our own data, as well as its contextual background within wrongful convictions generally and the specific disciplines of bite mark identification and hair microscopy science. We likewise provide a diagnosis for the pervasiveness of these forensic disciplines, namely an embarrassingly lax and self-perpetuating approach to the admissibility of unvalidated and false forensic evidence. In Part IV, we conclude with a discussion of the unique set of ethical challenges—and pressing obligations—that, left uncorrected, threaten the legitimacy of the justice system.

I. “The Shifted Paradigm”

Law and science are truth-seeking processes and therefore share a critical, but sometimes anomalous, relationship: “[s]cience helps the law understand the world in which legal policy must operate.”49 Whereas law values and relies on precedent to establish guarantees of trustworthiness,

scientific inquiry accepts precedent only as a baseline from which to seek a new way forward, sometimes quite rapidly.\textsuperscript{50} To the extent consistency and finality—component parts of precedent—are valued in science, it is only insofar as they remain scientifically valid. Put differently, falsified hypotheses are quickly discarded and, if referenced at all, are used to draw a line from what mankind once thought to be true to the current state of scientific knowledge. The law, on the other hand, has moved glacially to abandon techniques which science has proven false or exposed as baseless speculation, with little inquiry.\textsuperscript{51} Exacerbating this problem is the adversarial system’s propensity to value zealous advocacy over sound science,\textsuperscript{52} particularly when deployed against criminal defendants.\textsuperscript{53}

The rapid development and introduction of cutting-edge science in our courtrooms has intensified the tension, both with regard to emerging techniques and those with long, if undistinguished, histories. This is particularly true as it relates to traditional forensic individualization sciences. In their 2005 groundbreaking—and controversial—article, The Coming Paradigm Shift in Forensic Identification,\textsuperscript{54} Michael J. Saks and Jonathan J. Koehler, argued that “[l]egal and scientific forces are

\textsuperscript{50} See id. at 238.

\textsuperscript{51} See id. (internal citations omitted). In contrast, however, stands some recent Fourth Amendment jurisprudence. Take, for example, United States v. Jones, 132 S. Ct. 945 (2011), which considered whether federal law enforcement’s attachment of a GPS device to a drug suspect’s vehicle constituted a search under the Fourth Amendment. In holding that the aforementioned actions did, in fact, constitute a search, the Court discussed one’s right to privacy—previously considered very limited when one was out in public—in an era of secret, electronic monitoring. See id.

\textsuperscript{52} See Cooper, supra note 48, at 238 (internal citations omitted).


\textsuperscript{55} Koehler & Saks, The Coming Paradigm Shift in Forensic Identification Science, supra note 3.
converging to drive an emerging skepticism about the claims of the traditional forensic individualization sciences. As a result, these sciences are moving toward a new scientific paradigm.\textsuperscript{56} Calls for reforming the way the criminal justice system currently views and admits forensic evidence in court quickly followed suit.\textsuperscript{57} Among the numerous examples—some of which are novel and progressive—are those that argue that because of the surfeit of documented forensic error,\textsuperscript{58} “suspect

\textsuperscript{56} Id. at 892. To make traditional forensic individualization sciences fit the new paradigm—and, as a consequence, achieve some level of otherwise lacking scientific rigor—Saks and Koehler argue that DNA typing should be used as a model, noting that:

\begin{quote}
DNA typing technology was an application of knowledge derived from core scientific disciplines . . . [and] provided a stable structure for future empirical work . . . . Second, the courts and scientists scrutinized applications of the technology in individual cases. As a result, early, unscientific practices were rooted out. Third, DNA typing offered data-based, probabilistic assessments of the meaning of evidentiary “matches.” This practice represented an advance over potentially misleading match/no-match claims associated with other forensic identification sciences.
\end{quote}

\textit{Id.} at 893. Saks and Koehler’s suggestion is consistent with the NAS Report’s findings that “with the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source. In terms of scientific basis, the analytically based disciplines generally hold a notable edge over disciplines based on expert interpretation.”

\textsuperscript{57} NAS REPORT, supra note 4, at 100.

evidentiary categories” which “are both recurring features of wrongful convictions and not otherwise susceptible to correction through traditional trial mechanisms . . . should be subjected to heightened scrutiny for reliability under the Due Process Clause.” There are also proposals that would subject all “police generated” evidence—namely “eyewitness identification testimony, police officer testimony regarding a defendant’s confession, and a police informant’s testimony regarding a defendant’s incriminating statements”—to a pre-trial reliability screening prior to being offered into evidence.

Scholars are not the only proponents of reform; courts, too, have recently, albeit belatedly, joined the effort. In 2012, the Supreme Courts of two states—New Jersey and Oregon—issued opinions which redrew the landscape of those state courts’ treatment of eyewitness identification evidence, a landscape created by the near universally adopted, yet scientifically flawed, “balancing test” announced by the Supreme Court in Manson v. Brathwaite. In State v. Henderson, the New Jersey Supreme


59 Findley, supra note 40, at 727.
60 Thompson, supra note 40, at 330.
61 Manson v. Brathwaite, 432 U.S. 98, 110–14 (1977). The Court offered five factors—a list it intended to be non-exclusive—for courts to consider, including: “the opportunity of the witness to view the criminal at the time of the crime, the witness’ degree of attention, the accuracy of the witness’ prior description of the criminal, the level of certainty demonstrated by the witness at the confrontation, and the length of time between the crime and the confrontation.” Manson, 432 U.S. at 114 (citing Neil v. Biggers, 409 U.S. 188, 199–200 (1972)). The Manson test has been undermined by scientific research that courts have called a “near perfect scientific consensus” that “eyewitness identifications are potentially unreliable in a variety of ways unknown to the average juror” State v. Guilbert, 49 A.3d 705, 720–21 (Conn. 2012); see also State v. Henderson, 27 A.3d 872, 878 (N.J. 2011) (same); State v. Lawson, 291 P.3d 673, 690 n.5 (Or. 2012) (noting frequency of misidentification). See also Nat’l Research Council of the Nat’l Academies, Identifying the Culprit: Assessing Eyewitness Identification 13 (2014), available at https://public.psych.iastate.edu/glwells/NAS_Eyewitness_ID_Report.pdf (noting that Manson “was not based on much of the research conducted by scientists on visual perception, memory, and eyewitness identification, and
Court assessed decades of social science research regarding the vagaries of eyewitness identification and, as a result, revised both standards for the evidence’s admissibility and the instructions to juries about how to assess the evidence’s purported value. In *State v. Lawson*, the Oregon Supreme Court’s decision not only used many of the same factors employed by the *Henderson* court to reverse the conviction and establish a new evidentiary standard for the admission of such evidence, but also went further, shifting the burden of admissibility to the prosecution. As progressive as these proposed remedies and substantive evidentiary changes are, however, they provide only prospective relief; they are not directed at the continuing failures of justice identified by the data and illustrated by the developments discussed below.

A. FORENSIC EVIDENCE-BASED POST-CONVICTION EXONERATIONS

The phenomenon of post-conviction exonerations is now well-known and has been documented elsewhere. For the purposes of our argument, however, the frequency with which flawed forensic evidence serves as a leading cause of wrongful convictions is worth reiterating briefly. As a prominent study of the first 200 post-conviction exonerations conducted by Brandon Garrett illustrates, 57% of those convictions...
involved flawed forensic evidence. That statistic is consistent with another figure concerning wrongful convictions; 60% of the forensic witnesses who testified in wrongful conviction cases provided inaccurate testimony. More specifically, “[f]orensic evidence was the second leading type of evidence supporting . . . [the first 200] erroneous convictions.” Within that subset, serological analysis was the most commonly admitted, followed by hair evidence, bite mark evidence, and fiber comparison, respectively. Correspondingly—and as our empirical evidence below supports—Garrett’s study indicates that these cases not only involved the “use of evidence with limited probative value, but [also] the improper use of then-existing forensic science. To a surprising extent, the forensic testimony at trial was improper based on science at the time.” Hair microscopy testimony, for example, played a role in 22% of the cases which comprised the first 200 exonerations. Recent investigative reporting at The Washington Post revealed something else about this subset of cases, however: that, for years, the DOJ officials who had reviewed work in these cases and were aware that false or exaggerated testimony provided by its analysts had led to flawed convictions across the country, did not adequately inform defendants

72 Garrett, supra note 69, at 81.
73 Id.
74 Id. at 82. For example, Garrett reports “[a] preliminary review of serological testimony during these exonerees’ trials disclosed that more than half involved improper testimony by forensic examiners.” Id.
75 Id. at 83.
76 An appointed task force created during an inspector general’s investigation of misconduct at the FBI crime lab in the 1990s undertook the investigation. Spencer S. Hsu, Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department, WASH. POST (April 16, 2012), https://www.washingtonpost.com/local/crime/convicted-defendants-left-uninformed-of-forensic-flaws-found-by-justice-dept/2012/04/16/gIQAWTcgMT_story.html. The inquiry lasted nine years and ended in 2004. Id.
whose convictions were affected.\textsuperscript{77} DOJ officials later took the position that the limited notification comported with their legal and constitutional obligations and they “were not required to inform defendants directly.”\textsuperscript{78} Worse, the case review was limited, even though officials were aware that the potential problem was far broader; the FBI not only made its own experts available, but also trained “about 600 examiners from outside the FBI between 1973 and 1987, as well as “an additional 450 examiners . . . over the next dozen years.”\textsuperscript{79} The FBI-trained experts were taught to provide the same testimony the FBI has conceded is scientifically invalid.\textsuperscript{80}

\begin{itemize}
  \item \textsuperscript{77} Id.
  \item \textsuperscript{78} Id.
  \item \textsuperscript{79} Spencer S. Hsu, \textit{Review of FBI Forensics Does Not Extend to Federally Trained State, Local Examiners}, WASH. POST (Dec. 22, 2012), https://www.washingtonpost.com/local/crime/review-of-fbi-forensics-does-not-extend-to-federally-trained-state-local-examiners/2012/12/22/b7e9c3e-4965-11e2-ad54-580638ede391_story.html. See also Hsu, \textit{Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department}, supra note 75, which states that:

  The Washington Post worked with the nonprofit National Whistleblowers Center, which had obtained dozens of boxes of task force documents through a years-long Freedom of Information Act fight. Task force documents identifying the scientific reviews of problem cases generally did not contain the names of the defendants. Piecing together case numbers and other bits of information from more than 10,000 pages of documents, The Post found more than 250 cases in which a scientific review was completed. Available records did not allow the identification of defendants in roughly 100 of those cases. Records of an unknown number of other questioned cases handled by federal prosecutors have yet to be released by the government.

  \textit{Id.}

  \textsuperscript{80} There is considerable evidence that the FBI trained all examiners how to testify and exaggerate their findings beyond the limits of science. See Clyde Haberman, \textit{DNA Analysis Exposes Flaws in an Inexact Forensic Science}, N.Y. TIMES (May 18, 2014), http://www.nytimes.com/2014/05/19/us/dna-analysis-exposes-an-inexact-forensic-science.html?_r=0 (“A forensics expert who used to work in the federal lab, Max M.
Similarly, a 2013 investigation by the Associated Press (AP) revealed that at least twenty-four innocent men whose convictions and/or indictments were obtained through the use of bitemark evidence had been exonerated since 2000.81 Consisting of “decades of court records, archives, news reports,” and interviews with “[two dozen forensic scientists and other experts . . . including some who had never before spoken to a reporter about their work,” the AP investigation was the “most comprehensive” audit of bite mark case ever undertaken.82 What is most astounding about the number of wrongful convictions based at least in part on bite mark analysis which have been discovered thus far, however, is that the technique is rarely used.83

Houck, told [The New York Times] Retro Report that there was ‘absolutely a disconnect between what I could say as a scientist and what the prosecutors, or the defense attorneys, wanted me to say.’”); see also Spencer S. Hsu, FBI Lab’s Woes Cast Growing Shadow, INDEPENDENT (Dec. 23, 2012), http://www.independent.co.uk/news/world/americas/fbi-labs- woes-cast-a-growing-shadow-8430348.html (“[A]bout three dozen FBI agents trained 600 to 1,000 state and local examiners to apply the same standards that have proved problematic.”).

81 Amanda L. Myers, Once Key in Some Cases, Bite Mark Evidence Now Derided as Unreliable, DENVER POST (June 17, 2013), http://www.denverpost.com/ci_23474835/once-key-some-cases-bite-mark-evidence-now [hereinafter Myers, Once Key in Some Cases, Bite Mark Evidence Now Derided as Unreliable].


83 This statement is based primarily on the authors’ experience, both of whom have represented thousands of criminal defendants in previous careers as public defenders with the Public Defender Service of Washington, D.C and The Bronx Defenders.
B. NATIONAL ACADEMY OF SCIENCES REPORT AND RECENT COMPLEMENTARY FORENSIC DEVELOPMENTS

Even acknowledging its critiques, the NAS Report has been widely recognized as a game-changing document. Central to its concerns were findings associated with the use of flawed forensic science in criminal prosecutions, specifically the “potential danger of giving undue weight to [forensic] evidence and testimony derived from imperfect testing and analysis . . . .” For too long, as the Report noted, forensic science has been largely advanced within a legal, rather than a scientific, construct. Despite the dedicated work of forensic experts, the disaggregated, uncoordinated nature of the system and its legal focus has prevented interested communities from “establish[ing] strong links with a broad base of research universities and the national research community.” Without the integration of the research community, the forensic science system was deprived of the scientific research funding necessary to meet the foundational and innovational needs; left without measurement and technical standards to guide practice; and, isolated from other scientific communities that have improved many foundational issues (cognitive bias, root cause analyses, laboratory quality, etc.). The Report went on to conclude that, apart from nuclear DNA analyses, claims about individualization—including bite mark analysis and hair microscopy, among others—are unsupported by the most basic

85 NAS REPORT, supra note 4, at 4.
86 See id. at 14–15.
87 Id. at 15.
88 Id. at 14–15.
89 See supra note 56 and accompanying text.
foundational research that would allow such claims to be classified as sound science.\footnote{NAS REPORT, supra note 4, at 42–43.}

The scholarship and other reform that the Report has generated has been plentiful, much of it aimed at developing and refining solutions to the problems that the Report identified.\footnote{See e.g., Giannelli, Daubert and Forensic Science, supra note 82, at 57; Paul C. Giannelli, “Ballistics” Redux, 28 CRIM. JUST. 47, 48 (2013). Jennifer L. Mnookin et al., The Need for a Research Culture in the Forensic Sciences, 58 UCLA L. REV. 725, 729–32 (2011); William A. Tobin & Peter J. Blau, Hypothesis Testing of the Critical Underlying Premise of Discernible Uniqueness in Firearms-Toolmarks Forensic Practice, 53 JURIMETERICS J. 121, 141–42 (2013).} In addition, as discussed below, several practical suggestions for which the NAS Report advocated have been implemented, primarily with federal government impetus and support.\footnote{See NAT’L SCI & TECH. COUNCIL, COMM. ON SCI., SUBCOMM. ON FORENSIC SCI., STRENGTHENING THE FORENSIC SCIENCES (2014), available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/strengthening_the_forensic_sciences_may_-2014.pdf.} These developments have also raised the promise of a future for forensic science that engages both the legal and scientific communities. Though this is a new endeavor for both communities, proper support will lead to a successful collaboration of researchers, forensic practitioners, and law enforcement and result in data-driven methods and practicable standard implementation.\footnote{This portion of the article would not have been possible without the expertise of Sarah Chu, Senior Forensic Policy Advocacy at the Innocence Project, and her encyclopedic knowledge of the federal forensic science landscape.}

1. National Commission on Forensic Science

In 2013, the Department of Justice (DOJ) and the National Institute of Standards and Technology (NIST) signed a Memorandum of Understanding (MOU)\footnote{See Press Release, Dep’t of Justice, Department of Justice and National Institute of Standards and Technology Announce Launch of National Commission on Forensic Science (Feb. 15, 2013), available at http://nist.gov/oles/doj-nist-forensic-} outlining the framework for collaboration in
strengthening the validity and reliability of forensic sciences. The MOU provides clear guidance on how the DOJ and NIST will work together to “enhanc[e] oversight and improv[e] coordination across a broad range of forensic science disciplines.” Among the enhancements is the creation of a new federal advisory committee, the National Commission on Forensic Science (NCFS) and the creation of discipline-specific guidance groups housed within NIST.

NCFS is charged with providing policy recommendations regarding forensic science to the Attorney General and, more specifically, with “strengthening the validity and reliability of the forensic sciences,”

The objectives and scope of activities of the Commission are to provide recommendations and advice to the Department of Justice (DOJ) concerning national methods and strategies for: strengthening the validity and reliability of the forensic sciences (including medico-legal death investigation): enhancing quality assurance and quality control in forensic science laboratories and units: identifying and recommending scientific guidance and protocols for evidence seizure, testing, analysis, and reporting by forensic science laboratories and units; and identifying and assessing other needs of the forensic science communities to strengthen their disciplines and meet the increasing demands generated by the criminal and civil justice systems at all levels of government. In accomplishing these objectives, the Commission may not develop or recommend guidance regarding digital evidence.

See Dep’t of Just. & Nat’l Inst. of Standards and Tech., supra note 93, at 2.
improving quality assurance and quality control in forensic labs, and identifying protocols for evidence collection, analysis, and reporting. A central goal of NCFS is to advise the Attorney General on “the intersection of science and the courtroom” and to recommend standards and policies for implementation at federal law enforcement laboratories. At the first meeting of the NCFS on February 4 and 5, 2014, the Commission members—an impressive array of academic and research scientists, lawyers, judges, forensic science practitioners, and crime lab directors—began their work by suggesting various subcommittees tasked to specific charges of the MOU.

2. Basic and Applied Research and Standards Development

The NIST also agreed to support the objectives of the Commission through a two-pronged effort. First, NIST “awarded Iowa State University (Ames, Iowa) up to $20 million over five years to establish a Forensic Science Center of Excellence focused on pattern and digital evidence.” The Forensic Science Center of Excellence will conduct basic foundational research on forensic techniques that, even in the absence of this research,

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99 DEP’T OF JUST. & NAT’L INST. OF STANDARDS & TECH., supra note 93, at 3; see also Storolow, supra note 96.


102 Michael E. Newman, New NIST Center of Excellence to Improve Statistical Analysis of Forensic Evidence, NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (May 26, 2015), http://nist.gov/forensics/center-excellence-forensic052615.cfm. The Forensic Science Center of Excellence is led by Iowa State in partnership with Carnegie Mellon University, the University of Virginia, and the University of California, Irvine. Id.
have nevertheless long been accepted by criminal courts.\textsuperscript{103} The research “will focus on improving the statistical foundation for fingerprint, firearm, toolmark, dental and other pattern evidence analyses, and for computer, video, audio and other digital evidence analyses.”\textsuperscript{104}

Second, NIST will administer and coordinate the Organization of Scientific Area Committees (OSAC).\textsuperscript{105} This second prong involves the creation of “a sustainable infrastructure that will produce best practices, guidelines, and standards to improve [the] quality and consistency” of the forensic science disciplines.\textsuperscript{106} OSAC’s technical standards will augment the measurement standards that are developed independently by the Center for Excellence. OSAC will transition the currently independent Scientific Working Groups (SWGs)\textsuperscript{107} into “subcommittees” that will consider their problems in greater detail than the SWGs currently do.

\textsuperscript{103} See id.

\textsuperscript{104} Id. The National Institute of Standards and Technology goes on to describe this research agenda as follows:

NIST and university scientists working within the new center will develop tools to evaluate pattern and digital evidence analysis methods for how well they consider statistical modeling errors and uncertainties in measurement. This will allow forensic scientists to quantify the level of confidence they have in statistical computations made with these methods and the conclusions reached from those analyses.

\textsuperscript{105} S\textit{UMMARY OF THE NIST PROPOSED PLAN}, supra note 103, at 1.

\textsuperscript{106} SUMMARY OF THE NIST PROPOSED PLAN, \textit{supra} note 103, at 1.

previous work product and engage in new standards-setting activities. The OSAC “will be practice-focused” but “will not provide advice to the Attorney General . . . or the NCFS” directly. While NIST will administer the OSAC, its membership will be appointed by a NIST/DOJ leadership and membership selection committee. The NIST Forensic Science Program recently selected 402 experts to serve as members of the 23 subcommittees that make up the five Scientific Area Committees on Biology/DNA, Chemistry/Instrumental Analysis, Crime Scene/Death Investigation, Digital/Multimedia, and Physics/Pattern Interpretation.

C. FEDERAL CASE AUDIT & STATE LEGISLATION

The seismic pivot toward the use of validated science in criminal prosecutions discussed in the preceding sections is forward-looking reform. At least as pressing an issue emerging in this new era of scientific integrity is how the criminal justice system addresses convictions resting on discredited expert testimony. To that end, in what should be the beginning of a series of complementary efforts, the FBI and DOJ

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109 SUMMARY OF THE NIST PROPOSED PLAN, supra note 103, at 1.

110 See id. at 1–2.


112 For example, the Department of Justice recently announced that it will “conduct a
recently announced an unprecedented audit—both in mission and scope—of all FBI Laboratory hair comparison cases since the early 1980s. Questions about the validity of the FBI’s training of its forensic examiners—including the training it provided about how those examiners should testify about their purported findings—came under intense scrutiny after two cases in Washington, D.C. were the subject of post-conviction exonerations. In 1980, Santae Tribble was charged with and convicted of the murder of a D.C. taxi driver. Tribble’s conviction was based almost entirely on an FBI agent’s testimony that hair discovered in a stocking mask “matched [Trible’s hair] in all microscopic characteristics.” In December of 2012, Tribble was exonerated and released from prison after DNA testing excluded Tribble as the source of the hair. Tribble’s exoneration had been preceded by Kirk Odom’s,

quality assurance review of other forensic science disciplines practiced at the FBI—to determine whether the same kind of ‘testimonial overstatement’ we found during our review of microscopic hair evidence could have crept into other disciplines that rely heavily on human interpretation and where the degree of certainty can be difficult to quantify.” Sally Q. Yates, Deputy Attorney General, Remarks During the 68th Annual Scientific Meeting Hosted by the American Academy of Forensic Science (February 24, 2016), available at https://www.justice.gov/opa/speech/deputy-attorney-general-sally-q-yates-delivers-remarks-during-68th-annual-scientific. See also Spencer S. Hsu, Justice Dept. to Expand Review of FBI Forensic Techniques Beyond Hair Unit, WASH. POST (Feb. 25, 2016), https://www.washingtonpost.com/local/public-safety/justice-dept-to-expand-review-of-fbi-forensic-techniques-beyond-hair-unit/2016/02/25/5adf0b8c-dbda-11e5-81ae-7491b99e7df_story.html.

