

Forensic Science Identification Evidence: Tensions Between Law and Science

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Abstract

For decades, courtrooms around the world have admitted evidence from forensic science analysts, such as fingerprint, tool-mark and bite-mark examiners, in order to solve crimes. Scientific progress, however, has led to significant criticism of the ability of such disciplines to engage in individualization i.e., “match” suspects exclusively to evidence. Despite this, American courts largely reject legal challenges based on arguments that identification evidence provided by these forensic science disciplines is unreliable. In so holding, these courts affirm precedent that it is the adversarial system’s function to weed out frailties in forensic evidence, and find that criticism of the forensic sciences lacks sui generis qualities. This article provides an independent critique of relevant American case law, from which three themes emerge. These themes are (1) the law’s misuse of science; (2) law’s scepticism towards change; and (3) law’s narrow construction of rationality, which generates reductionist concepts, and divorces science from its social context. As such, this article shows how the American judiciary’s approach to this global issue provides a contemporary illustration of key institutional tensions between science and law, and offers some recommendations for reforms that aim to facilitate the legal process to utilize the most reliable forensic science evidence possible.

Introduction

Science and law are powerful social institutions that enjoy “great epistemic legitimacy and authority.”¹ One area of society in which these two institutions intersect, and, indeed, compete for epistemic legitimacy, is the criminal justice process. This is particularly the case when the criminal justice process ‘uses’ science to answer forensic questions and help solve crime.

Crime-solving can involve the application of both ‘hard’ and ‘soft’ science. Hard science refers to natural or physical sciences, such as chemistry, biology, mathematics, and physics. These sciences investigate the universe by means of hypotheses and experiments where precise measurement, calculation and prediction can generally occur.² In a crime-solving sense, hard science can tell us, for example, whether a driver has alcohol in his blood through toxicology testing, and, through the application of DNA technology, whether a suspect is the donor of a DNA profile found on an assault victim. By contrast, the soft sciences comprise disciplines that interpret human behaviour, institutions and society on the basis of investigations for which it can be difficult to establish such levels of precision.³ Soft sciences (also known as social sciences) include psychology, sociology and

anthropology. These disciplines can also inform crime solving. For instance, psychologists might testify about the validity of memories.

It is generally accepted that hard science methodologies produce results that have greater levels of cumulative certainty. Yet, disciplines in both categories can involve varying levels of accepted reliability.⁴ Moreover, both categories, at times, have 'housed' a now discredited theory.⁵ In fact, both hard and soft science will likely continue to include what end up as defunct theories, such is the progressive nature of science.

Alongside the application of traditional hard and soft science disciplines to aid the solving of crime are a vast array of forensic science identification techniques. These techniques include fingerprint, tool-mark, bite-mark, microscopic hair and shoe and tyre print analysis. These disciplines do not fall neatly into either category. They lack the so-called "predictive power" or cumulative certainty associated with hard sciences, as they have generally not been subject to precise and extensive experimentation.⁶ Although, notably, there is scope to develop robust experimental frameworks in these disciplines,⁷ and some efforts have been – and continue to be – made.⁸ Sometimes these disciplines are referred to as "soft sciences",⁹ particularly by the courts. This label is often resented by people working in these fields, however. This is because the "soft" label suggests that these disciplines involve an inferior scientific methodology, in comparison to that employed by "hard" science disciplines. Still, there is no official conclusion that this is (or should be) a definitive categorisation.

The difficulty involved in classifying these disciplines relates to the fact that they have been "invented by and for police departments."¹⁰ For decades examiners (who are mostly based in law enforcement departments) have claimed that, through analysis and comparison techniques,¹¹ they are able to match a suspect, with certainty, to evidence located at crime scenes and on crime victims.¹² The practice of "matching" a suspect exclusively to evidence is termed "individualization."¹³ These conclusions, however, lack scientific validation.¹⁴

Despite this, the criminal justice process routinely presents the methodologies of these disciplines as 'scientific', and the products of them as 'scientific knowledge'. America's adversarial system has embraced this type of evidence as having great levels of scientific validity, certainty and reliability. Judges have admitted evidence from a wide variety of forensic techniques and experts;¹⁵ lawyers have shaped prosecution and defence narratives in accordance with examiners' findings; and jurors have developed a thirst for the alleged certainty provided by such methods.¹⁶ Such evidence has filtered, with relative ease, into the rational processes employed in America for identifying the perpetrators of crimes.¹⁷ Forensic identification evidence of this kind aids the American criminal justice system in generating legitimate convictions that can survive the post-conviction relief appeals process and, thus, engender trust and stability in the law.

