THE BITE MARK DENTISTS AND THE COUNTERATTACK ON FORENSIC SCIENCE REFORM

Marvin Zalman* and James Windell**

ABSTRACT

An editorial in a scientific journal by forensic odontologists defending the admissibility of bite mark evidence, Epidermis and Enamel, is critiqued. The editorial’s primary deficiency is that it fails to address scientific challenges to the reliability and validity of bite mark evidence. The Article first traces the impact of bite mark analysis through two wrongful conviction case examples in Mississippi and Michigan. The Article then reviews the scientific research and reasoning that shows bite mark evidence to be unreliable and to lack scientific support. The critique of Epidermis and Enamel shows it to be riddled with logical flaws; failing to critically address scientific analyses showing the unreliability of bite mark analysis; erroneously deflecting criticism of bite-mark (in)accuracy by noting that wrongful convictions often have multiple causes; mischaracterizing social scientific research; falsely claiming that a number of exonerations were not wrongful convictions; being highly defensive; citing the testimonials of supporters; and defaming its critics. The illogical defense of bite mark analysis by forensic odontologists is explained in social psychological terms through the constructs of organizational deviance, groupthink, cognitive dissonance, cognitive bias, and Mercier and Sperber’s evolutionary theory of reasoning. We conclude by noting that the resistance to

* Marvin Zalman, J.D., M.A., Ph.D., is a Professor in the Department of Criminology and Criminal Justice, Wayne State University.

** James Windell, M.A., is an adjunct instructor in the criminal justice departments at Wayne State University and Oakland University. He is a former court clinical psychologist and his most recent criminal justice book is Juvenile Delinquency in American Society: Race, Class and Politics.

The authors wish to thank Jim Acker for his helpful comments on an earlier draft and Keith Findley for providing useful information. We also wish to thank exonerees Michael Cristini and Jeff Moldowan as well as Cindy Barach for their interviews that shed light on the Cristini-Moldowan case. Attorneys Dennis Dettmer and Michael Dezsi provided useful background information and helpful transcripts and briefs on that case. We also wish to thank Sam Gross.
scientific challenge by the forensic odontologists in their editorial
reflects the rear-guard defensiveness displayed by other forensic
analysts and unprogressive prosecutors.

Table of Contents

Introduction .................................................................750
I. A Tale of Two Dentists .................................................757
II. A Brief, Critical Review of Bite Mark Evidence ............775
III. A Critique of Epidermis and Enamel .........................789
IV. Unreasoned Reasons ..................................................809
V. Conclusion: The Counterattack on Reason and Evidence......822

INTRODUCTION

Controversy over the admissibility of bite mark evidence in crimi-
nal prosecutions has generated ample scientific, legal, and popular
literature.1 Perhaps the most curious document to come out of the
ongoing debate is a risibly titled editorial, *Epidermis and Enamel:
Insights into Gnawing Criticisms of Human Bitemark Evidence*
(“*Epidermis and Enamel*”), published in a forensic science journal
and authored by eleven forensic odontologists.2 The eleven-page
editorial article sought to dampen criticism of bite mark evidence
generated by a wave of exonerations in which testimony by forensic
dentists played a role.3 The article, while acknowledging the
exonerations,4 offers a shotgun, or perhaps a blunderbuss, blast of
defensive arguments rather than a rifle shot that hits the central
critique: that bite mark evidence is such an unreliable pattern-
comparison or feature-comparison method that courts should rule the
technique inadmissible.5 The central theme of *Epidermis and

---

1 See Samuel D. Hodge, Jr., et al., *The Growing Controversy Swirling Around Bite Mark Identification*, PRAC. LAW., Aug. 2017, at 33; infra Parts I & II.
2 See Robert E. Barsley et al., Editorial, *Epidermis and Enamel: Insights into Gnawing Criticisms of Human Bitemark Evidence*, 39 AM. J. FORENSIC MED. & PATHOLOGY 87, 87 (2018). The authors take pains to indicate that the article “is the work product solely of the authors
and not of the American Board of Forensic Odontology” and does not represent the views of
other organizations. Id. at 87. However, they also praise the ABFO for its leading role in
improving the reliability of bite mark analysis and note that “ABFO leaders are committed to
ongoing discussion to promote appropriate evolution of the field.” Id. at 88. Editors can play
important roles in forensic science (as well as in other professional areas). See, e.g., Peter R.
science is a scientific discipline rather than a loose collection of other disciplines).
3 See Barsley et al., supra note 2, at 88.
4 See id.
5 See id. at 88–89.
Enamel seems to be (it is never clearly asserted) that because wrongful convictions almost always result from a combination of errors generated by a variety of actors, and because “[t]he legal community has an obligation to safeguard against invalid and unreliable testimony,” and perhaps because forensic odontologists have helped to exonerate some of the wrongfully convicted, and because forensic odontologists are taking steps to improve their practices—bite mark analysis should continue to be admissible. A parallel central argument is that while “mistakes have been made in the past” by forensic odontologists “critics ignore the progress made by changes in standards, terminology, and the steps to inhibit bias.”

The editorial’s one page review of standards, guidelines, knowledge transfer and education, research, certification, proficiency, and casework, however, does nothing to answer the mounting and powerful scientific evidence showing bite mark evidence to be inherently unreliable.

Along with this central argument, Epidermis and Enamel also argues that erroneous judgments by some forensic odontologists do not represent the professional norm; criticizes its critics by denigrating their motives; includes testimonials of favorable writers; positions forensic odontology as a “self-correcting” life science; challenges the Texas Forensic Science Commission’s call for a bite mark evidence moratorium; and lists ways in which the bite mark analysis of forensic odontologists is becoming more proficient, while suggesting in passing that bite mark evidence be admitted only in unusual cases. What is most telling about this defense of bite mark analysis is what is missing. Epidermis and Enamel offers no

---

8 See id. at 89, 91–92.
9 Id. at 91.
10 Id. at 88.
11 See id. at 88, 89.
12 See id. at 87.
13 See id. at 94–95; infra Part II.
14 See Barsley et al., supra note 2, at 89.
15 See id. at 88.
16 See id. at 93–94.
17 See id. at 88.
18 See id. at 89. These defenses are analyzed and criticized in Part III.
19 Compare Michael Saks et al., Forensic Bitemark Identification: Weak Foundations, Exaggerated Claims, 3 J.L. & BIOSCIENCES 538, 566 (2016) (explaining that forensic bitemark analysis lacks validity and reliability in court), with Barsley et al., supra note 2, at 88 (describing forensic odontology as reliable and useful science in certain criminal cases, and ignoring the accepted issues with validity and reliability of forensic odontology). One thinks of
rejoinder to the substantive criticisms about the scientific basis or reliability of bite mark evidence\(^{20}\) which was raised by the National Research Council's 2009 report on forensic science\(^{21}\) or by a major review of the scientific critique of bite mark evidence by Saks et al.\(^{22}\)—both of which are cited in the editorial—or with the critical analysis by the President's Council of Advisors on Science and Technology,\(^{23}\) which is not cited.\(^{24}\)

The spectacularly weak reasoning at the center of *Epidermis and Enamel*, by purportedly self-correcting life scientists,\(^{25}\) along with its often-defensive tone and defamatory criticism of innocence organizations, leads us to explore in greater depth the professional and organizational dynamics and the psychological factors that led this well-educated group into a logical cul-de-sac. Our goal is to understand why some portion of the forensic odontology community arduously resists the findings of critical scientific inquiry, and in so doing, shed some light on rear-guard action against forensic science reform by other forensic examiners and scientists.\(^{26}\)

For those familiar with the innocence movement's history, the analogy of prosecutorial resistance to DNA post-conviction testing in the 1990s and 2000s comes readily to mind. Several authors have described the often bizarre lengths to which prosecutors went to block post-conviction DNA testing or to deny the results of exonerating

---

\(^{20}\) Compare Barsley et al., *supra* note 2, at 88 (challenging the critics of bite mark identification in forensic odontology), with Saks et al., *supra* note 19, at 566 (discussing the significant unreliability and validity of bite mark identification).


\(^{22}\) See Saks et al., *supra* note 19, at 538.


\(^{24}\) See Barsley et al., *supra* note 2, at 87; PCAST, *supra* note 23. In contrast to *Epidermis and Enamel*, a more sober reaction to bite mark analysis challenges is provided by Richard Souviron & Leslie Haller, *Bite Mark Evidence: Bite Mark Analysis is Not the Same as Bite Mark Comparison or Matching or Identification*, 4 J.L. & BIOSCIENCES 617 (2017), discussed *infra* Part IV.

\(^{25}\) See Barsley et al., *supra* note 2, at 88.

\(^{26}\) See *infra* notes 309–430 and accompanying text.
DNA tests. Others went beyond structural and cultural explanations to explore prosecutorial resistance in psychological terms. Aviva Orenstein draws on cognitive bias research and explains prosecutorial resistance by the unconscious and non-volitional category of denial, described as “a deeper, more emotional mechanism that our unconscious uses to screen out unpleasant realities and the resultant distressing feelings.” As a defense mechanism that masks certain realities which are “too terrible to be true,” denial has the paradoxical quality of being partial because the denier has to know the “terrible” reality at some level. “Denial need not be absolute”; it can take the form of minimizing a reality but is always a distortion of truth. Denial is wrapped up in the denier’s self-identity. “That the prosecutor has invested time and energy into proving the prisoner’s guilt and has learned to think of the accused as a bad guy affects the prosecutor’s ability to see mistakes and fosters denial.” The prosecutor’s “impossible” dual role as an advocate and as a minister of justice sets up a psychological bind wherein the “duty to do justice itself inspires denial.”


28 See Aviva Orenstein, Facing the Unfaceable: Dealing with Prosecutorial Denial in Postconviction Cases of Actual Innocence, 48 SAN DIEGO L. REV. 401, 425–28 (2011). Orenstein summarizes the explanations for prosecutorial resistance developed in prior scholarship: (1) emphasis on finality and concerns with costs; (2) career interests, especially the emphasis on winning cases; (3) maintaining public trust and not disrupting operations; (4) a hyper-adversarial culture; and (5) the personality of people drawn to work as prosecutors. See id. at 420–24.

29 Id. at 428.

30 Id. at 428–30 & n.144.

31 Id. at 430.

32 See id. at 431–32.

33 Id. at 430–31.

34 See id. at 432 (drawing in part on Barbara O’Brien, A Recipe for Bias: An Empirical Look at the Interplay Between Institutional Incentives and Bounded Rationality in Prosecutorial Decision Making, 74 Mo. L. REV. 999, 1001 (2009)).
In a similar vein, Susan Bandes locates the source of prosecutorial denial in the value of loyalty to one’s group, which in evolutionary terms is essential for human solidarity and survival. In complex societies group loyalty may conflict with other values, but in any event “loyalty is shaped and continually reinforced in a social context, through psychological mechanisms,” which include both emotional rewards and fears of enforcement mechanisms such as banishment. Those who join a group, share its goals, and thrive within it “are likely to internalize and adopt as their own not only the goals of the organization but its internal culture, beliefs, and ways of thinking about problems. Information that threatens this mutually beneficial symbiosis may be warded off at a very early stage in an individual’s thought process.” The complementary psychological categories explicated by Orenstein and Bandes may tap into similar neurological and social processes, which in turn help explain irrational thinking or even socially immoral decisions, as less than fully volitional.

To understand how DNA exonerations in the 1990s challenged the worldview and self-image of prosecutors and other criminal justice actors including forensic odontologists, one must enter (or reenter) a world in which the reality that a small percentage—but nevertheless thousands—of innocent people are convicted of felonies every year was inconceivable. So inconceivable that even reform-oriented criminal defense litigators considered such a scenario to be unreal.

---

35 See Bandes, supra note 27, at 481.
36 See id. at 481–82, 488.
37 Id. at 482.
38 Id. at 482–83.
39 See generally id. (discussing how the conceptual interpretation of one’s loyalty is molded and subsequently reinforced through psychological mechanisms within a social context); Orenstein, supra note 28 (analyzing the psychological implications of the prosecutorial self-identity and how it may lead to denial in postconviction cases of actual innocence).
40 Estimation of the incidence of wrongful convictions is a difficult and contested matter. See Samuel R. Gross et al., Rate of False Conviction of Criminal Defendants who are Sentenced to Death, 111 PNAS 7230, 7230, 7231 (2014). A generally held view among innocence scholars is that an unknown general rate of actual innocence error may run around 2 percent or higher. See id. at 7231, 7233; Marvin Zalman, Qualitatively Estimating the Incidence of Wrongful Convictions, 48 CRIM. L. BULL. 221, 240 (2012). This understanding has recently been challenged in analyses conducted by legal scholars. See Paul G. Cassell, Overstating America’s Wrongful Conviction Rate? Reassessing the Conventional Wisdom about the Prevalence of Wrongful Convictions, 60 ARIZ. L. REV. 815, 817 (2018); Paul G. Cassell, Jurisdiction-Specific Wrongful Conviction Rate Estimates: The North Carolina and Utah Examples, 60 ARIZ. L. REV. 891, 892 (2018); George C. Thomas III, Where Have All the Innocents Gone?, 60 ARIZ. L. REV. 865, 877 (2018). The last word on the subject has probably not been written.
But the realization that wrongful convictions occur with regularity led swiftly to new thoughts and policies that upset the complacent world view of many criminal justice actors.\textsuperscript{42} The literary and jurisprudential scholar, Stanley Fish, nicely captures how deeply felt is one’s sense of betrayal to a changed world. In the film version of \textit{How to Succeed in Business Without Really Trying},\textsuperscript{43} a comedy about the ethical underbelly of the American business world,\textsuperscript{44} the boss’s nephew, working in the mail room and expecting nepotistic advancement, cries out “That’s not fair!” when the boss declares that promotion will henceforth be based on merit.\textsuperscript{45} On the surface the line is humorous, but Fish digs deeper to ruminate on the way in which high order concepts like fairness are shaped by context and expectations.\textsuperscript{46} The nephew sees the rules of the game he has lived by, in which family relationship is a component of merit, as suddenly changing:

In effect he is reacting just as the elder son in a hereditary monarchy might react were he to be told just before the king died that from now on we’re going to do it differently and hold elections. In both cases the disappointment is more than personal; it extends to the overturning of a whole way of life, complete with a tradition, a set of expectations, obligatory routines, normative procedures, in-place hierarchies, and so on. And when a new way of life is forcefully introduced, the sense of betrayal is cosmic, and the terms in which it is expressed are abstract and universal \ldots \textsuperscript{47}

One might sympathize with people whose expectations, status, and way of life are upended, although responses to such deep changes have also produced ugly reactions that are judged harshly by

\textsuperscript{42} See Meltsner, \textit{supra} note 41, at 29–30.
\textsuperscript{43} See \textit{Stanley Fish, There’s No Such Thing as Free Speech, and It’s a Good Thing}, Too 3 (1994).
\textsuperscript{44} See \textit{id.}
\textsuperscript{45} \textit{Id.}
\textsuperscript{46} See \textit{id.} at 3–4.
\textsuperscript{47} \textit{Id.}
history. These attempts to plumb the deeper sources of resistance to change, which might include patently unreasoned argument, lead us to seek a deeper explanation of forensic odontologists’ resistance to the scientific critique of bite mark analysis.

The arguments of *Epidermis and Enamel* are so transparently weak that we are led to explore the forces that have generated such resistance to forensic science reform. Thus, while we critique *Epidermis and Enamel* as the weakly reasoned polemic that it is, it should be read as part of a larger counter attack by some “industry” forensic scientists against the movement to place the forensic sciences on a more scientific base, to improve the reliability of some feature-comparison disciplines, and where needed, to remove weaker methods from use by prosecutors and courts.

This Article proceeds as follows: Part I, A Tale of Two Forensic Dentists, compares the lurid career of Michael West, a bite mark specialist whose trail of error led to national notoriety, with speculation about the honest motivations that led a Michigan forensic odontologist, as a stand-in for others, to engage in bite mark analysis. In this section we argue that most mistakes that lead to wrongful convictions, including bite mark analysis, are products of normal human error rather than corrupt motives. Seeing wrongful convictions as the products of systemic error rather than “rotten apples” is a more accurate view of reality, is more likely to generate systemic reforms, and is more likely to convince well-meaning justice professionals that evidence-based changes are beneficial to their professions. Our case study of a Michigan exoneration in which bite mark evidence played a role also provides evidence for criticism of *Epidermis and Enamel*’s central thesis.

Part II, A Brief Review of Bite Mark Evidence, sets the foundation for issues related to the bite mark controversy. Criticism of bite mark evidence is one part of the crisis caused by DNA and non-DNA exonerations that led to a paradigm shift in forensic science, a reform

---

48 *See Eric Foner, Reconstruction: America’s Unfinished Revolution* 570–71 (1988). Given rising ideological polarization, we might better say that reactions have been judged harshly by the history of some. The reaction of white Southerners to their status change after the Civil War—the “redemption movement” that overturned Reconstruction, imposed the Jim Crow regime on African Americans, and set American race relations on its well-analyzed and doleful course—had enormously negative consequences on criminal justice. *See Michelle Alexander, The New Jim Crow: Mass Incarceration in the Age of Colorblindness* 30–32, 35 (2010); Foner, *supra*, at 593–95.

movement, and resistance to reform.\textsuperscript{50} This section, similar to a scientific article’s literature review, summarizes earlier studies describing how forensic dentistry and court decisions intertwined in the 1970s and 1980s to establish bite mark analysis as an accepted forensic science. This section will be useful to readers unfamiliar with the bite mark and forensic science controversies.

Part III, examining \textit{Epidermis and Enamel}, includes our critical review of the editorial and exposes its weak reasoning and defensive posture.

Part IV, Unreasoned Reasons, offers a speculative explanation of the social and psychological mechanisms behind \textit{Epidermis and Enamel}, based in part on established psychological constructs, including cognitive dissonance, and the evolutionary theory of reasoning advanced by Hugo Mercier and Dan Sperber.\textsuperscript{51}

Part V, Conclusion: The Counterattack on Reason and Evidence, places the resistance of the forensic odontologists whose analysis we criticize in Part III and who we try to understand in Part IV in the context of other forensic scientists and crime analysts who adhere to methodologies that have been superseded by more scientific and evidence-based methods.\textsuperscript{52}

I. A TALE OF TWO DENTISTS

Of the 200,000 dentists in the United States and Canada, about 100 or fewer are identified as board certified \textit{diplomates} of the American Board of Forensic Odontology (ABFO).\textsuperscript{53} There are about
three times as many forensic dentists who are not board certified; also, non-forensically trained dentists may participate in forensic dentistry.\textsuperscript{54} Few odontologists practice this investigative specialty full time.\textsuperscript{55} Before bite mark analysis was added to the forensic odontology toolkit, the unobjectionable practice of identifying deceased persons by linking dental remains to dental records was well established.\textsuperscript{56} How did well-trained practitioners of such a sober and intuitively reliable practice come to accept the questionable practice of bite mark comparison analysis?\textsuperscript{57} In this part we consider

\begin{itemize}
  \item \textsuperscript{54} In 2004 there were 425 members of the Odontology section of the American Association of Forensic Science compared to 84 ABFO Certified odontologists. See C. Michael Bowers, Forensic Dental Evidence: An Investigator's Handbook 
  \item See The Controversial History of Bite Mark Analysis, AM. STUDENT DENTAL ASS'N BLOG (June 15, 2016), https://www.asdablog.com/the-controversial-history-of-bite-mark-analysis/ [https://perma.cc/A678-TU8Y]. Forensic odontology textbooks include chapters on bite mark techniques. See, e.g., Bowers, HANDBOOK, supra note 54, at 67–105 (including a chapter on the techniques for understanding the appearance, characteristics, forensic terminology, and rationale of bite mark analysis in the 21st century). In addition to bite mark analysis, the scientific validity of the aging of a person by analysis of teeth has been questioned. See Brittany Mejia, Migrant Minor is Held in Adult Detention Facility for Nearly a Year After Dental Exam Found He Was Likely 18, L.A. TIMES (Oct. 2, 2018, 4:00 AM), https://www.latimes.com/local /california/la-me-in-dental-xray-20181002-story.html [https://perma.cc/RRQ8-6AM3].
  \item See NRC REPORT, supra note 21, at 176; infra Part II. Bite mark analysis is not the only unreliable forensic practice that was taken, for a while at least, to be based on unimpeachable science; the story of comparative or compositional bullet lead analysis provides a cautionary tale. See Edward J. Imwinkelried & William A. Tobin, Comparative Bullet Lead Analysis (CBLA) Evidence: Valid Inference or Ipse Dixit?, 28 OKLA. CITY U. L. REV. 43, 72 (2003); see, e.g., Max M. Houck, Exquisite Measurements, Erroneous Inferences: Compositional Bullet Lead Analysis, in FORENSIC SCIENCE REFORM: PROTECTING THE INNOCENT, 9 (Wendy J. Koen & C. Michael Bowers eds., 2017) (describing how the FBI’s CBLA method made the leap from “exquisite measurement to erroneous interpretation” after an independent review conducted by the National Academy of Sciences found the technique to be “flawed and without scientific basis”); Wendy Koen, Case Study: James Otto Earhart, in FORENSIC SCIENCE REFORM: PROTECTING THE INNOCENT, supra, at 4 (explaining how an FBI agent’s CBLA testimony was
the good faith of forensic analysts by examining the work of two forensic odontologists.\textsuperscript{58} Cases of forensic scientists’ outright fraud surely grab more headlines and are easier for the public to understand.\textsuperscript{59} The much larger and more pervasive problem, however, is, as stated by Professor Sandra Guerra Thompson, the paradox of the ethical and biased analyst.\textsuperscript{60}

Bite mark analysis was probably adopted as a reliable technique in (erroneous) good faith by most odontologists, despite some warning signs.\textsuperscript{61} We contrast the flamboyant career of bite mark practitioner Dr. Michael West, whose excesses might exemplify the bite mark analyst for many or mark it as an aberrant practice, with a case study of Dr. Allan Warnick’s erroneous bite mark evidence. Warnick, a “normal” odontologist, represents the norm among forensic odontologists, at least in his work style if not in his results.