113 See Spencer S. Hsu, Justice Dept., FBI to Review Use of Forensic Evidence in Thousands of Cases, supra note 45.

114 See Hsu, Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department, supra note 75.


116 Id. at 1.

another D.C. defendant who had been convicted of a 1981 rape. Odom served more than twenty years in prison. At Odom’s trial, an FBI analyst testified that a hair found on the victim’s nightgown was “microscopically like” Odom’s; yet, even according to the prosecution, the analyst had only “been able to distinguish between hair samples . . . “eight or 10 times in the past 10 years, while performing thousands of analyses.” The FBI and the DOJ have acknowledged that this type of testimony is scientifically invalid, along with two other varieties of testimony FBI examiners routinely proffered to jurors in an effort to quantify the significance of an association between a questioned and known hair.


119 See id.

120 Hsu, Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department, supra note 75.

121 See supra Part III.B. More specifically, the errors have been identified as follows:

*Error Type 1:* The examiner stated or implied that the evidentiary hair could be associated with a specific individual to the exclusion of all others.

*Error Type 2:* The examiner assigned to the positive association a statistical weight or probability or provided a likelihood that the questioned hair originated from a particular source, or an opinion as to the likelihood or rareness of the positive association that could lead the jury to believe that valid statistical weight can be assigned to a microscopic hair association.

*Error Type 3:* The examiner cites the number of cases or hair analyses worked in the lab and the number of samples from different individuals that could not be distinguished from one another as a predictive value
The Tribble and Odom cases were unique in their influence, but the scientifically invalid testimony used to secure their convictions was, as discussed below, routine and widespread. Aside from the false and misleading expert testimony and the failures of justice that resulted, at least as troubling is the initial response to the problem by the agencies responsible for it. As The Washington Post journalist Spencer Hsu documented in a series of articles, federal officials began reviewing these types of cases in the 1990s. But, instead of releasing this information—information which demonstrated that the testimony and the forensic work on which it was based was flawed—to the defendants whose convictions were affected, the federal task force only made it available to prosecutors.

Nonetheless, the audit has already resulted in several firsts. Recently, the Post reported that no fewer than twenty-seven death penalty

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122 See Hsu, Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department, supra note 75. In his article, Hsu noted that:

The [Washington] Post worked with the nonprofit National Whistleblowers Center, which had obtained dozens of boxes of task force documents through a years-long Freedom of Information Act fight. Task force documents identifying the scientific reviews of problem cases generally did not contain the names of the defendants. Piecing together case numbers and other bits of information from more than 10,000 pages of documents, The Post found more than 250 cases in which a scientific review was completed. Available records did not allow the identification of defendants in roughly 100 of those cases. Records of an unknown number of other questioned cases handled by federal prosecutors have yet to be released by the government.

Id.

123 See id.
convictions from around the country are among the affected cases. Among them is the case of Willie Manning, who had been scheduled for execution in Mississippi in May 2013 for the abduction and murder of two college students. The Mississippi Supreme Court denied Manning’s request for post-conviction DNA testing the week prior to his scheduled execution. In the days immediately preceding his execution date, however, the FBI and DOJ jointly wrote letters to Manning’s counsel and Mississippi officials explaining that Manning’s case had been included in the audit because the testimony provided by the FBI analyst in the case—that hair found at the crime scene implicated Manning—was “erroneous” and “exceeded the limits of the science” by claiming that the analysis could match the hair to an individual with “a relatively high degree of certainty.” Only hours before he was to die, the Court granted a stay.

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124 See Spencer S. Hsu, U.S. Reviewing 27 Death Penalty Convictions for FBI Forensic Testimony Errors, WASH. POST (July 17, 2013), https://www.washingtonpost.com/local/crime/us-reviewing-27-death-penalty-convictions-for-fbi-forensic-testimony-errors/2013/07/17/6c75a0a4-bd9b-11e2-89c9-3be8095fe767_story.html. According to the article, “[t]he death row cases are among the first 120 convictions identified as potentially problematic among more than 21,700 FBI Laboratory files being examined.” Id.


We have determined that the microscopic hair comparison analysis testimony or lab analysis report presented in this case included statements that exceeded the limits of science, and was, therefore, invalid. While this case did not involve a positive association of an evidentiary hair to an individual, the examiner stated or implied in a general explanation of microscopic hair comparison analysis that a
that was presumably based on the audit’s findings.\textsuperscript{128} Later that summer, the Court granted Manning leave to seek post-conviction DNA testing.\textsuperscript{129}

Similar retrospective efforts to identify and correct tainted convictions have gained ground in Texas and California. In the wake of appalling revelations about forensic malfeasance in criminal trials, executive meddling in efforts to right wrongs, and indefensible\textsuperscript{130} and inconsistent\textsuperscript{131} legal rulings, both states enacted legislation aimed at

questioned hair could be associated with a specific individual to the exclusion of all others — this type of testimony exceeded the limits of the science. The examiner also assigned a statistical weight or probability or provided a likelihood that, through microscopic hair comparison analysis, the examiner could determine that a questioned hair originated from a particular source, or an opinion as to the likelihood or rareness of a positive association that could lead the jury to believe that valid statistical weight can be assigned to a microscopic hair association — this type of testimony exceeded the limits of the science.

\textit{Id.}

\textsuperscript{128} \textit{See Order, Manning v. State, 112 So. 3d 1082 (Miss. 2013) (No. 95-DP-00066-SCT).}

\textsuperscript{129} \textit{See Order, Manning v. State, 119 So. 3d 293 (Miss. 2013) (No. 2013-DR-00491-SCT).}

\textsuperscript{130} \textit{See, e.g., In re Richards, 289 P.3d 860 (2012). California Lawyer determined that \textit{In re} Richards was the worst state court decision of 2012 because it created a “distinction between the testimony of experts and the testimony of laypersons in applying the protections against false evidence in Penal Code section 1473(b)” and thus “create[d] a substantial obstacle to correcting what the California Commission on the Fair Administration of Justice identified as the second-most-common factor contributing to wrongful convictions: erroneous scientific evidence.” Gerald F. Uelmen, \textit{New Balance at the California Supreme Court}, \textit{CAL. LAWYER} (Aug. 2013), http://www.callawyer.com/Clstory.cfm?eid=930177&wteid=930177_New_Balance_at_the_California_Supreme_Court.}

\textsuperscript{131} \textit{Compare Ex parte Henderson, 246 S.W.3d 690 (Tex. Crim. App. 2007) (granting state habeas relief to a woman who was previously convicted of killing a baby in her care because biomechanical evidence showed that the death could have been the result of an accident rather than an intentional act), with \textit{Ex parte} Robbins, 360 S.W.3d 446 (Tex.}
correcting the wrongs. In 2005, Texas created its Forensic Science Commission, whose mission is to “investigate, in a timely manner, any allegation of professional negligence or misconduct that would substantially affect the integrity of the results of a forensic analysis conducted by an accredited laboratory, facility, or entity.” In 2009, however, on the eve of the Commission’s report on Cameron Todd Willingham’s case—which was expected to find that the fire science used to secure Willingham’s conviction and death sentence was fundamentally flawed—Governor Rick Perry declined to re-appoint the Commission’s chairman and appointed three new commissioners. The Willingham report was delayed. In 2013, the Texas Legislature enacted several reforms, all aimed to one degree or another at the State’s stunning incidence of wrongful convictions, many of them based on flawed science. Perhaps foremost among the efforts is Senate Bill 344, Crim. App. 2011) (denying state habeas relief despite the testimony of several medical examiners, including the one who performed the original autopsy, which concluded that the cause of death was "undetermined" rather than "homicide").


133 TEX. CODE CRIM. PROC. ANN. art. 38.01 § 4(a)(3) (West 2015). The Commission has nine members who are appointed by the Governor. See id. at § 3(a).


135 See Possley, supra note 30.


138 Texas Senate Bill 1611, known as the “Michael Morton Act,” broadens
which allows challenges to convictions gained through now-discredited forensic techniques.\footnote{139}

Similarly motivated by forensic embarrassments—in this instance a 1997 murder conviction based on bite mark evidence and a State Supreme Court decision affirming the conviction that was voted the state’s worst appellate decision of the year—California recently passed Senate Bill 1058.\footnote{140} The legislation allows habeas petitioners to seek relief when a forensic expert repudiates his trial testimony or where that testimony is undermined by scientific or technological advancements subsequent to trial.\footnote{141}

defendants’ access to evidence that could prove innocence. Tex. S.B, 1611, 83rd Leg., R.S. (Tex. 2013) (enacted). Senate Bill 344 allows a defendant to challenge a conviction that was gained through forensic techniques that have since been discredited by modern science. Tex. S.B. 344, 83rd Leg., R.S. (Tex. 2013) (enacted). This bill responds to documented problems in old arson cases where junk science was used as evidence. \textit{Id.}

\footnote{139} See \textit{id}\textsuperscript{.}

\footnote{140} See S.B. 1058, 113th Cong. (Cal. 2014) (enacted).

\footnote{141} See \textit{id}.
D. EMPIRICAL DATA

Finally, we rest our argument on separate sets of data that deconstruct foundational legal doctrine and demonstrate empirically—when viewed in context with the developments above—the fallacies of the various forensic disciplines, as well as analysts’ willingness to tout and courts’ willingness to embrace such evidence in the absence of basic validation research. This phenomenon has been noted elsewhere, though its prevalence can now be definitively illustrated after several years of exonerations involving bite mark and hair microscopy testimony. For example, in another leading article, data illustrates that courts “policed the introduction of forensic testimony in these trials in a highly deferential manner, typically trusting the jury to assess the expert testimony.”

Defense attorneys’ failure to challenge the evidence in the first instance—combined with appellate courts’ failure to take the issues seriously—

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142 Garrett & Neufeld, supra note 10, at 90.

143 Some of the more egregious, but emblematic, examples include the two following cases. In Gerard Richardson’s direct appeal to the Superior Court of New Jersey, his counsel—as well as Richardson himself in a pro se pleading—exhaustively briefed what they argued was the erroneous admission of bite mark evidence. The court responded by simply stating that they had “carefully considered each of these contentions in light of the entire record and [found] them to be without sufficient merit to warrant a written opinion.” State v. Richardson, No. A-4235-95T4, at [pincite](N.J. Jan. 22, 1998). In Eddie Lee Howard’s death penalty conviction, the Mississippi Supreme Court was confronted with a host of valid claims about Dr. Michael West—the forensic odontologist’s—malfeasance, including instances where Dr. West had misidentified bite marks in other cases. See Howard v. State, 945 So. 2d 326, 352 (Miss. 2006). With regard to the admission of his testimony in Howard’s case, though, the court wrote:

In support of his post-conviction claim, Howard has offered numerous expert affidavits and other documents which attack Dr. West, his testimony, and bite mark evidence in general. These affidavits and other documents point out how many times Dr. West has been proven wrong and they discuss how unscientific his methods are. One affidavit even states that Dr. West made a misdiagnosis in Howard’s case, but, it does not go on and opine that Howard did not bite Kemp. Just because Dr. West has been wrong a lot, does not mean, without something
meant that many exonerees never challenged the forensic evidence; moreover, even where challenges were raised, courts invoked the “harmless error” doctrine to avoid granting relief, occasionally affirming plainly fabricated statistical conclusions.\footnote{Garrett & Neufeld, supra note 10, at 90–92.} In those instances where exonerees did challenge the putative scientific evidence, appellate courts typically relied on decades—and sometimes centuries—of precedent supporting the admissibility of the technique at issue to brush aside requests for relief.\footnote{See infra notes 226, 310 and accompanying text.}

We have termed this phenomenon the “Echo Chamber.” Courts fail to engage in a meaningful review of the proffered evidence through either a \textit{Frye} or \textit{Daubert} hearing and, instead, cite “persuasive” authority from sister states admitting such evidence, even in cases of first impression.\footnote{Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923) (requiring the proponent of novel scientific evidence to bear the burden of demonstrating that the evidence has “gained general acceptance in the particular field in which it belongs”).} In other cases, courts admit the technique based on some other rationale, typically that analysts—often those testifying, who have a professional interest in the technique’s continued admissibility—agree that the evidence at issue is “generally accepted” within their own “scientific” community.\footnote{Daubert v. Merrill Dow Pharm., 509 U.S. 579 (1993).}

A third line of reasoning leading to the uncritical admission of invalid scientific evidence involves abdicating judicial gatekeeping responsibly entirely and allowing juries to evaluate competing

more, that he was wrong here.

\textit{Id.}\footnote{See infra pp. 41–45 (desconstructing precedent-establishing cases in the field of forensic odontology).}
opinions, or even the legitimacy of the discipline itself.\textsuperscript{150}

\section*{II. Bite Mark Evidence}

\subsection*{A. Introduction}

Perhaps no discredited forensic assay has benefited more from criminal courts’ abdication of gatekeeper responsibilities than bite mark analysis. The genesis of the flawed jurisprudence can be traced back to a single case: \textit{People v. Marx},\textsuperscript{151} the first reported case to consider the admissibility of bite mark comparison evidence in human flesh.\textsuperscript{152} Although there was no pre-trial \textit{Frye}\textsuperscript{153} hearing—or any other evidence or rule-based admissibility hearing—to examine the validity and reliability of the new technique in \textit{Marx},\textsuperscript{154} over time, \textit{Marx} has proven to be a seminal decision. \textit{Marx} turned an obscure, unvalidated sub-discipline of “forensic odontology”\textsuperscript{155} into mainstream, “generally accepted,”

\begin{footnotesize}
\textsuperscript{150} Samuel R. Gross & Jennifer L. Mnookin, \textit{Expert Information and Expert Evidence: A Preliminary Taxonomy}, 34 SETON HALL L. REV. 141, 169 (2003) (“Once a witness has been permitted to testify as an expert under Rule 702, judges usually leave the task of correcting and explaining their instructional statements to the opposing parties and the expert witnesses they call.”).

\textsuperscript{151} 126 Cal. Rptr. 350 (Cal. Ct. App. 1975).

\textsuperscript{152} \textit{Id}.

\textsuperscript{153} \textit{Frye}, 293 F. at 1014.

\textsuperscript{154} \textit{Marx}, 126 Cal. Rptr. at 352–53, 355–57.

\textsuperscript{155} Courts, including the \textit{Marx} court, have conflated the identification of human remains through dental records with bite mark identification. The former is a well-established, relatively non-controversial technique; bite mark analysis is an entirely different discipline, relying on untested assumptions and the interpretation of injuries in human flesh. Nonetheless, courts have often treated the disciplines as essentially interchangeable, further insulating bite mark evidence from judicial scrutiny. \textit{See}, \textit{e.g.}, \textit{Handley v. State}, 515 So. 2d 121, 129 (Ala. Crim. App. 1987); \textit{Marx}, 126 Cal. Rptr. 350; \textit{People v. Milone}, 396 N.E.2d 1350 (Ill. 1976); \textit{People v. Middleton}, 429 N.E.2d 100, 103 (N.Y. 1981); \textit{State v. Jones}, 259 S.E.2d 120, 124 (S.C. 1979).
“scientific” evidence without any basic or applied research to validate the technique’s two underlying hypotheses that: (1) a properly trained

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156 Risinger, Navigating Expert Reliability, supra note 42, at 138 (“Marx came to be read as a global warrant to admit bite mark identification evidence whenever a person displaying apparent credentials chose to testify to an identification.”).

157 For the purposes of this article, we are using the terms “science” and “hypothesis” as the Supreme Court defined them in Daubert v. Merrell Dow Pharm., 509 U.S. 579 (1993). As Professor Edward Imwinkelried has explained, “the Court defined science as the process of formulating hypotheses about phenomena in the corporeal world and then engaging in experimentation or observation to falsify or validate the hypothesis. The Court decreed that to qualify his or her proffered testimony as ‘scientific . . . knowledge,’ the proponent must lay a foundation establishing the empirical validation of the expert’s underlying hypothesis.” Edward J. Imwinkelried, Should the Courts Incorporate a Best Evidence Rule into the Standard Determining the Admissibility of Scientific Testimony?: Enough Is Enough Even When It Is Not the Best, 50 CASE W. RES. L. REV. 19, 22 (1999) (internal citations omitted). What we have defined as the two underlying “hypotheses” of bite mark evidence and hair comparison evidence (see infra notes 200, 232 and accompanying text) are the authors’ construct, which we have advanced here to explore whether the interpretations of the data collected and proffered as evidence of the identity of a suspect have been scientifically validated. Scientific “validation” answers the question of “whether the methods and analyses employed were sound enough to justify the inferences drawn by the researcher.” JOHN MONAHAN & LAURENS WALKER, SOCIAL SCIENCE IN LAW: CASES AND MATERIALS 60 (6th ed. 2006). Although we are using the term “hypotheses,” this might also be conceived simply as two steps in the forensic identification process. The first step of the process establishes the “reliability” of the technique by determining whether the questioned item of evidence and the exemplar from a known source do, in fact, share sufficiently similar characteristics to make an association. See Saks & Koehler, The Individualization Fallacy in Forensic Science Evidence, supra note 42, at 199 (describing the two fundamental steps of forensic identification science); see also DAVID A. SCHUM, EVIDENTIAL FOUNDATIONS OF PROBABILISTIC REASONING (1994) (offering a general theory of evidence as it is understood and applied across disciplines, including law). The second step looks at the “diagnosticity” of the evidence by assessing the meaning of the match: “What is the probability that the questioned and the known originated from the same source?” Saks & Koehler, The Individualization Fallacy in Forensic Science Evidence, supra note 42, at 199. Whether referred to as hypotheses for simplicity or steps, both parts of the bite mark analysis process need to be validated scientifically. See Peter J. Neufeld & Neville Colman, When Science Takes the Witness Stand, 262 SCI. AM. 46, 49–52 (1990) (describing the importance of validity in the first step of forensic science—reliability of the pattern match—and stressing the importance of validity in the second step—
bite mark expert can make an association between a bite mark and a suspect’s “dentition” (the biting surface of teeth); and, (2) that a properly trained expert can provide a scientifically valid estimate of the rareness or frequency of that association (i.e., how many other dentitions may also be associated with the putative bite mark). Despite criminal courts continued acceptance of bite mark analysis, no such validation research exists today.\textsuperscript{159} Marx’s influence demonstrates the disinclination of criminal courts to engage in a rigorous analysis of putative scientific evidence—at least in criminal cases\textsuperscript{160}—or even to scrutinize precedent carefully when diagnosticity—by examining the “data and assumptions on which forensic laboratories have been relying to estimate the rarity”).

\textsuperscript{158} Robust reporting of error rates in the field does not exist, and at least one commentator has suggested an affirmative reason for that. See Risinger,\textit{ Navigating Expert Reliability, supra} note 42, at 142 (“[B]ite mark experts have benefited from their ability . . . to do few proficiency studies and to keep secret the results of such proficiency studies.”); see also C. Michael Bowers,\textit{ Problem-Based Analysis of Bitemark Misidentifications: The Role of DNA,} 159 FORENSIC SCI. INT’L S104, S106–S107 (2006). Even the results of controlled studies have been disturbing. At a 1999 American Board of Forensic Odontology bite mark workshop, “ABFO diplomats attempted to match four bitemarks to seven dental models [and] found 63.5% false positives.” Bowers, supra, at S106. A 2001 study of “bites made in pig skin, ‘widely accepted as an accurate analogue of human skin,’” resulted in 11.9 to 22.0 percent “false positive identifications . . . for various groups of forensic odontologists.” Id.

\textsuperscript{159} See NAS REPORT, supra note 4, at 173–76 (assessing the current state of bite mark analysis).