However, scientific progress over the last three decades has challenged the certainty of conclusions made by examiners in these disciplines. Since the 1980s, DNA technology has shone a uniquely critical light on the ability of numerous forensic sciences to engage in reliable individualization. Rigorous testing has led to DNA analysts being able to obtain a profile from cellular material left at crime scenes and

on victims and establish, with certainty and consistency, that only one person [i.e., a suspect] could have been the source of the specimen material.¹⁸ DNA evidence is, thus, the most reliable approximation of individualization evidence that the scientific method can currently offer. By contrast, the forensic science methods servicing the criminal justice system, do not (yet) have the same scientific underpinnings for their claims of individualization. The National Academy of Sciences confirmed this in their landmark 2009 report — *Strengthening Forensic Science in the United States: A Path Forward* (“NRC Report”). The report concluded, “[w]ith the exception of nuclear DNA analysis ... no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source.”¹⁹

DNA technology has exposed wrongful convictions worldwide and simultaneously revealed that erroneous forensic science evidence has contributed to the conviction of the innocent.²⁰ In light of this, how law responds to the uncertainty generated by progressing science in this context is an issue of global significance. The American criminal justice system’s engagement with this issue, however, provides a particularly compelling illustration of how this intersection of the legal process with scientific uncertainty reflects institutional tensions between law and science. There have been over 330 post-conviction DNA exonerations in America, 47% of which are attributable to unreliable forensic science evidence.²¹ These cases have sparked a nation-wide “revolution”, known as the American Innocence Movement, which umbrellas a multitude of ‘innocentric’ initiatives.²² They have also prompted Congress,²³ the revered National Academy of Sciences,²⁴ and the United States Supreme Court to acknowledge that these identification methods suffer from significant deficiencies.²⁵

Despite this, American courts largely reject legal challenges based on arguments that identification evidence provided by forensic science disciplines is unreliable. Whether a petitioner’s claim is couched in terms of a challenge to the admissibility of such evidence, or shaped as an argument that criticism of the methodologies represents a shift in scientific opinion that qualifies as newly discovered evidence, the courts generally uphold the admission of such evidence, and reject that it satisfies newly discovered evidence thresholds.

This article offers an independent critique of this body of case law, and through that critique shows how it illustrates institutional tensions between law and science. Part I sets out the general institutional differences between law and science. Using examples from the American courts’ engagement with challenges to the reliability of forensic science identification evidence, Part II demonstrates how three thematic tensions between law and science emerge from this body of case law. These themes are (a) law’s misuse of science; (b) law’s scepticism about change; and (c) law’s narrow construction of rationality. Part III suggests a number of reforms, which aim to facilitate the legal process to utilize the most reliable forensic science evidence possible. These reforms are: calling for the law to be more open-minded about change in the light of progressing science; the development of forensic science commissions that allow for multi-stakeholder collaboration to improve the use of forensic science in the criminal justice process; increased training for relevant social actors, including lawyers, judges, law enforcement and jurors; focused lawyering strategies that seek to address judicial concerns about challenges to forensics

science evidence; and, when it comes to making use of reliable scientific evidence, a more proactive harnessing of the institutional strengths of the courts by judges. Part IV concludes that the law must, in order to overcome the imaginative difficulties associated with being on the cusp of this paradigm shift, meaningfully acknowledge that these tensions exist.

Part I: The Institutional Differences Between Law and Science

The institutions of law and science approach the world in different ways. Faigman summarises that

Science progresses while law builds slowly on precedent. Science assumes that humankind is determined by some combination of nature and nurture, while law assumes that humankind can transcend these influences and exercise free will. Science is a cooperative endeavour, while most legal institutions operate on an adversary model.²⁶

A deconstruction of Faigman's summary is helpful in understanding how tension is generated between law and science in the context of the criminal justice process and forensic science. First, the progression of science versus the precedent-sensitive nature of, in particular, common law jurisdictions like America, impacts how both institutions view and respond to change. The term 'science' refers to a particular kind of knowledge that "reflects the privilege accorded to the fruits of the scientific method..."²⁷ The modern scientific method can fairly be described as "a mode of investigation characterized by cycles of systematic empirical observation and hypothesis formation."²⁸ Like law, the scientific method values precedent in that it employs controlled experiments and standardized procedures in order to test both previous and new hypotheses.²⁹

A key difference, however, is that the products of the scientific method are widely understood to be provisional: hypotheses are routinely revised or abandoned and replaced by new dominant theories.³⁰ This methodology "motivates more and more scientific study, and is thus vital to the scientific enterprise."³¹ Hence, science embraces change in order to prevent the entrenchment of dogma or, more colloquially, 'junk science.'³² Conversely, just as science is sceptical of the possibility of complete knowledge, law is sceptical about change. This is largely because law is loyal to ideals associated with the legal process vision, such as finality, predictability and procedural regularity, which help it to maintain social order. Thus, science might have progressed beyond the idea that many forensic sciences can engage in individualization with certainty, but the law continues to apply (sometimes century old) precedents that allow the admission of 'junk science' into courtrooms.

Second, Faigman makes reference to the social context of law and science. Both institutions are social enterprises; however the filtering of science through the legal process can have the effect of divorcing science from its social context. Evidence of fingerprints, tool-marks, and bite-marks, for example, "cannot definitively incriminate a defendant without the aid of a complex social infrastructure to make them visible and interpretable in a court of law."³³ The legal process, however, can distort ideas of what it means to be scientific and objective, as it can stifle the reality that science is

a social achievement. Law does not necessarily endorse the view that products of the scientific method are routinely formed via a social consensus on a set of facts.

Neither does the law, in its application of science, adhere to the accepted view in the scientific community that science is not 'value neutral', either in the selection of problems it investigates or in its application, as there is "always a normative choice underlying ... what to control and why."³⁴ The presence of these "value motivations ... calls for special caution in judging how well the process generating the asserted scientific knowledge has lived up to the ideals of science practice."³⁵ The legal process, however, is not necessarily cautious, as its filtering processes can result in scientific evidence being "viewed as no longer bearing traces of human subjectivity."³⁶ Consequently, social actors in the criminal process can demonstrate a relative willingness to place trust in science and technology because it *appears* to "take the establishment of the truth away from fallible human beings..."³⁷ Rather, the legal process promulgates the idea that science lodges 'truth' in impersonal agents, such as forensic science identification techniques and DNA analysis technologies. This process has become invested with the hope of providing "unbiased and reliable evidence about the facts of the matter."³⁸ However, as Jasanoff has warned, "Human actions...can never be entirely ruled out of the picture in the production of evidence."³⁹ Science simply isn't possible without human participation.