Michael West’s notorious career was marked by flagrant, unsupportable, and at times corrupt practices.\textsuperscript{62} He was identified as a purveyor of “junk science” in \textit{Actual Innocence}, the 2000 book which not only held out to be “infallible, solid, precise, scientific evidence,” but that the agent himself was also “revered” by those participating in the trial.

\textsuperscript{58} The reliability of bite mark evidence is reviewed in greater detail in Part II and a deeper psychological explanation is advanced in Part IV.

\textsuperscript{59} See, e.g., JIM DWYER ET AL., \textsc{Actual Innocence: Five Days to Execution and Other Dispatches from the Wrongly Convicted} 107–25 (1st ed., 2000) (discussing examples of how wrongful conviction cases are so easily picked up by mainstream media and disseminated to the general public); SANDRA G. THOMPSON, \textsc{Cops in Lab Coats: Curbing Wrongful Convictions through Independent Forensic Laboratories} 35–36 (2015) (explaining how the national publicity surrounding wrongful conviction cases has ousted incompetent criminal laboratories and invalid forensic practices). Forensic fraud takes the forms of performing tests with gross incompetence, lying about credentials, cheating on proficiency tests, tampering with drug evidence to steal drugs, “faking laboratory results, intentionally misinterpreting evidence, and giving flagrantly perjured testimony.” \textit{Id.} at 35. Sixty-seven laboratory scandals were identified in twenty-eight states resulting in one-hundred fifteen exonerations. \textit{Id.} at 52–61.

\textsuperscript{60} See THOMPSON, supra note 59, at 130–33.

\textsuperscript{61} An early survey found the motives that drew people to careers in dentistry included prestige, financial earnings, human service, autonomy, and manual skill. See D.M. More & Nathan Kohn, Jr., \textit{Some Motives for Entering Dentistry}, 66 AM. J. SOC. 48, 48 (1960). We have not discovered a similar article on motivations that draw dentists to forensic odontology. We speculate that prestige, human service, and manual skill will rate high as allurees to odontology, that autonomy will rate lower as odontologists will be subject to the control of medical examiners or litigators, and that the financial attraction will depend on the kinds of fees offered for workup and testifying offset by the earnings from their dental practices.

\textsuperscript{62} See Paul C. Giannelli, \textit{Bite Mark Analysis} 26–27 & nn.92–93 (Case Research Paper Series in Legal Studies, Working Paper No. 08-06, Jan. 2008). "A series of cases in Mississippi has made Dr. Michael West a controversial figure.” \textit{Id.} at 26. Cases included matching teeth to indentations on a bologna sandwich, which was destroyed; requiring use of photographic evidence leading to reversal of conviction as prejudicial; testifying to bite marks that another expert identified as ant bites; identifying bite marks made three weeks before inspection, contradicted by Dr. Richard Souviron who testified that the wound was not a bite mark, and if it were, was inconsistent with the teeth of alleged biter. \textit{See id.} at 26–27, 27 n. 92.
helped accelerate the innocence movement by bringing it to national attention.\textsuperscript{63} Wearing yellow goggles and applying a blue laser light, self-labeled the “West Phenomena,” he “claimed to be able to visualize tooth marks, cuts, and scrapes on the skin of crime victims that no one else could see. . . . No one has ever been able to duplicate West’s work.”\textsuperscript{64} West’s career is detailed in The Cadaver King and the Country Dentist: A True Story of Injustice in the American South, by Washington Post reporter Radley Balko and Mississippi Innocence Project Director Tucker Carrington.\textsuperscript{65} Balko had previously reported on Michael West.\textsuperscript{66}

\textsuperscript{65} See BALKO & CARRINGTON, supra note 49. The book is a complex, compound story of two wrongful convictions and exonerations, two forensic scientists, and “a sprawling, complex affair” about the control of death investigations in Mississippi. See id. at xiii–xix. Two African American working-class men, Levon Brooks and Kennedy Brewer, were convicted in 1992 and 1995 for murdering their girlfriends’ young daughters, Courtney Smith and Christine Jackson, in nearby Mississippi communities. See id. at 157–58, 195. They were exonerated in 2008 by DNA profiling and with the assistance of the Innocence Project. See Tucker Carrington, Mississippi Innocence: The Convictions and Exonerations of Levon Brooks and Kennedy Brewer and the Failure of the American Promise, 28 GEO. J. LEGAL ETHICS 123, 167–68 (2015). The killer was deranged local man, Justin Albert Johnson, a known drug user and sex offender at the time of the murders, and who was considered as a suspect and rejected. See BALKO & CARRINGTON, supra note 49, at 4–5, 19–20, 26–27, 31–32. The wrongful convictions were the product of shoddy police work that relied heavily on the assertion of pathologist Dr. Steven Hayne that bruises on the girls were bite marks, and on the analysis of Dr. Michael West. Id. at 8–10, 19–20, 22, 32. Hayne and West often worked as a team and the book details their questionable methods, including Hayne’s autopsy caseload, which was far greater than called for by professional standards. See id. at 94–95. Far from being a typical wrongful conviction narrative, The Cadaver King is a mind-boggling story of how these two driven and unscrupulous actors took advantage of a miserly state’s close to non-existent system for death investigation, corrupt coroners’ offices, and institutional racism, to dominate criminal autopsies in Mississippi. See id. at xvi–xix. They became go-to experts by less than critical prosecutors who seemed far more interested in assertions of guilt than the truth. See id. at xx. Attempts to reform Mississippi’s death investigation system continuously failed but eventually the egregious work led to West and Hayne being professionally sidelined. See id. at 317. The book is based in part on previously published work by Tucker Carrington. See id. at xxi; Carrington, supra.

When West’s career as a bite mark specialist bloomed in the tough-on-crime 1980s, the technique had already been accepted by several state courts and had become known to the public through the Ted Bundy serial killer case. While practicing medicine and working as a forensic odontologist, West engaged in bite mark research, published many articles on the topic, often with Robert Barsley, and testified for the prosecution in the first Mississippi trial where bite mark evidence was introduced (although the defendant was acquitted). A close look at his work in Levon Brooks’s wrongful conviction case shows that his techniques were highly questionable. He was an assistant coroner, garnered favorable local news coverage, and sought to insinuate himself in a serial murder case in order to expand his profile. A sign that West was on shaky ground as a forensic scientist in a corrupt prosecutorial and judicial system was his being called to testify and qualified as an expert in at least a dozen scientific or pattern-comparison categories in which he had little or no training. Balko and Carrington opine that “Michael West is either a master bullshit artist or an autodidact for the ages.” His earthy persona made him effective with juries; he always testified for the prosecution. In one case he removed a murder victim’s fingernails, mounted them on sticks, and claimed to match the fingernails to scratches on the suspect’s skin; however, he failed to produce test marks making it impossible to review his conclusions. Perhaps his worst technique was the practice of pushing dental casts from a suspect onto the skin of a victim where a
bite mark, or alleged bite mark, appeared, thus possibly fabricating evidence.  

In another case West simply looked at a clean knife in the home of a murder suspect with a good alibi and immediately declared it to be the murder weapon.  

He linked the knife to the murder by using ultraviolet light to claim to see impressions the knife handle left on the skin of the suspect’s hand purportedly made weeks before; when he overexposed photographs of the suspect’s hands, West made photocopies of the hands and drew the knife’s indentations patterns from memory. These techniques are patently absurd, but in every case West would support his assertions of matches, which were almost always admitted into evidence, with his signature phrase: “indeed and without doubt.”  

By 1996 West’s notoriety fetched him a cover story in the February issue of the American Bar Association Journal. Noting that “West’s self-proclaimed forensic abilities . . . have long been questioned by many of his peers,” and that “West has claimed to see things that he has not been able to document, fail[ing] to follow generally accepted scientific techniques,” he nevertheless remained in demand by prosecutors. Although Mississippi courts upheld his testimony, West was excoriated in several dissents, especially in the appeal from Levon Brooks’s conviction, in which Justice McCrae commented, “This is not the first time that Dr. West has been able to boldly go where no expert has gone before.”

---

79 See Balko & Carrington, supra note 49, at 119.  
80 See id. at 120.  
81 See id. In this case, West claimed that three forensic scientists used the method, but all filed affidavits denying this. See id. at 120–21. The suspect was ultimately released and sued West for civil damages. See id. at 121. The case was dismissed because while the affidavits of several forensic scientists discredited West’s methods, a supporting affidavit by Stephen Hayne, West’s partner in arms, led the court to ascribe the criticism of his methods as a difference of opinion among experts. See id. at 121–22.  
82 See Brooks v. State, 748 So. 2d 736, 749 (Miss. 1999) (McRae, J., dissenting). “This Court’s apparent willingness to allow West 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.” Id. at 750 (footnote omitted). West also used terms like “astronomical” and “without question” in “boastful reports larded with certainty.” Balko & Carrington, supra note 49, at 114.  
83 See Hansen, supra note 64, at 50. He was also called out by a report by John Stossel on ABC News, by the National Law Journal, New Orleans Times-Picayune, Newsweek and 60 Minutes. See Balko & Carrington, supra note 49, at 206, 241–42.  
84 Hansen, supra note 64, at 50–51.  
85 Brooks, 748 So. 2d at 748 (McRae, J., dissenting).
West’s decisions were so egregious that he was eventually brought to book. His status and affiliations were challenged in the late 1990s. The defense attorney in the case in which West identified a knife as a murder weapon by sight,

John Holdridge of the Mississippi and Louisiana Capital Trial Assistance Project, filed complaints about West with professional organizations. An ethics committee of the American Academy of Forensic Sciences [AAFS] concluded that West had “misrepresented data in order to support his testimony” and that the term “indeed and without doubt” was unwarranted. Similarly, an ethics committee of the American Board of Forensic Odontologists [ABFO] concluded that West had “materially misrepresented the evidence and data.” It also concluded that the “West Phenomenon” was not “founded on scientific principles” and that West had presented testimony “outside the field of forensic odontology.” Finally, the Crime Scene Certification Board of the International Association of Identification [IAI] concluded (but only by a majority) that there was a basis for the complaint and provided West with an opportunity to relinquish his “Senior Crime Scene Analyst” certification.

West continued to practice but as court rulings began to go against him he “stopped doing bite mark analyses in 2006 . . . [and] gave up his private dental practice in 2009.” “In 2012, he said in a deposition, ‘I no longer believe in bite mark analysis,’ and then later said to a reporter, ‘The science is not as exact as I had hoped.’” It is worth considering that West was not only an egregious confabulator among forensic dentists, but along with Steven Hayne and morgue owner Jimmy Roberts, poured enormous energy into efforts that “would come to dominate Mississippi’s medicolegal system. The

86 See id. at 749.
88 BALKO & CARRINGTON, supra note 49, at 317. Simultaneously, Steven Hayne’s control on forensic pathology slipped. See id. at 287, 288.
89 Id. at 315. Nevertheless, bite mark analysis, some of it inspired by West’s widely publicized methods, continue to be used by prosecutors and supported by courts. See Radley Balko, Yet Another Bite-Mark Conviction is Unraveling, WASH. POST (May 21, 2018, 2:09 PM), https://www.washingtonpost.com/news/the-watch/wp/2018/05/21/yet-another-bite-mark-conviction-is-unraveling/ [https://perma.cc/5Q6E-DB33].
Mississippi system was run by a triumvirate for years,” says one long-serving former coroner. ‘Imagine that. A pathologist, a small-town dentist, and a funeral director. . . . The state provided an audience of adoring idiots.”\(^{90}\) No other forensic odontologist came close to matching West’s outrageous career and none other was expelled from the ABFO.\(^{91}\)

Our study of Michigan exonerations led to the Cristini-Moldowan case and to Dr. Allan Warnick.\(^{92}\) Dr. Warnick, now retired, practiced dentistry in suburban Detroit with an unblemished record, until he expanded his work to include bite mark analysis.\(^{93}\) Drawn to forensic odontology, he did what was best in that specialization by identifying deceased victims of airplane crashes and of the 9/11 World Trade Center attack.\(^{94}\) He was chief forensic odontologist in the Wayne County Medical Examiner’s Office and a consultant to Macomb

---

\(^{90}\) Balko & Carrington, supra note 49, at 115 (alteration in original).

\(^{91}\) ABFO officers did file an ethics complaint against Dr. Michel Bowers, a prominent bite mark skeptic, with the American Academy of Forensic Sciences (AAFS) in retaliation for his outspoken criticism of bite mark evidence. See Balko, Bite Mark Attack, supra note 66. Dr. Bowers had previously resigned from the ABFO in 2011. See id. Dr. Bowers was also sued for defamation by two forensic odontologists (who testified for the prosecution in a wrongful conviction case). See id.

\(^{92}\) The review of Warnick’s work in the Cristini-Moldowan case provides some data to support our argument in Part IV, infra, suggesting why odontologists may find it difficult to drop bite mark analysis from their professional repertoire.


\(^{94}\) Dr. Warnick did not respond to our inquiries to be interviewed for our larger project after he retired. He testified that he taught about odontology or “legal dentistry” at the University of Detroit School of Dentistry. Dr. Warnick’s web site at the University of Detroit Mercy School of Dentistry reports that

Allan Warnick, DDS, DABFO, Course Director, Chief Forensic Odontologist, Wayne and Oakland County Medical Examiner’s Office, earned his degree from the University of Detroit School of Dentistry. Dr. Warnick is a Diplomate of the American Board of Forensic Odontology and a Fellow of the Academy of Forensic Sciences. Dr. Warnick is the Team Leader of the Michigan Dental Association Forensic Dental Identification Team, which has responded to the Northwest Flight #255, Flight #1487, and Comair Flight #3272 airplane disasters. Most recently, he was deployed as part of the NDMS-DMORT team to assist at the World Trade Center.

County, Monroe County, and the Michigan State Police. By all accounts Allan Warnick was a respected, sober, and competent professional and educator who displayed none of the flamboyance, carelessness, or excessiveness observed in Michael West’s career, and yet he was responsible for several mistaken identifications and one apparent ethical lapse coming out of his investment in bite mark analysis.

*Epidermis and Enamel*’s central argument is that wrongful convictions are caused by a combination of errors, implying that shared causation releases forensic odontologists from or attenuates their responsibility. Its loosely stated thesis creates a smokescreen that hides a critical problem seen in several cases, which offers a reason to eliminate bite mark evidence from prosecutions, namely that prosecutors rely on bite mark evidence to bolster weak cases. An expert witness who appears credible to jurors can overcome a prosecutor’s weak narrative. The Cristini-Moldowan case is a good example.

---

85 See *Otero*, 614 N.W.2d at 178; Trial Transcript, Cristini & Moldowan 1991, *supra* note 94, at 49. In addition, he taught at the University of Detroit Mercy School of Dentistry where he lectured at forensic investigation classes at Wayne State University.

86 Compare Class of 2019 Spirit Awards, *supra* note 93, with Radley Balko, *Leigh Stubbs, Mississippi Woman, Serving 44-Year Sentence Despite Discredited Testimony*, HUFFINGTON POST, (Dec. 6, 2017), https://www.huffpost.com/entry/leigh-stubbs-michael-west-forensics-discredited-testimony_n_922219 [https://perma.cc/X7GB-C7ZG] (stating that even though Michael West was discredited, he continued to use his self-proclaimed “West Phenomenon” to testify in court), and Randy Balko, *Washington Post Reports on Controversial Medical Examiner Dr. Steven Hayne, George C. Cochran Miss. Innocence Project* (May 15, 2014, 1:07 PM), https://innocenceproject.olemiss.edu/new-case-examiner/ [https://perma.cc/377M-EYJJ] (establishing that Michael West has been known to commit perjury on numerous occasions and was consistently criticized for his “sloppy practices and dubious testimony”).


88 See Barsley et al., *supra* note 2, at 92.

In the early morning hours of August 9, 1990, Emergency Medical Services responded to a call and found twenty-four-year old Maureen Fournier lying at the intersection of Glenwood Street and McCrary Avenue on Detroit's east side, nearly naked and “partially disemboweled.” She was immediately transported to a local hospital. Not fully alert, she moaned her parent’s phone number. Her jaw, broken in three places, was wired shut. Her main wounds were closed—head and rectal injuries. At the time of her operation to repair internal injuries, she had a blood alcohol concentration (BAC) of .274 and was in a state of severe inebriation. An emergency room examination with a speculum detected no injuries or small lacerations to the vaginal area. As Maureen was being readied for her operation to repair her rectal injuries, “a vaginal swab for a wet mount” was negative, indicating that “there were no sperm on the slide.” The severity of her injuries precluded police from interviewing her for two days.

Several days after the operation Maureen, supported by her sister, Colleen Corcoran, claimed that she was stopped on the night of

---

100 See Jeffrey Moldowan, NAT'L REGISTRY OF EXONERATIONS (July 17, 2019), https://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3481
101 See Plaintiff-Appellee's Answer to Application for Leave to Appeal at 14, State v. Moldowan, No. 232196 (Mich. Ct. App. 2001) [hereinafter Plaintiff-Appellee's Answer]. She remained in the hospital for 22 days. Id.
102 See Trial Transcript, Cristini & Moldowan 1991, supra note 94, at 35. Seven days after the injuries, Maureen slipped between coherence and a semi-stupor while odontologists obtained bite mark impressions. See id. at 51–52.
104 See Trial Transcript, Cristini & Moldowan 1991, supra note 94, at 26. “[H]er colon was protruding out of her abdominal cavity with severe injuries to her anus . . . .” Id. (recounting the testimony of the emergency room senior surgical resident in charge).
105 Id. at 12–13.
106 See id. at 26.
107 Id. at 38–39. Neither motile nor immotile sperm was detected. See id. at 44.
108 See Moldowan v. City of Warren, 578 F.3d 351, 364 (6th Cir. 2009).
109 Preliminary Examination, supra note 103, at 33. She testified to having been vaginally and anally raped. See id. at 24–25. She indicated that Last Rites were administered by a Catholic Priest and that her head was “split open.” Id. at 31–32. She was operated on for four hours and spent 22 days in the hospital. Id. at 34. She also testified that her pain was worse than giving birth and that she had to wear a colostomy bag permanently. See id. at 32, 34. The senior surgical resident at the emergency room physician who saw Fournier at about 4:30 a.m. reported, “She was in shock, her blood pressure was low. . . . [H]er core [body] temperature was 93 degrees.” Trial Transcript, Cristini & Moldowan 1991, supra note 94, at 22.
August 8, while walking in the vicinity of Eleven Mile and Mound Roads in the Macomb County city of Warren.\footnote{See \textit{Moldowan,} 578 F.3d at 363–64; Preliminary Examination, \textit{supra} note 103, at 13–15, 48.} Her story was that her former boyfriend of thirteen months, Jeffrey Moldowan, and three other men, Michael Cristini, James Cristini, and Tracy Tapp, drove up to her in a light-colored van, shoved her in, and drove her to Detroit.\footnote{See \textit{Moldowan,} 578 F.3d at 363–64; Preliminary Examination, \textit{supra} note 103, at 8, 16, 19, 59.} She was beaten, vaginally and anally raped, anally sodomized with a metal bar while in the van and left for dead on a Detroit street where she had never been before.\footnote{See \textit{Moldowan,} 578 F.3d at 364; Preliminary Examination, \textit{supra} note 103, at 24–27; Michigan Department of Corrections Presentence Investigation Report at 5, Moldowan v. City of Warren, No. 90-1517 FC (Macomb Cty. Ct. Mich. Jun. 3, 1991) [hereinafter Presentence Investigation Report].} The sisters supported the story by claiming that Moldowan made telephone threats and cited his previous abuse of Maureen.\footnote{See \textit{Moldowan,} 578 F.3d at 364; Preliminary Examination, \textit{supra} note 103, at 8–10, 78.}

Because Maureen claimed the abduction occurred in Warren, Detroit law enforcement turned the case over to the Warren police.\footnote{See \textit{Moldowan,} 578 F.3d at 363–64. The case was assigned to Det. Donald Ingles, described as clueless by interview subjects. See \textit{Summary of Interview with Jeff Moldowan in Casco, Mich.} (May 24, 2016) [hereinafter Moldowan Interview] (on file with authors).} Moldowan and the other three men were arrested and charged with kidnapping, assault with intent to commit murder, and sexual assault.\footnote{See \textit{Moldowan,} 578 F.3d at 364; Preliminary Examination, \textit{supra} note 103, at 16, 18–19, 29–30, 48, 61.} Tracy Tapp had a solid alibi and charges against him were quickly dropped.\footnote{See \textit{Preliminary Examination,} \textit{supra} note 103, at 3.} At the preliminary hearing, Maureen, who claimed to have been abducted at dusk, could not identify James or Michael Cristini.\footnote{See \textit{id.} at 365.} Based on a good alibi and Maureen’s confused testimony, charges against James Cristini were dropped.\footnote{See \textit{id.} at 364, 365; Moldowan Interview, \textit{supra} note 114, at 8; Memorandum of Law in Support of Motion to Compel Key Prosecution Witness to Undergo Polygraph Examination at 4, State v. Moldowan, No. 90-1517 (Cir. Ct. Macomb Cty. Mich. Sept. 6, 2001) [hereinafter Polygraph Examination].} Both Moldowan and Michael Cristini had alibis.\footnote{See \textit{id.} at 364, 365.} Jeffrey spent the entire evening with friends while Michael worked until 2:00 a.m. on August 9 delivering pizzas from a local restaurant, an alibi supported by witness testimony and receipts.\footnote{See \textit{id.} at 364, 365.} As for Jeffrey’s physical condition, a week before the August 9 attack on Maureen, Moldowan’s leg was
broken and in a cast after James Cristini ran over him with his car during an argument.\footnote{121}{See Moldowan Interview, supra note 114, at 2.}

Looked at objectively, the evidence against Cristini and Moldowan was weak. Maureen, an alcoholic, had been drinking heavily and was ejected from a bar at 8:30 p.m.\footnote{122}{See Polygraph Examination, supra note 120, at 3; Preliminary Examination, supra note 103, at 15, 41.} Her sister allegedly refused to pick her up and she walked around the streets in a confusing pattern.\footnote{123}{See Preliminary Examination, supra note 103, at 47, 58.} If Maureen’s BAC was .274 at 4:30 a.m., she was more highly intoxicated earlier in the night, casting doubt on her memory. She claimed to have been abducted at dusk in the preliminary examination, but testified at trial that she wandered the streets of Warren for hours before her kidnapping.\footnote{124}{See Polygraph Examination, supra note 120, at 3; Preliminary Examination, supra note 103, at 16.} Her story that four men she knew including her ex-boyfriend attacked her was undermined by the quick release of two;\footnote{125}{See Moldowan, 578 F.3d at 364.} police should have searched for the other two or reevaluated her story. Detectives never questioned why white guys from Macomb County would drop a body in a poor, African American Detroit neighborhood, rather than in more familiar haunts. No one questioned Moldowan’s ability to jump out of a van, abduct a struggling woman, participate in a gang rape, and inflict hideous injuries while his broken leg was in a cast. A huge red flag to her rape allegation should have been the absence of sperm—a fact that was not developed in the trial. Their alibis, especially Michael Cristini’s, were overlooked.