\textsuperscript{160} Take, for example, Mississippi appellate courts—the same courts that affirmed, among others, Levon Brooks’ and Eddie Lee Howard’s convictions, both of which were based on bite mark evidence. See Howard v. State, 853 So. 2d 781, 784–85 (Miss. 2003); Brooks v. State, 748 So. 2d 736, 739 (Miss. 1999); Levon Brooks, supra note 20. The Mississippi Supreme Court has spent considerable time discussing the merits—or lack thereof—of expert testimony in a number of different contexts, including the cause of plaintiff’s need for hip-replacement surgery where the expert lacked experience and training in orthopedics. See, e.g., Bailey Lumber & Supply Co. v. Robinson, 98 So. 3d 986 (Miss. 2012) (“[T]he expert opinion of a doctor as to causation must be expressed in terms of medical probabilities as opposed to possibilities.”); Univ. of Miss. Med. Center v. Lanier, 97 So. 3d 1197 (Miss. 2012) (noting that (1) “when the reliability of an
weighing the admission of such evidence. Indeed, the Marx court clearly recognized that basic tenets of science——generating a hypothesis, testing that hypothesis through laboratory and field experiments, publishing the results in peer-reviewed journals, repeating the experiments, and testing the results of those experiments under a wide variety of conditions——were entirely absent from the nascent field. The court itself wrote that there was “no established science of identifying persons from bite marks”; that “experts do not agree on the exact number of similarities necessary to make a positive identification;” and that “there was no evidence of systematic, orderly experimentation in the area.” Nonetheless, the Marx court found that, “[l]eaving aside the question whether tooth bites made into human flesh are sufficiently common in forensic dentistry to expect

expert’s opinion is attacked with credible evidence that the opinion is not accepted within the scientific community, the proponent of the opinion under the attack should provide at least a minimal defense supporting the reliability of the opinion,” and (2) that an “offered opinion that has been contradicted by published and peer-reviewed data, however, must be supported by some evidence of support and acceptance in the scientific community”); Sherwin Williams Co. v. Gaines, 75 So. 3d 41 (Miss. 2011) (holding as error the admission of expert testimony on the present value of the utility’s future cash flow where the expert acknowledged that his valuation was merely his opinion with no supporting methodology); McKee v. Bowers Window & Door Co., 64 So. 3d 926 (Miss. 2011) (denying expert qualification by distinguishing potential expertise as a general contractor from that of a storm window installation specialist); Dedeaux Util. Co. v. Gulfport, 63 So. 3d 514 (Miss. 2011) (engaging in close scrutiny of, among other things, utility cashflow and the relative valuation of storm windows); Patterson v. Tibbs, 60 So. 3d 742 (Miss. 2011); (holding that the testimony of the plaintiff’s three experts should have been excluded because the experts’ opinion that exposure to lead paint caused plaintiff’s brain injury was not based on “any scientific authority that acute, asymptomatic ingestion of lead could lead to the alleged injuries,” and likewise reminding trial judges that their gatekeeping duty under Daubert “includes making sure that the opinions themselves are based on sufficient facts or data and are the product or reliable principles and methods”).

162 Id. at 353.
163 Id.
164 Id. at 354.
that orderly experimentation will ever be possible,”\textsuperscript{165} the bite mark identification testimony was admissible. According to the court, the standard of “general acceptance”\textsuperscript{166} by recognized experts—i.e., the Frye test—was not determinative of admissibility because “the basic data on which the experts based their conclusion was verifiable by the court.”\textsuperscript{167} The court found that because it was able to observe with its own eyes—\textit{Marx} was a bench trial—the “matching” of the defendant’s dentition with the bite mark at issue it need not “sacrifice its . . . common sense in evaluating it”\textsuperscript{168} and could independently verify the conclusions the experts were urging. “Indeed,” the court wrote, “it is evident that in most cases the expert himself must accept certain dogmas of his profession on faith. We doubt that the average criminologist could supply the data on which the reliability of fingerprint evidence is based.”\textsuperscript{169} Thus was laid the foundation for the admissibility of bite mark analysis. Over the past three decades it has served as the foundation of at least twenty-four wrongful convictions and indictments.\textsuperscript{170}

\textbf{B. The Rise of Bite Mark Matching}

Exacerbating the error is the fact that subsequent cases of \textit{first impression} in other states relied on \textit{Marx} as precedent for both the proposition that a Frye hearing is unnecessary prior to the admission of bite mark evidence and the admissibility of bite mark analysis generally as “scientific” evidence for everything from dog bites\textsuperscript{171} to bites made in

\begin{footnotes}
\item[165] Id. at 355.
\item[166] Id.
\item[167] Id. at 356.
\item[168] Id.
\item[169] Id. at 356 n.14.
\item[170] See Myers, \textit{Men Wrongly Convicted or Arrested on Bite Evidence}, supra note 81 (detailing twenty-four cases).
\item[171] See, e.g., Davasher v. State, 823 S.W.2d 863 (Ark. 1992) (“The State requested this evidence to prove by scientific testimony that a wound located on Davasher’s leg was a bite inflicted by the [victim’s] dog, Scooter. Dr. Richard Glass, a forensic odontologist,
paper towels. As the graphic below demonstrates, like Marx, the overwhelming majority of these cases fail to examine the reliability of the technique prior to its admission at trial. Unlike Marx, however, all but three decisions arbitrarily label the evidence as “scientific.” For example, the next post-Marx California court to consider bite mark evidence, in citing to Marx, noted the “superior trustworthiness of the scientific bite mark approach,” which compared favorably to “other scientific-test evidence,” such as the “breathalyzer test.”

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was allowed to testify that he could not rule Scooter out as the dog that bit Davasher.”).

172 See, e.g., State v. Armstrong, 179 S.E.2d 870 (W. Va. 1988) (“[A]n examination of each tooth indicates an exact, perfect match between the appellant’s teeth and the bite-mark pattern on the paper towel, with no incompatibility. Dr. Sopher therefore concluded with a reasonable degree of dental certainty that ‘the bite-mark pattern in the towel is that of the teeth of Keith Armstrong, to the exclusion of all other individuals.’”).


175 Id. at 624.

176 Id.

177 Id.
This graph is a timeline of precedent-establishing cases that rely on *Marx* up until *Armstrong*, which became the first court to take judicial notice of the “general acceptance” of bite mark evidence in 1988. The three cases placed above the dotted line, *Slone, Bundy* and *Stinson*, are the only reported cases to hold pre-trial *Frye* hearings. Every decision, apart from *Kleypas, Kennedy*, and *Handley*, labeled bite mark evidence “scientific.”

The three reported cases of first impression in which trial courts

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178 The authors are indebted to University of Baltimore Law Professor Colin Starger, who created this graphic using software that he has developed for mapping Supreme Court precedent. See *The Supreme Court Mapping Project*, UNIV. OF BALTIMORE, http://law.ubalt.edu/faculty/scotus-mapping/ (last visited Oct. 10, 2015).
actually held *Frye* hearings demonstrate another deep flaw running through the jurisprudence: the failure to distinguish between the methodology experts employ to collect data and the scientific basis for interpreting the data collected. The former is typically well established, non-controversial, and impressive to triers of fact; the latter is often entirely absent.

Bite mark experts—who refer to themselves as “forensic odontologists”—employ an imposing array of techniques and analytical instruments to collect data and analyze teeth and the bite marks they purportedly leave. For example, the photographic techniques alone include infrared, ultraviolet, and trans-illumination photography, which penetrates below the surface of the skin. To ensure photographs of bite marks are to scale, an “American Board of Forensic Odontology Number 2 Photomacographic Scale”—a right angled ruler—is placed

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179 This phenomenon is true not only of bite mark evidence, but also of many other forensic techniques. See, e.g., Jules Epstein, *Preferring the “Wise Man” to Science: The Failure of Courts and Non-Litigation Mechanisms to Demand Validity in Forensic Matching Testimony*, 20 WIDENER L. REV 81, 114 (2014) (noting the National Research Council’s conclusions that available data does not support matching a bullet to a particular “box” of ammunition; that compositional analysis does not support definitive statements about the date of bullet manufacture; and, that detailed distribution of ammunition is such that probabilistic claims that a specific bullet came form a defendant should be avoided); NAT’L RESEARCH COUNCIL OF THE NAT’L ACADEMIES, FORENSIC ANALYSIS: WEIGHING BULLET LEAD EVIDENCE 1 (2004), available at http://www.nap.edu/catalog.php?record_id=10924.


182 Id. at 29, 32.


on the same plane as the alleged bite mark. Molds of suspect dentitions are created using a substance known as “polyvinylsiloxane.”\(^\text{185}\) Finally, “digital overlays”\(^\text{186}\) or outlines of exemplar “dentitions”—the biting surface of teeth—are generated through a digital software program and then used to superimpose the dentition to the photograph of the bite mark.\(^\text{187}\)

Forensic odontologists also make liberal use of scientific jargon and technical dentistry terms, such as the “occlusal view” of teeth (closed mouth)\(^\text{188}\); “avulsive” bite marks (flesh tearing)\(^\text{189}\); “central ecchymosis” in the bite mark (bruising in the center of a bite mark)\(^\text{190}\); “subcutaneous hemorrhage” (bleeding beneath the skin)\(^\text{191}\); “temporomandibular joint function” (an individual’s biting mechanics)\(^\text{192}\); anterior and maxillary dentition (upper and lower teeth)\(^\text{193}\); and other esoteric terminology.

Courts considering admissibility challenges—and jurors weighing life and liberty issues—are impressed by the facility these experts have with the language of science and the supposed precision and complexity of the data collection process.\(^\text{194}\)

However, while the terminology used by


\(^{186}\) See id. at 112.

\(^{187}\) See id.

\(^{188}\) DIPLOMATES MANUAL, supra note 180, at 96.

\(^{189}\) Id. at 101.

\(^{190}\) Id.

\(^{191}\) See Dorion, supra note 181, at 690.

\(^{192}\) DIPLOMATES MANUAL, supra note 180, at 97.

\(^{193}\) See id. at 96, 98.

\(^{194}\) See, e.g., Daubert v. Merrell Dow Pharm., 509 U.S. 579 (1993) (“Expert evidence can be both powerful and quite misleading because of the difficulty in evaluating it.”); United States v. Frazier, 387 F.3d 1244, 1263 (11th Cir. 2004) (“Simply put, expert testimony may be assigned talismanic significance in the eyes of lay jurors, and, therefore, the district courts must take care to weigh the value of such evidence against its potential to mislead or confuse.”); NEIL VIDMAR & VALERIE P. HANS, AMERICAN JURIES: THE VERDICT 181–82 (2007); B. Michael Dann et. al., CAN JURY INNOVATIONS IMPROVE JUROR UNDERSTANDING OF DNA EVIDENCE?, 90 JUDICIATURE 152 (2007); David H. Kaye et. al., STATISTICS IN THE JURY BOX: HOW JURORS RESPOND TO MITOCHONDRIAL DNA MATCH
forensic odontologists is beyond the ken of a typical lay juror, the core methodology is easily understood. In essence, experts place outlines of suspects’ teeth over photographs of bite marks and decide whether they “match.” That the analysis of the data is entirely subjective and lacks any basis in science is typically lost on courts and factfinders. The few reported Frye hearings reflect this misunderstanding. ¹⁹⁵

Wisconsin’s case of first impression, State v. Stinson, ¹⁹⁶ is a paradigmatic example. Stinson is one of three cases in which a pre-trial admissibility hearing was held before State v. Armstrong ¹⁹⁷ became the first case to take judicial notice of the supposed “general acceptance” of bite mark evidence in the scientific community. ¹⁹⁸ Ruling that the trial court did not abuse its discretion in finding that “there are adequate standards and controls in the area of forensic odontology, specifically for the identification of an individual through bitemark [sic] evidence and that

¹⁹⁵ See, e.g., People v. Slone, 76 Cal. App. 3d 611, 622 (Cal. Ct. App. 1978) (explicitly rejecting appellant’s contention that the expert’s conclusion that it was “highly probable” appellant’s teeth created the bite mark at issue was scientifically invalid); Bundy v. State, 455 So. 2d 330, 349 (Fla. 1984) (“The evidence in question is based on the examination of impressions made by human teeth and their comparison with models of known human teeth for the purpose of determining whether the impressions were or probably were or could have been made by a particular individual . . . the basis for the comparison testimony—that the science of odontology makes such comparison possible due to the significant uniqueness of individual dental characteristics—has been adequately established.”); see also Kennedy v. State, 640 P.2d 971, 978 (Okla. Crim. App. 1982) (“The means and techniques for making the models for comparison are complex, but they are based on standardized procedures known to produce accurate measurements.”).


¹⁹⁷ 369 S.E.2d 870 (W. Va. 1988).

¹⁹⁸ See Armstrong, 369 S.E.2d at 874–77; Stinson, 397 N.W.2d at 139.
that area of science is an accepted area . . . of science," the Wisconsin Court of Appeals did not evaluate either of the two fundamental hypotheses of bite mark analysis, namely that: (1) a properly trained analyst can make that type of association; and, (2) that the analyst can provide a scientifically valid estimate of that association’s evidentiary value. Instead, it focused on the impressive credentials of the experts and what appeared to be their sophisticated data collection and comparison techniques. The following excerpt from the opinion is worth quoting at length:

Dr. Lowell Thomas Johnson . . . a practicing dentist and a clinical professor of pathology at Marquette University School of Dentistry, testified for the state. On November 3, 1984, Dr. Johnson was called by the medical examiner and asked to examine the [63-year-old] victim’s body. Upon examining Cychosz [the victim], Dr. Johnson discovered eight complete or partial bite marks. To preserve this evidence, Dr. Johnson had a photographer from the state crime laboratory photography the bite marks. Dr. Johnson then made a rubber impression of the victim’s right breast which (sic) contained the greatest number of three-dimensional indentations. According to Dr. Johnson, when the wounds are three-dimensional, or when there are any indentations present, they can be well preserved by taking an impression of them. This impression is then later used to produce a static replica of the bite marks which (sic) will not be subject to distortion.

199 Stinson, 397 N.W.2d at 139–40 (holding that the “standards and controls” at issue were, of course, for the collection of the data, not the interpretation of the data collected).
200 See supra note 157–59. While we focus on these two hypotheses for purposes of this discussion, there are at least three other hypotheses underlying bite mark analysis: that forensic dentists are capable of distinguishing a bite mark from other pattern injuries; that the human dentition is unique; and, even assuming uniqueness, that human skin is capable of accurately recording the uniqueness. None of these hypotheses have been scientifically validated and, as discussed below, recent research tends to undermine them.
Dr. Johnson also testified that as part of established procedure, he preserved some of the tissue from the deeper bites. This was done by affixing an acrylic ring to the tissue surrounding the indentations and then removing that block of tissue for future study.

In addition to examining Cychosz, Dr. Johnson also did a complete forensic workup on Stinson. As part of the workup, a special camera was used to photograph the biting and facial surfaces of the teeth. A set of rubber impressions were then taken so a model of Stinson's teeth could be prepared. In addition, Dr. Johnson examined Stinson's teeth to observe the presence of defective or decayed teeth, or teeth which had been artificially restored.

Dr. Johnson also performed a similar dental workup on Robert Earl Stinson, the defendant's twin brother. Based on his comparison of the evidence taken from the victim with the models of Robert Earl’s teeth, Dr. Johnson concluded that there were some gross discrepancies which would rule out Robert Earl Stinson as having possibly made the bite marks.201

Dr. Johnson next testified extensively on the comparisons he made using the dental impressions of Stinson’s teeth and the bite marks found on the victim's body. He described and demonstrated the methods he used in making these comparisons. First, a comparison was made using the model of the bite marks and the model of Stinson's teeth. A comparison was also made by placing the

201 There is no evidence that the dentitions of twins are any more or less alike than any other adult dentitions.
model of Stinson's teeth over photos of the bite marks to see if the features were consistent. In addition, Dr. Johnson used an overlay technique, which he stated was another standard procedure in bite mark comparison. By taping a black and white negative of Stinson’s teeth over a color transparency of the bite mark, Dr. Johnson was able to compare the patterns of the bite marks with the patterns of the teeth. Based on these comparisons, Dr. Johnson concluded that the bites he examined on Cychosz “had to have been made by teeth identical in all of these characteristics to those that I examined on Robert Lee Stinson”

The state also called Dr. Raymond Rawson, a forensic odontologist, who, as chairman of the Bite Mark Standards Committee of the American Board of Forensic Odontologists, participated in formulating the standards and procedures for evaluating bite mark evidence. Dr. Rawson was asked to conduct an independent evaluation of the bite mark evidence using Dr. Johnson's models and photos. Dr. Rawson testified that the evidence in the case was “high quality” and “overwhelming.” He stated that this was an “exceptional” case because “[t]here were more . . . pieces of evidence than you usually see in a bite mark case.”

After examining Dr. Johnson's workup, Dr. Rawson stated that the methods Dr. Johnson used in gathering the evidence complied with the standards of the American Board of Forensic Odontology. Dr. Rawson then analyzed the evidence and concluded, to a reasonable degree of scientific certainty, that Stinson had inflicted the bite marks found on [the victim’s] body.

Dr. Rawson also reviewed the evidence produced
from the examination of Stinson's twin brother. Dr. Rawson testified that after an extensive analysis of the similarities and differences between the two brothers' mouths, he found significant discrepancies in their dentition. Therefore, Dr. Rawson concluded, Robert Earl Stinson could not have inflicted the bite marks found on Cychosz's body.

Dr. Johnson stated that the availability of bite marks from different parts of the body eliminated the possibility that the impressions obtained may have been distorted. He also testified as to the methods used in preserving and comparing the bite mark evidence gathered.

A total of fourteen upper and lower jaw impressions were made from the bite marks found on Cychosz’s body. Because of the opportunity to examine so many bites, and the fact that some of the bites were so deep as to be three-dimensional, Dr. Johnson testified he was able to detect a repetition of some particularly unique features in several of the bites.

Dr. Johnson later performed a forensic odontological examination of Stinson. Following the examination, Dr. Johnson noted the following unique features: one of the central incisors was fractured and decayed almost to the gum line; the lateral incisor in the upper jaw was set back from the other teeth; all of the upper front teeth were flared; the lower right lateral incisor was worn to a pointed edge; the right incisor was set out from the other teeth on the lower jaw. Dr. Johnson used these features along with the arch of the mouth and the spacing, width, and alignment of the teeth to make comparisons with the bite marks found on the victim. After an exhaustive examination of the photos, models and tissue
samples taken from Stinson and the victim, Dr. Johnson concluded, to a reasonable degree of scientific certainty, that the bite marks on the victim were made by Stinson.

The jury also heard from Dr. Rawson who concluded, based on the workup Dr. Johnson performed on both the victim and Stinson, that Stinson had inflicted the bite marks on the victim. In Dr. Rawson’s opinion the evidence in the case was overwhelming and he stated that “if we have four or five teeth that we are able to examine, then we can say that there is no other set of dentition like that.” In this case, Dr. Johnson was able to identify seventy-five individual tooth marks in various combinations of between five and eleven teeth.

Based upon this evidence, we hold that a jury could reasonably conclude beyond a reasonable doubt that Stinson murdered Cychosz. The reliability of the bite mark evidence in this case was sufficient to exclude to a moral certainty every reasonable hypothesis of innocence.202

Stinson was, of course, innocent.203 Although the bite mark evidence was presented to the jury as “scientific” evidence, the Stinson court found that, by the time Stinson’s appeal was heard, the state had rejected the Frye test—only to have the test reemerge two years later204—and thus that “evidence given by a qualified expert is admissible irrespective of the underlying scientific theory.”205 Borrowing the reasoning of Marx, the court found that bite mark evidence was a valuable aid to the jury because

202 Stinson, 397 N.W.2d at 137–39, 142 (emphasis added).
203 See supra note 17.
205 Stinson, 397 N.W.2d at 139 (emphasis added).
“[b]y looking directly at the physical evidence used, the models and the photos, the jury was able to judge for itself whether Stinson’s teeth did in fact match the bite marks found on the victim’s body.”\textsuperscript{206} As evidenced by the dozens of wrongful convictions,\textsuperscript{207} jurors are not capable of determining whether bite marks “in fact” match a defendant’s dentition or—more generally, but perhaps more importantly—to recognize that some prosecutors are willing to proffer pseudo-science as evidence of culpability in lieu of careful and thorough law enforcement investigations.\textsuperscript{208} Had Stinson’s jury relied on its own observations, Stinson may not have spent over two decades in prison. As the federal court adjudicating Stinson’s civil suit against the experts who testified at his trial noted, the “eyeball test” showed that his dentition did not “match” the bite mark; he was missing a tooth where the perpetrator appeared to have had one, and there was no explanation as to “why a bite mark was on [the victim’s] body where Stinson has a missing tooth.”\textsuperscript{209}

Stinson’s jury, of course, relied on the interpretation of the data urged by the “scientists,” even though there was—and is—no evidence that bite mark experts are capable of reliably associating a dentition with a bite mark; experts are not required to and do not undergo proficiency testing.\textsuperscript{210} Moreover, even if such associations could be made, there was—

\textsuperscript{206} Id. at 140.


\textsuperscript{209} Stinson v. City of Milwaukee, No. 09-C-1033, 2013 WL 5447916, at *12 (E.D. Wis. Sept. 30, 2013) (“Stinson’s tooth 8, which was broken to the root, could not create a mark on the victim’s skin without significant damage occurring.”).

\textsuperscript{210} Scholars have noted that bite mark examiners often fail to actually match bite marks to the dentition that made those bite marks, even in the context of controlled studies. Thus, as one forensic dentist has noted, bite mark evidence is subject to a “disturbingly high false-positive error rate.” Bowers, supra note 158, at S106. Such is
and is—no basis in science for concluding that a suspect is the source of the bite mark to the exclusion of all other potential sources. Put differently, since the two hypotheses underlying bite mark analysis have never been scientifically validated, conclusions offered by these experts are not helpful to a trier of fact because there is no evidence the technique is capable of providing probative evidence.

Jurisdictions that adopted the Marx “eyeball test” allowed proponents of bite mark analysis to have their cake and eat it too. Self-validating experts routinely proffered to juries “scientific” evidence of culpability, yet the empirical basis for the conclusions were not required to undergo Frye scrutiny, or, later, challenges pursuant to Daubert.

evidenced by: a 1975 study which found that bite mark examiners made “incorrect identification[s] of . . . bite[s]” on pig skin 24% of the time when the bites were made “under ideal laboratory conditions” and 91% of the time when “the bites were photographed 24 h[ours] after the bites were made;” a 1999 American Board of Forensic Odontology Bitemark Workshop “where ABFO diplomats attempted to match four bitemarks to seven dental models [and] found 63.5% false positives;” and, a 2001 study of “bites made in pig skin, widely accepted as an accurate analogue of human skin,” which resulted in 11.9–22.0% “false positive identifications . . . for various groups of forensic odontologists.”

211 See, e.g., NAS REPORT, supra note 4, at 176; H. David Sheets et al., Dental Shape Match Rates in Selected and Orthodontically Treated Populations in New York State: A Two Dimensional Study, 56 J. FORENSIC SCI. 621 (2011) [hereinafter Sheets et al., Dental Shape Match Rates].