Third, Faigman references the general methodologies employed by the institutions of law and science. On the one hand, science employs a largely cooperative methodology. Scientists are collaborative actors; the perspectives of their peers are fundamental to their practice. A scientist considers how their peers, mentors, colleagues and those who review their scholarship would evaluate their research.⁴⁰ The institution of science enables the organized pooling of limited understandings, the sharing of perspectives, and testing of correspondence by collective insights.⁴¹

This is in stark contrast to the methodology employed by the law in adversarial systems of justice, like America. The adversarial model forces the parties to take opposing stances, and, thus, can prevent a full consideration of scientific issues. This model encourages the parties to "produce evidence favourable to their respective sides, regardless of the quality of that science."⁴² This process can often polarize the scientific evidence at issue and rely on marginal experts, who are willing to be more certain in their conclusions, despite a lack of scientific evidence for those conclusions.⁴³ This means that the process ultimately fails to provide a full spectrum of evidence, about the science at issue, to the court. Evidence that reaches the court does not represent the relevant scientific field more generally; resulting in the court hearing "highly practiced alternative stories that only roughly approximate what might be termed reality."⁴⁴ In light of this, cross-examination techniques are crucial to the adversarial process. Cross-examination can have varied outcomes, however. It can serve to strengthen the reliability of sound forensic techniques by putting pressure on them, but also seduce juries into favouring unsound evidence because the witness has either being poorly examined or is a persuasive witness. Cross-examination can also result in the dismissal of sound scientific evidence from the courtroom, particularly if it is designed to subject reputable witnesses to ridicule and/or personal attack.⁴⁵

These institutional differences can have a significant impact when science enters the criminal justice process as evidence, where, through the testimony of expert

witnesses, science must speak to law.⁴⁶ As Jasanoff explains, “The use of scientific evidence...in court...brings into collaboration two institutions with significantly different aims and normative commitments.”⁴⁷ This is not a friction-free encounter as neither science nor law completely retains or completely relinquishes its autonomy.⁴⁸ Law must provide “coherence and ultimate resolution to the varied voices of scientific administration.”⁴⁹ However, in doing so, legal frameworks prevent the varied and discrete operations of scientific administration from being brought into corrosive comparison with each other, as such a comparison would reveal their “uncertain and overlapping bounds and challenge their claims to autonomy.”⁵⁰ Thus, forensic science serving the law cannot “proceed in quite the same ways as science done purely to advance the cause of science.”⁵¹ An examination of judicial responses to challenges to the reliability of forensic science identification evidence confirms the existence of these tensions. Part II examines this body of case law.

Part II: Tensions Between Law and Science: Emerging Themes From the Case Law

Using examples from the courts’ engagement with challenges to the reliability of forensic science identification evidence, Part II demonstrates how the courts exemplify three thematic tensions between the institutions of law and science. These themes are (a) the law’s misuse of science; (b) the law’s scepticism about change; and (c) the law’s narrow construction of rationality.

A. Law’s ‘(Mis)Use’ of Science

Science – whether it be in the form of fingerprints, bite-marks, or tool-marks - enters the criminal justice process as ‘evidence,’⁵² not as “bare facts or claimed truths about the world.”⁵³ It is not presented in a neutral form because the adversarial system forces it to ‘pick a side:’ scientific evidence is either presented in favour of the prosecution or the defense narrative. In order to be part of either narrative, “science must be worked into the particular kinds of propositions, representations, or material objects that the law regards as germane to establishing which party is telling the more plausible story.”⁵⁴ More specifically, in America, scientific evidence must satisfy admissibility frameworks, such as the **Daubert**⁵⁵ admissibility criteria (which operates at the federal level), and newly discovered evidence rules, which are designed to filter evidence to suit the epistemological needs of the law.

Law expects scientific evidence that survives this filtering process to be an objective ‘cure’ that provides certain answers to questions such as “who did the crime?” The cases of **Brooks v. State**⁵⁶ and **State v. Stubbs**⁵⁷ show how this process can force objectivity and reliability out of ‘science’ to the detriment of substantive accuracy. It also illustrates how marginal experts can influence litigation.

In **Brooks**, the petitioner had been convicted of capital murder based, in part, on the testimony of Dr. Michael West, who testified that two dentations present on the victim’s body had been made by Brooks. Brooks claimed that his trial court erred in admitting West’s testimony because he was not an expert in forensic odontology. In the Supreme Court of Mississippi, despite concerns about Dr. West⁵⁸ and the fact other experts found inconsistencies between the bite-mark and Brooks’ teeth,⁵⁹ the majority took the chance to “state affirmatively that bite mark identification evidence

is admissible in Mississippi.”⁶⁰ The court followed precedent, stating that because Brooks had the opportunity to present his own experts,⁶¹ and “to attack the qualifications of the expert, the methods and data used to compare the bite marks to persons other than the defendant, and the factual and logical bases of the expert’s opinions”⁶² his conviction was legitimate.