In retrospect, biases clouded police and prosecutorial thinking.\footnote{126}{See Moldowan Interview, supra note 114, at 8; Interview with Cindy Barach, in Roseville, Mich. (May 27, 2016) [hereinafter Barach Interview] (on file with authors).} Sympathy for the victim of a horrible attack stifled any serious probing of her credibility, and neither the police nor defense lawyers dug more closely into her lifestyle. Jeffrey Moldowan and Michael Cristini were suspect figures in police eyes.\footnote{127}{See Moldowan Interview, supra note 114, at 7.} Jeffrey was a school dropout, lived to party and do drugs, and had several encounters with the law, including a 90-day jail sentence for assaulting Maureen’s dad.\footnote{128}{See Barach Interview, supra note 126, at 2, 6–7; Moldowan Interview, supra note 114, at 2–3, 8–9.} The police were certain they had the right men; crime narrative weakness was brushed aside.
Any doubts were removed by the introduction of scientific evidence. Maureen’s doctors observed several bite marks on her body and Dr. Allan Warnick was tasked with their examination, but not for a week, giving time for the bite mark bruises to begin healing.129 He asked Dr. Pamela Hammel to assist.130 Two days after photographing the bite marks, he took impressions of Moldowan and Cristini’s dentitions.131 He worked up the case, making overlays and refining his analysis with the use of a scanning electron microscope.132 His expert opinion to the jury was that bite marks on Maureen’s neck and left breast area were made by Jeffrey Moldowan’s teeth133 and that a bite mark on Maureen’s right forearm was made by the dentition of Michael Cristini.134 He also testified that he excluded the dentition of two other individuals.135

The defense team was quite competent. Moldowan’s attorney, Jeffrey Schwartz, had done his homework and brought out much of the weakness in bite mark analysis: that it is a subjective method in contrast to dental identification, especially when the bite mark patterns on acetate are drawn by hand;136 that skin is a poor medium for bite mark registration;137 that bite marks in food tend to be more definite than on skin;138 that unlike fingerprints which do not change, bite marks on skin do change over time;139 and that unlike fingerprint analysis, there was no numbering method to gauge bite marks.140 He also brought out that bite mark analysis was the smaller part of Dr. Warnick’s odontology practice.141 Both defense attorneys had Dr. Warnick emphasize the qualifications of Dr. Raymond Rawson, a bite

---

129 See Trial Transcript, Cristini & Moldowan 1991, supra note 94, at 51, 110. He was called by the Warren Police Department on August 16, 1990, a week after the attack on Maureen to obtain bite mark impressions. Id.
132 See id. at 62, 77.
133 See id. at 62.
134 See id. at 77, 84. After conviction, Moldovan’s attorney got an opinion from Dr. Richard Souviron who wrote, “From analysis of the bite would [sic] pattern, it is my opinion that the bite on the right forearm and the bite on the neck were made by the same individual.” Polygraph Examination, supra note 120, exhibit 15 at 1.
135 See id. at 103, 113. “So that we are not talking about an exact replica [of the bite mark] done by a machine.” Id. at 103.
136 See id. at 105.
137 See id. at 106.
138 See id. at 107.
139 See id. at 107.
140 See id. at 137, 138–39.
141 See id. at 101, 102.
mark pioneer under whom Warnick trained, knowing that Dr. Rawson had been retained as a defense expert. A defense slip on cross-examination by Cristini’s lawyer allowed Warnick to express a statistical conclusion about the likelihood of a random match in terms that had to impress the jury, although it was later criticized. On direct examination, Warnick discussed a 1984 article by Dr. Rawson on bite mark uniqueness. Dr. Rawson indicated in his article that when four or five “areas of matching parts or distinctive areas” of bite marks and teeth are found, taking into account a world population of 4 billion, that “the chances are, and I use the term when we teach our classes, 2.1 billion to 1 that another individual can make those same marks.” The flawed statistical conclusion was re-emphasized when asked on cross-examination if someone else could show a similar dental pattern. This allowed Warnick to opine, “In utilizing the statistics that [Rawson] has shown, which I feel is an extremely good article, that chances of an individual having the same distinct points are probably well over three to four million to one.”

Forensic odontologists Dr. James Woodward and Dr. Raymond Rawson testified for the defense. Both were university-based, members of the American Board of Forensic Odontology and other organizations and were experienced bite mark analysts. Dr. Rawson, who never before testified for the defense in a bite mark case, was the more experienced of the two and testified because of his expertise with the scanning electron microscope. The defense odontologists testified that they found no match between the overlays made from models of the defendants’ dentition and the bite mark photos.

The prosecution’s weak case based on the story of a highly inebriated complainant, on her sister’s report that Moldowan made threatening calls, and on no physical evidence except for the bite mark testimony, carried the day. The vigorous defense challenge to bite mark evidence was insufficient to convince the jury that the

142 See id. at 115, 127.
143 See id. at 126–27.
144 See id. at 93–94. This analysis was based on Raymond D. Rawson et al., Statistical Evidence for the Individuality of the Human Dentition, 29 J. FORENSIC SCI. 245 (1984). Warnick’s erroneous understanding of the application of the statistical argument is discussed infra notes 260–272.
146 Defendant-Appellant’s Affidavit Explaining Delayed Application for Leave to Appeal 25, People v. Moldowan, 643 N.W.2d 570 (Mich. 2002) (No. 119812) [hereinafter Royal Brief].
148 See Royal Brief, supra note 146, at 25–26, 34.
wrong men were being blamed for a hideous attack. After conviction, Jeffrey lamely protested his conviction for the presentence report: “Moldowan states he is innocent. ‘At 8:30 or 9:00, I was at Alter Road and Shoemaker. Later, I was out in Clawson.’” The final word was not spoken. A glimpse of the Cristini-Moldowan exoneration to come appeared at the tail end of the Presentence Investigation Report: “Mrs. [Sally] Moldowan feels her son is innocent, supports him, has spent a good deal of money hiring private detectives and expert witnesses. She said her son lived with the victim for about six months, and added, ‘She’s telling this story to cover whatever happened that night.’”

Sally Moldowan was right. In the summer after the convictions, Cindy Barach, Jeffrey’s sister, a real estate salesperson, enlisted the help of private investigator, Leland Spencer, and the support of her boss, realtor Ralph Roberts, and began investigating his case. She and Spencer patiently and doggedly hung out in the neighborhood where Maureen’s body was found and posted reward notices with Maureen’s picture. The ugly reality that emerged was that Maureen had become a crack-addict, street-walking prostitute who frequented the Detroit east side area where her body was found. She was punished by crack-house enforcers for not paying her drug debts. Cindy Barach was told by a Detroit police officer that other prostitutes had been similarly punished. Desperate to shield their middle-class parents, social workers no less, from learning of their lifestyles, and from fear of retaliation, Maureen and Colleen, concocted their story to deflect suspicion from the really dangerous men in their lives.

It took Cindy Barach several years to locate and mobilize the witnesses, gain the excellent legal representation of attorney John Royal, and find in Carl Marlinga a sympathetic Macomb County prosecutor who, after interviewing witnesses, supported Moldowan and Cristini in their bid for a new trial. Witnesses came forward

---

149 See Presentence Investigation Report, supra note 112.
150 Id. at 5. The report included three pages of incriminating details largely lifted from the police investigation.
151 Id. at 8.
152 See Barach Interview, supra note 126, at 2, 6.
153 See id. at 2, 3, 4.
154 See id. at 3, 9.
155 Id. at 9.
156 Id.
157 See Hans Sherrer, Prosecutor Indicted for Bribery After Two Men Exonerated of Kidnapping and Rape, JUSTICE, no. 27, 2005, at 10; Royal Brief, supra note 146. But see Carl
who testified to the fact of Maureen’s prostitution in Detroit’s northeast area, her addiction, her involvement with crack cocaine dealers, and the reign of fear created by drug sellers and their enforcers.\(^{158}\) A friend testified that Maureen admitted to having lied about Jeffrey’s guilt.\(^{159}\)

The critical difference, however, was made by reversals related to the bite mark testimony. Prosecutor Marlinga announced publicly that a conviction based on false evidence violates due process and ethical rules require a prosecutor to rectify the matter when discovered.\(^{160}\) He therefore supported a new trial while maintaining that other evidence would support a conviction on retrial.\(^{161}\) The Michigan Supreme Court in 2002 ordered a new trial for Moldowan in a brief opinion reversing the conviction.\(^{162}\) “In this case the prosecutor’s two expert witnesses with respect to ‘bite-mark’ evidence have either recanted testimony which concluded that bite marks on the victim were made by the defendant or presented opinion evidence which has now been discredited.”\(^{163}\)

A decade earlier, no one questioned Dr. Warnick’s bite mark conclusions. The unraveling of his reputation was part of the larger story of DNA exonerations. Warnick linked two Wayne County suspects to murder victims through bite mark analysis, only to have both cases dismissed when DNA and other tests exonerated them.\(^{164}\)

---

Marlinga, Letter to the Editor, Change of Course Justified in Rape Case, DETROIT FREE PRESS, Aug. 22, 2002, at 17 (expressing that even though he is fully convinced that Moldowan committed the crime, Moldowan is nevertheless entitled to due process of law). The Michigan Supreme Court granted a new trial. See People v. Moldowan, 643 N.W.2d 570 (Mich. 2002) (reversing Moldowan’s conviction and remanding the case for a new trial).

\(^{158}\) See Royal Brief, supra note 146, at 38, 40, 42.

\(^{159}\) See id. at 38.

\(^{160}\) See Marlinga, supra note 157.

\(^{161}\) See id. Marlinga published his reasoning in the news media after an allegation linking his support for Moldowan’s new trial was claimed to result from a campaign contribution to him (he was running for Congress at the time) by Cindy Barach’s employer, Ralph Roberts. See Marlinga Says Ethics Guided His Decisions, MACOMB DAILY (Sept. 21, 2006), https://www.macombdaily.com/sports/marlinga-says-ethics-guided-his-decisions/ [https://perma.cc/87J4-E8SJ]. He was later federally prosecuted for this and was acquitted. See World’s Greatest Realtor and Keeper of Uniroyal Nail Files for Bankruptcy, DEADLINE DETROIT (June 04, 2012, 2:45 PM), http://www.deadlinedetroit.com/articles/642/world_s_greatest_realtor_and_keeper_of_uniroyal_nail_files_for_bankruptcy [https://perma.cc/4TBB-TU62]. He now serves as a trial judge. See Norb Franz, FBI, Oakland Sheriff Raid Utica Offices of Realtor Ralph Roberts, OAKLAND PRESS (Jun. 29, 2017), https://www.theoaklandpress.com/news/fbi-oakland-sheriff-raid-utica-offices-of-realtor-ralph-roberts/ [https://perma.cc/RA4K-A35G].

\(^{162}\) See People v. Moldowan, 643 N.W.2d 570, 570–71 (Mich. 2002).

\(^{163}\) Id. at 570.

These exonerations led the Wayne County Prosecutor’s office to quietly distance itself from his work in 1995. Warnick’s record became well known to the public in 1997 when Rod Hansen, an award winning reporter for a highly popular Detroit AM radio station, WJR, conducted a six-month investigation and ran a thirteen-part story over two and a half weeks that exposed the cases of Otero and Amolsch and explored the weaknesses of the bite mark evidence in Moldowan’s case and that of Carol Ege. Four of the thirteen stories focused on Jeffrey Moldowan’s case and when interviewed, Dr. Warnick backtracked from his earlier practice of citing astronomical odds of the likelihood of another person making a similar bite mark.

Equally significant, the reinvestigation led Dr. Pamela Hammel to recant her testimony at the 1991 trial, where she testified as a rebuttal witness. In seeking a new trial Moldowan argued that the prosecutor misused process by reserving Hammel as a rebuttal witness.

Asks Justice

The Wayne County Prosecutor’s Office concluded that it “will not approve warrants where the main evidence as to the identity of a potential defendant is the opinion of Dr. Warnick that he/she is the source of the bite marks.” Eqe v. Yukins, 485 F.3d 364, 372 (6th Cir. 2007).


166 See Affidavit of Pamela Wallace Hammel at ¶ 5 (Sept. 17, 1999) (on file with the authors); Hammel Testimony, supra note 130, at 35.

168 See Hammel Testimony, supra note 130, at 68, 69; Letter from Pamela Hammel, Forensic Dental Consultant, to John F. Royal, Co-Counsel for Defendant Moldowan (Aug 19, 1999) (on file with authors); see also Royal Brief, supra note 146, at 19.
The men were acquitted in their 2003 and 2004 retrials. Colleen and Maureen stuck to their stories, but their lies were exposed by the new witnesses who testified to their demimondaine lifestyle. More explosive was Dr. Hammel’s testimony that doubts she harbored about her bite mark identifications before the 1991 trial were overridden by a lie told by Dr. Warnick. In preparing for the 1991 trial she told Dr. Warnick that she “was having a difficult time lining up the acetates with the photographs of the bites and the models” and felt “very uncomfortable with the case.” Dr. Warnick suggested reversing the orientation of the acetate to align upper and lower teeth. In addition, he assured Dr. Hammel that he had sent the materials to a renowned forensic odontologist, Dr. Normal Sperber. That caused Dr. Hammel “to think the problem was with me,” and she went on to testify as a rebuttal witness in 1991 that both Moldowan and Cristini’s dentitions fit the bite marks. Several years later, she was brought in on the Amolsh and Ege cases and “realized that they were also bad cases,” and then learned that Dr. Warnick had never sent the Cristini and Moldowan material for a second opinion to Dr. Sperber; at that point she came to believe that he had lied to her. As a result, Dr. Hammel testified in Moldowan’s and Cristini’s second trials without compensation. When asked why she was testifying she said,

Yes, I would like to tell the ladies and gentlemen of the jury that I am here to right a wrong. I made a mistake and I want to correct that. I am responsible for my actions in the past, but I also feel like I was misled and misinformed to come to my incorrect conclusion.

---

171 See Royal Brief, supra note 146, at 38–44.
172 See Hammel Testimony, supra note 130, at 28, 32.
173 Id. at 28.
174 Id. at 34.
175 See id. at 32.
176 Id. at 34.
177 Id. at 35.
178 Id. at 37 (spelling the names phonetically as “Amosh” and “Egee”).
179 Id. at 38, 56.
180 Id. at 71, 81.
181 Id. at 72.
II. A BRIEF, CRITICAL REVIEW OF BITE MARK EVIDENCE

Forensic odontology is a recognized specialization within forensic science, defined broadly, forensic science is the application of science to legal matters. In the realm of criminal law, forensic sciences encompass a broad range of disciplines, each with its own distinct practices. The forensic sciences include such diverse areas as crime scene investigation, medicolegal death investigation, laboratory methods based on accepted physical science (e.g., toxicology, DNA profiling), and laboratory practices based on pattern-matching or feature-comparison methods, such as fingerprint (or friction ridge) analysis. Bite mark analysis and comparison falls into the latter category.

The sociology of forensic science provides a useful frame for our discussion. The tendency to compare a popular image of forensic science, perhaps shaped by the entertainment media, to an idealized image of research science should be tempered by appreciating the diversity of scientific practices and the distinctiveness of forensic science practices. Simon Cole contrasts “research science’ aimed at producing new knowledge about the natural world” with “more mundane activities such as industrial science or ‘regulatory

---


183 NRC REPORT, supra note 21, at 6. Odontology is a section within the American Academy of Forensic Science. See Types of Forensic Scientists, supra note 182.

184 “Forensic science’ has been defined as the application of scientific or technical practices to the recognition, collection, analysis, and interpretation of evidence for criminal and civil law or regulatory issues.” PCAST, supra note 23, at 1.


186 See PCAST, supra note 23, at 21, 25, 67; Murphy, supra note 185, at 723.

187 See PCAST, supra note 23, at 67.

188 See CHRISTOPHER LAWLESS, FORENSIC SCIENCE: A SOCIOLOGICAL INTRODUCTION 20, 24, 33 (2016). A sociological review of forensic science is incomplete without giving attention to the representation of forensic science in popular culture. See id. Idealized science has had a negative impact on the courts. See David S. Caudill & Lewis H. LaRue, Why Judges Applying the Daubert Trilogy Need to Know about the Social, Institutional, and Rhetorical—and Not Just the Methodological—Aspects of Science, 45 B.C. L. REV. 1, 30–1 (2003).
science,” and is critical of the National Academy of Sciences Report for not sufficiently marking this difference. Cole differentiates the social attributes of research and forensic science along a dozen criteria including: audience (peer scientists vs. legal actors); accountability mechanisms (scholarly peer review vs. legal adversarialism); data (intentionally collected and unlimited vs. adventitiously produced and inherently limited); knowledge claims (general vs. specific); time frame (open-ended vs. limited); product (scientific papers vs. reports); productivity goals (volume and impact vs. volume and speed); data sharing (unlimited, in principle vs. treated warily, sometimes prohibited by legal actors); research agenda (driven by paradigms vs. driven by demands of courts, the state); valid feedback (sometimes vs. rarely); reward structure (prestige vs. bureaucratic); and reporting of results (conservative, statistical, ambiguous vs. ambitious, colloquial, unambiguous).

Contemplating these differences warns us to be cautious about easily imposing the characteristics of research science on forensic science, and instructs us about the distance that must be travelled by forensic scientist to accept valid critiques and move forensic science toward a reform position.

The innocence movement has become a vital reform program across most criminal justice system practices, including forensic science. While a forensic science reform movement existed before innocence consciousness arose in the 1990s and 2000s, according to Simon Cole the innocence crisis “has become a crucially important input into the forensic science reform process.” The crisis presaged a

---


191 See Cole, Culture, supra note 189, at 44 tbl.1.


193 See Cole, Innocence Crisis, supra note 192, at 167; Zalman & Carrano, Sustainability, supra note 192, at 974–75; Zalman, supra note 63, at 1468.

194 Cole, Innocence Crisis, supra note 192, at 167. Innocence consciousness is defined as
paradigm shift brought on by DNA and other exonerations, which challenged a complacent view toward forensic science. It should be noted, in general, that reactions to the National Academy of Science’s critical report by various forensic science organizations varied from strong support, to measured support, to resistance. The two landmark surveys—the National Research Council’s congressionally authorized review of forensic science generally, and the narrower review of “Feature-Comparison Methods” by the President’s Council of Advisors on Science and Technology (PCAST)—were, after assessing existing research, especially critical of bite mark analysis. A major research project headed by Dr. Mary Bush at the State University of New York at Buffalo School of Dental Medicine, conducted between 2009 and 2013 and based on cadaver models of bite marks, has seriously eroded the scientific foundation and assertions of reliability of bite mark evidence. Proficiency tests of bite mark samples by odontologists that displayed weak agreement has further undermined the belief in bite mark analysis reliability. Significantly, the Texas Forensic Science Commission called for a moratorium on the use of bite mark comparison in 2016. In this Part we provide a brief summary of these findings, relying on three recent and overlapping articles which critique bite mark analysis.

the idea that innocent people are convicted in sufficiently large numbers as a result of systemic justice system problems to require efforts to exonerate them, and to advance structural reforms to reduce such errors in the first place. Innocence consciousness replaces a belief that the justice system almost never convicts an innocent person.

Zalman, supra note 63, at 1468.


See Cole, Innocence Crisis, supra note 192, at 175, 176.

See NRC REPORT, supra note 21, at 176; PCAST, supra note 23, at 87.

See M. Chris Fabricant & Tucker Carrington, The Shifted Paradigm: Forensic Science’s Overdue Evolution from Magic to Law, 4 VA. J. CRIM. L. 1, 60 & n.236, 62 (2016) (citing to the published research resulting from Dr. Bush’s project).

See infra notes 289–305 and accompanying text.

See Bowers, Pseudoscience, supra note 53, at 37; Saks et al., supra note 19, at 542; Erik Eckholm, Texas Panel Calls for an End to Criminal IDs via Bite Mark, N.Y. TIMES, Feb. 12, 2016, at A10.