212 See, e.g., Handley v. State, 515 So. 2d 121, 131 (Ala. Crim. App. 1987) (“Based upon our own precedent and the persuasiveness of other jurisdictions’ rulings, we, too, hold that the admissibility of the dental witness’s bite mark comparison does not depend on meeting the Frye standard. In the instant case, the jury itself was able to look at photographic overlays of the plastic models of the bite marks and of appellant’s teeth.”); People v. Slone, 76 Cal. App. 3d 611, 624 (Ct. App. 1978) (“The Marx court distinguished the bite mark evidentiary presentation from other scientific-test evidence . . . on the ground that there was a more trustworthy basis for admissibility of the bite-mark-identification evidence . . . due to the fact that the trier of fact could see for itself, by looking at the material-object exhibits . . . what constituted the basis for comparison with a defendant’s dentition.”); Bundy v. State, 455 So. 2d 330, 349 ( Fla. 1984) (“With bite marks evidence, the jury is able to see the comparison for itself by looking directly at the physical evidence in the form of photographs and models . . . The technique is similar to
hair comparison evidence, which is admissible even though it does not result in identifications of absolute certainty as fingerprints do.”); People v. Milone, 356 N.E.2d 1350, 1358 (Ill. 1976) (“Another factor effecting the admissibility of scientific testimony involves the nature of the evidence being offered. In Jennings, the court refused to accept testimony based upon the workings of a machine (lie detector) which had not proved to be substantially reliable and the results of which were subject to various subjective interpretations. Bite mark comparison, on the other hand, involves only a visual comparison between the wound and the dentition of the defendant. The great care taken to preserve and gather the physical evidence in this case precludes any problems arising in regard to the quality of the exhibits being compared. For this reason, the testimony of the experts serves only to lend assistance to the trial court in interpreting physical evidence not within the ken of the average trial judge’s knowledge.”); State v. Peoples, 605 P.2d 135, 139 (Kan. 1980) (“The superior trustworthiness of the scientific bite mark approach . . . is due to the fact that the trier of fact could see for itself . . . what constituted the basis for comparison with a defendant’s dentition.”); Commonwealth v. Cifizzari, 492 N.E.2d 357, 363, 363 n.15 (Mass. 1986) (“The admissibility of expert dental witnesses’ testimony does not depend on meeting the Frye test. The experts’ testimony merely aided the jury in comparing the photographs of the bite marks with the defendant’s dental impressions. . . . We are not denigrating from Frye because we recognize the importance of establishing scientific reliability of new theories. We simply rule that Frye is not here applicable.”); Kennedy v. State, 640 P.2d 971, 977 (Okla. Crim. App. 1982) (“We cite with approval the leading California case on bite-mark identification [Marx]. There, the Court of Appeals emphasized that the bite-mark evidence was trustworthy because the basic data on which the experts based their conclusions were verifiable by the court. In Marx, as here, the trier of fact was shown models, photographs, and overlays of the victim’s wounds and the accused teeth. The jury and the judge could see the extent to which the bite marks conformed to his teeth.”); State v. Jones, 259 S.E.2d 120, 124 (S.C. 1979) (internal quotation marks and citations omitted) (“In this case, we think admissibility depends upon . . . the degree to which the trier of fact must accept, on faith, scientific hypotheses not capable of proof or disproof in a court and not even generally accepted outside the courtroom.”); State v. Armstrong, 369 S.E.2d 870, 876 (W. Va. 1988) (“Many of the courts have emphasized that the reliability of bite-mark evidence, unlike most scientific evidence, is, when presented properly in the particular case, readily apparent; it is a ‘common sense’ type of comparison of physical evidence which lends itself readily to verification and understanding. The judge and the jury can see the extent to which the bite mark conforms to the suspect’s teeth.”).

509 U.S. 579 (1993). As discussed below, by the time the Supreme Court decided Daubert—and, six years later Kumho Tire—bitemark jurisprudence had been established; there exists not a single published decision applying Daubert analysis to bite
Some states adopted the “eyeball test” specifically to exempt certain pattern-matching forensic techniques from judicial scrutiny, relying instead on lay jurors to distinguish between valid science and subjective speculation masquerading as scientific evidence. Connecticut jurisprudence in this area demonstrates how these pattern-matching techniques were allowed into court through the backdoor Marx created for bite mark evidence. The Connecticut Supreme Court adopted Daubert as the standard for the admissibility of scientific evidence in 1997. In doing so, the court emphasized the importance of the trial court acting as a “gatekeeper” and assuming responsibility for mark evidence.

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214 526 U.S. 137 (1999). It is important to note that the Supreme Court in Kumho Tire rejected the distinction between science and technical evidence for purposes of applying the Daubert test because such a distinction would be difficult to draw. The Court wrote that, “it would prove difficult, if not impossible, for judges to administer evidentiary rules under which a gatekeeping obligation depended upon a distinction between ‘scientific’ knowledge and ‘technical’ or ‘other specialized’ knowledge. There is no clear line that divides the one from the others.” Id. at 148.

215 State v. Reid, 757 A.2d 482, 487 (Conn. 2000); Bundy, 455 So. 2d at 349 (“The technique is similar to hair comparison evidence, which is admissible even though it does not result in identifications of absolute certainty as fingerprints do.”); Kennedy, 640 P.2d at 977 (“The jury and the judge could see the extent to which the bite marks conformed to [the defendant’s] teeth.”).

216 Marx cited no precedent—and there appears to have been none—for this “eyeball test” as it relates to bite mark evidence; yet, as discussed infra, it has also been used to admit hair comparison testimony. Instead, Marx cited Frye for the proposition that it applies only when “the trier of fact must accept, on faith, scientific hypotheses not capable of proof or disproof in court and not even generally accepted outside the courtroom.” People v. Marx, 54 Cal. App. 3d 100, 110 (Cal. Ct. App. 1975). The court reasoned that if there was no risk of overwhelming the trier of fact, then the court need not “sacrifice its independence in favor of deference to the expert.” Id. at 111. Frye, however, makes no such distinction. Rather, Frye applies “when the question involved does not lie within the range of common experience or common knowledge, but requires special experience or special knowledge.” Frye v. United States, 293 F. 1013, 1014 (D.C. 1923).

determining the validity and reliability of scientific evidence, noting that “a judge is in a much better position than a juror to assess accurately the fundamental validity of [scientific] evidence.” 218 The court acknowledged that a juror’s understanding of scientific evidence is “largely dependent on the presentations of the parties and their experts;” 219 that “expert presentations may often be misleading;” 220 and, that “cross-examination may often be difficult and ineffective in bringing out flaws in the expert’s reasoning.” 221 Judges, on the other hand, “have the benefit of reviewing briefs and other documents” 222 and demanding “supplemental briefing on any issue that needs clarification.” 223 The court went on to note that “certain types of evidence, although ostensibly rooted in scientific principles and presented by expert witnesses with scientific training, are not ‘scientific’ for the purposes of [the] admissibility standard for scientific evidence.” 224 Such evidence “simply require[s] the jurors to use their own powers of observation and comparison,” and thus does not require a Daubert hearing. 225

By the time the West Virginia Supreme Court became the first state high court to take judicial notice of the general acceptance of bite mark evidence, twenty-one states had already decided it was admissible, without a single dissenting opinion. 226 Though the jurisprudence does not

218 Id. at 746.
219 Id. at 748.
220 Id.
221 Id.
222 Id.
223 Id.
224 State v. West, 877 A.2d 787, 805 (Conn. 2000) (internal quotation marks and citations omitted).
225 State v. Reid, 757 A.2d 482, 487 (Conn. 2000).
226 See State v. Armstrong, 369 S.E.2d 870, 875 (W. Va. 1988) (“This case presents a question of first impression for this Court, specifically, the admissibility of bite-mark evidence. All of the twenty-one jurisdictions which have specifically addressed this question in a reported opinion, where a qualified expert was involved, have held bite-mark evidence to be admissible for positive identification purposes, and the general
withstand contemporary scrutiny, it supported—and continues to support—the argument that every state which considered the admissibility issue decided that bite mark analysis passed evidentiary muster, however little muster was required. Subsequent cases of first impression became foregone conclusions. As the chart below demonstrates, courts began citing to one another as a matter of course, creating an echo chamber of ill-considered opinions.

As noted above, Marx looked to Frye to support the conclusion that bite mark analysis was exempt from Frye scrutiny.227 This anomalous, yet remarkably influential, reasoning had another pernicious effect on trace evidence jurisprudence: allowing the experts themselves to define the “relevant scientific community.” In Frye—which involved a challenge reliability of bite-mark comparison techniques has been sufficiently established, such that a hearing in each case to establish the general reliability thereof is not necessary. The courts have rejected challenges to bite-mark evidence based upon constitutional, evidentiary and scientific arguments.”)

227 See supra note 216.
to the admissibility of a lie detector test—the court precluded the evidence because it had not yet “gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments thus far made.”\textsuperscript{228}

Precedent-establishing cases across the country uniformly defined the relevant scientific community as the forensic dentists themselves.\textsuperscript{229} Those who “generally accepted” the discipline—many of whom practiced in the field and had a vested interest in its success—constituted the relevant community whose general acceptance was required for admissibility.\textsuperscript{230} The self-referential and self-interested community essentially resulted in the question of the field’s admissibility being a foregone conclusion. By the time that the NAS Committee—which was comprised of leading scientists in all relevant fields\textsuperscript{231}—examined the

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\item[\textsuperscript{228}] Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923).
\item[\textsuperscript{229}] See, e.g., People v. Slone, 76 Cal. App. 3d 611, 624, 625 (Cal. Ct. App. 1978) (relying on testimony of three forensic odontologists which showed “bite-mark-identification technique had gained general acceptance in the scientific community of dentistry—the relevant scientific community involved”); People v. Watson, 75 Cal. App. 3d 384, 401–02 (Cal. Ct. App. 1977) (basing admission on Marx, and finding that, once a new scientific technique has been accepted by the court, it may not be disrupted without “evidence reflecting change in the attitude of the scientific community,” presumably forensic odontologists); People v. Marx, 54 Cal. App. 3d 100, 110 (Cal. Ct. App. 1975) (giving credence to the testimony of the state’s experts, who were optimistic that dental identification techniques could be used to identify bite marks, implying that the relevant scientific community were the experts themselves); People v. Smith, 468 N.E.2d 879, 889 (N.Y. 1984) (basing admission on the claim that the technique of comparing one photo of a bite mark to another was sufficiently reliable and had been “accepted by the scientific community,” comprised of prosecution and defense experts who together “acknowledged the reliability and acceptance of photographic comparisons”); People v. Middleton, 429 N.E.2d 100, 103 (N.Y. 1981) (admitting evidence by finding that “the test is not whether a particular procedure is unanimously indorsed by the scientific community, but whether it is generally acceptable as reliable . . . [;] [t]he techniques employed (photography, freezing of tissue specimens, the taking of dental molds, visual observation) are accepted and approved by the majority of the experts in the field”);
\item[\textsuperscript{230}] See supra note 229 and accompanying text.
\item[\textsuperscript{231}] See NAS REPORT, supra note 4, at iv–ix.
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validity and reliability of bite mark analysis and concluded that the technique was inherently weak and lacked any basis in science in 2009, decades of state court precedent had reached exactly the opposite conclusion.\textsuperscript{232}

Finally, it is worth noting, albeit briefly for purposes of substantive discussion, that a research team led by Dr. Mary Bush—a tenured professor at the State University of New York at Buffalo’s School of Dental Medicine and past president of the American Society of Forensic Odontology—began to develop studies in the field subsequent to the publication of the NAS Report and the attention the Report brought to the shortcomings of forensic odontology.\textsuperscript{233} Twelve studies that tested the foundational issues related to skin’s ability to act as a substrate for interpreting data were ultimately conducted.\textsuperscript{234} Each used a cadaver model, and each was published in a peer-reviewed scientific journal.\textsuperscript{235}

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\item The NAS Report noted that skin is simply not a suitable medium to record bite marks: “bite marks on the skin will change over time and can be distorted by the elasticity of the skin, the unevenness of the surface bite, and swelling and healing.” \textit{Id.} at 174. In addition, problems may also arise because of “distortions in photographs and changes over time in the dentition of suspects.” \textit{Id.} The report goes on to note that the first hypothesis underlying bite mark analysis (i.e., that an association can be made between a dentition and a bite mark) is flawed because— despite guidelines published by the American Board of Forensic Odontology, which provide for various methods of bite mark analysis— “[t]here is no science on the reproducibility of the different methods of analysis that lead to conclusions about the probability of a match.” \textit{Id.} Indeed, “[e]ven when using the guidelines, different experts provide widely differing results and a high percentage of false positive matches of bite marks using controlled comparison studies.” \textit{Id.} As to the second hypothesis—i.e., that a valid estimate of the probative value of a putative “match” can be stated—“there is no established science indicating what percentage of the population or subgroup of the population could also have produced the bite.” \textit{Id.}

\item See \textit{infra} notes 235–36.

\item See \textit{id.}

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Broadly speaking, the studies’ research strongly suggests what is intuitive; even assuming the uniqueness of human dentition, human skin is not capable of capturing that uniqueness with sufficient fidelity to identify “the biter.” Moreover, bite marks created by the same dentition on the same individual appeared substantially different, depending on the angle of the body and whether the mark was made parallel or perpendicular to “Langer lines.” Likewise, in a study conducted using orthodontically...
treated dentitions—i.e., teeth straightened through orthodontic work—Dr. Bush and her team found that bite marks created by treated dentitions could not be reliably distinguished from each other. More specifically, the research team found that:

[a]s may be anticipated, orthodontic treatment had a very strong effect on dental shape similarity. The match rate in the known orthodontically treated set was 42.7% of individuals using the same threshold parameter in only 110 specimens. This confirmed that when orthodontically treated or naturally well-aligned, dentitions may be indistinguishable. This result is also a measure of how successful orthodontic treatment is at producing homologous dental arch shapes. The orthodontically treated human dentition is not unique, as measured here with high accuracy and precision.

The Bush studies confirm the NAS Report’s observation that the “validity of forensic odontology” may be “severely limited” because it relies on interpreting data from a bite mark, which “will change over time and can be distorted by the elasticity of the skin, the unevenness of the surface bite, and swelling and healing.” It is for this same reason that there are no measurement processes or objective standards for bite mark analysis. The field simply has no methodology to account for the great variation in the size and shape of the bite marks created by the same

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238 Sheets et al., Dental Shape Match Rates, supra note 211, at 621–26.

239 Id.

240 NAS REPORT, supra note 4, at 174.

dentition. Moreover, manipulating a mold of a suspect’s teeth on the victim’s decomposing body and declaring a “match” is plainly a scientifically invalid method, incapable even of associating a particular dentition with a bite mark, to say nothing of the false individualization claims made in so many cases.

III. Hair Evidence: Unchallenged and Unvalidated

A. Introduction

Microscopic hair comparison attempts to link a known hair—typically from a suspect in a criminal case—and a questioned hair, typically a hair found at a crime scene. Like bite mark analysis—and indeed all pattern and impression forensic assays—this technique rests on two hypotheses: (1) that a properly trained hair examiner can make an association between a questioned sample hair and sample hair from a suspect; and, (2) that a properly trained hair examiner can provide a scientifically valid estimate of the rareness or frequency of that association. As discussed infra, court-sanctioned, yet scientifically invalid conclusions concerning the second hypothesis have had a long and ignoble history in the United States, and no court has ever rejected the validity of the first hypothesis in a reported opinion. This, despite the staggering number of wrongful convictions obtained at least in part through the use of

242 See id. at 175 (“The effect of distortion on different comparison techniques is not fully understood and therefore has not been quantified.”).
243 See supra notes 236–39 and accompanying text.
244 The ABFO has since retreated from its claim that bitemark experts can identify the unique source of an alleged bitemark, a development discussed more fully infra, at Part IV.A.
246 See supra note 157–59. For example, ballistics, latent print analysis, and bite mark evidence rest on the same hypotheses, i.e., that a properly trained expert can make an association between a mark at a crime and provide a statistical valid expression of the probative value of such an association.
hair comparison evidence and recent, highly publicized research conducted by FBI hair comparison experts which demonstrates unacceptably high error rates in their own work.247

Judicial acceptance of the first hypothesis has humble origins, not as expert testimony, but as evidence introduced through lay witnesses using their own powers of observation to compare known and crime scene hairs. The first reported use of such evidence may be traced back to a murder investigation on a cotton plantation in Sunflower County, Mississippi, where, in 1855, John Browning and his son, Gaston Browning, were tried for the murder of John Neal, the overseer of the Hill and McNeill Plantation.248 Amongst other injuries, Neal’s neck had been dislocated and broken.249 A search of the defendants’ home revealed a noose with drops of blood; moreover, “[o]n the rope near the noose were found several hairs, which upon comparison corresponded exactly in color and length with Neal’s hair.”250 Despite this evidence—and a not insignificant amount of additional circumstantial evidence—one justice of the Mississippi Supreme Court found the evidence insufficient to sustain the capital conviction, and neither defendant was ever convicted of the crime.251

247 There is—and was—an abundance of evidence of the existence of error. In 2002, Bruce Budowlwle, the research director of the FBI DNA Laboratory, and Max Houck, an expert in hair microscopy and director of the forensics program at West Virginia University, published a study that reviewed human hair examinations within the FBI laboratory that underwent both microscopical comparison and mtDNA analysis between 1996 and 2000. See Max M. Houck & Bruce Budowle, Correlation of Microscopic and Mitochondrial DNA Hair Comparisons, 47 J. FORENSIC SCI. 964 (2002). Of the eighty cases in which FBI hair examiners found a positive microscopic association, nine cases resulted in exclusions when the same hairs were subjected to mitochondrial DNA testing. Id. at 964–66. According to the NAS Report, the study “illustrates not only the imprecision of microscopic hair analyses, but also the problem with using imprecise reporting terminology such as ‘associated with,’ which is not clearly defined and which can be misunderstood to imply individualization.” NAS REPORT, supra note 4, at 161.

248 See Browning v. State, 33 Miss. 47 (1857).

249 Id. at 56.

250 Id. at 58.

251 Id. at 84.
Thirteen years later, in *Commonwealth v. Dorsey*,\(^\text{252}\) the Supreme Judicial Court of Massachusetts approved the introduction of hair comparison testimony by two lay witnesses, one of whom claimed that hairs found on a club alleged to have been the murder weapon appeared to be human hairs and the other of whom claimed that the hairs “resembled the hair of the deceased.”\(^\text{253}\) The *Dorsey* court found that observational evidence “gained through [the] senses” by lay witnesses was admissible and did not require expert testimony.\(^\text{254}\) The court, in other words, articulated one of the earliest “eyeball” tests to admit lay opinion testimony of trace evidence. Lay testimony concerning handwriting, shoe impression, hair comparison, and evidence that a “fragment of a garment” originated from a particular source—e.g., fiber analysis—was therefore admissible.\(^\text{255}\) However, “[w]hen other tests than the senses are to be applied to these subjects in order to gain knowledge that cannot be gained by common observation, but must be acquired by the application of special skill or learning, the testimony of experts must be resorted to.”\(^\text{256}\)

Over the next century, trace evidence analysis—including hair comparison—became the province of experts as crime solvers began using increasingly sophisticated instruments to amplify observations of hairs.\(^\text{257}\)

\(^{252}\) 103 Mass. 412 (Mass. 1869).

\(^{253}\) *Id.* at 419.

\(^{254}\) *Id.* at 420.

\(^{255}\) *Id.*

\(^{256}\) *Id.*


From the viewpoint of conventional science, the forensic identification sciences are contenders for being the shoddiest science offered to the courts. After being in business for nearly a century, they still have developed little that would be recognized as a scientific foundation and, consequently, have little basic science to apply to their operational activities. For much of the twentieth century, the courts readily
Although the observations experts made using these instruments—the collection of the data—did indeed require special skill and training, the conclusions concerning “matches” between known and evidentiary hairs—the interpretation of the data, i.e., the science—is no more probative today than it was at the turn of the nineteenth century.\textsuperscript{258} Nor have the core claims of the experts changed since that time.\textsuperscript{259} As with bite mark analysis, however, courtroom presentations have become more robust. They now often feature elaborate demonstrations accompanied by detailed visual demonstrations of microscopic images, experts referring to themselves as “scientists,”\textsuperscript{260} and the employment of terms such as “reasonable scientific certainty,”\textsuperscript{261} all without a judicial inquiry into reliability\textsuperscript{262} to frame and support the conclusions. The rationale for admitted these fields, apparently because they were flying the banner of science and not because they presented sound data supporting their claims.

\textit{Id.} at 879.

\textsuperscript{258} \textit{Id.}


\textsuperscript{260} The label itself is problematic, as it may accord to a discipline a level of gravitas that is undeserved. See, e.g., United States v. Starzecpyzel, 880 F. Supp. 1027, 1038 (S.D.N.Y. 1995) (noting that forensic document examination, despite its certification procedure and the like, cannot be regarded as scientific knowledge after \textit{Daubert}).

\textsuperscript{261} This term has come under criticism recently because, among other things, the term itself is ambiguous and has different meanings for different analysts. See, e.g., United States v. Taylor, 663 F. Supp. 2d 1170 (D.N.M. 2009); United State v. Glynn, 578 F. Supp. 2d 567 (S.D.N.Y. 2008).