The dissent had reservations, however, about Dr. West’s alleged “unmatched ability to conclude that no one other than the defendant could have produced the marks on the deceased...”⁶³ The dissent had concerns about the reliability of bite-mark individualization evidence,⁶⁴ the sore divide between expert opinions,⁶⁵ and “West’s propensity for testifying with a confidence seen in no other expert.”⁶⁶ Justice McRae detailed many concerns about West, including that he had materially misrepresented evidence and data, used methods not founded on scientific principles and claimed to have expertise in a vast array of identification disciplines.⁶⁷ Justice McRae concluded that the majority’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.”⁶⁸

West’s testimony also formed part of the state’s narrative in **Stubbs**. In that case, Stubbs was convicted of, *inter alia*, an aggravated assault and subsequently challenged the admission of bite-mark evidence against her. At trial, West testified that the victim had bite-marks on her hip and that Stubbs could not be excluded from being the donor. West concluded this after he had pressed the dental mold of Stubbs’s teeth on to the victim’s skin.⁶⁹ Again, the Mississippi Supreme Court followed precedent and found that West was an expert in forensic odontology, and because the adversary system allowed Stubbs to attack West’s testimony, the trial court had not erred in admitting West’s evidence.⁷⁰

Brooks was exonerated by DNA evidence in 2008⁷¹ and Stubbs’s aggravated assault conviction was vacated in June, 2012.⁷² The state’s narrative in both cases, therefore, was materially erroneous – but it was nonetheless able to produce ‘scientific’ evidence to support its case. Moreover, as the dissent pointed out in **Brooks**, the defense provided ‘science’ to the contrary. West’s evidence in both cases is an example of the type of scientific “over-claiming” that can be generated by the adversarial system. Over-claiming is associated with more marginal experts. A scientist who resists over-claiming is striving to maintain their professional integrity. As Hussey Freeland explains, “a scientist who resists framing her work in terms of too-high certainty—over-claiming—is not simply being uncooperative, but instead is striving to maintain her social identity.”⁷³

With this in mind, it is important to note that forensics analysts associated with the routine practice of crime-solving forensic science disciplines, have historically been, and remain, rooted in law enforcement, and not in a particular scientific field. As a consequence, these disciplines are neither typically rooted in research that has application beyond criminal investigations nor practiced by professionals outside of law enforcement. These disciplines can be fragmented, poorly regulated and lack standardized procedures,⁷⁴ as well as resources. Research into their methods can be limited, unpublished and narrowly circulated, and there is often a lack of will to pursue validation of the methods they employ.⁷⁵ Despite these limitations, forensic analysts are crucial participants in the production of knowledge to be used in criminal trials. Those who engage in over-claiming, however, arguably become what

Fitzpatrick would term “mythical and magical forms of authority.”⁷⁶ Quite like Foucault described the “mythic heroes of discipline” in asylums, such agents do not introduce science into the courtroom, but rather a personality “whose powers borrowed from science are only their disguise, or at most their justification.”⁷⁷ Law, in this context, is engaging scientific administration in “all its mythic purity...as the very nature of things, set beyond the doubts and diversities that compromise it in operation.”⁷⁸

The law can distort science; minimising its rigour, care and professionalism in the process. Cases such as **U.S. v. Hicks**⁷⁹, **U.S. v. Mitchell**⁸⁰ and **U.S. v. Baines**⁸¹ provide examples of this. In **Hicks**, the United States Court of Appeals for the Fifth Circuit approved as reliable trial testimony provided by the state’s ballistics expert that the suspect cases were fired from a rifle found at Hick’s residence. This was based, in part, on the court accepting testimony that the discipline’s error rate was “zero or near to zero.”⁸² In **Mitchell** and **Baines** the courts willingly accepted that fingerprint identification had a very low error rate.⁸³ Ultimately, the scientific method may prove that both disciplines have extremely low error rates. However, at the time of writing (and certainly the determination of these three cases) that is not a scientific fact. In 2009, the National Research Council (NRC) reported that claims of a zero error rate in fingerprint identification are clearly “unrealistic”⁸⁴ as the discipline is not (yet) properly underpinned by science.⁸⁵ The NRC made similar comments about firearms identification evidence,, concluding that “the scientific knowledge base for tool mark and firearms analysis is fairly limited”⁸⁶ and in order to make the process of individualization more precise and repeatable, “additional studies should be performed.”⁸⁷

These cases also show how the courts are willing to inject certainty into provisional facts. As Jasanoff has explained, “the law accept[s] facts that science might still deem provisional...Scientific facts needed to resolve legal disputes frequently come into being only as those disputes unfold. They are not available before the fact in some convenient storehouse of relevant, well-documented, yet case-specific facts.”⁸⁸ This acceptance of provisional facts can be seen in other cases too. For instance, in **U.S. v. Crisp**,⁸⁹ which concerned fingerprint identification evidence, the Fourth Circuit Court of Appeals conceded, despite approving individualization evidence, that “further research...and the development of even more consistent professional standards was desirable.”⁹⁰

The case of **U.S. v. Aman** is similar.⁹¹ In that case, a U.S. District Court in Virginia acknowledged the concerns of the NRC and conceded that “[t]he absence of a known error rate, the lack of population studies, and the involvement of examiner judgment all raise important questions about the rigorousness of friction ridge analysis.”⁹² The District Court agreed that further testing and study would enhance the precision and reviewability of fingerprint examiners’ work,⁹³ but, relying on **Crisp**, ruled that Aman’s challenge to the reliability of the fingerprint evidence allegedly linking him to an arson fire was not meritorious.⁹⁴ Notably, both courts considered that cross-examination was the appropriate remedy for challenging “shaky” forensic identification evidence.⁹⁵ As discussed in Part II(C) *infra*, however, this reliance is arguably misplaced because it ignores the difficulties associated with the social context of challenging forensic science evidence.