An earlier, devastating critique of bite mark evidence was authored by the late Erica Beecher-Monas, a laboratory scientist and legal scholar:

Simply put, bite-mark testimony cannot meet [the relevance] standard. It has no empirical support. None of the trappings of science, the scientific sounding titles, group “certification” and publication in journals put out and reviewed by other members of the group, can serve to make bite-mark evidence helpful in deciding the perpetrator’s identity
The first article by Michael J. Saks, joined by thirty-seven leading scholars, had its origin in an amicus curiae brief challenging bite mark evidence. It briskly reviews the challenges to forensic science in recent years and succinctly describes how the admission of an unusual (and “exceedingly rare”) bite mark into evidence in a California case led other courts to incautiously accept bite mark evidence without it ever passing muster under tests of relevance. Saks et al. specify with clarity, thoroughness, and in lay language the issues regarding the challenge to bite mark evidence, a review of how to think scientifically about forensic evidence, the meaning of a forensic “inclusion,” the inherent limitations of bite mark evidence, the inability of forensic dentists to come to reliable (similar) conclusions in simulated bite mark tests, and reviews the research of Dr. Mary Bush et al. on bite marks in a cadaver model that suggests that the likelihood of bite marks on skin ever being unless the theory and assumptions on which the identification is based, the data supporting the theory, and the methodology used are sound. Bite-mark testimony fails on each of these fronts: the theory is based on unsupported assumptions, the data is absent and what we do have demonstrates the invalidity of the theory, and the methodology lacks professional guidelines or standards, and is entirely subjective. Absent empirical support, the testimony can have no tendency to make a disputed issue of identity more or less probable.


This article was modified from “Amici Brief” of Michael Saks, Thomas Albright, Thomas L. Bohan, Barbara E. Bierer, C. Michael Bowers and 38 Other Scientists, Statisticians and Law-and-Science Scholars and Practitioners in Support of the Petition for Writ of Habeas Corpus by William Joseph Richards.

Bowers, Pseudoscience, supra note 53, at 37 n.46.

The article references the NRC Report. See NRC REPORT, supra note 21. It also indicates that several previously used forensic techniques such as voiceprints, comparative bullet lead analysis, and older standards for determining the existence of arson from the residue of fires have been abandoned in the face of scientific re-analysis. See Saks et al., supra note 19, at 540–41, 542.

See People v. Marx, 126 Cal. Rpt. 350, 357 (Ct. App. 1975); Saks et al., supra note 19, at 545, 547.

See Saks et al., supra note 19, at 547–48.

See id. at 549, 550–51, 552.

See id. at 552.

See id. at 548.

See id. at 563.
2019/2020] Counterattack on Bite Mark Evidence Reform 779

reliable evidence is low.\textsuperscript{210} Saks et al. conclude by castigating the courts for having allowed unreliable evidence into criminal trials,\textsuperscript{211} holds out no hope that bite marks can ever be seen as reliable evidence,\textsuperscript{212} and by referring to the “rise and coming fall of bitemark evidence,”\textsuperscript{213} recommends that courts should declare such evidence as inadmissible.\textsuperscript{214}

Fabricant and Carrington,\textsuperscript{215} the second article, reviews the phenomenon of “shifted science”—that courts often lag behind scientific advances—and is critical of the weak pattern-comparison forensic techniques of hair and bite mark evidence.\textsuperscript{216} Its strong suit lies in deconstructing how courts have bootstrapped bite mark evidence as a purportedly scientific technique when the field of forensic odontology had not done so.\textsuperscript{217} The article quotes a Wisconsin Court of Appeals case\textsuperscript{218} at length to show how reciting the exacting techniques of bite mark analysis with professional jargon is so impressive to lawyers and jurors as to cloud the underlying weaknesses of the practice.\textsuperscript{219} This article usefully cites the dozen articles produced between 2009 and 2013 by Dr. Mary Bush and the scientific research team she led.\textsuperscript{220}

\textsuperscript{210} See id. at 565, 566.
\textsuperscript{211} See id. at 566–67.
\textsuperscript{212} See id. at 563.
\textsuperscript{213} Id. at 566.
\textsuperscript{214} Cf. id. at 566–67 (cautioning courts to carefully examine bitemark identification before allowing it as evidence).
\textsuperscript{215} See Fabricant & Carrington, supra note 198.
\textsuperscript{217} See, e.g., Fabricant & Carrington, supra note 198, at 38–39 (“People v. Marx, the first reported case to consider the admissibility of bite mark comparison evidence in human flesh [without any proper evidentiary hearing was cited by other states], turned an obscure, unvalidated subdiscipline of ‘forensic odontology’ into mainstream, ‘generally accepted,’ ‘scientific’ evidence without any basic or applied research to validate the technique’s . . . underlying hypotheses . . . .”).
\textsuperscript{218} See State v. Stinson, 397 N.W.2d 136, 137–39, 142 (Wis. Ct. App. 1986); Fabricant & Carrington, supra note 198, at 47–52.
\textsuperscript{219} See id. at 60 n.236. The scientists in these articles include Dr. Mary A. Bush, Peter J. Bush, Kyle Thorsrud, and Dr. Raymond G. Miller of the Laboratory for Forensic Odontology Research, School of Dental Medicine, SUNY at Buffalo; Dr. Robert R. J. Dorion, Laboratoire de sciences judiciaires et de médecine légale, Ministère de la Sécurité publique Québec; Dr. Howard I. Cooper; Dr. H. David Sheets, Department of Physics, Canisius College. See Mary A. Bush et al., The Response of Skin to Applied Stress: Investigation of Bitemark Distortion in a Cadaver Model, 55 J. FORENSIC SCI. 71, 71 nn.1–2 (2010); Mary A. Bush et al., Inquiry into the
In the most recent and succinct article challenging bite mark evidence, published in a scientific journal, Dr. C. Michael Bowers makes several points not stated or emphasized in Saks et al. or in Fabricant and Carrington. It is worth noting, for example, that an injury caused by a bite mark can be a source of DNA evidence if properly gathered by first responders. Also, helpful in our attempt to understand the thinking of bite mark odonatologists, we recognize that while the environment of forensic science “is predominantly separate from university, medical and commercial empirical scientific rigors[, t]his path was not intentional.” In this vein, Bowers emphasizes the uniformity of scientific critics of bite mark analysis and the relative scientific isolation of ABFO members.

Although bite mark analysis was fixed in the popular imagination by its prominent use to convict serial killer Ted Bundy in 1979 for the murders of two Florida State University coeds, the Bundy case was the first high-profile criminal trial introducing expert bite mark


See Bowers, Pseudoscience, supra note 53, at 38. The article explained that Weak Foundations by Saks et al. originated as an amicus curiae brief. See id. at 37 n.46.

See id. at 35.

See infra Part IV.

Bowers, Pseudoscience, supra note 53, at 34.

Bowers states in his article,

Contemporary independent scientific reviews of forensic expertise use surprisingly similar language in rejecting its use. In the clearest terms possible, they describe a framework of scientific rigor and supporting research that should exist but are absent from proffering bitemark analysts. The material reads like a primer for the Scientific Method and these groups, rich with scientific qualifications, are outside the insular community of bitemark matching dentists—in contrast to the membership of the American Board of Forensic Odontology. The qualifications of these external reviewers exist at the highest levels of the relevant physical and biological sciences.

Id. at 36 (footnote omitted).

evidence; yet this case did not seem important to the legal acceptance of bite mark evidence. Cases as early as 1870 and a 1954 bite-marks-in-cheese case were ruled admissible, but the important precedent is People v. Marx. Three dentists in this murder trial identified the defendant’s teeth as the source of the bite marks on the victim’s body. When challenged, the California Court of Appeals concluded that the experts applied scientifically and professionally established techniques to show the defendant made the bite marks on the female victim. According to Saks et al., “Marx became the paradoxical seed from which most, if not all, subsequent decisions about admissibility of bitemark expert testimony grew.” As Saks et al. note, Marx magically converted an exception to the rule into the rule: forensic dentists were free to testify in trials as courts cited Marx as precedent for admissibility although that decision did not apply the Frye general acceptance test.

Oddly, while the courts were consistently allowing bite mark comparison testimony in criminal cases between 1954 and 1981,

---

228 See infra notes 229–235 and accompanying text. The reputations of forensic odontologists Richard Souviron and Lowell Levine who matched bite marks to castings of Bundy’s teeth were elevated; their success may have influenced others. See Balko & Carrington, supra note 49, at 112. Michael West was drawn to investigate the case of Florida serial killer Danny Rolling (who was “inspired” by Ted Bundy), playing “the Gainesville murders for maximum exposure” and being quoted in the newspapers. Id. at 111–12. The growing skepticism of bite mark comparison evidence suggests that the evidence introduced against Bundy would be more sharply questioned today. See Gina Tron, If Ted Bundy’s Trial was Today, He May Have Walked Free—Thanks to Bite Mark Evidence, Oxygen (Feb. 14, 2019, 12:56 PM), https://www.oxygen.com/blogs/how-ted-bundy-got-convicted-is-bite-mark-evidence-credible [https://perma.cc/7759-LBPQ].
230 See Doyle v. State, 263 S.W.2d 779, 779 (Tex. Crim. App. 1954); Bowers, Handbook, supra note 54, at 183–84 (discussing other cases along with the Doyle case); Metcalf, supra note 229. The Texas Court of Criminal Appeals affirmed Doyle’s conviction, viewing a bite mark in cheese as the equivalent of footprints and fingerprints “so long recognized by this court.” Doyle, 263 S.W.2d at 780. Other Texas cases have admitted evidence of a bite mark made on skin. See Patterson v. State, 509 S.W.2d 857, 861 (Tex. Crim. App. 1974); Metcalf, supra note 229.
231 See People v. Marx, 126 Cal. Rptr. 350 (Ct. App. 1975); Saks et al., supra note 19, at 545.
232 See Marx, 126 Cal. Rptr. at 352–53.
233 See id. at 356.
234 Saks et al., supra note 19, at 545.
235 See id. Additionally, Patterson held bite mark analysis evidence admissible, going to weight and not admissibility. See Patterson, 509 S.W.2d at 863 (citing Polk v. State, 500 S.W.2d 825 (Tex. Crim. App. 1973)).
236 See, e.g., State v. Garrison, 585 P.2d 563, 566, 567 (Ariz. 1978) (allowing Dr. Campbell to provide expert testimony explaining the methods used to match the dental imprints from the
both dentists and odontologists themselves were struck by the flaws in procedures to identify matches between defendants and the bite marks on victim’s bodies. As odontologists Mertz and Stinson point out in their 1997 text, *Forensic Dentistry*, they believed that considerable work was needed before bite mark comparison techniques could be considered scientific. Furthermore, following the formation of the American Board of Forensic Odontology (ABFO) in 1976, many odontologists expressed concerns that the procedures used by odontologists—which had been accepted by the courts—were somewhat less than scientific. Saks et al. support this point by citing a respected criminalist.

Odontologists’ skepticism likely led the ABFO to form a bite mark study committee. Its members conducted their own research and noted there was great variability in bruising, discoloration, and bite marks left on the skin, and that variability related to an individual’s skin and even the victim’s gender. This research resulted in ABFO’s 1984 adoption and subsequent 1986 publication of guidelines for “Bite Mark Analysis.” After that, the ABFO attempted to bring out a set of scoring guidelines for bite mark analysis, but it became evident that bite marks were so different from one another that the ABFO had no choice but to retract its intention. Not only could the organization agree that there was little scientific basis for a handbook on either scoring or analysis, but the ABFO freed a prisoner based on a previously improper evaluation of bite mark evidence in the case of *Wilhoit v. State* in 1991.

victim’s skin to that of the accused; *Marx*, 126 Cal. Rptr. at 356–57 (Ct. App. 1975) (affirming the trial court’s decision to allow expert testimony regarding bite-mark evidence); State v. Temple, 273 S.E.2d 273, 280 (N.C. 1981) (holding that the trial court had “properly admitted the testimony of Drs. Webster and Hudson,” which concluded that the bite-marks on the victim’s skin matched the defendant’s teeth).


238 See *id.* at 137.

239 See *id.*

240 See Saks et al., *supra* note 19, at 547 n.29 (citing ANDRE A. MOENSSENS ET AL., *SCIENTIFIC EVIDENCE IN CIVIL AND CRIMINAL CASES* 985 (4th ed. 1995)).


242 See *id.* at 138.


244 See Stimson & Mertz, *supra* note 237, at 139.

245 See *id.*

By 1994, the ABFO developed guidelines for bite mark terminology; at the very least, they agreed on definitions and the use of terms. The guidelines, for example, agreed to define a bite mark as “a physical alteration in or on a medium caused by the contact of teeth.” This set of guidelines also listed the standards of proof in written and oral testimony. These included such degrees of certainty as a “possible biter,” a “probable biter,” and a “reasonable medical/dental certainty.” However, since the ABFO was concerned about odontologist outliers, Stimson and Mertz wrote that when forensic dentists made false claims about their findings and the reliability of those findings they were often using statements and results that were “unprovable and reckless.” Alex Forrest and Alistair Soon, in their 2016 text, acknowledged the scientific limitations of conclusions drawn from bite mark analysis. They concluded that, at best, only three possible outcomes of bite mark comparison could be asserted: “1. Can exclude the suspect. 2. Cannot exclude the suspect. 3. Cannot reach a conclusion because of insufficient detail to perform a valid comparison.” Forrest and Soon go on to say that the British Association for Forensic Odontology includes the category “Beyond reasonable doubt,” which, these authors contend, “is statistically unjustified and inappropriate in a legal setting.”

As noted, in 2016 PCAST found that “[b]itemark analysis is a subjective method,” that bite mark standards do not provide “well-defined standards” that would lead to reliable conclusions when trying to match dentition to bite marks left on a victim, and that “skin has been shown to be an unreliable medium for recording the precise patterns of teeth.” The report concludes that “bitemark analysis does not meet the scientific standards for foundational validity” and that “the prospects of developing bitemark analysis into a scientifically valid method [are] low.” These conclusions are

247 Stimson & Mertz, supra note 237, at 139.
248 Id. at 141.
249 See id. at 142.
250 Id. at 145.
251 See id. at 137, 145.
253 Id.
254 PCAST, supra note 23, at 83.
255 Id.
256 Id. at 84.
257 Id. at 87.
based on three important assumptions: (1) that dentition and dental characteristics differ substantially from one person to another and that each person’s dentition is unique; (2) that the skin can reliably capture the distinctive features of the characteristics of any person’s dentition; and (3) that trained and experienced forensic dentists can match bite marks left on the skin of a victim with the dental characteristics of an individual.\textsuperscript{258} Herein we discuss the research related to each assumption in greater depth.

Assumption 1: each person’s dentition is unique. According to PCAST, a number of studies cast serious doubt on this fundamental premise of the field of forensic odontology.\textsuperscript{259} However, there were also studies that purported to establish a scientific basis for this aspect of forensic dentistry. For instance, a 1984 paper claimed that human dentition was unique “beyond any reasonable doubt[.]”\textsuperscript{260} This study examined 397 bite marks that were made in a wax wafer.\textsuperscript{261} Twelve parameters from each were then measured and it was concluded that the chance of two bite marks having the same parameters is less than one in six trillion.\textsuperscript{262} More a theoretical rather than an empirical paper, it reports that the bite marks were not actually compared to one another in this study.\textsuperscript{263}

In 2010, however, a paper published by the Mary Bush group critiqued Rawson et al.’s claims.\textsuperscript{264} Bush et al. studied 344 human dental casts, measuring them by three-dimensional laser scanning.\textsuperscript{265} This study found “that matches occurred vastly more often than expected under the theoretical model.”\textsuperscript{266} “For example, the theoretical model predicted that the probability of finding even a single five-tooth match among the collection of bitemarks is less than one in one million . . . .”\textsuperscript{267} Yet in a study examining uniqueness in human dentition, Bush, Bush, and Sheets revealed 32 such matches.\textsuperscript{268} Studying human mandibular models in both two

\begin{footnotesize}
\begin{enumerate}
\item See id. at 8.
\item See id. at 84, 85–86.
\item Rawson et al., \textit{supra}, note 144. This study was the grounds for Dr. Warnick’s exaggerated statistical claims. See \textit{supra} notes 142–145 and accompanying text.
\item See PCAST, \textit{supra} note 23, at 84.
\item See id.
\item See id.
\item See id.; Bush et al., \textit{Inquiry}, \textit{supra} note 220, at 983.
\item See PCAST, \textit{supra} note 23, at 84; Bush et al., \textit{Inquiry}, \textit{supra} note 220, at 977.
\item PCAST, \textit{supra} note 23, at 84; see Bush et al., \textit{Inquiry}, \textit{supra} note 220, at 978.
\item PCAST, \textit{supra} note 23, at 84.
\end{enumerate}
\end{footnotesize}
dimensions (2D) and three dimensions (3D) and then performing statistical analysis, random matches could not be eliminated.\textsuperscript{269} In fact, there were a substantial number of random matches.\textsuperscript{270} The authors contend that it is not possible to avoid random matches.\textsuperscript{271}

Almost all of the above-cited studies, as PCAST pointed out, were conducted under ideal conditions.\textsuperscript{272} That is, the bite marks were produced in mediums other than skin.\textsuperscript{273} How well does the skin allow bite marks to be analyzed?

Assumption 2: the skin captures the precise pattern of teeth. Studies in which bite marks were made on the skin of animals or humans were shown to be very unreliable in terms of recording the precise pattern of teeth. For instance, “[s]tudies that . . . involved inflicting bitemarks either on living pigs”\textsuperscript{274} or on human cadavers\textsuperscript{275} have demonstrated that there are significant distortions.\textsuperscript{276} A 2010 study by Bush, Cooper, and Dorion, in which bite marks were produced by known biters, concluded that the skin distorts bite marks so substantially and so variably that current procedures for comparing bite marks are unable to reliably exclude or include a suspect as a potential biter.\textsuperscript{277} The authors stated that “the same dentition could not create a measurable impression that was consistent in all of the parameters in any of the test circumstances.”\textsuperscript{278} Experimental conditions, it must be noted, are unlike criminal events because “biting often occurs during struggles, in which the skin may be stretched and contorted at the time a bitemark is created.”\textsuperscript{279}

At the most basic level of bite mark analysis, “research suggests that forensic odontologists do not consistently agree even on whether an injury is a human bitemark at all. A study by the American Board

\textsuperscript{269} See id. at 119–20.
\textsuperscript{270} See id. at 120.
\textsuperscript{271} See id. at 122. See also Mary A. Bush & Peter J. Bush, Current Context of Bitemark Analysis and Research, in BITEMARK EVIDENCE: A COLOR ATLAS AND TEXT 303, 308–309 (Robert B. J. Dorion ed., 2d ed. 2011), reviewing the Rawson et al. study and concluding, “The statement that human dentition is unique is not justified.”
\textsuperscript{272} See PCAST, supra note 23, at 84.
\textsuperscript{273} See id.
\textsuperscript{274} Id.; see Iain A. Pretty, Reliability of Bitemark Analysis, in BITEMARK EVIDENCE: A COLOR ATLAS AND TEXT, supra note 271, at 587, 593, 594.
\textsuperscript{275} See PCAST, supra note 23, at 84; H. David Sheets et al., Bitemarks: Distortion and Covariation of the Maxillary and Mandibular Dentition as Impressed in Human Skin, 223 FORENSIC SCI. INT’L 202, 203 (2012).
\textsuperscript{276} See PCAST, supra note 23, at 84; Sheets et al., supra note 275, at 206.
\textsuperscript{277} See Bush et al., Inquiry, supra note 220, at 982.
\textsuperscript{278} Id. at 983.
\textsuperscript{279} PCAST, supra note 23, at 84.
of Forensic Odontology (AFBO) [sic] involved showing photos of 100 patterned injuries to ABFO board-certified bitemark analysts.”

These analysts were asked three elementary questions: “(1) whether there was sufficient evidence to render an opinion as to whether the injury is a human bitemark; (2) whether the mark is a human bitemark . . . or not a human bitemark; and (3) whether distinct features ([such as] arches and toothmarks) were identifiable.”

After a total of 38 examiners analyzed the photos, ABFO “reported that there was unanimous agreement on the first question in only 4 of the 100 cases and agreement of at least 90 percent in only 20 of the 100 cases. Across all three questions, there was agreement of at least 90 percent in only 8 of the 100 cases.”

In a similar Australian study, fifteen odontologists were shown a series of six bite marks from contemporary cases. Five of the six bite marks were confirmed by living victims to have been caused by teeth. The odontologists were asked to comment on whether the injuries were actually bite marks. The results of this study found great variability among the odontologists in their conclusions about the origin, circumstance, and characteristics of the injuries. The researchers were surprised that those forensic dentists “with the most experience (21 or more years) tended to have the widest range of opinions as to whether [a] mark was of human dental origin.”

The odontologists’ opinions varied considerably as to whether they thought a given mark was suitable for analysis, and individual odontologists showed little consistency in their approach to analyzing bite marks. The researchers concluded, “This inconsistency indicates a fundamental flaw in the methodology of bitemark analysis and should lead to concerns regarding the reliability of any conclusions reached about matching such a bitemark to a dentition.”