\textsuperscript{262} See, e.g., State v. West, 877 A.2d 787, 807 (Conn. 2005) (finding that hair comparison evidence is rooted in science but is not subject to a threshold reliability hearing because it “simply requires jurors to employ their own powers of observation and comparison”); State v. Reid, 757 A.2d 482, 487 (Conn. 2000) (finding that hair comparison evidence “is based in science” but is not subject to a threshold reliability hearing because it allows jurors “to make their own determinations as to the weight they
would accord the expert's testimony in the light of [the evidence] . . . and their own powers of observation and comparison’); Murray v. State, 3 So. 3d 1108, 1117 (Fla. 2009) (internal quotation marks and citations omitted) (reiterating that “[v]isual and microscopic hair comparison is not based on new or novel scientific principles and, therefore, does not require a Frye analysis’’); McDonald v. State, 952 So. 2d 484, 498 (Fla. 2006) (finding visual and microscopic hair comparison does not require a Frye analysis because it “is not based on new or novel scientific principles’’); Jent v. State, 408 So. 2d 1024 (Fla. 1981) (finding that hair analysis evidence is not so unreliable and scientifically unacceptable that it is error to admit it); Beam v. State, 463 S.E.2d 347, 349 (Ga. 1995) (finding that the crime lab expert’s hair analysis is admissible because § 24-9-67 of the Official Code Of Georgia Annotated states that “the opinions of experts on any question of science . . . or like questions shall always be admissible’’); People v. Harvey, 568 N.E.2d 381, 387 (Ill. App. Ct. 1991) (finding the trial court, following a voir dire hearing to determine the number of scientific areas of consistency between the hair samples, acted within its discretion in admitting the evidence, despite the State’s failure to establish that the hairs were identical to a mathematical certainty), McGrew v. State, 682 N.E.2d 1289 (Ind. 1997); Johnson v. Commonwealth, 12 S.W.3d 258 (Ky. 1999) (concluding that Kentucky trial courts may take judicial notice that hair comparison analysis is scientifically reliable); Commonwealth v. Tarver, 345 N.E.2d 671, 676–77 (Mass. 1975) (“It was sufficiently shown in the record that the use of microscopic examination has been generally accepted by the community of scientists involved.’’); People v. Browning, 308 N.W.2d 264 (Mich. Ct. App. 1981); People v. Collins, 204 N.W.2d 290, 293–94 (Mich. Ct. App. 1972) (holding that the defense’s objection to the State witness’s opinion that there was a “reasonable scientific certainty” that hairs shared a common origin—an objection which was based on the fact that “inability to identify hair samples by microscopic analysis is universally recognized”—affected the weight rather than the admissibility of the evidence); State v. Hudson, 970 S.W.2d 855, 860 (Mo. Ct. App. 1998) (holding that plain error review was not appropriate where the court’s determined that hair analysis was admissible after the defendant argued the hair analysis was inadmissible because the scientific principles were not generally accepted under Frye’’); State v. Millisor, No. 9-98-69, 1999 Ohio App. LEXIS 3542, at *12–13 (Ohio Ct. App. Aug. 4, 1999) (finding analyst’s statement that hair samples are consistent to a reasonable scientific certainty admissible); Williamson v. State, 812 P.2d 384, 405 (Okla. Crim. App. 1991) (citing Driskell v. State, 659 P.2d 343, 356 (Okla. Crim. App. 1983) (stating that the court remained committed to its “position as expressed in Driskell . . . which sanctioned the use of hair comparison evidence and the determination that any question about the procedures and conclusions drawn therefrom should be raised on cross-examination,” despite the fact that the appellant had asked the court to reconsider its acceptance of hair comparison analysis and had cited four studies in support of his position that the analysis “[did] not meet sufficient standards of scientific reliability”);
abdicating gatekeeping responsibilities has its roots in *Dorsey* and other early jurisprudence in this area.

An examination of these early opinions reveals a persistent line of reasoning that mirrors *Marx’s* bite mark analysis: the judicial determination that a comparison of two items to decide whether or not they “match”—even when such analysis is performed by a “scientist” using sophisticated analytical instruments—is not subject to *Frye* scrutiny because conclusions drawn from a comparative examination are elemental, independently verifiable by the trier of fact, and unlikely to mislead or confuse jurors.263 Put differently, the “eyeball test” articulated in *Dorsey* for the admissibility of lay observations of trace evidence was eventually extended to shield expert testimony from judicial scrutiny as well. It must be emphasized that the judicial labeling of this or other pattern-matching techniques as “non-scientific” or “technical knowledge” based on the perception that they are straightforward forensic assays—unlike, for example, DNA genotyping—is not a defensible position. The Supreme Court in *Kumho Tire* rejected the distinction between scientific and technical evidence for purposes of applying the *Daubert* test, noting

Commonwealth v. Chmiel, 30 A.3d 1111, 1142 (Pa. 2011) (conceding that “a once-viable science [hair analysis] may lose its wide acceptance in the scientific community and may be challenged pursuant to Rule 702,” although the science was widely accepted at the time of the appellant’s trial in 2002); State v. Fagundes, 614 P.2d 198 (Wash. Ct. App. 1980) (finding that it was in the discretion of the trial judge to admit hair analysis evidence following an analyst’s testimony regarding her testing methods and their general acceptability in the scientific community); State v. Hicks, 549 N.W.2d 435, 437 (Wis. 1996) (acknowledging that an “[analyst] stated that . . . to a reasonable degree of scientific certainty, the unknown Negro and Caucasian hair specimens ‘could have’ come from Hicks and D.F.”).

263 See, e.g., State v. Fukusaku, 946 P.2d 32, 44 (Haw. 1997) (affirming the trial court’s refusal to apply *Daubert* scrutiny to hair trace evidence because of its overwhelming acceptance by criminal courts and noting that, because “the scientific principles and procedures underlying hair and fiber evidence are well-established and of proven reliability, the evidence in the present case [could] be treated as ‘technical knowledge’”); *McGrew*, 682 N.E.2d at 1292 (discussing how hair comparison evidence is not subject to *Daubert* scrutiny because the technique relies on observations made by persons with specialized knowledge rather than being a matter of scientific principles).
that: “[I]t would prove difficult, if not impossible, for judges to administer evidentiary rules under which a gatekeeping obligation depended upon a distinction between ‘scientific’ knowledge and ‘technical’ or ‘other specialized’ knowledge. There is no clear line that divides the one from the others.”

Thus Kumho Tire eliminated the arbitrary labels that effectively precluded inquiry into the foundational bases of expert testimony considered non-scientific for admissibility issues only. Virtually no state, however, has applied Kumho Tire to pattern-matching techniques, even in jurisdictions that have generally adopted Daubert. Instead, courts have shielded these assays from Frye/Daubert scrutiny, while allowing experts to refer to themselves as scientists and exploit the aura of “mythic infallibility” scientific evidence often holds over lay jurors.

Furthermore, inquiries into whether two evidentiary items are indistinguishably similar (i.e., match) and conclusions about how probative those associations are the domain of science. More precisely,

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265 See id.
267 Indeed, this is reason that the National Academy of Sciences had the authority to issue its comprehensive assessment of the state of forensic “science.” As the NAS Report stated:

The law’s greatest dilemma in its heavy reliance on forensic evidence, however, concerns the question of whether—and to what extent—there is science in any given “forensic science” discipline. Two very important questions should underlie the law’s admission of and reliance upon forensic evidence in criminal trials: (1) the extent to which a particular forensic discipline is founded on a reliable scientific methodology that gives it the capacity to accurately analyze evidence and report findings and (2) the extent to which practitioners in a particular forensic discipline rely on human interpretation that could be tainted by error, the threat of bias, or the absence of sound operational procedures and robust performance standards. These questions are
validating the accuracy of the expert’s conclusion is an inherently scientific inquiry. For such an inquiry to result in a scientifically valid conclusion, the interpretation of the data must be drawn from a reliable foundation. Where conclusions by pattern-matching experts are made without objective thresholds for declaring an association or underlying statistical data by which to judge the relevance of the association, the conclusions are entirely subjective and therefore unscientific. It does not significant.

Thus, it matters a great deal whether an expert is qualified to testify about forensic evidence and whether the evidence is sufficiently reliable to merit a fact finder’s reliance on the truth that it purports to support. Unfortunately, these important questions do not always produce satisfactory answers in judicial decisions pertaining to the admissibility of forensic science evidence proffered in criminal trials.

NAS REPORT, supra note 4, at 9.

268 The NIST research agenda discussed above should lead to developing a more scientific basis for these conclusions. That this basic research is only now being undertaken further demonstrates the inadequacy of the current state of scientific knowledge underlying these techniques.

269 An example of this critique as it relates to ballistics and toolmarks can be found in Itiel’s Dror’s piece, How Can Francis Bacon Help Forensic Science? The Four Idols of Human Biases:

The subjective and unspecified identification criterion of sufficient agreement is an example of idola fori. Furthermore, the AFTE Theory of Identification stipulation that the determination of ‘sufficient agreement is the product of the examiner’s personal training, skills, and experience’ also involves idola specus—the subjective individual’s experience determines decisions, rather than scientifically measurable criteria based on objective, quantifiable measurement divorced from and independent of the specific incidental individual who is making the observations.

necessarily follow that analyses based on an expert’s training and experience are without value, but the limited value of conclusions drawn from experiential foundation must be plainly communicated to jurors. Expert witnesses must be not permitted to claim the mantle of “science” in courtroom testimony, while at the same time avoiding the judicial scrutiny scientific evidence is required to undergo before it is proffered as such to lay jurors.

B. THE RISE OF HAIR MICROSCOPY

Apart from some notable early exceptions, the only consistent limits courts placed on hair evidence were restrictions on conclusive individualization claims—i.e., explicit assertions that the defendant was the source of the questioned hair to exclusion of all other potential sources—and the use of statistics to suggest that a defendant was the probable source of a crime scene hair. Although the establishment of the

270 See NAS REPORT, supra note 4, at 8 (“[A]lthough some techniques may be too imprecise to permit accurate identification of a specific individual, they may still provide useful and accurate information about questions of classification.”).

271 The authors are indebted to Professor Simon A. Cole for his insight into the role of science in validating the conclusions proffered by expert witnesses, which significantly advanced our thinking on this topic. See also infra Part III (discussing the limiting language of hair comparison associations).

272 See, e.g., Knoll v. State, 12 N.W. 369, 370 (Wis. 1882) (“The opinion of the witness as to the fact that the hair came from the head of the same person was not admissible on the ground that the inquiry related to a scientific subject—one which required peculiar knowledge or previous study and experience to give information about. . . The witness, then, could not testify to his opinion on the ground that the subject-matter of the inquiry related to a scientific subject, and was expert testimony.”).

273 Hair experts began incorporating statistics into their conclusions largely based on a single 1974 study by Barry Gaudette, a former hair examiner for the Royal Canadian Mounted Police. See B.D. Gaudette & E.S. Keeping, An Attempt at Determining Probabilities in Human Scalp Hair Comparison, 19 J. FORENSIC SCI. 599, 599–606 (1974). The use of this research to provide a statistical weight for hair examiners’ conclusions has been entirely discredited. See NAS REPORT, supra note 4, at 23–24.

274 See e.g., United States v. Massey, 594 F.2d 676, 679–81 (8th Cir. 1979)
FBI crime lab in 1942 professionalized the technique,\textsuperscript{275} the result was not

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\item reversing and remanding for new trial because, in light of the importance of the hair comparison evidence, the use of statistical evidence from the Canadian study by Gaudette and Keeping—which found there was a 1 in 4,500 possibility that the hair could have come from someone other than the defendant—was not harmless error; Williamson v. Reynolds, 904 F. Supp. 1529 (E.D. Okla. 1995) (finding reversible error when an expert cited Gaudette’s studies—which estimated that the probability that two microscopically similar hairs came from two different sources was 1 in 4,500 and that the probability for this kind of error in pubic hair analysis was 1 in 800—because the implication was that the hairs belonged to the petitioner); People v. Cooper, 809 P.2d 865, 878–79 (Cal. 1991) (“Unlike fingerprint comparison, an absolute match is not possible when comparing hairs.”); Thompson v. State, 539 A.2d 1052, 1057–59 (Del. 1988) (finding that hair comparison evidence does not create probable cause to arrest a suspect because it is universally acknowledged that hair comparison evidence is not a form of positive identification, though it may link a suspect to a crime); Long v. State, 689 So. 2d 1055, 1058 ( Fla. 1997) (reversing defendant’s conviction for insufficient evidence because “[h]air comparisons cannot constitute a basis for positive personal identification because hairs from two different people may have precisely the same characteristics”); Jackson v. State, 511 So. 2d 1047, 1049 (Fla. Dist. Ct. App. 1988) (reversing trial court’s denial of defendant’s motion for acquittal and vacating his conviction and sentence because the defendant’s conviction hinged on hair comparison evidence which did not result in absolute identification); People v. Linscott 566 N.E.2d 1355, 1360 (Ill. 1991) (finding the state’s use of Gaudette statistics and its expert’s conclusively stating the hairs belonged to defendant constituted reversible error); State v. Carlson 267 N.W.2d 170, 176 (Minn. 1978) (holding that the Gaudette statistics were improperly received but were cumulative and unprejudicial); State v. Scarlett, 426 A.2d 25, 28 (N.H. 1978) (finding harmless error, despite the fact that information about the Gaudette study was erroneously admitted as double-hearsay—at least—when a witness cited the study for the proposition that there was a forty-five to one chance that consistent hair had different origins); State v. Bridges, 421 S.E.2d 806, 808 (N.C. App. 1992) (finding no reversible error when witness testified to two studies on the probability of matching caucasian hairs coming from two different sources; the court found that evidence was admissible but could not be used to positively identify a person.); Crawford v. State, 840 P.2d 627, 636 (Okla. Crim. App. 1992) (finding witness properly testified as to the limits of hair comparison analysis when she stated that she could not conclude that a hair belonged to a particular individual beyond a reasonable doubt.); Brown v. State, 751 P.2d 1078, 1080 (Okla. Crim. App. 1988) (finding harmless error in admitting the Gaudette statistics).
\end{itemize}
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better science, but widespread, exaggerated claims of the capabilities of hair evidence. As discussed earlier, there is evidence that the FBI understood the inherent limitations of hair microscopy evidence but deliberately obfuscated these limitations through testimony that either implicitly or explicitly argued that association between a suspect’s hair and a crime scene hair was highly probative evidence of the defendant’s presence at the scene. Instead of utilizing a validated measurement process with objective thresholds for declaring a “match” (hypothesis one), experts began making claims that the internal characteristics of hair—as observed though the high-powered, side-by-side microscopic examination of questioned and known hairs—revealed similarities of such minute quality that simply “matching” the two hairs was probative evidence of the source of the questioned hair. Such claims were made


276 See supra notes 262–66 and accompanying text.

277 See supra notes 273–74 and accompanying text.

278 See, e.g., United States v. Hickey, 596 F.2d 1082, 1084 (1st. Cir. 1979) (“An FBI agent testified that some hairs found on one of the ski masks, sweater, and in the hair brush were ‘microscopically identical’ to the hairs of the defendant . . . .”); Massey, 594 F.2d at 678 (“Agent James Hilverda, an expert in microscopic analysis, testified that Carl Massey's hair was similar to three of the five hairs found in the blue ski mask in all categories of microscopic comparison.”); United States v. Holleman, 575 F.2d 139, 145 (7th Cir. 1978) (“An expert from the FBI laboratory testified that he had examined the human hairs found on those items and compared them to Taylor's hair. They matched in every one of the twenty microscopic, identifiable characteristics.”); Pitts v. State, 617 S.W.2d 849, 851 (Ark. 1981) (“The Negroid hair, when examined with a microscope, had 20 different characteristics. Sample specimens of Pitts's hair had exactly the same 20 characteristics.”); Padilla v. People, 397 P.2d 741, 743 (Colo. 1964) (describing how witness matched the victim’s hairs to those found in the defendant’s car and stated “unequivocally that the hairs were from one and the same person.”); Beam v. State, 463 S.E.2d 347, 348 (Ga. 1995) (discussing crime lab expert who found that hair recovered
despite the fact that there is microscopic variability between hairs originating from the head of the same individual.\textsuperscript{279}

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\textsuperscript{279} See, e.g., Breen v. State, 349 So. 2d 113, 117 (Ala. Crim. App. 1977) (noting that the witness, the Supervisor of Scientific Investigation for the Birmingham Police Department, "testified that there was a great deal of variation in hair diameter, color, length and texture on a single head and for this reason hair could not be specifically identified as belonging to a particular individual"); People v. Allen, 41 Cal. App. 3d 196, 202 (Cal. Ct. App. 1974) (criminologist “admitted on cross-examination that the present state of the art of testing hair presently made identification by hair samples inconclusive, as hair of any individual had a range of distinguishing characteristics"); NAT’L RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE 158 (1992) (“Although hair examiners can associate a hair with racial characteristics and body source (trunk, head, or pubic area) the variations among hairs on a given person make definitive association of a
The juxtaposed photos below illustrate the persuasive power of visual demonstrations of so-called “matches.” One photo depicts a hair from Jimmy Ray Bromgard; the other a hair recovered during the investigation of the sexual assault of an eight-year-old girl for which Bromgard stood accused.\textsuperscript{280} The FBI-trained hair comparison expert who testified in the prosecution of Bromgard claimed that his analysis revealed that the recovered hair belonged to Bromgard.\textsuperscript{281} More specifically, he asserted that the head and pubic hairs found on the sheets were indistinguishable from Bromgard’s and that there was less than one in ten thousand (1/10,000) chance that the hairs did not belong to him.\textsuperscript{282} The photo below was used to display the visual similarities. Bromgard was convicted and spent nearly 15 years in prison.\textsuperscript{283} He was exonerated in 2002 after post-conviction DNA testing established that the hairs in the figure actually originated from different sources.\textsuperscript{284}

\textsuperscript{280} Digital copies of these photographs were provided to the authors by Mr. Bromgard’s attorney, Peter J. Neufeld. The original court exhibit remains in Mr. Neufeld’s files.

\textsuperscript{281} Hsu, \textit{Review of FBI Forensics Does Not Extend to Federally Trained State, Local Examiners, supra note 78}.


\textsuperscript{283} See id.

\textsuperscript{284} See id.
These types of visual demonstrations of microscopic “matches” were supported by impressively credentialed “scientists,” who—like the bite mark experts discussed above—urged jurors to accept their conclusions as probative evidence of the defendant’s guilt.\(^{285}\) Yet, instead of developing a statistical basis to provide scientifically valid conclusions concerning the probative value of an association between a known and a questioned hair (hypothesis two),\(^ {286}\) FBI examiners used meaningless

\(^{285}\) See supra notes 273–74 and accompanying text.

\(^{286}\) Nevertheless, examples of the use of such statistics are as plentiful as they are invalid. See, e.g., People v. Linscott, 566 N.E.2d 1355, 1360 (Ill. 1991); State v. Carlson, 267 N.W.2d 170, 176 (Minn. 1978); compare State v. Bromgard, 862 P.2d 1140, 1141 (Mont. 1993) (expert testified that “in his experience the odds were one in one hundred that two people would have head hair or pubic hair so similar that they could not be distinguished by microscopic comparison and the odds of both head and pubic hair from
terms of art\textsuperscript{287} that simultaneously masked the lack of population data while conveying to jurors that the defendant was the likely source of the questioned hair.\textsuperscript{288} To do so, agents from the FBI’s hair and fiber unit proffered—and trained other analysts to proffer\textsuperscript{289}—scientifically false and misleading testimony. This invalid testimony fell into three broad categories. First, and most brazenly, experts baldly asserted and or implied that the defendant was the source of the questioned hair to exclusion of all other potential sources.\textsuperscript{290} Second, experts also used fictitious numbers to assign a statistical weight or probability to the proposition that the questioned hair originated from a particular source.\textsuperscript{291} Where experts refrained from using numbers, probabilistic opinions were expressed through language that led jurors to believe that valid statistical weight could be assigned to a microscopic hair association.\textsuperscript{292} Finally, analysts employed inappropriate substitutions of heuristically gained knowledge for a valid statistical basis in order to bolster the conclusion that a questioned hair belonged to the defendant.\textsuperscript{293} As in the Odom case discussed above, such testimony was expressed by citing the number of hair analyses the expert performed in the lab over the course of her career and the number of samples from different individuals that could not be

\textsuperscript{287} See supra note 276 (citing examples of expert testimonial conclusions concerning the probative value of hair comparison evidence).

\textsuperscript{288} Id.

\textsuperscript{289} See infra Part III.

\textsuperscript{290} The FBI has labeled such testimony as a “Type 1 Error[].” See supra note 119.

\textsuperscript{291} See supra notes 273–74.

\textsuperscript{292} This variety of false and misleading testimony has been labeled as a “Type 2 Error[]” by the FBI. See supra note 119.