Cases such as **Brooks**, **Stubbs**, **Hicks**, **Mitchell**, **Baines**, **Crisp** and **Aman** all provide examples of how facts in law and facts in science differ, and, ultimately, what

both institutions count as “truth.” These cases go towards affirming Jasanoff’s view that, “what counts as true for the law need not count as true for science, and in exceptional cases even scientific truths may not be accepted as valid for legal purposes.”⁹⁶

This all demonstrates the most salient difference between legally relevant facts and normal scientific facts, namely that legal facts are “frequently specific to the cases they are supposed to illuminate, whereas scientific facts are expected to have more general validity.”⁹⁷ To count as probative, legal facts must have *sui generis* qualities i.e., be unique to the case at hand. This is illustrated by case law related to newly discovered evidence claims. For instance, petitioners have alleged that the criticism aimed at standard tool-mark identification evidence is newly discovered evidence. The appellate courts have responded conservatively to these claims, choosing to (1) defer to lower court decisions disqualifying such criticism as newly discovered evidence; and (2) reject that the findings of the 2009 NRC Report – including the unprecedented finding that individualization was not proper in forensic disciplines such as firearms identification - are newly discovered evidence. These cases show that the shift in scientific opinion contained in the NRC Report, with regards to firearms identification evidence, fails to qualify as newly discovered evidence. This is largely because courts take the view that the report presents no “new” facts given that it cites to older research and lacks specificity to individual cases.⁹⁸ Cole and Edmond have noted how the judiciary’s intense focus on specificity has made it difficult for petitioners to apply general concerns from the NRC Report to specific case issues.⁹⁹ Courts are interested in relevant evidence bearing on facts in issue in the specific proceedings. As it stands, petitioners are failing to bridge the gap between the NRC Report’s findings and the impact they have on their individual case. This failure tends to be fatal to the “verdict changing capacity” requirement of newly discovered evidence rules.¹⁰⁰

The situation is similar in relation to other forensic science identification methods, namely fingerprint analysis, microscopic hair analysis, shoe-print analysis and blood stain pattern analysis. The cases of **Johnston v. State**,¹⁰¹ **Enderle v. Iowa**,¹⁰² and **Pennsylvania v. Edmiston**¹⁰³ demonstrate this. Again, these cases show that the courts’ demand for probative evidence that bears on the specific facts at issue, in the single case before them, is fatal for newly discovered evidence claims. In other words, the *sui generis* nature of adversarial legal proceedings has been used to limit the impact of the 2009 NRC Report to support newly discovered evidence claims.¹⁰⁴ In light of these findings, lawyers should revise how they approach these claims, as discussed in Part III. The law’s demand for specificity hinders its ability to change its approach or, more specifically, to change established precedent. Precedent is the law’s way of tying everything to the past. This is at odds with the progressive nature of science, which tends to look forward.¹⁰⁵ The courts’ approach to generally reject challenges to the reliability of forensic science identification evidence are perhaps illustrative of when, due to the methodological differences between science and law, “Recalcitrance can be endemic...”¹⁰⁶ Given the progressive nature of science, there will always remain areas where the dominance of science is not accepted and “recalcitrants are not prepared to submit to its operatives or to the necessity of fact.”¹⁰⁷ In these situations, the law’s institutional frameworks, in effect, cause science to fail. This, Fitzpatrick argues, “has to be recognised and dealt with.”¹⁰⁸ In such instances, science cannot be simply interpreted and applied – it has to be

enforced. All this illustrates how science can be “dangerously” misconstrued by law.¹⁰⁹ To defend science against this (and enforce it properly), however, the law must embrace the view that scientific progress can require change. However, as sub-section (B) explains, the law can be sceptical about change that is urged by scientific progress.

B. Law’s Scepticism About Change

Scientific progress has revealed that individualization claims made by numerous forensic science disciplines are unreliable. This NRC Report’s conclusions exemplify such progress. The law, however, is yet to embrace this progression. Judges, it seems, are happier “accepting some knowledge of the past than of the future”¹¹⁰ and reflect what Midgley labels as the “imaginative difficulty” associated with being on the cusp of a paradigm shift.¹¹¹

The courts’ sceptical approach is underpinned by their institutional loyalty to precedent. For example, if a judge knows that precedent dictates that individualization testimony by bite-mark examiners is admissible evidence, he is likely to (at least as a starting position) reason that all individualization evidence by all bite-mark examiners is admissible.