280 Id.
281 Id. at 84–85. The study was conducted by Adam Freeman and Iain Pretty and the raw data were reviewed by PCAST Senior Advisor Professor Karen Kafadar. See id. at 84 n.231, 85 n.232.
282 Id. at 85.
284 See id.
285 See id.
286 Id. at 666.
287 Id. at 667, 670.
288 Id. at 670.
Assumption 3: trained and experienced forensic odontologists can match bite marks with the teeth making those bite marks. The 2009 National Academy of Science Report found that the scientific validity of bite mark analysis had not been established.289 “In its own review of the literature PCAST found few empirical studies that attempted to study the validity and reliability of the methods to identify the source of a bitemark.”290 Other studies attempting to establish the validity of matching go back decades. For example, in a 1975 paper, two examiners were asked to match photographs of bite marks made by twenty-four volunteers in skin from freshly slaughtered pigs with dental models from these same volunteers.291 Some of the photographs were taken right after the bite marks were made, some an hour later, and others twenty-four hours after the bite mark was produced.292 The experimenter found that the two examiners’ performance was not only poor, but their ability to match bite marks with biters deteriorated with time.293 That is, the longer the delay between the bite mark and the photograph, the greater the inability to match. At the twenty-four-hour mark, the incorrect identification was almost 84 percent.294

A 1998 study examined whether forensic dentists, along with general dentists, dental students, and lay participants could determine whether color prints of bite marks from fifty actual criminal cases were produced by an adult or a child.295 Comparing the results to the verdicts in the cases, it was discovered that all groups, including forensic dentists, did poorly.296 Three years later, thirty-two AFBO-certified diplomates were asked to indicate how certain they were as to which dental models made each of four bite marks.297 The experts were given seven models, four of which did produce the bite marks, along with three unrelated models.298 The forensic odontologists made incorrect attributions eleven percent of

289 See NRC REPORT, supra note 21, at 173, 174.
290 PCAST, supra note 23, at 85.
292 See id.
293 See id. at 169.
294 See PCAST, supra note 23, at 86; Whittaker, supra note 291, at 169.
296 See id. at 13, 15, 17.
298 See id. at 105.
the time.  

That same year, in another study involving ten AFBO-certified diplomates, bite mark evidence from a dental model clamped onto a freshly slaughtered pig was given to them along with two possible sources; the researchers made sure that sufficient detail was provided in the photographs of the bite marks. The mean false-positive rate found in this study was 15.9%, meaning that about one in six identifications was incorrect. In a similar study with twenty-nine forensic dentists, including nine who were AFBO-certified diplomates, the dentists were provided with photographs of eighteen human bitemarks and dentition from three human individuals. The examiners were asked to match the bite marks with one of the three individuals (or that the bite mark did not come from the three individuals). The error rate in this study was seventeen percent, or again, they misidentified the match one in every six identifications.

Thus, the research does not support any of the three assumptions that are crucial for bite mark analysis to be considered reliable. Yet, courts continue to allow these bite mark experts to testify in criminal court trials—despite years of wrongful convictions based on the testimony of these expert witnesses. While there are repeated calls for the elimination of bite mark evidence in trials, still the travesty of unscientific evidence is allowed in court—all with no efforts by the ABFO or the forensic odontologists to study their field or to restrict its members from offering highly subjective opinions in trials.

Having reprised some of the substantial scientific and legal criticism that erodes if not destroys the scientific basis and reliability

299 See PCAST, supra note 23, at 86.
300 See id.
301 See id.
302 See id.
303 See id.
304 See id.
305 See id.
306 See Beecher-Monas, supra note 201, at 1372–74.
307 See, e.g., id. at 1374–75 (stating that permitting bite-mark evidence testimony to be introduced at trial, despite its proven lack of scientific reliability, is detrimental to the criminal justice system and adds no probative value to the jury in their determination of any disputed issue of fact); Fabricant & Carrington, supra note 198, at 7 (questioning the justice system’s ability to sufficiently determine the underlying scientific value associated with bite-mark analysis, further explaining that courts and litigants often reflexively rely on bite-mark evidence despite its growing notoriety as a scientifically invalid precedent); Saks et al., supra note 19, at 541–42 (expressing concern, stemming from the judicial system’s perceived reluctance to question the reliability of bite-mark evidence, despite the lack of empirical evidence to support such testimony).
308 See Balko, Flawed Science, supra note 66.
of bite mark evidence as a forensic tool to identify culprits, we now turn to the defense of that method offered by a group of forensic odontologists.

III. A CRITIQUE OF EPIDERMIS AND ENAMEL

*Epidermis and Enamel*, outlined at the beginning of this article, is an editorial-article which argues, largely by indirection, against courts’ ruling bite mark evidence inadmissible as an unreliable pattern-comparison forensic technique. The article’s thesis comes midway: “Bitemark evidence at trial can be powerful and compelling. The tissue damage created by human teeth is demonstrable. The judges and juries that hear the testimony and see the demonstrations can better understand bitemark evidence, including the violent nature and potential pain associated with biting.” To state that a bruise which probably is a bite mark is “demonstrable” is not the same as providing evidence that bite mark comparisons made by forensic odontologists are grounded in science or have been proven a reliable method of pattern comparison.

*Epidermis and Enamel* begins by noting that critics seek “obsessively” to eliminate bite mark evidence “from United States courtrooms” and then provides “An Odontology Response.” In this section the authors state that forensic odontology is an applied science “derive[d] from well-founded maxims that evolve over time as more knowledge is gained.” As with other applied science conclusions that are accepted by courts, opinions of forensic odontologist are “subject to cognitive (observer effect) biases.” What the authors miss here is a major conclusion to be drawn from PCAST and other careful analyses of pattern-comparison practices which generate impression evidence: that some forensic pattern-comparison practices are more reliable than others. Some, like ear mark or lip mark impression evidence, seem intuitively weak and have been found wanting, although prosecutors still promote them

---

309 See supra notes 2–24 and accompanying text.
310 See Barsley et al., supra note 2, at 89.
311 Id. at 94.
312 Id. at 88. Critics’ reviews are discussed infra in text accompanying notes 413–443.
313 Id. at 88.
314 Id.
315 Id.
316 See NRC REPORT, supra note 21, at 150.
as reliable forensic identification techniques. Latent fingerprint analysis is the feature-comparison method with the best record of being acceptably reliable. Fingerprint analysis, which is no longer deemed to be error free, has been subject to substantial research and has advanced farthest among the feature-comparison techniques from a deterministic to a probabilistic model. PCAST reviewed several studies and indicates that serious efforts are now being made to try to put the field on a solid scientific foundation—including by measuring accuracy, defining quality of latent prints, studying the reason for errors, and so on. Much credit belongs to the FBI Laboratory, as well as to academic researchers who had been pressing the need for research. Importantly, the FBI Laboratory is

317 The NRC Report notes that very few laboratories, according to a European survey, perform lip print or ear print examinations making it challenging to determine their reliability. See id. at 149–50. One American exoneration involved the submission of lip print evidence at trial, Lavelle Davis:

In 2006, Kane County Circuit Court Judge Timothy Q. Sheldon granted the petition following a hearing at which independent experts testified that lip print identification was not accepted science.

Davis’s attorneys also presented a letter from the chief of the FBI’s latent fingerprint unit stating: “The FBI Laboratory has not conducted any validation studies of lip print identification and has determined that it will not perform lip print analysis.”

Lavelle Davis, NAT’L REGISTRY EXONERATIONS (June 2012), https://www.law.umich.edu/special/exoneration/Pages/casedetail.aspx?caseid=3160 [https://perma.cc/5FU5-FYD7]. In Lavelle Davis’s case, an independent expert witness was

Andre A. Moenssens, professor emeritus at the University of Missouri, Kansas City Law School, and “Distinguished Fellow” of the American Academy of Forensic Sciences. Moenssens was emphatic when he stated that “lip impressions are a form of impression evidence very similar to earprints, elbow prints, and other comparative endeavors which have neither developed as forensic disciplines nor been the topic of extensive scientific research and experimentation”. Furthermore, he adds “…the use of lip print comparisons in criminal prosecutions has been very rare and the comparison methodology or case details have mainly been transmitted anecdotally.”

Gabriel M. Fonseca et al., Lip Print Identification: Current Perspectives, 65 J. FORENSIC & LEGAL MED. 32, 35 (2019) (alterations in original) (emphasis omitted). Nevertheless, there is substantial research on lip print identification and the practice seems to be used with some regularity in Poland; Fonseca et al. are cautiously negative about the reliability of lip print identification evidence but hope for better research. See id. at 37.

318 See PCAST, supra note 23, at 101.

319 See Christophe Champod, Fingerprint Identification: Advances Since the 2009 National Research Council Report, PHIL. TRANSACTIONS ROYAL SOC’Y B, May 4, 2015, no. 20140259, at 1–4. Although the field of friction ridge analysis has moved in this direction, many “fingerprint examiners today have adopted a new language without the necessary educational and scientific change that comes with it.” Id. at 3.
responsible for the only black-box study to date that has been published in a peer-reviewed journal.\footnote{PCAST, supra note 23, at 95.}

One well cited post-National Academy Report study found a very high level of reliability in a test of fingerprint examiners.\footnote{See Bradford T. Ulery et al., Accuracy and Reliability of Forensic Latent Fingerprint Decisions, 108 PNAS 7733, 7738 (2011).} Comparable efforts by the ABFO, however well intentioned, do not compare to the quality and quantity of research conducted regarding the reliability of fingerprint analysis, and the distance between the advances related to fingerprint analysis and bite mark evidence are great.\footnote{The ABFO has responded to the forensic science challenge by expressing a commitment to proficiency testing, suggesting a second opinion in bite mark cases, seeking accreditation, establishing ethical standards and eliminating the acceptability of “certainty” statements by odontologists. See Barsley et al., supra note 2, at 87–89. The claim that “odontologists do not continue analysis in most cases they initially evaluate,” id. at 89, speaks well to the care taken by odontologists but does not allay the concern that the unreliability shown in various tests may result in wrongful convictions.}

From our lay perspective, a critical difference between latent fingerprint and bite mark (or lip impression, or ear impression, or elbow impression) analysis is the amount of information imparted by the impressions of incisors left on skin compared to even one fingerprint; the greater information content in fingerprints allows for the potential for more accurate, although always probabilistic, identifications.\footnote{See id. at 88; Bradford T. Ulery et al., Understanding the Sufficiency of Information for Latent Fingerprint Value Determinations, 230 FORENSIC SCI. INT’L 99, 99–100 (2013).}

In any event, *Epidermis and Enamel* barely mentions the scientific criticism of bite mark evidence and concocts a variety of supportive arguments that are logically flawed. It does not provide a research-based or a logical reply to the scientific critique.\footnote{It makes some head-scratching statements, for example, “Regarding criticisms of the uniqueness of the dentition, logic holds that the dentition is unique on a molecular level . . . .” Barsley et al., supra note 2, at 88; see supra Part II.}

It could have done so as there continues to be a stream of bite mark research that is published,\footnote{See, e.g., Valeria Santoro et al., Experimental Study of Bite Mark Injuries by Digital Analysis, 56 J. FORENSIC SCI. 224, 224 (2011) (researching bite marks on pig skin analyzed mathematically; authors note that distortion of bite mark on skin not taken into account); Mihran Tuceryan et al., A Framework for Estimating Probability of a Match in Forensic Bite Mark Identification, 56 J. FORENSIC SCI. S83, S83–84 (2011) (discussing a statistical model from dental casts and bite mark images from the casts pressed into foam cushion doll). Such work continues after the publication of *Epidermis and Enamel*. See, e.g., Uttara Deshpande & Scheila Mânica, Exploring Bite Marks on Different Types of Skin Tones, 6 REVISTA BRASILEIRA DE ODONTOLOGIA LEG. 40, 40, 41 (2019) (analyzing the validity of bitemark identification procedures using skin tone as a control variable). In his blog post, Dr. Bowers was dismissive toward the kind of research in the last publication: “As usual, dentists show little interest and
alluring on the surface such studies do not shake the critical analysis of bite mark reliability that is described in this Part.

If there is a main argument it seems to be that wrongful convictions are rarely if ever the product of a single error (e.g., eyewitness misidentification alone) but are almost always the product of multiple errors. This is old news, but is important to take into account when developing comprehensive strategies to reduce the likelihood of wrongful convictions.326 Consequently, the authors conclude that bite mark evidence critics who advocate removing it from admissible forensic evidence are wrong.327 Epidermis and Enamel does not quite make the point directly, but suggests this conclusion by listing nineteen wrongful conviction cases in which bite mark evidence was introduced against twenty one defendants, and by showing that in every case one or more of fourteen other factors played a role in bringing about the wrongful conviction.328 “The authors submit that the cases that have been characterized as wrongful convictions involving bitemark evidence also included factors unrelated to bitemark evidence.”329 To which one answers, “So what?” If the scientific critique is that bite mark comparison evidence is inherently unreliable, then pointing out that other errors generally ignore the fact that skin is easily distorted. This paper studies skin color. Meh.”


326 See George Castelle & Elizabeth F. Loftus, Misinformation and Wrongful Conviction, in WRONGLY CONVICTED: PERSPECTIVES ON FAILED JUSTICE 18, 18 (Saundra D. Westervelt & John A. Humphrey eds., 2001); James M. Doyle, Learning from Error in the American Criminal Justice, 100 J. CRIM. L. & CRIMINOLOGY 109, 109, 126 (2010); Zalman & Carrano, Sustainability, supra note 192, at 986. In addition, appreciating the cascading effects of multiple error in causing wrongful convictions has led to fruitful research and research proposals, including studies using matched comparison samples and a proposal that social science researchers analyze wrongful convictions with path-analysis or decision tree methods. See Richard A. Leo & Jon B. Gould, Studying Wrongful Convictions: Learning from Social Science, 7 OHIO ST. J. CRIM. L. 7, 21–28 (2009). The Epidermis and Enamel polemic seems insensitive to the need to conduct meaningful research to better assess the causes of wrongful convictions, as is seen in its failure to understand the research of Gould et al., supra note 99. See Barsley et al., supra note 2, at 92; infra notes 338–341 and accompanying text.

327 See Barsley et al., supra note 2, at 87, 88. The odd thing is that Epidermis and Enamel does not say this directly, although it is the main point of the article. The point is made indirectly by a combination of obsequiousness and an attack on lawyers who represent the wrongfully convicted, which may be the covert aim of the article. Epidermis and Enamel concludes, “Odontologists today are more reflective and conservative in their approach to bitemark casework. Judges should continue to improve their skills as gatekeepers. This gatekeeping role must not devolve to third parties that are potentially unqualified or may have partisan political or financial agendas.” Id. at 95.

328 See id. at 89, 90–91 tbl.1.

329 Id. at 89.
occur in exoneration cases is a classic non sequitur.\textsuperscript{330} The non sequitur, though hidden by a cloud of other arguments and by the editorial’s remorseful tone, should be apparent to any careful reader.\textsuperscript{331} If this is the best argument that bite mark analysis defenders can come up with, it tends to support our thesis that their thinking reflects a psychological and social process similar to the denial of DNA exonerations by the prosecutors observed by Orenstein.\textsuperscript{332} A less charitable explanation sees the article as propaganda, addressed not to legal and scientific bite-mark-evidence-critics, but to a base of supporters among police, prosecutors, judges and other forensic examiners, who seek to preserve a redoubt of certainty in a world made more probabilistic by the challenges to forensic science.\textsuperscript{333}

\textit{Epidermis and Enamel} supports its claim in a section (mis)describing an important empirical study of wrongful conviction causation by Gould et al.\textsuperscript{334} This social scientific study compared 260 wrongful convictions and 200 near misses and found ten statistically significant factors associated with why some wrongful prosecutions led to wrongful conviction while others were dismissed or resulted in acquittals.\textsuperscript{335} Of the ten statistically significant factors associated with wrongful conviction, some are included among common wrongful conviction “causes” (e.g., \textit{Brady} violations; errors in forensic analysis).\textsuperscript{336} However, several factors usually counted as “causes” of wrongful conviction (e.g., false confessions; mistaken, as opposed to intentional, eyewitness identification) were not statistically significant.\textsuperscript{337} Additionally, several variables that are not typically included among standard wrongful conviction “causes” were significantly associated with wrongful conviction (e.g., state death

\textsuperscript{330} See id. at 89, 92. A commercial website lists non sequitur among 300 logical fallacies. See LOGICALLY FALLACIOUS, Non-Sequitur, https://www.logicallyfallacious.com/tools/lp/Bo/LogicalFallacies/136/Non-Sequitur [https://perma.cc/A79F-CFSV].

\textsuperscript{331} The cloud of material in the article, or irrelevant filler includes a listing of what a bite mark can signify, as well as attacks on innocence organizations. See Barsley et al., supra note 2, at 88, 92, 94.

\textsuperscript{332} See Orenstein, supra note 28, at 402–03, 428–30. We expound on this matter in Part IV. We address this issue in Part V. Simon Cole “suggests that some of the current sense of crisis in forensic identification may be attributed to a historical failure to articulate defensible epistemological foundation for the testimonial claims that forensic identification experts make.” Simon A. Cole, Forensics Without Uniqueness, Conclusions Without Individualization: The New Epistemology of Forensic Identification, 8 LAW, PROBABILITY & RISK 233, 234 (2009).

\textsuperscript{333} See Barsley et al., supra note 2, at 92; Gould at al., supra note 99, at 447.

\textsuperscript{334} See Gould et al., supra note 99, at 477, 494.

\textsuperscript{335} See id. at 488–89.

\textsuperscript{336} See id. at 489.
penalty culture positively associated; age of defendant negatively associated with wrongful convictions). The editorial misses the import of the fact that Gould et al. identified the factors as correlates rather than causes. While *Epidermis and Enamel* relies on that conclusion to support its view that multiple factors absolves erroneous bite mark analysis, the larger goal of Gould et al. was to infuse the study of wrongful conviction with scientific rigor by not calling significant factors “causes” if they could not meet the most stringent standards of scientific causation as is the case in controlled experiments.

We believe that a better understanding of Gould et al. supports our argument that a real danger of bite mark analysis is to bolster weak prosecution cases. One of their most baffling statistical findings was that a *weak* prosecution case is statistically associated with wrongful convictions. This finding was so counterintuitive that the study’s principal investigators turned to a panel of experienced criminal justice professionals who suggested that prosecutors who believed they were right but had weak evidence were more willing to engage in unethical behavior, like withholding exculpatory evidence. Thus, “[w]eak facts may also encourage prosecutors to engage in certain behaviors designed to bolster the case, which our statistics show help predict an erroneous conviction.” Rather than supporting *Epidermis and Enamel*’s vacuous main argument, the Gould et al. study undercuts it. Their argument is also part of the fog machine, filling the editorial with irrelevant or erroneous, but smart-sounding, arguments.

Misreading Gould et al. connects to another way in which *Epidermis and Enamel* intentionally or blindly smudges reality. It is now accepted that cognitive biases are a normal part of human psychology, and includes the thinking of forensic scientists and

---

338 See id. at 485–86.
339 See id. at 494, 501. “Bite marks often are associated with highly sensationalized and prejudicial cases, and there can be a great deal of pressure on the examining expert to match a bite mark to a suspect.” NRC REPORT, supra note 21, at 175.
340 Gould at al., supra note 99, at 501 (“Of all the statistically significant factors that harm an innocent defendant, a weak prosecution case is hardest to explain.”).
341 See id. at 495, 501. “To fully understand our statistical results, a qualitative assessment of the cases, aided by the expert panel, was vital.” Id. at 495.
342 Id. at 501.
Counterattack on Bite Mark Evidence Reform

analysts. Epidermis and Enamel acknowledges this fact but blurs its impact by conflating cognitive biases with the physical perceptual biases discovered in early nineteenth century psychological research and illogically goes on to say that if cognitive bias affects all forensic scientists then there is no issue with such bias among forensic odontologists. Confirmation bias, a key cognitive bias implicated in wrongful convictions and often related to the notion of “tunnel vision,” is defined as “the tendency to interpret new information in ways that confirm one’s pre-existing beliefs.” Mercier and Sperber suggest that confirmation bias is better thought of as “myside bias.”

---


345 See Barsley et al., supra note 2, at 88; Kurt Danziger, The Origins of the Psychological Experiment as a Social Institution, 40 AM. PSYCHOL. 133, 138 (1985).

346 They state,

In applied science, opinions are formed by humans and are subject to potential human error. Decision making is a cognitive process subject to cognitive (observer effect) bias. This is unintentional and outside of awareness. Most disciplines in forensic sciences and medicine are vulnerable to this bias, yet the courts accept and rely on opinion testimony from witnesses deemed to possess adequate knowledge, skill, training, and experience.

Barsley et al., supra note 2, at 88.


348 See Jeff Kukucka et al., Cognitive Bias and Blindness: A Global Survey of Forensic Science Examiners, 6 J. APPLIED PSY. MEMORY & COGNITION 452, 452 (2017).

349 They state,

[People] have no general preference for confirmation. What they find difficult is not looking for counterevidence or counterarguments in general, but only when what is being challenged is their own opinion. Reasoning does not blindly confirm any belief it bears on. Instead, reasoning systematically works to find reasons for our ideas and against ideas we oppose. It always takes our side. As a result, it is preferable to speak of a mysiede bias rather than a confirmation bias.

MERCIER & SPERBER, supra note 51, at 218.
Confirmation bias, which has led to numerous wrongful identifications, often comes about because the forensic expert receives direct communication from a police officer or because of cross-communication among different forensic examiners during an investigation, 350 or because police and prosecutors request re-examination by a forensic expert if the first report results in an unfavorable conclusion providing a more favorable result. 351 It also involves forensic and other experts overestimating the strength of their evidence. 352 Confirmation bias, therefore, is exacerbated by experts being influenced by extraneous information and contextual pressure. 353

The complacency exhibited by Epidermis and Enamel toward cognitive biases misses the many proposals and measures being advanced for combating the negative effects of cognitive biases in critical decision-making areas like forensic science including “thinking slow,” blinding, including comparison samples in forensic tests, expanding awareness of cognitive biases, cultural changes and the like. 354 The problem with bite mark evidence is that, as already noted, almost all odontologists are practicing dentists who work part time at the entirety of forensic cases and that not only are bite mark cases the smaller part of their forensic work, but they tend to be sought by police and prosecutors in “sensationalized” cases. 355 Thus,

---

350 See Saul M. Kassin et al., The Forensic Confirmation Bias: Problems, Perspectives, and Proposed Solutions, 2 J. APPLIED RES. MEMORY & COGNITION 42, 43 (2013).