\textsuperscript{293} The FBI has labeled such testimony as a “Type 3 Error[].” See supra note 119.
distinguished from one another.294 This testimony was proffered to suggest—without evidence—that human hair was virtually unique and, therefore, that the microscopic “match” between the known and questioned hair was highly probative evidence.295

These misleading statements—accompanied by impressive visual and oral explanations of points of microscopic comparison—allowed experts to argue that human hairs were “microscopically identical,”296 (i.e., essentially unique) and conclude that the questioned hair was therefore “consistent with” having originated from the defendant.297

294 See the discussion of the Odom exoneration at Part I.C.
295 These errors have been classified as “Type 3” errors. See supra note 119.
296 See supra note 278 and accompanying text.
Affirming appellate courts, however, often pointed to the term “consistent with” in finding that the evidence—even if unreliable—was unlikely to have affected the outcome of trial because the expert qualified the conclusions.298

The prosecution of Timothy Scott Bridges in North Carolina is a useful illustration of the dissonance between what a jury was lead to believe the probative value of hair evidence was and the way appellate courts characterized the evidence on appeal. Such characterizations of hair evidence by appellate courts perpetuated decades of invalid precedent and gave license to hair examiners to continue to mislead juries. At Bridges’ 1991 trial for the beating and rape of an elderly woman, an FBI-trained hair expert testified that two head hairs found at a crime scene were “consistent with” Bridges.299 He explained that “if an unknown hair is consistent with the standard source in all respects, then it is likely that the hair originated from the same source as the standard.”300 While acknowledging that no single characteristic in Bridges’ hair could be considered unique, the expert testified that “all of those characteristics in combination is what makes it a strong identification.”301 The analyst invented statistical evidence to falsely claim that, based on his examination of 2,000 to 3,000 hairs, the “a conservative estimate . . . would be approximately one in a thousand” that one would find two people from the general population with Caucasian head hairs whose hair would contain identical microscopic characteristics.302 Finally, he testified that it was his opinion that “it is likely that [the two hairs] originated from Timothy Scott Bridges.”303 The appellate court—relying on the “disclaimer” and the court’s previous acceptance of the same type of

298 See supra note 297.


300 Id. at 773.

301 Id. at 839.

302 Id. at 803–04.

303 Id. at 825.
testimony from the same expert—found that the statement that “it [the hair] is quite likely to have been from [the defendant],” was appropriate because the expert “did not rule out the possibility that the hair originated from someone other than the defendant.”304 Although the “statistical illustration,” was error, it was harmless because it “was based on the expert's experience and expertise in the hair microscopy field and did not eliminate the possibility of sources of the hair other than defendant.”305 The error was the only physical evidence tying the Bridges to the crime, and the prosecutor argued that two hairs from the crime scene “match[ed]” the defendant and that the expert—who “was qualified by the judge as an expert in this field of hair”—had assured the jury that “was likely to have come from the defendant.”306

Since Bridges’ conviction,307 at least seventy-four defendants have been wrongfully convicted based at least in part on microscopic hair comparison.308 While the DNA revolution that inspired Saks and Koehler’s predicted paradigm shift has brought some level of additional scrutiny to the misleading claims of these and other trace evidence

305 Id. at 809.
306 Bridges Transcript, supra note 299, at 999–1000.
307 While this article was in final revisions, Mr. Bridges’s 1991 conviction was vacated, and he was released from prison after 25 years. The court found that introduction of the hair comparison in the case violated Mr. Bridges’s due process rights under both the federal and North Carolina constitutions. See Consent Order, State v. Bridges, No. 90-CRS-23102-04 (Mecklenburg Cnty. Superior Ct. Oct. 1, 2015) (“The admission of testimony containing the identified error types [identified in the FBI review] violated the Defendant’s right to due process because it exceeded the limits of science and overstated the significance of the hair analysis to the jury.”) (on file with authors); Order Directing Defendant’s Release, State v. Bridges, No. 90-CRS-23102-04 (Mecklenburg Cnty. Superior Ct. Oct. 1, 2015) (on file with authors); Notice of Dismissal, No. 90-CRS-23102-04 (Mecklenburg Cnty. Superior Ct. Feb. 16, 2016)
experts, a century of case law supported—and continues to support—the admissibility of false and misleading expert testimony in the field of hair microscopy. The unanimity of case law proceeded apace, even in jurisdictions with multiple DNA exonerations of wrongfully convicted defendants. State v. Reid—the first opportunity the Connecticut Supreme Court had to consider the admissibility of hair comparison evidence after the state adopted the Daubert test—is illustrative of how invalid precedent continues to frustrate due process. In response to a rare and strenuous objection to introduction of hair microscopy evidence, the trial court—in still a rarer occurrence—held a Daubert hearing prior to the introduction of the evidence. In finding the evidence properly admitted because the “technique had been admitted in Connecticut courts for many years,” the Connecticut high court went a step further, finding that, in any event, hair comparison evidence was not the type of evidence required to undergo Daubert scrutiny:

Although [the expert’s] training is based in science, he testified about a subject that simply required the jurors to use their own powers of observation and comparison. During his testimony, [the expert] displayed an enlarged photograph of one of [Mark Reid’s] hairs and one of the hairs recovered from the victim’s clothing as they appeared

309 See, e.g., Garrett & Neufeld, supra note 10.

310 See, e.g., Johnson v. Commonwealth, 12 S.W.3d 258, 262–63 (Ky. 1999) (“Based upon the overwhelming acceptance of this evidence by other jurisdictions, as well as our own history of routine admission of this evidence at trial, trial courts in Kentucky can take judicial notice that this particular method or technique is deemed scientifically reliable.”).

311 757 A.2d 482 (Conn. 2000).


313 Although such hearings are referred to as “Porter hearings” in Connecticut, we use the label “Daubert hearing” in states that have adopted the Daubert test for consistency.

314 Reid, 757 A.2d at 487–88.
side-by-side under the comparison microscope. [The expert] explained to the jurors how the hairs were similar and what particular features of the hairs were visible. He also drew a diagram of a hair on a courtroom blackboard for the jurors. The jurors were free to make their own determinations as to the weight they would accord the expert's testimony in the light of the photograph and their own powers of observation and comparison. The jurors were not subject to confusing or obscure scientific evidence, but were able to use the testimony to guide them in their own determination of the similarity of the two hairs.\textsuperscript{315}

Post-conviction DNA testing proved that Reid was innocent of the rape for which he was convicted.\textsuperscript{316} Apart from highly suspect eyewitness identification evidence,\textsuperscript{317} the only evidence introduced against him was

\textsuperscript{315} \textit{Id.} at 487. In an apparent effort to foreclose any future challenge to the admissibility of hair comparison evidence, the court found that, “even if a [Daubert/Porter] hearing were necessary, . . . microscopic hair analysis satisfied the \textit{Porter} test because of its general acceptance in the scientific community.” \textit{Id.} at 488 n.3. The court further found that:

in \textit{Kumho} . . . the United States Supreme Court held that a trial court has discretion to apply \textit{Daubert} to all expert testimony, not just that which constitutes ‘scientific evidence.’ We need not decide in this case whether to apply \textit{Kumho} in our \textit{Porter} analysis, however, because it would not alter our conclusion that the trial court properly admitted the evidence.

\textit{Id.} at 488 n.4.


\textsuperscript{317} \textit{See Reid}, 2003 WL 21235422, at *7. The victim had been forcibly raped in a
hair comparison testimony from the lead criminologist at the Connecticut Forensic Science Laboratory. The expert testified “unequivocally” that three pubic hairs discovered on the victim’s panties, bra, and sock were “were Negroid pubic hairs,” and concluded “to a ‘reasonable degree of scientific certainty,’” that the pubic hairs found on the victim's clothing were microscopically similar to those pubic hair samples taken from Mark Reid. DNA testing not only excluded Reid as the source, but it also established that the pubic hairs originated from the caucasian victim.

Because it was a case of first impression, the court looked to other jurisdictions for support “that a Daubert hearing [was] not required for admission of microscopic hair analysis,” including the Tenth Circuit’s opinion in Williamson v. Ward, a decision arising out of a habeas corpus petition by condemned Oklahoma prisoner Ronald Williamson. 

Like Reid, Williamson was innocent but had been convicted on hair microscopy evidence; indeed, Williamson was exonerated the year before the Reid decision. In Reid’s case, the court mischaracterized Williamson as standing for proposition that hair microscopy was not the type of

[318] See id. at *3–4.
[319] Id. at *5.
[320] Id. at *12.
[322] See id. at 487; Williamson v. Ward, 110 F.3d 1508 (10th Cir. 1997).
[323] Williamson and his co-defendant Dennis Fritz were both innocent. See Ron Williamson, INNOCENCE PROJECT, http://www.innocenceproject.org/Content/Ron_Williamson.php (last visited Nov. 21, 2015).
evidence required to undergo 

325 Daubert scrutiny. The Tenth Circuit reversed the district court’s decision, which found that hair microscopy failed every element of the Daubert test, because due process—not Daubert—was the controlling standard for federal habeas review of state court evidentiary rulings. The Tenth Circuit affirmed the district court’s granting of relief on other grounds, but directed the trial court to conduct its own evidentiary hearing on the admissibility of the hair evidence.

Before the case could be retried, though, Ronald Williamson and Dennis Fritz—a co-defendant who had been tried separately—were exonerated after post-conviction DNA testing revealed that the hair microscopy claims were misleading and false and that that a witness for the state had been the true perpetrator. State courts—including Oklahoma criminal courts—nevertheless took pains to point out that the failed Daubert test in Williamson was not controlling precedent and thereafter continued to admit hair comparison evidence. Oklahoma hair

325 State v. Reid, 757 A.2d 482, 487 (Conn. 2000).
326 The district court was “unsuccessful in its attempts to locate any indication that expert hair comparison testimony meets any of the [Daubert] requirements.” Williamson v. Reynolds, 904 F. Supp. 1529, 1554 (E.D. Okla. 1995). The court further observed that “[a]lthough the hair expert may have followed procedures accepted in the community of hair experts, the human hair comparison results in this case were, nonetheless, scientifically unreliable.” Id. at 1554.
327 See Williamson v. Ward, 110 F.3d 1508, 1523 (10th Cir. 1997).
328 See id.
329 See generally JOHN GRISHAM, THE INNOCENT MAN (2006). DNA testing revealed that none of the hairs that hair microscopy experts had labeled “matches” belonged to the defendants. See Ron Williamson, supra note 324. In addition, a DNA profile developed from the semen evidence matched a third person, who had been one of the state’s witnesses at trial. See id. Ron Williamson—and Dennis Fritz, who was also charged and convicted—were exonerated and released in April 1999. See id. At one point, Williamson was within five days of execution. Id. Collectively, the two spent eleven years imprisoned. See id.
330 See McGrew v. State, 673 N.E.2d 787, 800 (Ind. Ct. App. 1996) (“Mindful of our Supreme Court’s endorsement of Daubert and its progeny, we nonetheless conclude that Williamson is inapplicable to this case.”); Bryon v. State, 935 P.2d 338, 359 n.62 (Okla. Crim. App. 1997) (“Williamson is not binding on this Court. Bryon offers no other reason
microscopy jurisprudence demonstrates the lethal dissonance between scientific reality and legal precedent. The rejection of the federal court’s Daubert analysis occurred in 1997, between 1998 and 2012, eight defendants whose convictions were obtained at least in part through hair evidence were exonerated, including three people sentenced to death. Nonetheless, there has never been a negative admissibility ruling concerning such hair evidence in Oklahoma; in the only documented challenge, the defendant lost. The defendant in that case—Curtis McCarty—was innocent of the capital murder for which he was convicted. He argued for the exclusion of hair evidence in a pretrial motion in limine because “the reliability of forensic hair comparison to review this settled area of law.”); State v. Fukusaku, 946 P.2d 32, 43 n.5 (Haw. 1997).

331 See Bryon, 935 P.2d at 359 n.62.


333 See McCarty v. State, 904 P.2d 110, 125 (Okla. Crim. App. 1995) (“[McCarty] acknowledges that hair comparison evidence is routinely used in criminal trials and this Court has previously found such testimony to be admissible. . . . However, he urges this Court to reconsider its position regarding the admissibility of hair analysis evidence, a request rejected by this Court in the past. [McCarty] has not persuaded this Court to now hold otherwise.”) (internal citations omitted).

334 See Curtis McCarty, supra note 332.
evidence has not been adequately established.”

The court admitted the evidence, and the appellate court, relying on Oklahoma precedent, reaffirmed the admissibility of hair comparison evidence.

Perhaps most interesting is courts’ treatment of the admissibility of hair evidence in those jurisdictions that featured precedent excluding the discipline. Such treatment is, in some sense, a disturbing inversion of trial and appellate courts’ reflexive embrace of precedent in the bite mark context. In New Hampshire, for example, the state supreme court affirmed the trial court’s exclusion of the evidence as early as 1969, noting that “the evidence on hair-identification offered by the State would not be acceptable to scientists in the field” and, as such, did not meet the Frye standard requirement that the “scientific principle involved . . . ‘be sufficiently established to have gained general acceptance in the particular field in which it belongs.’”

Thereafter, the evidence was admitted in three reported New Hampshire cases decided subsequent to Coolidge—in 1976, 1978 and 1981 respectively—which dealt with the admissibility of hair testimony.

In People v. Roff, a 1979 New York case, the appellate court found that:

335 McCarty, 904 P.2d at 125.
336 See id.
338 See State v. Scarlett, 426 A.2d 25, 27–28 (N.H. 1981) (relying on Farrow and distinguishing Coolidge, the court determined that expert testimony that (1) hair found on defendant’s bed and the victim’s hair were “morphologically similar” in “fifteen recognized microscopic characteristics,” and (2) that when hairs are “found to be consistent with respect to all these different microscopic characteristics . . . the chances of them having come from anyone else are forty-five to one” was admissible); State v. Farrow, 386 A.2d 808, 815 (N.H. 1978) (relying on Breest, the court admitted evidence where the expert witness “could not positively identify that the hair” belonged to defendant, but could conclude that the hair was similar to the defendant’s “in all fifteen recognized microscopic characteristics”); State v. Breest, 367 A.2d 1320, 1331–33 (N.H. 1976) (rejecting a due process challenge to an expert witness’ hair comparison and identification testimony that there “exists a high degree of probability and reasonable ability that we have had contact between this (victim’s) clothing and that (defendant’s) car”).
[The trial court erred] in receiving and refusing to strike the testimony of the chemist that the hair taken from the bathroom and found at the scene of the crime could have come from the same person and that there was some similarity between the two samples, and erred in receiving the physical evidence itself . . . because the evidence was inadequate to connect the hair samples with defendant's hair, it was inadmissible, because it did not “accurately portray a relevant and material element of the case.”

Thereafter, however, New York hair evidence jurisprudence stands in direct opposition to Roff, supporting the admissibility of such evidence.

C. THE FBI’S TRAINING OF HUNDREDS OF STATE HAIR EXAMINERS TO PROVIDE FALSE AND MISLEADING TESTIMONY

The false hair comparison evidence that helped wrongfully convict David Johns Bryson and Jimmy Ray Bromgard was introduced through two disgraced forensic analysts from state crime labs: Joyce Gilchrist and Arnold Melnikoff, respectively. Both analysts—like many hundreds of others, including the analyst in the Bridges case—were trained by the FBI in a two-week training course at the FBI Academy in Quantico, Virginia, and both later stated that they had been trained by the FBI to

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340 See, e.g., People v. Allweiss, 396 N.E.2d 736 (N.Y. 1979); Matter of Barber v. Rubin, 72 A.D.2d 347, 350 (N.Y. App. Div. 1980) (“[A]n expert in the field can conclude with a reasonable degree of certainty whether hair from an unknown source matches the hair from a known source; that hair samples microscopically alike or closely similar can be said with a high degree of probability to have originated from the same source.”).

341 See Spencer S. Hsu, Review of FBI Forensics Does Not Extend to Federally Trained State, Local Examiners, supra note 78.

342 See Bridges Transcript, supra note 299, at 766.
provide false and misleading testimony. Gilchrest’s records showed that she was trained to use her experience to bolster the strength of her conclusion:

In her files, she kept a certificate of completion from her January 1981 class, including a session on ‘Discussion of the significance of hair comparisons, testimony matters and pertinent literature.’

In her notes, she copied the FBI caveat that one cannot conclusively determine the source or origin of a hair. But, the notes also showed that instructors were teaching their students how to sidestep the limits of the science — by pointing out their experience.

‘Can conclude source — point out however in my experience, have rarely seen hairs from diff. people exhibiting the same microscopic characteristics,’ the notes say.

Other FBI-trained examiners made nearly identical assertions related to using bench experience as both a workaround for the lack of a valid statistical basis and a way to undermine the “disclaimer.” As noted, there is evidence that there was, in fact, no massive failure by FBI scientists to appreciate fundamental scientific principles, but rather that the limitations of hair comparison evidence were understood and deliberately obscured to implicate defendants. For example, during the 1985 “International Symposium on Forensic Hair Comparisons” at the FBI Academy in Quantico, a revealing panel discussion took place concerning the lack of a statistical basis to support the claims of hair comparison

343 See Hsu, Review of FBI Forensics Does Not Extend to Federally Trained State, Local Examiners, supra note 78.
344 Id.
345 Id.
experts.\textsuperscript{346} This panel included two participants from the FBI Laboratory, the Chief Scientist for the Hair and Fibers Section for the Royal Canadian Mounted Police, the Chief Scientific Officer for the Metropolitan Police Forensic Science Laboratory in London, the Scientific Director for the General Biology Section in Germany, and Dr. Peter De Forest, a Professor of Criminalistics at John Jay College.\textsuperscript{347} During the discussion, Dr. De Forest explained the limits of the “evidential value of hair” and some of the “defense expert’s perspectives on the hair question” that he had gleaned through his experience.\textsuperscript{348} He emphasized that “hair examination” is non-absolute associative evidence whose “power” is to “exclude hair.”\textsuperscript{349} Dr. De Forest also explained how experts are prone to overstating the value of hair comparison through the inappropriate leveraging of bench experience:

I have a problem with the divergence from a laboratory report in which the conclusion is these hairs could have shared a common origin to the presentation of testimony in court when the expert says something to the effect that, ‘Yes, these hairs were found to be similar and in my experience I have examined thousands of hairs and I have never found two hairs from different sources that were alike.’ I think that is very misleading and it is not substantiated by any data.\textsuperscript{350}

Dr. De Forest and other panelists emphasized that it was “clear more [had] to be done” concerning the training of hair microscopy


\textsuperscript{347} See id. at 193.

\textsuperscript{348} Id. at 199.

\textsuperscript{349} Id.

\textsuperscript{350} Id. at 204.
“experts.” He noted that he was involved with an FBI-sponsored Committee of Forensic Hair Comparison, which he felt “should be an ongoing committee” because they had “not solved all the problems by any means.” More recently, FBI Special Agent Michael Malone—a former supervisor in the FBI’s Hair and Fiber Unit—acknowledged in a civil deposition that, by the mid-1980s, FBI agents had had conversations “to [the] effect” that “[s]ince we didn’t have a database and we didn’t have, you know, real probabilities, scientifically valid probabilities, let’s try and use these numbers of the cases that we have looked at in lieu of real probabilities.”

Nevertheless, as recently as 2009, the FBI published a report insisting that the technique could provide a “strong basis for an association” and that, although hair microscopy was “not a means of positive identification,” it could “provide substantial information because of the variation in hair among individuals.” The report likewise stated that the significance of the association could be expressed “qualitatively or semi-qualitatively” and that the only “limitation on the science [was] that there was always the possibility of a coincidental match.”

351 Id. at 209.
352 Id.
354 See Oien, supra note 245.
355 Id.
D. THE FALL OF HAIR MICROSCOPY

The tide only began to turn against hair microscopy with the 2009 publication of the NAS Report.\textsuperscript{356} The Report concluded that hair microscopy could not uniquely identify one person as the source of a hair; instead, at best, a “match” between two hair samples “mean[t] only that the hair could have come from any person whose hair exhibited – within some levels of measurement uncertainties – the same microscopic characteristics.”\textsuperscript{357} In addition, the NAS Report made it clear that first hypothesis underlying the technique was invalid, noting that there was no consensus “on the number of features on which hairs must agree before an examiner may declare a ‘match.’”\textsuperscript{358} The second hypothesis was likewise found to be invalid, as there were no statistics on the distribution of particular hair characteristics in the population.\textsuperscript{359} The Report’s ultimate conclusion was “that testimony linking microscopic hair analysis with particular defendants [was] highly unreliable,” and that evidence of a match “must be confirmed using mtDNA analysis.”\textsuperscript{360}

Following the NAS Report, a series of news articles in \textit{The Washington Post} revealed that erroneous testimony by FBI hair examiners was “widespread and could affect potentially thousands of cases in federal, state and local courts.”\textsuperscript{361} \textit{The Post} reported that, despite the claims made by FBI analysts, it was virtually impossible to distinguish between two human hairs from different sources; in one instance, mitochondrial DNA testing revealed that two “FBI-trained analysts . . . could not even distinguish human hairs from canine hairs.”\textsuperscript{362} Consequently, “hundreds of defendants nationwide remain in prison or on

\textsuperscript{356} See NAS REPORT, supra note 4.
\textsuperscript{357} \textit{Id.} at 156.
\textsuperscript{358} \textit{Id.} at 160.
\textsuperscript{359} \textit{Id.}
\textsuperscript{360} \textit{Id.} at 161.
\textsuperscript{361} Hsu, \textit{Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department}, supra note 75.
\textsuperscript{362} \textit{Id.}
parole for crimes that might merit exoneration, a retrial, or a retesting of evidence using DNA because FBI hair and fiber experts may have misidentified them as suspects.”

The NAS Report, in conjunction with intense media scrutiny and numerous exonerations—particularly those of three men in the Washington, D.C. area who were exonerated after mitochondrial DNA contradicted hair microscopy testimony proffered by FBI examiners eventually persuaded the FBI to reexamine the thousands of cases between 1980 and 2000 where its agents testified to a positive association between a defendant’s hair and a questioned hair collected from a crime scene.

In doing so, the FBI essentially adopted the NAS Report’s critique, acknowledging for the first time that hair microscopy is limited “in that the size of the pool of people who could be included as a possible source of a specific hair is unknown.” Therefore, an examiner may not apply “probabilities to a particular inclusion of someone as a source of a hair of unknown origin.”

Instead, the strongest conclusion one can draw is that the suspect could be included in a class of people of unknown size that

363 Id.


366 FED. BUREAU OF INVESTIGATION, MICROSCOPIC HAIR COMPARISON ANALYSIS AGREEMENT, supra note 119, at 1.

367 Id.
could have been a possible source of the evidentiary hair.\textsuperscript{368}

The FBI has acknowledged the three categories of errors discussed above,\textsuperscript{369} which were routinely proffered by its agents—and those they trained—in thousands of cases.\textsuperscript{370} In the FBI’s ongoing review, the DOJ has agreed to waive any statute of limitations or procedural bars under 28 U.S.C. § 2255 in federal post-conviction cases where error is found, due to the manifest unfairness of punishing a criminal defendant for the FBI’s protracted campaign to advance the prosecution’s case without regard to the limitations of hair microscopy.\textsuperscript{371} Even so, hair comparisons have been proffered to juries as “scientific” evidence and used to convict people—and to uphold wrongful convictions on direct appeal—sometimes with very little other corroborating or incriminating evidence.