A number of cases demonstrate this sort of reasoning. **Brooks**¹¹² is a prime example in the context of bite-mark evidence. In that case, despite concerns about Dr. West and the fact other experts found inconsistencies between the bite-mark and Brooks’ teeth, the majority took the chance, on the basis of precedent, to “state affirmatively that bite mark identification evidence is admissible in Mississippi.”¹¹³ This sort of broad-brush avoids an immediate examination and discourages a future examination of the substance of the tension between law and science in this context. As Beecher-Monas has found, “By far the most widely used gate-keeping avoidance technique that judges employ is admitting bite-mark evidence because other courts have done so.”¹¹⁴

The same judicial approach has been noted in relation to tool-mark identification evidence. Case law concerning the admissibility of tool-mark identification evidence is “typified by decisions admitting such testimony with little, and usually no, reference to legal authority beyond broad ‘discretion and an adroit sidestepping of any judicial duty to assure that experts’ claims are valid.”¹¹⁵ As Faigman *et al* summarize, “Appellate courts defer to trial courts, and trial courts defer to juries. Later appellate courts simply defer to earlier appellate courts.”¹¹⁶ The crux of the issue is this: the number of years that a particular precedent (concerning the admissibility of a particular forensic identification discipline) has been applied for, should not be viewed as indicative of that discipline having scientific validity or the relevant conclusion being scientifically reliable. Unfortunately, however, some courts do see things this way. For example, in **Mitchell**, the United States Court of Appeals for the Third Circuit rejected a challenge to fingerprint identification evidence on the basis that, amongst other things, it had been tested by one hundred years of application in the adversarial system.¹¹⁷ Such reasoning doesn’t inject efficacy into the law, but rather shows how a robust fidelity to *stare decisis* can compel the law to repeat past mistakes.

The sceptical view of change reflected by the judicial opinions explored in this article exemplifies how the institutions of science and law view the concept of “bedrock.” For science, achieving “bedrock”, i.e., sedimentation of scientific knowledge is desirable, but ultimately the primary concern of science is “preventing flaws from settling into the precipitating knowledge, so that the bedrock will be less likely to crack as more new knowledge settles upon it.”¹¹⁸ Having said that, it should be acknowledged that there are numerous examples of scientific communities standing still despite the existence of a large evidence base pointing towards a particular conclusion,¹¹⁹ and snubbing the research of pioneering scientists. In fact, the research of Watson and Crick that eventually led to the discovery of the structure of DNA is an example of the latter.¹²⁰ Still, science is generally progressive.

By contrast, the main aim of the law is to maintain social order. The law, of course, allows for some flexibility so that it might adapt in line with changing social conditions and progressing scientific thought. In fact, there are numerous examples of American courts rejecting scientific disciplines on the basis that progressing thought has found them to be unreliable. Sometimes this judicial practice is *ab initio* i.e., from the beginning. The wide rejection of polygraph evidence following **Frye v. U.S.**¹²¹ in 1923 is an example of this, although it should be noted some courts have departed from this ruling.¹²² Courts have also rejected evidence elicited by hypnosis, with researchers finding that hypnotically elicited recall is *per se* inadmissible in 27 states.¹²³ More often, however, rejection of scientific evidence is more gradual and subtle. For instance, in recent years, following further medical research, some courts (including the United States Supreme Court) have voiced concerns about the validity of Shaken Baby Syndrome as a medical diagnosis.¹²⁴ This slower approach is more common in the law because, ultimately, for law, sedimentation and the formation of new bedrock so closure can be achieved is favoured.¹²⁵ In other words, a strong fidelity to finality, precedent, and consistency in judicial decision-making are the order of legal business, even if legitimate scientific discovery suggests they shouldn't be. Sudden changes made to long-term precedents can, ironically, be quickly snubbed out.

The **Llera Plaza** cases demonstrate this point in the context of fingerprint individualization evidence. In 2002, Judge Pollak of the U.S. District Court for the Eastern District of Pennsylvania made an unprecedented decision. In **U.S.v. Llera Plaza (Llera Plaza I)**,¹²⁶ Judge Pollak held that “no expert witness for any party will be permitted to testify that, in the opinion of the witness, a particular latent print is—or is not—the print of a particular person.”¹²⁷ Judge Pollak's ruling was the first ‘successful’ defense challenge to fingerprint identification evidence.¹²⁸ Still, **Llera Plaza I** was short-lived. Weeks later, Judge Pollak reversed his decision. In so doing, Judge Pollak bowed to precedent, stating “to postpone present in-court utilization of this ‘bedrock forensic identifier’ pending such research would be to make the best the enemy of the good.”¹²⁹

Case law concerning challenges to the veracity of individualization claims by certain forensic sciences provides support for Midgley's view that myths do not alter quickly or in a wholesale way.¹³⁰ Testimony that a fingerprint can be “matched” to a suspect, tool-marks on suspect ammunition can be “matched” to a suspect gun, and bite-marks on a victim's body can be “matched” to a suspect's dentition, has been admissible in American courtrooms for decades.¹³¹ As such, the ideas that such

testimony conveys are arguably the types of “prominent ideas”¹³² that Midgley suggests cannot “die” until the problems within them have been resolved.¹³³ In the instant context, this resolution might fairly be interpreted to mean that precedents allowing the largely unreserved admission of such individualization evidence cannot “die” until stakeholders in the criminal justice system internally resolve the controversy surrounding these disciplines in some way, shape or form.