351 See id.; Michael J. Saks et al., Context Effects in Forensic Science: A Review and Application of the Science of Science to Crime Laboratory Practice in the United States, 43 SCI. & JUST. 77, 86 (2003); Glen Whitman & Roger Koppl, Rational Bias in Forensic Science, 9 LAW PROB. & RISK 69, 69 (2010) ("[C]urrent organization of forensic science induces biases in the conduct of forensic science even if forensic scientists are perfectly rational.").

352 See Andrea O. Baumann et al., Overconfidence Among Physicians and Nurses: The Micro-Certainty, Macro-Uncertainty Phenomenon, 32 SOC. SCI. & MED. 167, 173 (1991); Kassin et al., supra note 350, at 43.

353 See Kassin et al., supra note 350, at 43. Extraneous information includes knowing that a suspect has confessed, being aware that there is an eyewitness identification, or knowing that there is testimony from a snitch or informant. See Dror & Charlton, supra note 344, at 612; Kassin et al., supra note 350, at 46.


355 See NRC REPORT, supra note 21, at 175; Trudy Brunot, Necessary Skills to Be an Odontologist, CHRON, https://work.chron.com/necessary-skills-odontologist-30838.html [https://perma.cc/TSJ3-XSD6].
the tendency of forensic odontologists to bolster weak cases is 
exacerbated by the inevitable impact of cognitive biases in their case 
work. Unlike a full-time forensic laboratory analyst who can be 
insulated from the contextual elements of the case, forensic 
odontologists are briefed on all the biasing aspects of cases. Perhaps blinding and other methods of reducing cognitive biases in 
bite mark analysis may be possible, but Epidermis and Enamel 
expresses no awareness or interest in such protective measures.

Epidermis and Enamel also argued, “The legal community has an 
obligation to safeguard against invalid and unreliable testimony.”

This is true; indeed, commentators have noted that judges act as 
effective gatekeepers to screen out weakly supported scientific 
evidence in civil cases but not in criminal prosecutions. Thus, if 
judges were really doing their jobs in criminal cases, they would be 
more critical of bite mark evidence. But the point is made by 
Epidermis and Enamel in another non sequitur that passes the buck, 
a tu quoque fallacy: “turn[ing] criticism back upon the critic instead 
of dealing with the criticism itself.”

A mitigating factor implied by Epidermis and Enamel is that “only” 
a small fraction of the 351 DNA exonerations reported by the 
Innocence Project, “27 or 28 cases, approximately 8% of their total, 
included bitemark evidence and resulted in later exonerations.”

Given that many factors, including a dozen or more forensic science 
methods, contribute to wrongful convictions, it is no argument in 
defense of bite mark analysis to imply that “only” 27 or 28 wrongful

---

356 See Souviron & Haller, supra note 24, at 620–21. But see Gary Edmond et al., Contextual 
Bias and Cross-Contamination in the Forensic Sciences: The Corrosive Implications for 
Investigations, Plea Bargains, Trials and Appeals, 14 LAW, PROBABILITY & RISK 1, 1 (2015) 
(discussing how most forensic science evidence is not insulated from contextual information 
about the case that can result in bias).

357 See Peter J. Neufeld, The (Near) Irrelevance of Daubert to Criminal Justice and Some 
Suggestions for Reform, 95 AM. J. PUB. HEALTH S107, S109 (2005); D. Michael Risinger, 
Navigating Expert Reliability: Are Criminal Standards of Certainty Being Left on the Dock?, 64 

358 See Fabricant & Carrington, supra note 198, at 38 (“Perhaps no discredited forensic 
assay has benefited more from criminal courts’ abdication of gatekeeper responsibilities than 
bite mark analysis.”).

359 See 33 Logical Fallacies Everyone Should Know, PASTORBRIANCHILTON https:// 
pastorbrianchilton.wordpress.com/2014/07/28/33-logical-fallacies-everyone-should-know/ 
[https://perma.cc/FQ35-UZVG].

360 See Barsley et al., supra note 2, at 88.

361 See NRC REPORT, supra note 21, at xvi, 182. See generally FORENSIC SCIENCE REFORM: 
PROTECTING THE INNOCENT, supra note 57, at 1, 25, 57, 95, 137, 167, 203, 239, 271, 299, 331 
(discussing different forensic science methods throughout).
convictions based in part on bite mark analysis have been identified among the Innocence Project’s list of DNA exonerations. Procedural challenges to obtaining exonerations and the many ways that prosecutors deflect wrongful convictions make it likely that other similar cases have not come to light, suppressing the number of exonerations. The authors then add an entirely unsubstantiated and false claim, writing, “However, not all of these cases were actual exonerations and not all of the exonerations were based on DNA,” raising doubts about the quality of the journal’s peer review process.

An additional argument is that forensic odontologists have helped to exonerate some of the wrongfully convicted. The logic is that by relying on forensic odontologists to win a client’s freedom, the defense lawyer acknowledges the basic validity of bite mark comparison analysis; the original prosecution expert was in error and is set right by a more proficient forensic dentist for the prisoner. To a degree this is the Cristini and Moldowan case, except that they were not represented by innocence organization lawyers in the post-conviction

---

363 “[A]ny system involving human judgment, particularly at as many stages as a criminal case proceeds through, will yield some errors. However, to the extent that forensic science plays an important role in criminal proceedings, errors produced by flawed and unvalidated evidence and testimony are unnecessary . . . .” Adam B. Shnierman, Prosecutors Respond to Calls for Forensic Science Reform: More Sharks in Dirty Water, 126 YALE L.J.F. 348, 350 n.9 (2017) (emphasis added).

364 In a number of clear wrongful conviction cases, prosecutors obtain guilty pleas for time served and release factually innocent defendants who, after years of imprisonment, are desperate to be released. See, e.g., Michael Hall, The Trouble with Innocence, TEXAS MONTHLY (Mar. 2017), https://features.texasmonthly.com/editorial/the-trouble-with-innocence/ [https://perma.cc/93HV-CBDL] (discussing the Kerry Max Cook case, where the defendant (Cook) was convicted despite being factually innocent and was desperate to be released for decades). In other cases, government-official defendants in civil rights cases settle wrongful conviction cases, but “although the government defendants settled, they insisted that the settlement contain no admission of wrongdoing and that the facts of the wrongful conviction and prosecution would be concealed behind a confidentiality agreement. This isn’t uncommon. In fact, it is normal.” James Doyle, Keeping the Wrong Secrets: The ‘Cone of Silence’ Around Exonerations, CRIME REPORT (May 28, 2019), https://thecrimereport.org/2019/05/28/keeping-the-wrong-secrets-the-cone-of-silence-around-exonerations/ [https://perma.cc/6YA8-FFZE].

365 Barsley et al., supra note 2, at 88.

366 The American Journal of Forensic Medicine and Pathology is published by a respected academic publisher, Wolters Kluwer; as the article is an editorial, perhaps peer review was waived or relaxed; the journal’s web page does not impart information about peer review. “To be sure, no one is naïve enough to believe that peer review exposes all, or even most, faulty scientific knowledge claims. Rather, most sober observers understand peer review as a modest quality assurance procedure that functions as a mild deterrent against poor, or even fraudulent, scientific work.” Cole, Culture, supra note 189, at 40.

367 See Barsley et al., supra note 2, at 88 (“Some [exonerees] were exonerated at least partially based on the postconviction work of specialist odontologists with extensive bitemark experience unrelated to the IP [Innocence Project] . . . .”).
phase or at their second trials but by private practitioners. If such clients are represented by innocence organizations, the innocence advocate (who as a matter of policy argues that bite mark evidence should be held inadmissible) could be accused of hypocrisy.

To sort out this argument requires understanding the institutional roles of defense lawyers generally and “innocence lawyers” affiliated with innocence organizations. Risinger and Risinger explain that the new innocence lawyer role in American criminal litigation differs from a traditional defense attorney’s role at trial, appeal, or in post-conviction proceedings. Traditional legal practice norms, established in England and the United States from the late-eighteenth to the mid-nineteenth centuries, require defense lawyers to accept any person charged with a crime as a client and are unconcerned with the client’s factual guilt or innocence. The lawyer’s role is to provide effective defense within the rules of evidence and to “put the government to its proof.”

In contrast to traditional defense lawyers, the


[370] See id. The “cab rank” rule is not strictly applied in America as there are allowable practical and personal reasons for an attorney to not defend specific clients, but such deference is allowable if an unpopular defendant can be reasonably represented. See id. at 124 n.1.

[371] Id. at 124. More abstractly, the defense lawyer’s role encompasses the principles of partisanship (zealous advocacy for the client), neutrality (as to the moral merits of the client’s case), and non-accountability (the lawyer is not held accountable for the client’s views or actions). Id. at 130.

innocence lawyer selects only clients who have been carefully screened to determine, to the degree possible, that they are factually innocent. What is surely galling to many prosecutors and investigators who think of themselves as on the prosecution team, is that the traditional “criminal defense lawyer is there to aggressively test and contest the evidence proffered by the government, and to insure that all constitutional limitations on the prosecution are respected regardless of their impact on the accuracy of the verdict of guilt, and regardless of underlying guilt or innocence.”

When innocence lawyers engage in postconviction litigation to free clients they believe are innocent, given the exigency of litigation and the obligation of an attorney to mobilize all relevant evidence in the client’s interest, they must use the same legal tools used by traditional attorneys and thus can be characterized as professionally unconcerned with the ground truth of the case. It would be malpractice and a basis for an ineffective-assistance-of-counsel claim for an attorney to not use a forensic odontologist’s services to counter a prosecutor’s expert. In light of the professional and ethical demands on defense attorneys, their use of forensic odontologists as experts, even by innocence organization attorneys whose policy stance opposes bite mark evidence, might be deemed hypocrisy, but it is logically not an argument for the scientific validity or reliability of bite mark evidence.

Nevertheless, the argument has some weight. There may be a residual area in which bite mark evidence might be used to eliminate


374 Risinger & Risinger, supra note 369, at 124 (emphasis added).

375 See id. at 127–28, 129. But see id. at 123, 125, 130 (theorizing that innocence lawyers have different functions).

376 See Barsley et al., supra note 2, at 91; Krieger, supra note 372, at 354 (listing practices that could lead to ineffective defense representation).

377 This argument is related to Epidermis and Enamel’s criticism of the Texas Forensic Science Commission’s moratorium on bite mark analysis, discussed below. See infra notes 397–403 and accompanying text.
a suspect in a case where a bite mark pattern is so far out of sync with a suspect’s dentition that the suspect should be released, whatever other factors have raised police suspicion. This point also weakly supports the argument that the work of some forensic dentists who testify regarding bite mark comparisons was so shoddy that other, more experienced or competent odontologists have the skills to correctly perform bite mark analysis.

To a degree *Epidermis and Enamel* draws support from testimonials of like-minded authors, including a forensic pathologist who argues that “visual cognition is as, or more, important than the abstract weighing of evidence”; die-hard forensic examiners who have stridently attacked the innocence challenges to forensic science; a Texas trial judge who argued that the admissibility of bite mark evidence is in the purview of courts and not a Commission; and a “populist style” bad-mouthing of the financial success of the Innocence Project by a disaffected former director of an innocence organization. Whatever the merits of these authors,
testimonials are essentially argument from authority, a form of defeasible argument that is “rationally compelling though not deductively valid.”

Anyone barely familiar with the scientific revolution of the sixteenth and seventeenth centuries should know without citation that a major achievement of the new science was that ancient knowledge could be replaced with knowledge derived from direct observation (often using novel instrumentation like the microscope) and experimentation.

What should have been a potent source of support for bite mark analysis in *Epidermis and Enamel* is a page devoted to “A Path Forward” in which the authors cite recommendations under six categories: Standards and Guidelines, Knowledge Transfer and Education, Research, Certification, Proficiency, and Casework. Under Standards and Guidelines, the authors note that the ABFO responded to problems generated by forensic odontologists’ testimony of certainty by creating a decision tree:

Once it has been determined that a patterned injury has been caused by human teeth, today an opinion in a bitemark report is limited to “inconclusive,” “dentition can be excluded as having made the bitemark,” or “dentition cannot be excluded as having made the bitemark.” Current ABFO Standards and Guidelines do not condone terminology that indicates the dentition of an individual is the only possible cause of the bitemark.

This improvement indicates that the ABFO has been responsive to criticism, but only up to a point. This reform is welcome and may reduce erroneous bite mark attribution, but acknowledgement of

and praises his work finds his attack on the Innocence Project confusing and unwarranted. See Email from Keith Findley, Assoc. Professor of Law, Univ. of Wis.–Madison Law Sch., to Marvin Zalman, Professor, Wayne State Univ. Criminal Justice Dep’t (Feb. 15, 2019, 4:00 PM) (on file with author).


Barsley et al., *supra* note 2, at 94–95.

*Id.* at 94.

error does not address the range of scientific challenges to bite mark comparison analysis.\textsuperscript{389} As for the other points, they add virtually nothing. Relationships to universities and to medical examiner offices do not substitute for critical research.\textsuperscript{390} \textit{Epidermis and Enamel} simply says that research “is needed” but does not refer to any.\textsuperscript{391} The ABFO certifies forensic odontologists and states that a forensic dentist should not be allowed to testify without certification,\textsuperscript{392} but without knowing the details of ABFO certification, it is wise to withhold judgment.\textsuperscript{393} Wariness regarding certification is justified by the article’s bland three-line statement that “all odontologists certified by the ABFO should periodically take and pass ABFO proficiency tests,”\textsuperscript{394} without mentioning the devastatingly poor results of such tests.\textsuperscript{395} The final paragraph, “Casework,” recommends second opinions.\textsuperscript{396} This section’s fine rhetoric is part of the article’s smokescreen and simply does not provide a competent defense of the scientific basis or reliability of bite mark comparison analysis.

Although \textit{Epidermis and Enamel} is obsequious at points, agreeing with some boilerplate desiderata taken from “a critic of bitemark evidence”\textsuperscript{397} at the article’s conclusion, it is not hard to miss its venomous attacks on the Texas Forensic Science Commission and especially on the Innocence Project.\textsuperscript{398} The vehement and defamatory nature of its comments deserve attention because it supports the psychological processes that we believe has blinded the authors to a rational approach,\textsuperscript{399} and links the odontologist-authors with other...
forensic examiners and scientists who have reacted with irrational negativism to the innocent challenges to the forensic sciences.\footnote{See discussion infra Part V.}

In what it describes as a “case study,” Epidermis and Enamel devotes a page to describing and criticizing the Texas Forensic Science Commission (TFSC).\footnote{See Barsley et al., supra note 2, at 92–93.} In brief, the article criticizes the TFSC for proposing a moratorium on the admission of bite mark testimony based on a case where a forensic odontologist violated ABFO standards, and on this basis urges establishing a review process to screen bite mark cases.\footnote{See id. at 92.} As with the point regarding defense lawyers hiring forensic odontologists, Epidermis and Enamel finds it “ironic” that the TFSC both recommends that bite mark evidence not be admitted and yet “counterintuitively” has “certified forensic odontologists and attorneys working together to assess” bite mark cases.\footnote{See id.}

If these dental and legal practitioners were deemed to have sufficient knowledge, skill, training, and experience to be capable of making potentially life-altering determinations on behalf of the commission, and used public funds to do so, this suggests that the TFSC considers bitemark evidence expertise to have merit.\footnote{See id.}

This tendentious conclusion does not necessarily follow. As we suggested above, despite the overall weaknesses of bite mark evidence, there may be cases in which the admission of bite mark evidence may have been so patently wrong that a second look is called for, especially when a prisoner’s liberty is at stake.\footnote{See, e.g., People v. Marx, 54 Cal. App. 3d 100, 112 (Cal. Ct. App. 1975) (finding the defendant guilty of voluntary manslaughter based in part on bite mark evidence); Souviron & Haller, supra note 24 (explaining that the Marx decision opened the floodgates for the misuse of bite mark comparison in subsequent convictions).} Also, it would have been unfair and impolitic for the TFSC to review bite mark cases without involving forensic dentists. Nevertheless, this point carries some weight and in Part V we suggest that further consideration of a limited role of bite mark analysis may be permissible.\footnote{See infra notes 558–559 and accompanying text.} In addition, the odontologist-authors, like the nephew mail room worker in How
to *Succeed in Business without Really Trying,* cry foul when they discovered that autopsies conducted by forensic pathologists are legally exempted from TFSC review and analysis by forensic odontologists are not, especially when the authors claim that odontology is not forensic analysis, but is instead “the specialized practice of . . . dentistry,” just as pathology is a medical specialization. “Not fair!” There may be merit to this special pleading, or perhaps not if the foundation of forensic pathology and the proficiency of pathologists has been better established than that of forensic odontologists. In any event, while this argument may appeal to the self-regard of forensic odontologists, it does not answer the issue of that method’s scientific basis or reliability and adds to the smog of arguments generated by the editorial.

*Epidermis and Enamel* does not isolate the TFSC but sees the hand of the Innocence Project, Svengali-like, manipulating the Commission. Indeed, the authors’ obsession with the New York Innocence Project may be the article’s real motive. The article begins on a petulant note by citing journalistic and legal criticism of bite mark evidence and analysis rather than by asserting the method’s strengths. The authors claim its “critics have been persuasive through forcefulness and repetition,” implying that reason lies with the forensic odontologists and suggesting that the

407 See Fish, *supra* note 43, at 3; *supra* notes 43–45 and accompanying text.
408 See Barsley et al., *supra* note 2, at 92–93.
409 See *id.* at 93.
410 They state,
411 “They can keep their $100,000 ‘VIP’ tables at galas, their friends from Goldman Sachs, and their need for control. It is not for me.” *Id.* at 93 (quoting Jeff Blackburn’s ill-tempered attack on the Innocence Project).
412 “Reports of errors made by odontologists in bitemark cases in the 1980s and 1990s have been the recent focus of aggressive and disparaging criticisms.” *Id.* at 87. The “aggressive” criticism claim may simply be seen as well-written and well-supported criticism. Again, a conspiratorial tone is engendered by asserting that “[s]ome journalists have been *enlisted* to further bolster critics’ arguments.” *Id.* (emphasis added). This is a subtly libelous attack on Radley Balko, a successful journalist and author with a libertarian bent who has criticized many aspects of the criminal justice system.
413 *Id.*
public had been duped with fake news. At the outset, *Epidermis and Enamel* claims that critics have ignored “the progress made by changes in standards, terminology, and the steps to inhibit bias” since the 2009 National Academy of Sciences Report; but as our review has shown, forensic odontologists ignore the analysis that shows these steps to be ineffective in making bite mark analysis reliable.

The authors of *Epidermis and Enamel* simply cannot fathom challenges from its critics—who include “some members of the media, some but not all criminal defense attorneys, and some from within forensic science and forensic odontology.” The critics’ comments are deemed so disparaging of forensic odontology “that a reasonable person might be convinced to distrust or totally disregard all opinions and conclusions of [its] members.” But the critics singled out for the sharpest attack “include some individuals from the Innocence Project, Inc [sic] and its affiliates in the innocence network (hereafter referred to as the Innocence Project [IP]).” The authors do not clearly understand the name of the Innocence Project (“Inc” is not part of its name) or the nature or structure of the institutional innocence movement. “[T]he Innocence Project does not actually have any affiliates; all innocence organizations in the Innocence Network are independent and none is controlled in any way by the Innocence Project . . . .”

---

414 See id. (“Those influenced include the public, some governmental agencies, and members of the legal profession.”).
415 Id.
416 Id. at 88.
417 Id. This statement seems to be lifted and paraphrased from Collins and Jarvis without citation: “Much of this rhetoric disparaged the forensic sciences to the extent that reasonable people might be persuaded to distrust the work being performed in America’s crime laboratories.” Collins & Jarvis, Contextual, supra note 381, at 8.
419 Email from Keith Findley, supra note 383; see Keith A. Findley & Larry Golden, The Innocence Movement, the Innocence Network, and Policy Reform, in WRONGFUL CONVICTON AND CRIMINAL JUSTICE Reform, supra note 192, at 93, 95; McMurtrie, supra note 418, at 25.
today goes simply by that name) was officially founded in 1992 “as a clinical program at Cardozo Law School, creating an organized, systematic way to investigate old cases and use DNA to exonerate prisoners when possible.”

The Innocence Project at first had only four staff persons and was overwhelmed by a flood of inquiries by prisoners. Although it has grown into a substantial and well-funded non-profit organization with more than fifty employees, in reality many of the fifty-five U.S. innocence organizations that are Innocence Network members “are underfunded, understaffed, and overworked.”

The attack on the Innocence Project by Epidermis and Enamel then shifts from ignorant petulance to something close to defamation:

Interestingly, some trial attorneys from the IP may stand to gain financially from reviewing various cases being conducted ostensibly to determine if forensic methods are questionable, unreliable, or have resulted in wrongful convictions. This concern raises questions of potential conflicts of interest at best and the likelihood of an agenda-driven disingenuous attack at worst.

There is a double irony in this statement. First, in order to use the trademarked name Innocence Project or to be an Innocence Network member, an organization must be a nonprofit organization, so no direct payments are involved in innocence work. Secondly, with
rare exceptions, we assume that bite mark dentists receive fees for their analysis and testimony, but we do not claim that testimonial fees cynically and corruptly “buy” their opinions. We do assume that cognitive biases, which affect everyone, have some influence on the thinking of expert witnesses and on attorneys, but that is far different from the smear found in Epidermis and Enamel. This insult against innocence organization lawyers is based on one cited source, a blog post by John Collins in Science 2.0, which refers to an anonymous complaint made apparently by “a concerned employee of a crime laboratory.” The complaint was made to the New York Joint Commission on Public Ethics (JCOPE) against the Innocence Project co-founders Barry Scheck and Peter Neufeld. Collins characterized Scheck and Neufeld, who at the time held seats on the New York Commission on Forensic Science, as publicly disparaging forensic experts who use “perfectly acceptable methods utilized in America’s forensic science laboratories” and “have undertaken a campaign to specifically discredit the science of forensic hair comparison.” This seems to be a reference to a major program in which the FBI crime laboratory acknowledged the weak foundation and risks of microscopic hair analysis, another discredited forensic

---

425 An example was provided by Dr. Pamela Hammel who testified pro bono in the second Moldowan and Cristini trials as a way of rectifying her earlier error. See Hammel Testimony, supra note 130, at 42, 71, 72, 91, 92.