IV. ATTENDANT OBLIGATIONS

The long-predicted and now manifest paradigm shift in forensic identification evidence is rooted in a systemic, century-long failure by nearly all criminal justice stakeholders to comprehend, question, challenge, and exclude as unreliable the false and misleading assertions made by forensic experts and exploited by advocates to persuade lay jurors. This fundamental breakdown in the adversarial process this nation relies upon to discover the truth—illustrated most starkly by the empirical data—compels several prospective and retrospective ethical and professional obligations. Because the shift has occurred across disciplines and over time, the obligations extend not only to specific individuals in those disciplines, but also to distinct professional and governmental entities.

What follows in this section are some broad suggestions for how our justice system might recover scientific integrity and how these solutions might be implemented. Included as well as are some discrete

\textsuperscript{368} See id.

\textsuperscript{369} See id. (discussing error types).

\textsuperscript{370} See Reimer, supra note 365.

\textsuperscript{371} See infra note 427.
proposals that we believe must be an aspect of whatever solution is implemented. Some of what is at stake is obvious, beginning with the reputation of the criminal justice system itself.\footnote{372} If past history is any indication, it goes almost without mentioning that a failure to act will stymie the discovery of numerous instances of wrongful conviction. Apart from that, though, as former Attorney General Janet Reno once noted at a conference to address the wrongful conviction phenomenon:

\begin{quote}
If the public’s confidence in the results of the criminal justice system erode, then the public will not accept the criminal justice system’s findings and results . . . [a]nd what we do with the criminal justice system, which is the hallmark of the legal system for so many Americans looking in from the outside, will make a profound difference for this century.\footnote{373}
\end{quote}

The ethical and professional obligations that we argue apply are unprecedented. But so too are the circumstances that obligate their imposition. The system-wide problems that we have identified here will not self-correct.\footnote{374} Additionally, traditional sources of authority for corrective direction—including the Model Rules and governing bodies’ ethical guidelines—are almost exclusively prospectively focused and, more importantly, simply do not address these kinds of systemic failures. While there have certainly been instances where courts have attempted to correct episodes of systemic forensic fraud, those instances were less about the shortcomings of a discipline and more about the malfeasance of

\begin{footnotes}
\footnote{373} AM. JUDICATURE SOC’Y, CONFERENCE ON PREVENTING THE CONVICTION OF INNOCENT PERSONS 5 (2003).
\footnote{374} Indeed, hair microscopy and bite mark analysis still enjoy near universal admissibility. See supra Parts II–III.
\end{footnotes}
specific individuals involved in them.\textsuperscript{375} Here, the fault lies at the core of the disciplines themselves and in layers of invalid legal precedent. There is no rule or ethical obligation that contemplates these problems, much less addresses them. To the extent that individuals are involved, it is not discrete outliers, but line prosecutors and defense attorneys, who acted without correction for decades. Those prosecutors and defense attorneys were aided and abetted by forensic witnesses—who operated within unvalidated disciplines, exaggerated findings, or both—as well as courts that shamelessly facilitated all of it, abdicating their gatekeeping responsibilities and relying on lay jurors to separate science from subjective speculation convincingly masquerading as science. At the same, courts continued to allow courtroom advocates to further exploit invalid expert opinions in opening and closing statements.\textsuperscript{376} Where DNA exonerations made it apparent that the claims these experts were making were grossly unreliable, courts failed to engage in any type of responsible analysis when asked to provide correction. The list of those held accountable for proffering unvalidated forensic testimony is short;\textsuperscript{377} for

\textsuperscript{375} For a good overview of several incidents of systemic forensic fraud, see Paul C. Giannelli, \textit{Scientific Fraud}, 46 CRIM. L. BULL. 1313 (2010).

\textsuperscript{376} \textit{See}, e.g., Bridges Transcript, \textit{supra} note 299, at 999–1000.

\textsuperscript{377} \textit{See}, Paul C. Giannelli & Kevin C. McMunigal, \textit{Prosecutors, Ethics, and Expert Witnesses}, 76 FORDHAM L. REV. 1493 (2007). There are several documented incidents, each of which also reflects an acknowledgement of the damage to the system as a whole. The FBI, for example, which runs the nation’s most renowned forensic lab, had one of its own analysts plead guilty to a charge of making false statements, an occurrence which, according to the Justice Department’s Inspector General, “has damaged intangibly the credibility of the FBI laboratory” as a whole. Maurice Possley et al., \textit{Scandal Touches Even Elite Labs}, CHICAGO TRIBUNE (Oct. 21, 2004), http://www.chicagotribune.com/news/watchdog/chi-041021forensics-story.html. In addition, some courts have authorized administrative actions into incidences of gross forensic malfeasance. \textit{See In re Investigation of the W. Va. State Police Crime Lab., Serology Div.}, 438 S.E.2d 501 (W. Va. 1993) (discussing the fact that the West Virginia Supreme Court appointed a special judge to investigate claims that Fred Zain, a serologist in the West Virginia State Police Forensic Laboratory, gave false testimony and sometimes offered comment about the effect of gross forensic malfeasance). Courts have also on occasion—often in dissent—offered criticism. \textit{See, e.g.}, Brooks v. State, 748 So. 2d 736, 750 (Miss. 2006) (McRae, J., dissenting) (internal citations omitted) (“This Court's apparent willingness to allow West
those individuals and entities responsible for the admission of bite mark testimony and hair microscopy evidence, the list is virtually non-existent.

For these reasons, then, we first argue that at least two positions typically proffered by prosecutors to deny petitioners post-conviction relief ought to be unethical to advance as a result of the information marshaled in this article. It is our position that individual prosecutors should be ethically barred from arguing: (1) that a defendant-petitioner should have known at the time of trial that a forensic discipline was unvalidated or false, particularly if its admission into evidence was achieved through improper processes, like the ones described earlier; and, (2) that whatever prejudice may have resulted from the admission of such evidence could have been cured through cross-examination and/or by the “disclaimers” described above. Second, as it relates to defense counsel, we argue that it is per se ineffective assistance of counsel to fail to testify to anything and everything so long as the defense is permitted to cross-examine him may be expedient for prosecutors but it is harmful to the criminal justice system.”).

Leaving aside the issue that arises from the admission of false evidence, there is a good deal of scholarship that specifically addresses the effectiveness of cross-examination regarding forensic evidence. See, e.g., Jonathan Koehler, *If the Shoe Fits They Might Acquit: The Value of Forensic Science Testimony*, 8 J. EMPIRICAL STUD. 21 (2011). Indeed, one experiment, which tested the reaction of potential jurors to flaws in microscopic hair examination, found that alerting jurors to problems had little impact on their decision-making. See Dawn McQuiston-Surrett and Michael J. Saks, *Communicating Opinion Evidence in the Forensic Identification Sciences: Accuracy and Impact*, 59 HASTINGS L.J. 1159, 1167–69 (2008) (“Whether or not jurors were informed about the limitations of microscopic hair examination on cross-examination or by the judge had little measurable or meaningful impact on their judgments about the likelihood that the defendant was the source of the crime-scene hair or their perceived understanding of the expert’s testimony.”).

For further support of this proposition, see *Hinton v. Alabama*, 134 S. Ct. 1081, 1084 (2014) (holding that where the only evidence linking defendant to crime was ballistic evidence, counsel was ineffective for failing to seek additional funds, which he wrongly believed were not available, to hire a better qualified expert to rebut prosecution’s expert).

The following is a non-exhaustive list of authorities finding counsel ineffective for various failures in responding to scientific evidence or expert testimony: *Williams v.*
Thaler, 684 F.3d 597, 604 (5th Cir. 2012) (holding that trial counsel was ineffective in his failure “to obtain any independent ballistics or forensics experts, and was therefore unable to offer any meaningful challenge to the findings and conclusions of the state’s experts, many of which proved to be incorrect”); Elmore v. Ozmint, 661 F.3d 783, 851, 864, 869–72 (4th Cir. 2011) (holding that failure of petitioner’s lawyers to investigate state’s forensic evidence—including hair and serology evidence—constituted ineffective assistance of counsel); Duncan v. Ornoski, 528 F.3d 1222, 1235 (9th Cir. 2008) (“[W]hen the prosecutor’s expert witness testifies about pivotal evidence or directly contradicts the defense theory, defense counsel’s failure to present expert testimony on that matter may constitute deficient performance.”); Bell v. Miller, 500 F.3d 149, 155–57 (2d Cir. 2007) (holding that counsel was ineffective for failing to consult medical expert regarding reliability of shooting victim’s identification); Richey v. Bradshaw, 498 F.3d 344, 361–64 (6th Cir. 2007) (holding that defendant’s counsel provided ineffective assistance in arson trial where counsel failed to properly cross-examine the state’s experts or to present competing scientific evidence); Ege v. Yukins, 485 F.3d 364, 378–80 (6th Cir. 2007) (holding that counsel’s failure to object to admission of bite mark testimony constituted deficient performance—as required for petitioner to meet the “cause” prong of the cause-and-prejudice standard for review of the defaulted habeas claim—where bite mark was only physical evidence connecting her to crime scene); Dugas v. Coplan, 428 F.3d 317, 323, 328–31, 341–42 (1st Cir. 2005) (holding that counsel was ineffective in failing to pursue a “not arson” defense where state’s strongest evidence was expert testimony on arson); Draughon v. Dretke, 427 F.3d 286, 296–97 (5th Cir. 2005) (holding that counsel was ineffective in failing to offer expert ballistics evidence in defense where government’s prosecution was based on testimony from ballistics expert); Soffar v. Dretke, 368 F.3d 441, 443, 473–78 (5th Cir. 2004) (holding that defense counsel’s failure to pursue and develop expert ballistics testimony that would have presented the jury with conflicting evidence bearing on the defendant’s role in the crime was ineffective); United States v. Tarricone, 996 F.2d 1414, 1418–20 (2nd Cir. 1993) (holding that defense attorney was ineffective for failing to consult a handwriting expert who might have proven that the defendant never signed the agreement at issue in case); Sims v. Livesay, 970 F.2d 1575, 1580–81 (6th Cir. 1992) (holding that counsel was ineffective for not hiring expert to analyze the bullet holes and powder patterns on a quilt the homicide victim held in her hands at the time of her shooting); Sturgeon v. Quarterman, 615 F. Supp. 2d 546, 572 (S.D. Tex. 2009) (finding ineffective assistance of counsel in failure to prepare expert witness to testify about unreliability of eyewitness identification); State v. Smith, 85 So. 3d 1063, 1083 (Ala. Crim. App. 2010) (finding ineffectiveness supported by lack of expert testimony relating to police procedures); State v. Fitzpatrick, 118 So. 3d 737, 753–57, 759, 762–64, 769–70 (Fla. 2013) (holding that counsel was ineffective for failing to adequately investigate and obtain expert assistance to rebut state’s forensic expert’s testimony); Commonwealth v. Bussell, 226 S.W.3d 96, 105 (Ky. 2007) (holding
challenge these unvalidated disciplines going forward. Third, as it relates to courts, we argue that: (1) taking judicial notice of the admissibility of putative scientific evidence is inappropriate because science is not static;\(^\text{380}\) (2) decisions regarding the admissibility of trace evidence should be treated as cases of first impression, without any reliance on flawed precedent; and, (3) similarly, following the DOJ’s lead in waiving procedural objections, reviewing courts should not invoke procedural bars to deny relief to defendant-petitioners if the rationale supporting denial of

that counsel was ineffective for failing to adequately investigate and obtain expert assistance to rebut state’s forensic expert testimony); Wolfe v. State, 96 S.W.3d 90, 94–95 (Mo. 2003) (finding that counsel was ineffective for failing to test hair samples found in victim’s car); Cravens v. State, 50 S.W.3d 290, 295 (Mo. Ct. App. 2001) (holding that counsel was ineffective in failing to locate and present expert witnesses on forensic pathology and bullet analysis); Wilhoit v. State, 816 P.2d 545, 546–47 (Okla. 1991) (holding that counsel’s failure to investigate bite-mark evidence constituted ineffective assistance of counsel); Ard v. Catoe, 372 S.C. 318, 327, 330–31, 336 (S.C. 2007) (finding that counsel was ineffective for failing to adequately develop and present gunshot residue evidence in response to government’s expert testimony); but see United States v. Higgs, 663 F.3d 726, 738 (4th Cir. 2011) (finding no Strickland violation where “counsel conducted a thorough and effective cross-examination . . . demonstrating that [he was] well acquainted with the criticisms” of the forensic discipline at issue); United States v. Davis, 406 F.3d 505, 509 (8th Cir. 2005) (“Davis’s trial counsel cannot be said to be ineffective for failing to challenge the FBI’s methodology on a basis that was not advanced by the scientific community at the time of trial.”); Libby v. McDaniel, No. 3:04–CV–0038–LRH–RAM, 2011 WL 1301537, at *1, 9 (D. Nev. Mar. 31, 2011) (finding no ineffective assistance of counsel where defendant “offered no evidence that, as of 1990, the research or expertise necessary to successfully challenge forensic evidence was reasonably available to trial counsel”); Wyatt v. State, 71 So. 3d 86, 103 (Fla. 2011) (finding no ineffective assistance of counsel where the flaws in the forensic discipline were not known until well after defendant’s trial); Robertson v. State, No. M2007–01378–CCA–R3–PC, 2009 WL 277073, at *1, 17 (Tenn. Crim. App. Feb. 5, 2009) (finding no ineffective assistance of counsel where, at time of trial, counsel “did not have the benefit of the FBI’s retraction”).

\(^{380}\) See Cornell v. 360 W. 51st St. Realty, 22 N.Y.3d 762, 785–86 (N.Y. 2014) (“[S]cientific understanding, unlike a trial record, is not by its nature static; the scientific consensus prevailing at the time of the Frye hearing in a particular case may or may not endure.”); see also supra Parts II–III (discussing cases that took judicial notice of hair and bite mark evidence).
relief is that defendant-petitioners knew or should have known of the disciplines’ flaws. Lastly—again following the FBI/DOJ’s lead—we argue that there now exists affirmative ethical and professional obligations on a host of entities both to identify and review case files for convictions based in whole or in part on unvalidated forensic science and to make substantive contact with affected defendant-petitioners, as well as the final prosecuting body, defense counsel of record, and the tribunals where jurisdiction lies for those cases.

A. Unique Nature of Ethical & Professional Obligations

In contemplating how best to implement these professional and ethical obligations, it is worth discussing briefly why currently available remedies are inadequate. The scholarship on the ethical implications surrounding questionable forensic evidence is prolific, especially as it

381 Our argument is in accord with the American Society of Crime Lab Directors/Laboratory Accreditation Board, which issued the following statement in response to the joint FBI/DOJ hair microscopy case audit:

We have an ethical obligation to take appropriate action if there is potential for, or there has been, a miscarriage of justice due to circumstances that have come to light, incompetent practice or malpractice. It is not ASCLD/LAB’s intent to direct that such reviews be conducted by any laboratory or judicial system but it is our recommendation that each laboratory, in consultation with the appropriate legal authorities, consider whether there may be past cases, specifically involving convictions, in which it would be appropriate to evaluate the potential impact of the reported conclusions and/or related testimony on the conviction.


382 See, e.g., AM. BAR. ASS’N, REPORT TO THE HOUSE OF DELEGATES 1 (2004)
concerns prosecutors’ duties. There is even specific scholarship and guidance directed at the use of hair microscopy evidence and bite mark evidence. But these discussions do not address the problems that we have illustrated for at least two significant reasons. First, there is a temporal problem. Model Rule of Professional Responsibility 3.3, “Candor Toward the Tribunal,” requires a lawyer not to “offer evidence that the lawyer knows to be false” and states that, “[i]f a lawyer . . . comes to know of . . . [the evidence’s] falsity, the lawyer shall take reasonable remedial measures, including, if necessary, disclosure to the tribunal.” But the obligation to take remedial measures extends only

("[Counsel should] have competence in the relevant area or consult with those who do where forensic evidence is essential in a case."); see generally AM. BAR ASS`N, ACHIEVING JUSTICE: FREEING THE INNOCENT, CONVICTING THE GUILTY (2006) [hereinafter ACHIEVING JUSTICE].

383 See ACHIEVING JUSTICE, supra note 382377, at 99; Giannelli & McMunigal, supra note 343; Aronson & McMurtrie, supra note 372.


385 See Giannelli & McMunigal, supra note 377, at 1501–06; see also N. Mariana Islands v. Bowie, 243 F.3d 1109, 1118 (9th Cir. 2001) ("[A prosecutor’s due process duty] requires a prosecutor to act when put on notice of the real possibility of false testimony. This duty is not discharged by attempting to finesse the problem by pressing ahead without a diligent and a good faith attempt to resolve it. A prosecutor cannot avoid this obligation by refusing to search for the truth and remaining willfully ignorant of the facts.").

386 MODEL RULES OF PROF’L CONDUCT R. 3.3 (1983). Note, however, that Comment 8 to Rule 3.3 clarifies the parameters of knowing presentation of false evidence by stating that, “[t]he prohibition against offering false evidence only applies if the lawyer knows that the evidence is false. A lawyer’s reasonable belief that evidence is false does not preclude its presentation to the trier of fact.” MODEL RULES OF PROF’L CONDUCT R. 3.3 cmt. 8.

387 MODEL RULES OF PROF’L CONDUCT R. 3.3.
until “the conclusion of the proceeding,” which the comment to the rule defines as “when a final judgment in the proceeding has been affirmed on appeal or the time for review has passed.” In almost every instance, the set of affected cases that is of concern here will fall far outside of the time-frame that would require a lawyer to take remedial measures. Similarly, other discussions—like those involving amending Rule 3.8, Special Responsibilities of a Prosecutor, to add a “gatekeeping role” for prosecutors or those invoking Rule 1.1’s requirement of “competence” to counter claims that Rule 3.3’s, Candor Toward the Tribunal, “knowing” scienter and the elastic definition of what comprises “false” evidence for advocates prohibits the imposition of ethical sanctions—are likewise unhelpful. To begin with they are prospective solutions, and, as solutions, seem unlikely either to be pursued or seriously adjudicated. More specifically, those responsible for these failures of justice—or, maybe more importantly, those who would be most effective at addressing them—have not acted based on what are typically viewed as incentives to do so. For example, the doctrine of prosecutorial immunity—which had been at least somewhat limited so that aggrieved petitioners might be able to seek redress for the most abusive acts of prosecutorial malfeasance—has not made a difference in redressing these failures in

388 MODEL RULES OF PROF’L CONDUCT R. 3.3 cmt. 13.
389 Id.
390 There is no prohibition against offering such measures anyway, regardless of the passing of the time frame. See MODEL RULES OF PROF’L CONDUCT R. 3.3. The authors have not seen a case where any lawyer has taken such steps in these circumstances.
392 MODEL RULES OF PROF’L CONDUCT R. 1.1 (1983). The rule requires “competent representation to a client,” which is defined as “the legal knowledge, skill, thoroughness and preparation reasonably necessary for the representation.” Id.
any meaningful or measurable way. In fact, the Supreme Court has substantially broadened, not limited, the protection afforded to prosecutors by the doctrine.\footnote{395 See Connick v. Thompson, 563 U.S. 51 (2011) (holding that there can be no municipal liability for a district attorney’s office’s failure to train its prosecutors to turn over exculpatory (Brady) evidence on the basis of a single violation of that obligation); Van de Kamp v. Goldstein, 555 U.S. 335, 344 (2009) (holding that extended immunity included the concededly administrative acts of a district attorney’s office’s supervisory prosecutors in systemic “training or supervision or information-system management”); see also Ted Sampsell-Jones & Jenna Yauch, Official and Municipal Liability for Constitutional and International Torts Today: Does the Roberts Court Have An Agenda?, 80 FORDHAM L. REV. 623 (2011). See also Barry Scheck, Professional and Conviction Integrity Programs: Why We Need Them, Why They Will Work, and Models for Creating Them, 31 CARDOZO L. REV. 2215, 2221 (2010) (internal quotation marks and internal citations omitted), which states that:}

State bar discipline—also held out as an incentive—is likewise an unsatisfactory solution.\footnote{396 Interestingly, the doctrine of prosecutorial immunity and state bar discipline are connected. Amicus briefs filed by district attorneys and attorneys general groups advocating for the extension of prosecutorial immunity have claimed that the specter of such professional sanctions is a sufficient check. Scheck, \emph{supra} note 397, at 2222 n.27.} Available data is replete with the systemic failure of state bar disciplinary entities to hold prosecutors—or defense
attorneys, for that matter—accountable for misconduct.\textsuperscript{397} Judges, too—who are arguably best-suited to observe and consider misconduct in the trials over which they preside—fare no better. In a 2008 study in California, data showed that, in cases involving findings of prosecutorial misconduct between 1997 to 2006—of which there were 444—fifty-four were reversed, which triggered a per se legal duty to report.\textsuperscript{398} Yet there was not a single referral.