Newly discovered evidence cases relating to Comparative Bullet Lead Analysis (CBLA) evidence arguably provide support for this idea. This is because they show a shift in judicial approach after stakeholders in the criminal justice process collaborated to address problems associated with prominent (but ultimately inaccurate) ideas about the reliability of CBLA evidence. Historically, CBLA evidence had been used to show that “bullets came from the same box, the same manufacturer, were related in time or geography, or generally linked the defendant to the crime in some unspecified manner.”¹³⁴ The reliability of this method, however, has been significantly criticised. Consequently, some petitioners have argued that the criticism represents a shift in scientific opinion that qualifies as newly discovered evidence. These claims have generally triggered judicial intervention in favour of the petitioner.¹³⁵ Concerns about the ‘newness’ of the criticism aimed at CBLA evidence and how probative that criticism is to a particular case (given it comes from sources unrelated to specific cases) have seemingly been side-lined by the judiciary. This is in stark contrast to how the judiciary has approached newly discovered evidence claims on the basis of the 2009 NRC Report as it relates to other forensic science disciplines. As previously discussed, such claims rarely trigger relief.¹³⁶ One explanation for the unusual judicial approach towards CBLA evidence may well be that there was a wider multi-institutional response across the criminal justice system to concerns about the use of CBLA evidence.¹³⁷ This included the FBI forcing the discontinuance of CBLA evidence in 2004, after a report questioning its validity was published by the National Academy of Sciences.¹³⁸ This result suggests that multi-agency collaboration is a useful way to encourage the legal process to acknowledge scientific progress and adapt judicial decision-making accordingly. As such, the author further explores the idea of multi-stakeholder collaboration in Part III *infra*.

The ‘death’ of a myth is not common or quick. Rather, Midgley says such ideas are more likely to “transform themselves gradually into something different...”¹³⁹ Case law concerning firearms identification evidence reflects this idea. From 2005 onwards, some courts began to discourage individualization testimony by firearms examiners and curtail the language experts used to connect weapons to suspect ammunition. In **U.S. v. Green**,¹⁴⁰ the trial court admitted expert testimony but refused to allow the expert to conclude that the shell casings came from a specific pistol to the exclusion of every other firearm: “That conclusion—that there is a definitive match—stretches well beyond [the expert’s] data and methodology.”¹⁴¹ The expert was permitted to describe his observations and comparisons regarding the shell casings.¹⁴² The same court considered a similar challenge weeks later in **U.S. v. Monteiro**.¹⁴³ In **Monteiro**, the defendant sought to exclude expert testimony that suspect cartridge cases matched firearms linked to him. The court rejected the defendant’s challenge, finding that the underlying scientific principle of individualization in firearm identification was valid. But on the basis that an identification is largely subjective, and there is no existing reliable statistical or scientific methodology that allows an expert to testify to a match to an absolute

certainty, the expert was only allowed to testify to a “reasonable degree of ballistic certainty.”¹⁴⁴

Similarly, in **U.S. v. Diaz**,¹⁴⁵ the court found that individualization claims in the firearms-identification field were not supported. Thus, the court only allowed the examiners to testify “that a match has been made to a ‘reasonable degree of certainty in the ballistics field.’”¹⁴⁶ In **U.S. v. Glynn**,¹⁴⁷ the trend continued. In **Glynn**, the court concluded that allowing the examiner to testify that he had matched ammunition to a particular gun “to a reasonable degree of ballistic certainty” would “seriously mislead the jury as to the nature of the expertise involved.”¹⁴⁸ To resolve this problem, the court (1) limited the expert to testifying that a firearms match was “more likely than not;” (2) prevented the expert from testifying that he reached his conclusions to any degree of certainty; and (3) prevented the expert from testifying that ballistics was a science.¹⁴⁹ Some courts continued this conservative trend after the publication of the NRC Report. For example, in **U.S. v. Taylor**,¹⁵⁰ the court admitted the firearms identification evidence but limited the examiner to testifying that the ammunition came from the defendant’s rifle within a “reasonable degree of certainty in the firearms examination field.”¹⁵¹

A few courts have also expressed concern about the form of expert testimony in cases involving fingerprint evidence¹⁵² and bite-mark evidence.¹⁵³ Still, the most notable shift in perspective accounted for in the cases of **Green**, **Monteiro**, **Diaz**, **Glynn** and **Taylor**, only goes towards showing how the law avoids the real substance of its tension with science in this context by oversimplifying the problem. As sub-section (C) explores, this reductionist approach engenders a narrow approach to rationality that can divorce science from its social context to the detriment of substantive accuracy.

C. Law’s Narrow Construction of Rationality

Taking a reductionist approach to concepts related to the legal analysis of scientific evidence allows the law to develop rationality in its decision-making processes. In an intellectual world, reductionism offers order and simplicity.¹⁵⁴ The engendering of rationality and regularity is particularly fundamental to the law. This can be seen in the case law examined in the article (and beyond). This is because these cases demonstrate a high level of judicial fidelity to ideals associated with legal process theory.