426 See Barsley et al., supra note 2, at 88. The field of psychology has been deeply affected by a wealth of research in the last half-century that “discovered” and has elaborated on cognitive biases and psychological predilections. See KAHNEMAN, supra note 343, at 4. We elaborate on this theme in Part IV. One author previously addressed similar issues related to ideological predilections. See Marvin Zalman, A Brief Reply to Professor Cassell, 48 SETON HALL L. REV. 1493, 1495, 1512–13 (2018) (explaining the policy behind a more accurate criminal justice system).


428 See Collins, Ethics, supra note 427.

429 See id. (emphasis added).

The anonymous complaint appears to have vanished; in any event the idea that Innocence Project lawyers pursued this project for personal monetary gain is preposterous. Yet the sly and indirect way in which \textit{Epidermis and Enamel} advances such a baseless rumor is uncomfortably close to purveyors of disinformation campaigns or conspiracy-league dabblers who are so prevalent today on social media and even in some traditional news outlets. It is worrying when such “data” and “arguments” are advanced by credentialed professionals and academicians and appears in a scientific journal. That eminent professionals have advanced a hollow argument littered with unsupported invective, calls for a closer look.

\section*{IV. \textsc{Unreasoned Reasons}}

What explains the illogical and hollow reasoning of \textit{Epidermis and Enamel}? Despite research that has undermined if not demolished the basic assumptions of bite mark comparison analysis\footnote{See supra Part II.} the forensic odontologist-authors of \textit{Epidermis and Enamel} continue to support the practice of comparing suspects’ dentition with bite marks\footnote{See Barsley et al., supra note 2, at 89, 95.} and claiming, in some cases, that “dentition cannot be excluded as having made the bitemark.”\footnote{Id. at 94. This is ABFO-approved terminology that replaces earlier terms (like match) that made positive assertions. See id. at 95. Standing alone the statement may be true but fails to consider that the high levels of error pose real dangers of misattribution and wrongful convictions.} The accumulated criticism and undermining of bite mark evidence has led those dentists to admit previous errors without abandoning the technique.\footnote{See id. at 89.} If anything, \textit{Epidermis and Enamel} pushes back
against critics and hardens their self-styled position as legitimate experts in this aspect of forensic science.\textsuperscript{435}

This article began by reviewing scholarship about prosecutors’ irrational resistance to DNA testing. Along with institutional and cultural factors, the psychological constructs of loyalty and denial offered deeper insights, suggesting that prosecutors’ overtly rational explanations to reject compelling DNA exoneration masked underlying and potent motive forces.\textsuperscript{436} This Part, in similar fashion, explores possible drivers of the odontologists’ forensic denial of bite mark counter-evidence. Before we begin, two linked caveats should be considered. First, our account does not have the explanatory power of a psychological experiment or full-fledged case study, and so must remain a suggestive rather than a scientific explanation.\textsuperscript{437} Second, we draw on a vast expanse of social psychological research that has for at least a half century explored the regularities of human

\textsuperscript{435} See id. at 88–89. They state,

The ABFO-certified forensic odontologists who follow the ABFO Standards and Guidelines are qualified to diagnose human bite injuries, compare those injuries with dentitions that may or may not have caused them, and express an opinion. There is no other group of individuals similarly qualified to complete bitemark analyses and comparisons.

\textsuperscript{436} See supra notes 27–48 and accompanying text.

error and has generated important disciplinary advances, making possible other explanatory hypotheses.

It is worth noting that the scientific challenge to bite mark analysis is not an existential threat to the practice of forensic odontology. Forensic dentists could drop bite mark analysis and still engage in other accepted practices. This makes Epidermis and Enamel's strenuous resistance to critics, and its failure to confront the scientific challenges to bite mark evidence, all the more curious. We explore their resistance to change through three broad lenses. The first is the social psychological group dynamics that occur in organizations and more specifically the sociology of organizational deviance. The second approach is the familiar psychological

---

438 We cite popular literature that draws on psychological research. Areas of research include cognitive bias, see Gerd Gigerenzer, Gut Feelings: The Intelligence of the Unconscious 25 (2007); Tversky & Kahneman, supra note 343, at 50; normal accidents, see Charles Perrow, Normal Accidents: Living with High-Risk Technologies 9 (1999); safety, see Inst. of Med., To Err Is Human: Building a Safer Health System ix (Linda T. Kohn et al. eds., 2000); behavioral economics, see Dan Ariely, Predictably Irrational: The Hidden Forces That Shape Our Decisions xviii (2008); memory studies, see Daniel L. Schacter, The Seven Sins of Memory: How the Mind Forgets and Remembers 1 (2001); decision-making, see Paul C. Nutt, Why Decisions Fail: Avoiding the Blunders and Traps That Lead to Debacles xi (2002); and a number of works on what Kathryn Schulz dubbed wrongology, Kathryn Schulz, Being Wrong: Adventures in the Margin of Error (2010); e.g., Robert A. Burton, On Being Certain: Believing You Are Right Even When You’re Not (2008); Thomas Gilovich, How We Know What Isn’t so: The Fallibility of Human Reason in Everyday Life (1991). In criminal justice and innocence studies, applied psychological research on eyewitness identification, false confessions, the testimony of child witnesses, and the psychology of the justice process have been fundamental to slowly moving justice system actors from a kind of “legalistic scholasticism” toward more scientific ways of thinking. See Richard A. Leo, Rethinking the Study of Miscarriages of Justice: Developing a Criminology of Wrongful Conviction, 21 J. Contemp. Crim. J. 201, 202, 208, 209, 205, (2005); see also Stephen J. Ceci & Maggie Bruck, Jeopardy in the Courtroom: A Scientific Analysis of Children’s Testimony 7 (1995) (discussing case studies surrounding the validity of child testimony); Elizabeth F. Loftus, Eyewitness Testimony 153 (1979) (analyzing individual differences in eyewitness testimony); Dan Simon, In Doubt: The Psychology of the Criminal Justice Process 2–3 (2012) (applying methods of experimental psychology in an attempt to better understand the criminal justice system); Saul M. Kassin & Gisli H. Gudjonsson, The Psychology of Confessions: A Review of the Literature and Issues, 5 Psychol. Sci. Pub. Int. 33, 59 (2004) (discussing the psychology of false confessions and the need for a collaborative effort amongst the relevant legal and social science experts to attempt to mitigate future instances of wrongful convictions, often caused by faulty interrogation practices).

439 This admission may not seem important to lawyer-readers, but as social scientists we believe it is important to state.

440 See Shalini Gupta et al., Contemporary Practice in Forensic Odontology, 18 J. Oral & Maxillofacial Pathology 244, 245–48 (2014). The dental identification of unidentified corpses is not subject to controversy, although other aspects of odontology such as tooth aging may be questionable. See id. at 245, 247. Any such inquiry is beyond the scope of this article.

construct of cognitive dissonance. The third analytic frame is the newer evolutionary interactionist theory of reasoning advanced by Mercier and Sperber.

While individuals may experience change as annoying and bothersome, change in an organization or association means meeting resistance to proposed changes among the group’s members. Given the ABFO’s role in the bite mark saga, we begin by reviewing the functions and roles of professional organizations, which generally establish ethics and set practice standards for members.

According to Robert Merton, the foremost obligation of the professional organization is to set rigorous professional standards and help enforce those standards for professional practice. Within a dominant organization, a subculture may develop. By definition, a subculture is simply a culture within a culture and most often subcultures share values and norms with the dominant culture. However, a subculture may not observe all the norms and values set by the dominant organization. But a subculture may be or may become a counterculture if it acts in direct and active opposition to the larger culture. In some instances, the subculture gains the status of deviant when it violates the norms of the dominant culture. The members of the subculture or the counterculture can be said to be engaging in cognitive deviance, that is, they hold beliefs that are unconventional and non-normative and at odds with the umbrella organization. And while this may cause the subculture of “believers to be shunned, isolated, marginalized, rendered powerless, criticized, condemned, or punished,” it is possible, too, that the subculture gains dominance in the main organization.

---

442 LEON FESTINGER, A THEORY OF COGNITIVE DISSONANCE 3 (1957).
443 See MERCIER & SPERBER, supra note 51, at 7–9; infra notes 500–516 and accompanying text.
446 Id.
447 Id.
448 Id.
449 See id. at 6; see, e.g., id. at 15–16 (discussing examples where subcultures gain the status of “deviant” when they oppose norms and values of the larger culture they are a part of, such as prison gangs within a larger prison system).
450 See id. at 15; ERICH GOODE, DEVIANT BEHAVIOR 338 (6th ed. 2001).
451 See GOODE, supra note 450, at 338, 340.
strongly supported bite mark analysis gained the upper hand in the thinking of most members of the ABFO.

As indicated previously, the ABFO as early as the 1980s began to register some doubt about their members' abilities to make accurate bite mark matches. However, the ABFO, following courts' lead in admitting bite mark evidence, got over this doubt and more recently has been supportive of bite mark analysis, perhaps indicating that a cognitively deviant idea supported by a fraction of forensic odontologists came to be accepted or even became a dominant idea. The ABFO not only came to accept bite mark analysis as normative but now defends its position by attacking critics of bite mark evidence. This kind of pushback tends to be fairly typical when people and organizations are under fire. Rather than accepting criticism, admitting that mistakes were made and adopting new, more empirically based positions, people very often marshal evidence to prove they were right all along.

Clinard and Meier suggest that deviant subcultures can respond to criticism by (1) becoming more secretive; (2) manipulating the setting (or creating the appearance) of legitimacy; (3) changing to nondeviant beliefs or behaviors; (4) developing a new subculture; or, (5) rationalization. It is easy to see how the forensic odontologists responded to the criticism that threatened their ability to testify about bite marks in court. While the dominant culture (the ABFO) initially was wary of bite mark analysis, expressing “guarded professional conservatism,” when forensic odontology came to adopt bite mark analysis it responded, through Epidermis and Enamel, by using some of these stratagems. It claims that they weeded out rogue/deviant odontologists, they tightened guidelines and standards for forensic odontologists, they admitted past mistakes, and claimed that their “aggressive” critics do not understand the research and “experience” behind forensic odontology.
Viewing forensic odontologists through the sociology of deviance lens, they have employed similar measures for dealing with criticism. For instance, they have attempted to create an appearance of legitimacy; they have used rationalization by suggesting only a few “rogue” forensic odontologists were responsible for most transgressions of standards (and ethics); and they have created a new subculture by seeing themselves as outsiders and pariahs who are victims of their critics. By pushing back in various ways against any critics or authoritative organizations that seek to exercise control over their deviancy, forensic odontologists may work harder to assert their expertise in the area of bite mark comparison. Gary Marx refers to this as escalation and argues that when enforcement action (for example, through sanctions or suspensions) is taken by an authoritative body, this action actually promotes further deviance. However, because of the years in which the ABFO took no action against forensic odontologists, the forensic odontologists may have come to believe that they would suffer no sanctions and could operate with impunity.

When members of an association or organization are confronted by the prospect of change, members may band together to resist the change. The reasons for this may include the combined difficulty of giving up old habits or behaviors, the problem of learning new thinking, attitudes, or behaviors, and close-mindedness. On a sociological level, for an organization or an association to change, it requires the members to debate and agree on a new set of norms or values—which demands a major shift in the association’s regulatory functions. The psychological reactions to change, then, is a relevant foundation for our analysis discussion. For the individual, change portends uncertainty, insecurity, loyalty to the past and a

460 See CLINARD & MEIER, supra note 445, at 90–94; Barsley et al., supra note 2, at 88–89, 94.
461 See Barsley et al., supra note 2, at 89, 95.
462 See id. at 89.
463 See id. at 88–89.
465 See id. at 12.
467 Id. at 118.
conflict of interest. In addition, change often means losses for individuals, and in the case of forensic odontologists who frequently testify in criminal trials, change may well represent a perceived loss of status and possibly of income, although most odontologists have dental practices and will continue to identify the dentition of bodies that are otherwise hard to name. But in order to more fully understand personal resistance to change, we review the odontologists’ reactions through the concept of cognitive dissonance.

If forensic odontologists find it difficult or impossible to admit their fallibility and self-correct, it makes them human to be sure. Beyond that, to further our understanding of their tenacious grasp on a failed approach, it is also instructive to look at what drives the human need for self-justification in the face of counterevidence. According to psychologists Carol Tavris and Elliot Aronson, the engine that drives the need to justify our beliefs and actions, especially our wrong-headed positions and actions, is the uncomfortable feeling that social psychologist Leon Festinger called “cognitive dissonance.” Festinger saw cognitive dissonance as a state of tension that occurs when an individual holds two ideas or beliefs that are at odds with each other, and “the existence of dissonance will give rise to pressures to reduce it.”

Applying cognitive dissonance to the forensic odontologists who avidly support bite mark evidence, a forensic dentist may believe, “I am honest and have integrity.” At the same time, that forensic dentist might also think, “My courtroom testimony has resulted in

---

469 See Karabal, supra note 466, at 117, 118.
470 See Melinda Seley, Change is Loss and Loss Requires Grief, AVENUES COUNSELING (Oct. 11, 2017), http://avenuescounselingcenter.org/change-loss-loss-requires-grief/ [https://perma.cc/P7VW-QVA7].
471 See CAROL TAVRIS & ELLIOT ARONSON, MISTAKES WERE MADE (BUT NOT BY ME): WHY WE JUSTIFY FOOLISH BELIEFS, BAD DECISIONS, AND HURTFUL ACTS 13 (2015). The theory was initially presented in FESTINGER, supra note 442. Festinger applied the theory of cognitive dissonance to explain the tenacity of millennial prophetic cults that persist after the prophecy fails. See FESTINGER ET AL., supra note 437, at 4–5, 216. While such extreme beliefs are not attributed to forensic dentists, the preconditions for the operation of cognitive biases for odontologists are similar to that of cultists: (1) there must be a conviction, (2) there must be commitment to the conviction, (3) the conviction must be “amenable to unequivocal disconfirmation,” (4) such an unequivocal disconfirmation must occur, and (5) social support must be available subsequent to the disconfirmation. Id. at 216. The major differences are that conviction in bite mark analysis is grounded in measurable professional work and not in metaphysical beliefs, and that the scientific arguments and findings that show bite mark evidence to be unreliable are different from the unequivocal disconfirmation of a prophecy that the world will end at a certain date. Nevertheless, if the evidence disconfirming the reliability of bite mark evidence is strong, the five preconditions for cognitive dissonance exist.
472 FESTINGER, supra note 442, at 2–3, 42.
sending an innocent man to prison.” Having those two conflicting thoughts or ideas would be inconsistent with each other and that would result in mental discomfort. Given this psychological unpleasantness, the odontologist, according to Festinger’s theory, would have to find a way to reduce the inconsistency.\(^{473}\) Tavris and Aronson suggest four ways that an individual might go about resolving this state of tension generated by cognitive dissonance.\(^{474}\)

First, continuing with the forensic odontologist example, he (or she)\(^{475}\) might minimize the extent of the problem and the damage caused by his testimony.\(^{476}\) He could say that only one person he has testified against was later exonerated, or that he has put away many guilty people even if there were some not-so-guilty people he helped send to prison. In *Epidermis and Enamel*, these forensic dentists did minimize the damage. They point out early in the article, that only eight percent of exonerations based on DNA evidence involved bite mark evidence.\(^{477}\)

Second, he could blame the victim or otherwise shift the blame.\(^{478}\) That is, he could argue that the person who he has said made the bite marks during the commission of a crime should have confessed rather than risk going to trial. In *Epidermis and Enamel*, the authors shift responsibility both to a “small subset of the overall discipline” and to the legal community: “[T]he legal community must acknowledge their roles in wrongful convictions.”\(^{479}\)

Third, the conflicted odontologist could “kill the messenger.”\(^{480}\) This way of resolving the dissonance would involve pushing back against the scientists who conducted research that undermines his position as a respected and credible forensic scientist.\(^{481}\) He could do this by filing ethics charges against the scientific researcher who criticized him. In *Epidermis and Enamel*, the authors suggest that trial lawyers from the Innocence Project may stand to gain financially by reviewing previous cases to determine if faulty forensic science resulted in wrongful convictions.\(^{482}\)

\(^{473}\) See id. at 3.

\(^{474}\) See TAVRIS & ARONSON, supra note 471, at 160–61.

\(^{475}\) Ten of the eleven authors of *Epidermis and Enamel* are males, so we will use the masculine pronoun in our examples. See Barsley et al., supra note 2.

\(^{476}\) See TAVRIS & ARONSON, supra note 471, at 160.

\(^{477}\) See Barsley et al., supra note 2, at 88.

\(^{478}\) See TAVRIS & ARONSON, supra note 471, at 161.

\(^{479}\) See Barsley et al., supra note 2, at 89.

\(^{480}\) See TAVRIS & ARONSON, supra note 471, at 161.

\(^{481}\) See id. at 161–62.

\(^{482}\) See Barsley et al., supra note 2, at 88.
And fourth, he could dismiss all of the scientific research. He might argue that the studies that discredit bite mark matching were carried out by researchers who had an agenda that was anti-forensic odontology or that the research was done by jealous or vengeful scientists. The authors of *Epidermis and Enamel*, while not totally dismissing the research that shows the flaws in bite mark evidence assumptions, characterize the evidence by calling it “aggressive and disparaging criticisms,” and in another place contending that bite mark evidence critics “ignore the progress made by changes in standards, terminology, and the steps to inhibit bias.”

Of course, people, such as forensic odontologists, experiencing the discomfort of cognitive dissonance could resolve the dissonance by a fifth possibility: admitting that past errors were based on a flawed method, and base future work and courtroom testimony on methods supported by credible research studies. To their credit, the eleven authors of *Epidermis and Enamel* acknowledge “mistakes have been made in the past.” However, instead of fully absorbing the power of the bite mark critique, they elide the challenge by stating that they have corrected the problems with bite mark analysis. But *Epidermis and Enamel* presents no evidence that the ABFO or individual odontologists have conducted any new scientific research to show that forensic odontology is something more than junk science. They write that calling it “junk science’ . . . is inappropriate,” while at the same time offering no scientific support. Nowhere do they state that they have learned from the legitimate research studies that have been critical of bite mark matching. Had they done so, it would be an appropriate way to resolve their cognitive dissonance.

One forensic odontologist serves as a role model in this regard. A Fellow of the American Academy of Forensic Sciences and a Diplomate of the American Board of Forensic Odontology, C. Michael Bowers is also a Clinical Associate Professor at the University of Southern California’s School of Dentistry. In 2004, he published

---

483 See Tavris & Aronson, supra note 471, at 162.
484 Barsley et al., supra note 2, at 87.
485 Id.
486 Id.
487 See id. at 89.
488 See supra note 325 and accompanying text (regarding ongoing bite mark research). We doubt that ongoing bite mark research of the kind cited will shake the criticisms leveled against bite mark analysis and comparison reviewed in Part II.
Forensic Dental Evidence: An Investigator’s Handbook, which included a chapter on bite mark evidence. Although the chapter took a cautious approach, Bowers implies that he was convinced at that time that odontologists could match bite mark evidence with particular individuals. However, in more recent years, he became a leading critic of bite mark evidence. More recently, and citing the scientific research that undermines bite mark evidence, Bowers has recognized that he can no longer support the method, and views it as the “poster child” for failed forensic science.

Two other forensic odontologists, Richard Souviron and Leslie Haller, have, in response to the argument presented by Saks et al., retreated from the full support of bite mark analysis. They distinguish bite mark analysis from bite mark comparison, arguing that there is a place for forensic bite mark analysis, while apparently limiting bite mark comparison for the exclusion of suspects. Their language is far more respectful of bite mark analysis, and from a strategic perspective may be the kind of face saving rhetoric that will be helpful in getting forensic odontologists to tiptoe away from bite mark comparisons.

There is a divide between the willingness of Bowers, Souviron, and Haller, odontologists who formerly supported bite mark analysis, to engage intellectually with critical findings on the one hand, and the authors of Epidermis and Enamel on the other. The first group has carefully considered the content and implications of the scientific challenge and has dealt with the cognitive dissonance produced by it in a thoughtful and responsible manner. Dr. Bowers is quite outspoken in his blogpost about his battles with his contemporaries regarding bite mark evidence, for example, referring to a “train wreck,” where the ABFO continued to use their debunkable beliefs in microscopic chips and twists of crooked teeth leaving fingerprint-like impressions on injured human skin. Mike Bowers, When Prosecutors Continue to Use Bitemarkers’ Junk Testimony in New Jersey, CSIDDS, https://csidds.com/2018/05/01/when-prosecutors-continue-to-use-bitemarkers-junk-testimony-in-new-jersey/ [https://perma.cc/EK5F-4STX]. As a result, he “quit the ABFO” and raised doubts about role of the AAFS; he also views prosecutors’ reference to bite mark analysis as a science the product of groupthink. See id.

either by accepting the critique or has offered a reasoned argument in response.\textsuperscript{497} The second group glossed over the criticism and has reflexively pushed back.\textsuperscript{498} This observation leads to our third explanation for the unreasoned reasons in \textit{Epidermis and Enamel} and the evolutionary theory of “Reason” developed by cognitive psychologists Hugo Mercier and Dan Sperber.\textsuperscript{499}

In Mercier and Sperber’s new interactionist theory of human understanding, the faculty or module of reason is an evolutionary adaptation designed to make human group living successful.\textsuperscript{500} Because solitary thinking is lazy and biased and can lead to erroneous conclusions,\textsuperscript{501} Reason serves the functions of “producing reasons for justifying oneself, and . . . producing arguments to convince others”\textsuperscript{502} in the interactionist setting in which humans evolved.\textsuperscript{503} These functions “provide tools for the kind of rich and versatile coordination that human cooperation requires.”\textsuperscript{504} They make communication effective even when the communicators lack sufficient credibility in the eyes of their audience to be believed on trust. Reason produces reasons that communicators use as arguments to persuade a reticent audience. Reason, by the same token, helps a cautious audience evaluate these reasons, accept good arguments, and reject bad ones.\textsuperscript{505}

This theory of the function of human reasoning differs from the classical view that the function of human reason is to “enhance

\textsuperscript{497} See, e.g., Bowers, \textit{Pseudoscience}, supra note 53, at 35–36, 38; Souviron \& Haller, \textit{supra} note 24, at 620–21. As we suggested, the reasoned argument of Souviron and Haller may not be the best argument, but at least it is framed in a way that invites a counterargument, rather than the frustration of dealing with the unreasoned reasons of \textit{Epidermis and Enamel}. See Souviron \& Haller, \textit{supra} note 24, at 621–22. See \textit{generally} Barsley et al., \textit{supra} note 2 (effectively dismissing the critics arguments as unfounded without providing sufficient objective evidence in support of their refutations).