Also unlikely to be helpful, at least in the near future, are forensic science organizations themselves. They have shown little to no inclination to address seriously the problems for which they are directly responsible, particularly issues related to fundamental scientific weaknesses. In addition to the sweeping critique of the substance of many traditional forensic science disciplines, the NAS Report also noted that only “some fields” have “[s]tandards and codes of ethics.”\textsuperscript{400} Those that do have codes of ethics have codes that “vary in content”\textsuperscript{401} and lack “consistent mechanisms for enforcing”\textsuperscript{402} them. Furthermore:

Many jurisdictions do not require certification in the same way that, for example, states require lawyers to be licensed. Therefore, few forensic science practitioners face the threat of official sanctions or loss of certification for serious ethical violations. And it is unclear whether and to what extent forensic science practitioners are required to adhere to ethics standards as a condition of employment.\textsuperscript{403}

The NAS’s concern is borne out by anecdotal evidence. As Spencer Hsu

\begin{itemize}
\item \textsuperscript{397} See id. at 2222.
\item \textsuperscript{398} See id. at 2223–24.
\item \textsuperscript{399} See id.
\item \textsuperscript{400} NAS REPORT, supra note 4, at 23.
\item \textsuperscript{401} Id. at 214.
\item \textsuperscript{402} Id. at 26.
\item \textsuperscript{403} Id.
\end{itemize}
of *The Washington Post* reported with respect to forensic hair analysis, for example, even though “Justice Department officials . . . [knew] for years that flawed forensic work might have led to the convictions of potentially innocent people . . . prosecutors failed to notify defendants or their attorneys even in many cases they knew were troubled.”404 According to a July 2014 report by the DOJ Office of the Inspector General, there were several “serious deficiencies” with an FBI Criminal Division Task Force’s internal review of “cases involving the use of scientifically unsupportable analysis and overstated testimony by FBI Lab examiners in criminal prosecutions.”405 First among the deficiencies was the failure to prioritize capital cases in its review.406 It took the Task Force almost five years to identify affected death penalty cases, thus depriving “state authorities” of the basis “to consider delaying scheduled executions.”407 As a result, Texas executed Benjamin H. Boyle408 before his case was reviewed by the Task Force even though “[t]he prosecutor deemed the [FBI] Lab analysis and testimony . . . material to the defendant’s conviction”409 and death sentence.410 In addition, the OIG report found that the affected

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404 Hsu, *Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department*, supra note 75. For a listing of affected cases, see *Convictions Linked to FBI Lab’s Suspect Forensics*, WASH. POST, http://www.washingtonpost.com/wpsrv/special/local/fbi-crime-lab-case-reviews/ (last visited Nov. 21, 2015).


406 Id.

407 Id.

408 Id. at ii.

409 Id. According to the report, an “independent scientist who later reviewed the case found the FBI Lab analysis to be scientifically unsupportable and the testimony overstated and incorrect.” Id.

410 See Hsu, *Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department*, supra note 75 (“In one Texas case, Benjamin Herbert Boyle was executed in 1997, more than a year after the Justice Department began its review. Boyle would not have been eligible for the death penalty without the FBI’s flawed work, according to a prosecutor’s memo.”) Two others were executed prior to their cases being reviewed (though there was no finding of materiality); another capital
defendants were not provided with “appropriate and timely disclosures . . . particularly in cases . . . [where] the analysis or testimony was material to the conviction and the report of the independent scientists established that such evidence was unreliable.”

The response to the conclusions of the NAS Report and the ever-increasing number of wrongful convictions from the insular and largely independent forensic odontology community demonstrates the urgent need for legislation to provide avenues of post-conviction relief for prisoners whose convictions rest on discredited scientific evidence. First, there has been no effort at all to address known problems in past cases, even though the empirical data that would support such a review is well-documented and mounts annually. Worse, efforts that have been made to rectify the discipline’s shortcomings have been directed mainly at salvaging an increasingly maligned discipline. For example, in August 2013—in the wake of wrongful convictions and indictments, lawsuits against the dentists who proffered false and misleading testimony, and the devastating conclusions of the NAS Report—the American Board of Forensic Odontology (ABFO) finally conceded that individualization claims were invalid in “open population” cases where the universe of

defendant died in prison of natural causes before his case was reviewed. See TASK FORCE REVIEW, supra note 404, at ii.

411 Id. at iii. The report concluded that, of the 402 cases reviewed for the report, only in 13 were disclosures made to defendants or their last counsel of record. Id.

412 A 2013 investigation by the Associated Press revealed that at least twenty-four innocent men whose convictions and/or indictments were obtained through the use of bitemark evidence have been exonerated since 2000. See Myers, Once Key in Some Cases, Bite Mark Evidence Now Derided as Unreliable, supra note 80. Based on “decades of court records, archives, news reports” and interviews with “[t]wo dozen forensic scientists and other experts . . . including some who had never before spoken to a reporter about their work,” the Associated Press’ investigation was regarded as the “most comprehensive” audit of bitemark cases ever undertaken. Id.

potential suspects was unknown. This dramatic and unprecedented change in the guidelines is a long-overdue admission that such testimony is scientifically invalid. But the change was not made publically, and no effort was made by the ABFO, or any other entity, to identify those convictions that were, in whole or in part, the result of this type of now-rejected methodology. In short, the development, such as it is, seems to affect only the argument for the continued legitimacy of the discipline itself.

414 “The Biter,” i.e., the individual responsible for the bite mark at issue, was the highest level of certainty sanctioned by the ABFO until August of 2013, when the Reference Manual was updated. See DIPLOMATES REFERENCE MANUAL, supra note 180, at 119. See also AM. BOARD OF FORENSIC ODONTOLOGY, GUIDELINES AND STANDARDS DRAFT 14 (2014) (“The ABFO does not support a conclusion of ‘The Biter’ in an open population case(s”). Additionally, according to an article in the Wall Street Journal, although current president-elect of the ABFO, Dr. Peter Loomis, stated in July of this year that bite mark evidence could be used to “include or exclude a suspect,” he acknowledged that it “shouldn’t be used to identify a suspect.” Jack Nicas, Flawed Evidence Under a Microscope: Disputed Forensic Techniques Draw Fresh Scrutiny; FBI Says It Is Reviewing Thousands of Convictions, WALL ST. J. (July 18, 2013), http://www.wsj.com/articles/SB1000142412788732426340578614161262653152.

415 In a recent New York Times article about Eddie Lee Howard’s case in Mississippi, the current president of the ABFO was quoted as saying that “actually naming an individual biter to a reasonable degree of certainty should be very limited.” Erik Eckholm, Mississippi Death Row Case Faults Bite-Mark Forensics, N.Y. TIMES (Sept. 15, 2014), http://www.nytimes.com/2014/09/16/us/mississippi-death-row-appeal-highlights-shortcomings-of-bite-mark-identifications.html. In Howard’s death penalty case, the ABFO member who testified—Dr. Michael West—stated “to a reasonable medical certainty” that Howard’s teeth inflicted the bite mark on the victim and further said, “Do I have any doubt [Howard’s] teeth made that bite on [the victim’s] breast? I don’t have any.” See Transcript of Record at 561, 584, State v. Howard, No. 92-400-CR1 (Lowndes Cnty. Cir. Ct. May 22, 2000).

416 In fact, in response to the New York Times article on Howard’s case, the ABFO posted the following on its website:

The New York Times printed an article on 9/16/2014 faulting “bite-mark forensics.” It highlights an appeal recently filed by the Mississippi Innocence Project with the Mississippi Supreme Court, a 22 year old case in which bite mark testimony was provided by Dr.
Even assuming, though, a best-case scenario in which actors act with appropriate humility and haste, there are a host of practical difficulties. Hair microscopy serves as a good example. A legitimate audit of cases involving unvalidated hair microscopy evidence would have to include not only cases in which FBI analysts testified—several thousand cases over a twenty-five year period—but also those in which state analysts testified. As discussed, beginning in the late 1970’s, the FBI lab implemented a two-week training program in hair and fiber analysis for state and local lab employees, and there is ample evidence state practitioners were taught to proffer misleading testimony to triers of fact.\footnote{See supra notes 273–74 and accompanying text.}

As more and more states began to rely on their local and state labs

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Michael West. Like every news article, there are misstatements and some erroneous information is given. In particular, the author parrots the flawed Innocence Project publicity that 17 people previously convicted based on “expert bite matches” have been exonerated by DNA evidence. The IP often uses the number of 24 so at least the number is down a bit, but in actuality the number is 10, and of these, five of the opinions were not “match” as the article mentions but a lesser opinion. While any number of wrongful convictions is unacceptable and we are all cognizant of the fact that some terrible mistakes have been made in the past, we cannot ignore the fact that hundreds of positive outcomes have occurred throughout the country wherein bite mark evidence played a crucial role in the judicial process to assist the triers of fact. The ABFO continues to make changes to ensure accuracy of expert opinions. The ABFO has developed the Bitemark Analysis and Comparison Decision Tree, is continuing to develop a bitemark proficiency examination, has significantly raised the bitemark and other requirements for examination eligibility for new candidates, requires recertifying diplomates to take a recertification examination and has revised the standards, guidelines and terminology for bitemark analysis.
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Peter Loomis, President, Am. Board of Odontology, Third Quarter Message (Sept. 24, 2014).
to provide hair examiner reports and testimony in their state investigations and prosecutions—particularly in the 1980s and 1990s—the Bureau’s two-week program trained in excess of 500 examiners over a period of twenty-five years.\footnote{See id.} In short, there are likely thousands of cases—in which FBI examiners or FBI-trained state analysts provided testimony\footnote{A review of transcripts from state hair comparison cases during this period revealed a pattern of similar, invalid testimony by state hair experts, many of whom—if not most of whom—learned to provide such testimony at the FBI training course. See Post-Conviction Memorandum, supra note 384, at 2 n.2 (“Among other things, this affidavit discusses the FBI’s training; in it, Mr. Howard states: ‘I was taught at the FBI class that the best basis for testimony was our own experience through case-work.’ The affidavit relates to improper hair comparison testimony provided by one time chief of the Montana State Crime Laboratory Arnold Melnikoff in Jimmy Bromgard’s trial for raping a young girl. After nearly 15 years in prison, Mr. Bromgard was exonerated through post-conviction DNA testing.”).}—that would need to be part of an audit.\footnote{The American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) recognized the need for possible state reviews, as well. ASCLD/LAB recommended “each laboratory, in consultation with the appropriate legal authorities, consider whether there may be past cases, specifically involving convictions, in which it would be appropriate to evaluate the potential impact of the reported conclusions and/or related testimony on the conviction.” ASCLD Press Release, supra note 381.} Moreover, to the extent that errors are found, counsel and defendants in those cases must be appropriately notified. Many of the cases will be decades old, records will be difficult to locate, and, in some instances, counsel will be impossible to locate. For jurisdictions already strapped for resources to fund their criminal justice systems, finding the resources—monetary and otherwise—to do so may well turn out to be impossible.
B. SUGGESTED SOLUTIONS

Conviction Integrity Programs (CIPs)\(^\text{421}\) have been used with success throughout a number of prosecutors’ offices around the country, and with certain modifications, may be the best administrative template for a successful remedy. Foremost among these programs’ strengths is their practical approach to reviewing a discrete, identifiable set of cases for specific types of error. In essence, CIPs fill a gap that Rule 3.8 does not.\(^\text{422}\) In addition, they can stand as real, on-the-ground embodiments of aspirational standards that exist elsewhere.\(^\text{423}\) The units that we propose would—given the discrete focus on a certain subset of cases involving unreliable scientific evidence—be developed outside of, rather than within, prosecutors’ offices and would thus function more like a neutral administrative agency than a branch of an adversarial office.\(^\text{424}\) Like other successful CIPs, their founding structure would incorporate best practices that, among other things, would grant them privileged access and cooperation, namely open file sharing—including work product from both prosecutors’ and defense attorneys’ files—and mutual investigative assistance from all individuals and entities, including the forensic labs and analysts\(^\text{425}\) involved in identified cases.


\(^{422}\) See Bruce A. Green & Ellen Yaroshefsky, Prosecutorial Discretion and Post-Conviction Evidence of Innocence, 6 OHIO ST. J. CRIM. L. 467, 511 (2009).

\(^{423}\) See MODEL RULES OF PROF’L RESPONSIBILITY EC 7-13 (1980); see also AM. BAR ASS’N, AMERICAN BAR ASSOCIATION PROJECT ON STANDARDS FOR CRIMINAL JUSTICE, Standards 3-3.9(c), 3-3.11, available at http://www.americanbar.org/publications/criminal_justice_section_archive/crimjust_standards_pfunc_toc.html.

\(^{424}\) See Green & Yaroshefsky, supra note 422, at 482 nn.87 & 89, 483 n.96.

\(^{425}\) The cooperation of analysts may require that these individuals be accorded some limited immunity, either upon request or when set forth as a reason for not participating in a review.
C. MODIFICATION OF PROCEDURAL BARRIERS

In addition to these modified conviction integrity models, procedural barriers cannot be erected to frustrate the very purpose of auditing these cases: the determination of whether false scientific evidence contributed to securing a conviction. Thus, where such evidence was introduced, waivers of typical statute of limitations bars and other procedural default mechanisms must be granted as a matter of course. These suggestions are in accord with newly-developed post-conviction statutory modifications adopted in Texas and California, and, equally as importantly, coincide with the position that the DOJ has adopted with respect to affected cases identified in its hair microscopy audit. With respect to the FBI/DOJ audit, for example, letters notifying parties of the introduction of false evidence have stated:

In the event that the Defendant seeks post-conviction relief based on the Department’s disclosure that microscopic hair comparison reports or testimony used in this case contained statements that exceeded the limits of science, we provide the following information to make you aware of how we are handling such situations in federal cases. In such cases under 28 USC § 2255, in the interest of justice, the United States is waiving reliance on the statute of limitations under Section 2255(f) and any procedural default defense in order to permit the resolution of legal claims arising from the erroneous presentation of microscopic hair examination laboratory reports or testimony.427

426 See supra note 138–41 and accompanying text; see also infra note 427.  
427 Letter from John Crabb Jr., U.S. Dep’t of Justice, to Robert P. McCulloch, St. Louis Cnty. Prosecutor’s Office (Aug. 20, 2013) (on file with authors). There is ample precedent for this position. See, e.g., Wilson v. Beard, 426 F.3d 653, 661 (3d Cir. 2005) (holding that due diligence did not require prisoner to monitor local news twelve years after conviction when there was no reasonable basis to conclude that local news would provide information on prisoner’s case); United States v. Atchison, No. 09-C-2105, 2012 WL 581163, at *1, 5 (N.D. Ill. Feb. 22, 2012) (holding that due diligence does not require
In addition, most states’ post-conviction statutes require not simply that evidence—in this case, errors affecting the admitted forensic evidence—is newly-discovered, but that its discovery would have affected the outcome of the trial. This standard, too, should be modified with respect to the cases that a CIP deems meritorious. Specifically, because so many of these cases will be so old and information difficult to access and assess, the standard should be akin to a due process analysis of whether false evidence was admitted into the trial, and, if so, whether there is any reasonable likelihood the evidence affected the judgment of the jury. If so, relief should be warranted. Alternatively, the burden of proving that the trial was fundamentally fair notwithstanding the introduction of unvalidated forensic evidence should rest with the prosecution, which would be required to show that the constitutional error was harmless “beyond a reasonable doubt.” More specifically, where the court, the prosecutor, and defense counsel all operated under the false assumption that the scientific evidence at issue was valid and reliable, there was no

See generally In re Personal Restraint of Trapp, No. 65393–8–I, 2011 WL 5966266, at *1, 5 (Wash. Ct. App. Nov. 28, 2011) (holding that petition based on newly discovered CBLA evidence was not time barred because, while “a report generally calling CBLA evidence into question may have been published in 2004, the extent of the FBI’s misleading’ testimony in [the petitioner’s] case only became apparent after a detailed review of the trial record by specialists at the FBI laboratory sometime in 2009”).

See, e.g., LA. CODE CRIM. PROC. ANN. art. 930.3(7) (2015). Some states allow newly discovered evidence arguments only in support of an actual innocence claim. See, e.g., MD. CODE ANN. § 8-301(a) (West 2015); CAL. PENAL CODE § 1473.6(a)(1) (West 2015) (newly discovered evidence must “point unerringly to his or her innocence”).


See, e.g., L.A. CODE CRIM. PROC. ANN. art. 930.3(7) (2015). Some states allow newly discovered evidence arguments only in support of an actual innocence claim. See, e.g., MD. CODE ANN. § 8-301(a) (West 2015); CAL. PENAL CODE § 1473.6(a)(1) (West 2015) (newly discovered evidence must “point unerringly to his or her innocence”).

meaningful adversarial testing of the false evidence. Thus, the introduction of the now discredited evidence—which was nevertheless proffered to the jury as infallible “scientific” evidence of guilt—was so unfair it resulted in a “breakdown in the adversarial process” in violation of petitioner’s due process rights.\footnote{See, e.g., Brecht v. Abrahamson, 507 U.S. 619, 639 (1993) (Stevens, J., concurring) (“The Fourteenth Amendment prohibits the deprivation of liberty ‘without due process of law’; that guarantee is the source of the federal right to challenge state criminal convictions that result from fundamentally unfair trial proceedings.”); Estelle v. McGuire, 502 U.S. 62, 70 (1991) (“[T]he Due Process Clause guarantees fundamental elements of fairness in a criminal trial.”); Strickland v. Washington, 466 U.S. 668, 696 (1984) (“[T]he ultimate focus of inquiry must be on the fundamental fairness of the proceeding whose result is being challenged. In every case the court should be concerned with whether, despite the strong presumption of reliability, the result of the particular proceeding is unreliable because of a breakdown in the adversarial process that our system counts on to produce just results.”); United States v. Cronic, 466 U.S. 648, 656 (1984) (“The right to the effective assistance of counsel is thus the right of the accused to require the prosecution’s case to survive the crucible of meaningful adversarial testing.”); Chambers v. Mississippi, 410 U.S. 284, 294 (1973) (“The right of an accused in a criminal trial to due process is, in essence, the right to a fair opportunity to defend against the State’s accusations.”); Spencer v. Texas, 385 U.S. 554, 563–64 (1967) (“Cases in this Court have long proceeded on the premise that the Due Process Clause guarantees the fundamental elements of fairness in a criminal trial.”); accord Michigan v. Bryant, 562 U.S. 344, 370 n.13 (2011) (“The Due Process Clauses of the Fifth and Fourteenth Amendments may constitute a further bar to admission of, for example, unreliable evidence.”).}

CONCLUSION

On one hand, the extent of the problems that this article illustrates and the call that it makes for affirmative acts of reform risk its being characterized as simply more of the same: a partisan philosophical position about the state of the criminal justice system, albeit this time costumed with an abundance of data and excerpts from case law. Were that characterization correct, then equally partisan responses in opposition could follow as a matter of course. The end result would be a stalemate: one side arguing that what this article documents is the natural by-product
of a broken system; the other that it is the natural, collateral consequence of a system trying—albeit with too much aspiration—to balance public safety against the competing claims of defendants’ due process rights.

The fact of the matter is, however, that this article, though it certainly documents disturbing failures—both in individual cases as well in several disciplines—is nevertheless focused on a finite number of specific cases, a circumscribed jurisprudence, and a group of individuals and entities that can themselves provide an immediate and effective solution. Or not. The results of that decision, though, are stark. To the extent that it is an overstatement to claim that a decision one way or the other defines the character of the system as a whole, it is not too much to claim that—given what we know about the kinds of failures documented here—a decision to act, or not, characterizes specific individuals and entities. And that characterization works from the bottom up, as it were, to create a larger, more resonant definition.

To illustrate, consider the following case: The defendant was convicted of sexual assault in Mississippi in 1981 and sentenced to twenty-five years in prison. The evidence against him, as the Mississippi Supreme Court noted, “was conflicting.”

He was identified by the victim as the person who had assaulted her, as well as by another individual, who testified that she had observed the defendant at the victim’s house on the day of the assault. The defendant denied having committed the offense and testified that he had been in Chicago on the day it occurred. He voluntarily surrendered to police upon his return.

The only physical evidence that connected the defendant to the crime scene was human hair. According to the court, “[h]air samples taken from the appellant and the prosecutrix's clothing were compared in the F.B.I. laboratory. All twenty individual characteristics identified in

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431 Hyde v. State, 413 So. 2d 1042, 1044 (Miss. 1982).
432 See id. at 1043.
433 See id.
434 See id.
435 See id.
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appellant’s hair matched the characteristics of the hair taken from the victim's clothing.\textsuperscript{436}

In 2001, after the DOJ and FBI became aware that the analyst who had provided the testimony in the Mississippi case was Michael Malone—known by then “as the agent making the most frequent exaggerated testimony”\textsuperscript{437}—the DOJ wrote a letter to the district attorney in Mississippi whose office had prosecuted the case.\textsuperscript{438} The letter alerted the prosecutor to the fact that the Mississippi case was under federal review and asked the prosecutor for “any other information [he] may have related to the . . . case to determine if Malone’s laboratory work was material to the conviction.”\textsuperscript{439}

By that time, the case had been appealed and affirmed, and the trial transcript—at least the copy that the Mississippi Supreme Court had used—was located in the State archives in Jackson. The authors recently read it. Among the claims that the FBI analyst Malone made were these: that in order to be qualified for his job, he had to perfectly match fifty hairs to fifty people\textsuperscript{440} and that the hairs recovered from the crime scene “microscopically matched the head hairs of . . . [the defendant]. In other words, they were indistinguishable from his head hairs. How unlikely [would it be for two different people to share the same observed characteristics]? In about ten thousand hair exams, I’ve only seen two occasions where I had hairs from two different people that I couldn’t distinguish.”\textsuperscript{441}

In March of 2002—eight months after the DOJ had alerted the district attorney to the potential problem and asked for assistance—the

\textsuperscript{436} Id.

\textsuperscript{437} See Hsu, Convicted Defendants Left Uninformed of Forensic Flaws Found by Justice Department, supra note 75.

\textsuperscript{438} Letter from Amy Jabloner, U.S. Dep’t of Justice, to Ben Saucier, Dist. Attorney, Jackson County (July 26, 2001) (on file with authors).

\textsuperscript{439} Id.

\textsuperscript{440} See Transcript of Record at 160, State v. Hyde, No. 53424 (Jackson Cnty. Cir. Ct. Apr. 24, 1982).

\textsuperscript{441} Id. at 170–71.
district attorney responded. In a handwritten response on a single fax cover page, the district attorney said “This is a 20 year old case with all record files having been previously destroyed. No determination to your request can be made.”

No substantive additional action has been taken on the case since.

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442 Fax from Ben Saucier, Dist. Attorney, Jackson County, to Ellis Gordon, U.S. Dept. of Justice (March 23, 2002).