\textsuperscript{498} See Barsley et al., \textit{supra} note 2, at 88.

\textsuperscript{499} See \textsc{Mercier \& Sperber}, \textit{supra} note 51, at 180. They capitalize “Reason.” See \textit{id}. at 8.

\textsuperscript{500} See \textit{id}. at 181, 182–83 (reasoning shaped by natural selection).

\textsuperscript{501} See \textit{id}. at 9, 235. “When people reason on their own, they mostly produce reasons that support their decisions or their preconceived ideas, and they don’t bother to make sure that the reasons are strong.” \textit{Id}. at 235. See \textit{generally id}. at 210–20.

\textsuperscript{502} \textit{Id}. at 8; \textit{see also id}. at 235 tbl.2 (summarizing results of production of reasons (biased and lazy) with the evaluation of others’ reasons (unbiased and demanding)).

\textsuperscript{503} See \textit{id}. at 9, 287.

\textsuperscript{504} \textit{Id}. at 8.

\textsuperscript{505} \textit{Id}. at 9; \textit{see also id}. at 107–201 (providing further support for these assertions).
individual cognition.” It also seeks to encompass the psychological findings related to the flaws of human reasoning that are cognitive biases. In the older view, the mental process of reasoning—"attending to reasons for adopting new conclusions"—can be a solitary endeavor that can lead to brilliant or to warped insights. In the new theory, Reason’s functions are rooted in the link between cooperation and survival, the intrinsic unreliability of communication, and the need to detect lying.

The simple existence of communication within groups does not tend toward accuracy. The phenomena of groupthink, group polarization, and the biasing effects of motivated reasoning have generated many examples of erroneous reasoning. “When people have their ideas closely aligned to start with, it leads to polarization.” From Mercier and Sperber’s evolutionary perspective, good reasons and decisions are more likely to result from the process in which the reason module developed in human societies: face to face argumentation. They provide evidence to show that actual, robust argumentation provides better results to solving problems than solitary thought. In this perspective, the epitome of reasoning is science, where an individual scientist’s hypothesis reflecting her myside bias “is tempered by a more demanding quality control that weeds out the weakest arguments.”

---

506 See id. at 179, 182 (denoting the intellectualist view).
507 See id. at 4 (“The idea that reason does its job quite poorly has become commonplace.”).
508 A similar analysis is seen in Daniel Schacter’s book, which views seven memory flaws, including bias, as side effects of memory functions that allow humans to operate successfully. See SCHACTER, supra note 438, at 4–5.
509 MERCIER & SPERBER, supra note 51, at 52.
510 See, e.g., id. at 17–20 (providing examples of the solitary rational man following his reasoned theories to ill or fruitful conclusions).
511 See Schacter, supra note 179, at 8.
515 See JANIS, supra note 511, at 3; Kunda, supra note 513, at 496; Myers & Bishop, supra note 512, at 779.
516 MERCIER & SPERBER, supra note 51, at 334.
517 See id. at 182–83. Mercier and Sperber call this the interactionist approach to reason.
518 See id. at 264.
519 Id. at 322.
interactions, and the testing of findings and hypotheses through methods designed to disconfirm them.

Applying Mercier and Sperber’s theory of reasoning, we conclude that *Epidermis and Enamel*’s authors did not engage in a real argument with the critics. The illogic at the root of *Epidermis and Enamel* was generated by groupthink or group polarization rather than a real exchange with bite mark evidence critics.519 In contrast, Bowers is open to the data offered by scientific critics and finds that a meaningful response cannot be marshaled.520 Souviron and Haller occupy a different space. Their short article is defensive in that it makes much of the distinction between bite mark analysis and bite mark comparison and argues that odontologists can still do bite mark analysis.521 This tack, however, can be seen as a tactical retreat that offers a way for odontologists to back away from the main reason they are called on by the prosecution: to make bite mark comparisons. So, while claiming that the National Academy of Sciences Report got it wrong,522 bemoaning that dentists with “no training at all” were doing bite mark comparisons,523 and warning against an “over-reaction” that would eliminate bite mark analysis,524 their willingness to admit that “Saks et al. do an excellent job describing” the misuse of bite mark comparison leaves them with no alternative but to “agree that, with rare exception, bite mark comparison is not able to identify a suspect with a reasonable degree of certainty. However, under some circumstances bite mark comparisons can be useful for the exclusion of suspects.”525 We cannot predict whether forensic odontologists as a group will finally engage in a meaning analysis of critical arguments and research and fully retreat from bite mark analysis as Bowers has done, or step back under the protective cover provided by Souviron and Haller, to renounce only bite mark comparisons. It is worrisome that *Epidermis and Enamel* drew on sources that have irrationally and broadly opposed forensic

---

519 In the research science world, attempts to disconfirm findings are expected. See id. at 323. Because such challenge is expected, a research scientist will seek out counterarguments in advance of publication, improving the quality of individual work. “Scientists compete for the attention of their peers: only those who make the best arguments have a chance of being heard.” Id. “From a sociology of science point of view, a proof is an argument that is considered, in a scientific community, as conclusive once and for all.” Id. at 324 (emphasis added).
522 See id. at 621.
523 Id.
524 See id. at 622.
525 Id. at 621–22.
Moreover, the use of lawsuits and ostracism as ways of dealing with critics, rather than scientific or rational counterarguments, suggests that the odontologists will be resistant to exchanging ideas.

We have examined the legal and scientific criticism of bite mark evidence, and the reaction to it, by opening a window on the organizational and psychological dynamics that have fueled opposition. We would be relieved to end our analysis at this point, but, unfortunately, the reasoning problems displayed by *Epidermis and Enamel* are expressed by other forensic scientists and may be finding an audience among some prosecutors.

V. CONCLUSION: THE COUNTERATTACK ON REASON AND EVIDENCE

Investigative writer Edward Humes, in his recently published popular book, *Burned*, analyzes the wrongful conviction of JoAnn Parks, based on a flawed arson investigation; her case has not (yet) resulted in an exoneration. Humes describes the origin of the evidence- and science-based standards for arson investigation, *NPFA 921*, in the 1990s, which led to the discovery of flashover and its importance in fire investigation. Yet, as late as 2018, a fire investigator could double down and deny that this scientific revolution ever occurred, supported by a prosecutor who would argue that position to maintain a conviction.

It is dismaying that two decades after scientific standards were established to determine whether fires are set intentionally, a fire investigator would stand by the old, discredited, methods, “loyal to [his] convictions” to quote Bandes’s ironic usage, when a flawed investigation is challenged. It should come as no surprise that a sudden change of standards will not be immediately welcomed and easily adopted. This may especially be the case in an area like arson

---

526 Barsley et al., supra note 2, at 93–94.
530 See Bandes, supra note 27, at 486.
investigation where untrained investigators, perhaps without college degrees and with minimal training, cannot meet the rigorous requirements of a fire protection engineer. Such a defensive reaction should not rile up forensic odontologists because the elimination of bite mark analysis or comparison would not put any of them out of work.

The reactions of the fire examiners and the prosecutors in JoAnn Parks’ case raises questions about the extent of resistance to change in forensic science in criminal prosecutions. A good answer requires extensive inquiry into the reactions to challenges to the older forensic science paradigm among the scientists and analysts who conduct forensic examinations, the prosecutors who employ them, the defense attorneys tasked with challenging them, and the judges who are responsible for determining their ability to testify and the admissibility of their testimony. Such a full exploration is far beyond the scope of this article. In this conclusion we offer a few thoughts about the resistance to reason and evidence derived from our investigation into the work of the bite mark dentists.

The obverse of this question is the degree to which forensic science has improved in reaction to the National Academy of Sciences Report. Although the question cannot be easily answered, there is some good news. For example, advances are being made in fingerprint analysis about studies assessing error rates, proficiency testing, and the potential to convert fingerprint analysis into an objective method. Improvements are seen to a lesser degree in other feature-comparison areas like firearms analysis. The National Academy of Sciences Report has also stimulated inquiry into the need for broader research agendas related to mature forensic

---


533 See PCAST, supra note 23, at 87, 91, 101; Champod, supra note 319, at 2, 3, 5. “While the FBI should be commended for its progress [in implementing fingerprinting reforms], more progress is still needed.” Simon A. Cole, Commentary, Implementing Counter-Measures Against Confirmation Bias in Forensic Science, 2 J. APPLIED RES. MEMORY & COGNITION 61 (2013) (noting that the FBI protocol has not been published, nor adopted by other U.S. laboratories, nor extended to other disciplines).

534 See PCAST, supra note 23, at 111.
areas based on established science. Even the Innocence Project reports that the 2009 National Academy of Sciences Report has “spurred various meaningful science-based criminal justice reforms,” and notes the significant federal funding which has supported forensic science research. Whether such improvements represent a substantial shift in the overall accuracy of forensic science experts in criminal justice will require analysis by specialists. Simon Cole, in 2013, referred to the “slow progress and staunch resistance” in how forensic examiners report their results, as the forensics disciplines are undergoing culture change. A wide scan of the wrongful conviction horizon, which involves the entire investigation-prosecution-adjudication complex, indicates that meaningful reform is a big and long project requiring informed change in every area of justice system practice.

Whatever the balance sheet between advances in and resistance to forensic science reform, we must attend to carping or misguided criticism. Of course, reform proponents should welcome evidence-based objections to proposed changes that raise measured and answerable concerns. That is the very point of the human faculty of reason.

![Image]

Over the past ten years, the National Institute of Justice has spent more than $123 million on grants to address the research needs outlined in the NAS report, including improving accuracy and reliability of methods and quantifying measures of uncertainty. This investment has yielded evidence that advanced some forensic science disciplines from their status as ‘reviewed by the NAS report in 2009’ to ‘improved levels of validity.’

Id. for example, soon after the NRC Report, the fingerprint scientific working group expressed concerns not addressed by the report and referred to forthcoming research. See Champod, supra note 319, at 2. While fingerprint analysts may have been engaged in rearguard action, their engagement with the criticism at least paved the way to later, iterative reform activity. See, e.g., Simon A. Cole, Individualization is Dead, Long Live Individualization! Reforms of Reporting Practices for Fingerprint Analysis in the United States, 13 LAW, PROBABILITY & RISK 117, 117–19 (2014).

See id. at 270–73 (commenting favorably on the adversary process from their psychological perspective).
Administrative Procedures Act,\textsuperscript{542} and the process of real, as opposed to sham, political democracy and deliberation.\textsuperscript{543} Effective change must encompass the process of dialogue and informed input if it is to lead to workable solutions and legitimacy. However, some negative argumentation may be aimed not at improving proposed reforms, but only at preserving status quo advantages, or may be based on irrational fears,\textsuperscript{544} on other covert goals, or may simply be misguided.\textsuperscript{545}

We cannot know whether the kind of negativity and unreason encountered in \textit{Epidermis and Enamel} is widespread among forensic analysts and scientists. A more likely and hopeful scenario is that most forensic analysts want to improve their reliability and will join the forensic reform movement. As noted by Cole, a forensic science reform movement existed before the innocence movement, and many forensic science organizations formally supported the broad reforms called for by the National Academy of Sciences Report.\textsuperscript{546} It is also surely the case that many analysts in the feature-comparison methods will follow reform scripts without fully understanding the reasons for change or fostering the kind of culture change envisioned by many reformers.\textsuperscript{547}

Nevertheless, justice-system decision makers, including gatekeeping and appellate judges, should be concerned that some forensic odontologists pursue an insular intellectual path, and by turning inward have generated self-serving and patently weak arguments to support bite mark analysis rather than trying to refute the critical arguments against bite mark evidence with better evidence.\textsuperscript{548} Indeed, the collective unreason displayed in \textit{Epidermis and Enamel} may interfere with more rational considerations for the preservation of bite mark evidence, such as its use to exonerate


\textsuperscript{543} See, e.g., Martin H. Redish & Andrew L. Mathews, \textit{Why Punitive Damages are Unconstitutional}, 53 EMORY L.J. 1, 22 (2004) (referring to democracy as the “prime mechanism for the cultivation of human reason and moral development”).

\textsuperscript{544} For example, some forensic odontologists may fear losing positions.

\textsuperscript{545} \textit{E.g.}, Marvin Zalman, \textit{The Anti-Blackstonians}, 48 SETON HALL L. REV. 1320, 1326 (2018).

\textsuperscript{546} See supra notes 120–123 and accompanying text.

\textsuperscript{547} See Black & Daeid, supra note 50, at 3. Issues related to forensic culture are far from simple, as noted in a 2013 symposium on the topic. See Ian Burney et al., Editorial, \textit{Introducing ‘Forensic Cultures’}, 44 STUD. HIST. & PHIL. BIOLOGICAL & BIOMEDICAL SCI. 1, 1 (2013); Cole, \textit{Acculturating}, supra note 190, at 437, 443, 466–67.

\textsuperscript{548} The likely implication is that at some level the bite mark dentists understood that they could not mobilize scientific evidence or strong arguments to refute the critics and instead resorted to a polemic.
espoused by Souviron and Haller, or the cautious statement by Mary Bush and Peter Bush that “bitemark evidence can be compelling and of significant evidentiary value under certain circumstances.” Our view is that the practice of forensic odontology, occurring in the hurly-burly of ongoing and urgent crime investigations, can almost never create the controlled atmosphere of the scientific experiment, and on balance will produce more wrongful convictions than accurate identifications. Thus, while we do not oppose rational debate on the issue, the weight of evidence both from legal experts and forensic scientists supports the termination of using bite-mark evidence, at least to prosecute.

The flawed logic of *Epidermis and Enamel* raises specific concerns of its defense of a small forensic science field that has generated a number of wrongful convictions. A larger concern is that *Epidermis and Enamel*’s illogic and blind resistance may reflect the thinking of a larger number of forensic scientists and analysts, and may find an eager audience among prosecutors who strategically or ideologically reject forensic reforms. Collectively, prosecutors have the power to expand this kind of science denial and they can utilize writings, however weak, to advance their interest, just as the forensic odontologists drew on the defensive and flawed reasoning of John Collins and Jay Jarvis. Two of their articles are little more than a long and whining complaint against Innocence Project leaders Barry Scheck and Peter Neufeld for having made uncomplimentary

---

549 Souviron & Haller, supra note 24, at 5.

550 Bush & Bush, supra note 271, at 314–15. We note that this weak, conciliatory statement was written soon after or as the Bush team was concluding that “[a]ny individual characteristics present in the dentition may or may not be present in the skin and, if so, may be significantly distorted.” *Id.* at 314. Bush and Bush also concluded, “Establishment of error rates in bitemark casework may therefore be beyond reach.” *Id.*

551 We are just as concerned that even one false conviction has been supported by the application of lip mark analysis. In the serious world of crime detection, the pressures to solve crimes can push detectives toward all kinds of unverified methods, leading to mischief. See Zalman, supra note 347, at 152. For example, if a psychic assists an investigator in correctly solving one crime, others may clamor for attention, discounting the fortuitous nature of the success. See, e.g., Benjamin Radford, *Psychic Tip on Long Island Serial Killer?*, DISCOVERYNEWS (Apr. 14, 2011, 9:05AM), http://news.discovery.com/human/psychic-tip-on-long-island-serial-killer.html [https://web.archive.org/web/20110417044331/http://news.discovery.com/human/psychic-tip-on-long-island-serial-killer.html].

statements about forensic science.\textsuperscript{553} Weak or nonexistent logic was employed to conclude that forensic science needs little correcting.\textsuperscript{554}

We would think that the poorly argued editorializing of overly sensitive forensic examiners and managers could be easily ignored,\textsuperscript{555} except that in addition to their influence on the forensic odontologists, their message seems to appeal to at least some prosecutors. As noted above,\textsuperscript{556} a Collins and Jarvis article was either originally published or reprinted in a journal that appeared to be a vehicle for the views of a distinctly partisan group of prosecutors. The inaugural issue of the \textit{Journal of the Institute for the Advancement of Criminal Justice} (Summer 2007), the only one available online, was devoted to supporting California’s Three-Strikes Law.\textsuperscript{557} Again, one would not make much of this except for the strident negative reaction of the National District Attorneys Association to the publication of the PCAST Report.\textsuperscript{558} “\[\textit{R}e]\textit{presenting} 2,500 elected and appointed

\begin{footnotesize}

\textsuperscript{554}For example, the simple inductive conclusion has been made that unverified forensic science is \textit{the second leading cause} of wrongful conviction. This is based on enumerating causal factors appearing in DNA exonerations. In this way, the Innocence Project showed that flawed forensic science appeared in 36% of DNA exoneration cases. Collins and Jarvis softened this to 20% by keeping the numerator (71 cases) and expanding the denominator from the number of exonerations to the “\textit{total number of instances}” of errors found in the exoneration cases, a way of using numbers as a scaffold for the logical flaw of discrediting one’s critic (\textit{tu quoque}). See Collins & Jarvis, \textit{Wrongful}, supra note 553, at 21–22. They engage in similar numerology and parse cases to claim that the forensic scientists did not commit malpractice. They also set the stage for defaming the innocence movement that was continued by \textit{Epidermis and Enamel}. See id. at 23–25; see, e.g., Barsley et al., supra note 2, at 93–94 (criticizing the Innocence Project’s statistics).


\textsuperscript{556}See supra note 381.


District Attorneys across the United States, as well as 40,000 Assistant District Attorneys,559 the NDAA is clearly a powerful organization and its opinions are consequential. The NDAA spokesperson reminded PCAST that it “is merely a temporary advisory body, whose existence expires at the end of this [Obama] administration,”560 and if the orientation of prosecutors were in any doubt, President Obama’s own Attorney General, Loretta Lynch, brushed the report aside.561 In a thoughtful and informative review, Professor Adam Shniderman noted that “[t]he NDAA’s hyperbolic response to the PCAST Report borders on contempt for truth and justice.”562

This may be so, but as *Epidermis and Enamel* has shown, the proper use of reason, let alone doing science or drawing on scientific findings, cannot gain traction where social arrangements are such that only one voice is heard, promoting motivated reasoning, groupthink and group polarization. As the NDAA’s warning made clear, if PCAST’s influence depends on power rather than reason and science, it extends only as far as a President’s term or a President’s willingness to expend political capital to weigh in against entrenched and remorseless prosecutors for whom winning trumps truth every time. And it might seem that in a presidential administration where the findings and institutions of science are openly trashed, and where the slow advance toward forensic science reform has been blocked,563

---

30. 2016, https://www.crime-scene-investigator.net/PDF/national-district-attorneys-association-response-to-the-report-forensic-science-in-criminal-courts-ensuring-scientific-validity-of-feature-comparison-methods.pdf [https://perma.cc/4QJ6-GADZ]. The NDAA accused PCAST of being biased, lacking the membership of even “a single working forensic scientist”; was aghast that PCAST claimed that “forensic feature comparison methods belong to the scientific field of ‘metrology (including statistics)’... [when] no metrologists were included on PCAST’s working group”; displayed its scientific chops by distinguishing between complex DNA mixture samples that could and could not be deconvoluted; and a bit more. See id.
559 See Testimony of Kay Chopard, supra note 558, at 2.
561 Shniderman, supra note 363, at 357.
562 For example, former Attorney General Jeff Sessions terminated the Justice Department’s involvement in the National Commission on Forensic Science (NCFS), and appointed a prosecutor who had been a thorn in NCFS proceedings as head of the Justice Department’s Forensic Science Working Group, described as an “opaque pseudo-successor to the very public work” of the NCFS. *See* Liliana Segura & Jordan Smith, *Bad Evidence: Ten Years After a Landmark Study Blew the Whistle on Junk Science, the Fight over Forensics Rages*
a new Dark Age is descending. Still, it is important to know that serious work on refining forensic science standards continues to advance in the Organization of Scientific Area Committees (OSAC) for Forensic Science under the National Institute of Standards and Technology (NIST). Most progressive and middle-of-the-road prosecutors are sufficiently grounded in concerns for truth and justice to appreciate forensic science reforms. A new bipartisan rapprochement regarding penal policies has tempered if not eliminated the prosecutorial drive to win cases at all costs. Even in today’s world, then, courts, prosecutors, and police, when confronted with the substantial scientific work and reasoning that has undermined the admissibility of bite mark evidence, may decide that bite mark analysis should not be admissible, and in coming to such a conclusion, might also consider the kind of reasoning that has been used by defenders of such methods.


567 See Souviron & Haller, supra note 24, at 622; supra Part II (except, perhaps, to exonerate suspects).