At the centre of the legal process vision is the principle of institutional settlement. This principle theorizes that that it is procedural regularity in the decision-making process of a competent institution that legitimizes the institution’s decisions, not whether its decisions are substantively accurate. Procedure is critically important because it, *inter alia*, provides an effective way of obtaining “good” decisions, facilitates the collaboration of institutions in an interconnected institutional system (like the criminal justice system), and enhances the legitimacy of the law by generating consistency.¹⁵⁵ The trouble with a largely unreserved loyalty to the legal process vision, however, is that it can tend to “exalt the form over the substance of what is being said, the method over the aim of an activity, and precision of detail over the completeness of cover.”¹⁵⁶

For instance, if we consider the cases of **Green, Monteiro, Diaz, Glynn and Taylor** examined in sub-section (B). In those cases, the judiciary have moved away from allowing firearms experts to testify in absolute terms of individualization; instead requiring them to testify in, allegedly, more diluted terms such as “more likely than not” and “to a reasonable ballistic certainty.” This approach, which appears to be a judicial attempt to rationalise the criticism aimed at individualization evidence in the context of firearms identification, boils down the tension between law and science to a simple matter of terminology. This is problematic, however. This is because even initial research studies in to this ‘question of interpretation’ have shown that both judges and jurors are comfortable converting subjective probability evidence into findings of liability.¹⁵⁷ As such, restricting firearms examiners (and other such experts for that matter) to phrases such as “to a reasonable degree of certainty” and “more likely than not” may well not have the desired effect of deterring jurors from inaccurately thinking there is an absolute “match” between suspect ammunition and a known weapon. In other words, this reductionist approach overlooks relevant social concepts, i.e., how the terminology will be interpreted by the social actors involved in the criminal justice process.

For instance, although she takes the view that not allowing testimony indicating “absolute certainty” or “scientific certainty” is a step in the right direction, Bonnie Lanigan is mindful that alternative, diluted phrases could be confusing for jurors.¹⁵⁸ In relation to firearms evidence, she notes that “the phrase “ballistic certainty”-- especially when “ballistics” is not an accurate term as it encompasses all projectiles-- may not sound that different to a juror from the phrase “scientific certainty.”¹⁵⁹ Both phrases imply certainty that doesn’t yet exist in this discipline.¹⁶⁰

The idea that this reductionist approach overlooks the complex assessments undertaken by jurors when confronted with such evidence, is supported by a study published in 2015.¹⁶¹ This study examined the way that a sample (i.e., potential jurors) responded to two types of forensic evidence, namely a DNA comparison and a shoeprint comparison, when an expert explained the strength of the evidence in three different ways.¹⁶² The findings of the study suggest that “perceptions of forensic science evidence are shaped by prior beliefs and expectations as well as expert testimony...”¹⁶³ It underscores, therefore, that there are qualitative aspects to individuals’ assessment of forensic evidence, including value judgments about credibility, the risk of error, how the forensic evidence fits with other evidence presented in the case, and how it is popularized and conveyed by the media and other literature.¹⁶⁴ All this supports this author’s overall point, namely that there is a far more complex social context to this routine courtroom interaction between ‘expert’ and jury, than the judiciary’s reductionist approach takes account of.

Cases such as **U.S. v. Gutierrez-Castro**¹⁶⁵ also demonstrate a boiling down of the tension created by scientific progress to one of terminology, but in a slightly different context. In that case, the state wanted to introduce the testimony of James McNutt. McNutt would testify that suspect prints belonged to Gutierrez-Castro. Gutierrez-Castro argued that, while McNutt was a certified fingerprint examiner and that he had completed several classes on fingerprint analysis, the 2009 NRC Report “indicate[d] that certification may not be a valid indication of knowledge or ability.”¹⁶⁶ Gutierrez-Castro argued there was no standardised or approved method of certification; hence McNutt was not qualified to offer expert testimony about fingerprint analysis. The

court rejected Gutierrez-Castro's argument, seemingly siding with the state's argument that McNutt had undertaken demanding training culminating in regular proficiency tests.¹⁶⁷ The court was not deterred by concerns that most proficiency tests do not reflect real-life conditions. However, reducing the problem to a matter of terminology, the court gave permission for McNutt to testify, but would *not* allow: (1) the state to offer him as an expert witness in the jury's presence; (2) the trial court to certify McNutt as an expert witness in the jury's presence; and (3) allow the jury instructions to refer to McNutt as an expert.¹⁶⁸

The **Gutierrez-Castro** decision arguably attempts to engage in the social context aspects relevant to the tension between the law and science at issue. The court attempts to respond to the idea that jurors are easily seduced by people described as 'experts' and as a consequence pay little attention to the veracity of the discipline they are tasked with judging.¹⁶⁹ In the context of fingerprint identification this is arguably a positive step as, for example, studies have found that a vast majority of jurors agree that fingerprint identification is a 'science' and that fingerprints are the most reliable means of identification.¹⁷⁰ Still, expert labels are not necessarily relevant to the greater social context issue, namely how jurors interpret testimony that conclusively links a suspect to evidence via a forensic science method of identification. This opportunity is, in effect, bypassed.

All told, these shifts in terminology can end up being cosmetic noises that simply contribute towards disguising the uncertainty pervading these disciplines. As recognised by the National Commission on Forensic Science's Sub-committee on Reporting and Testimony, these phrases are meaningless in a scientific sense.¹⁷¹ They are not used by experts outside of courtrooms and the legal process should not insist that they are used.¹⁷² Moreover forensics science service providers "should not endorse or promote the use of this terminology."¹⁷³

This avoidance of the greater social context is also evident when considering cases where the courts have rationalised their rejection of challenges to forensic science identification evidence on the basis of finality interests. The doctrine of finality developed out of a taxonomy detailed by Professor Paul M. Bator in 1963.¹⁷⁴ Bator argued that the finality of criminal judgments serves important interests that are harmed by expansions of post-conviction rights, and proposed that because we can never be 100% certain that no error of law or fact was made during trial (or appellate) proceedings, "we must impose an end to litigation at some point or else the case could conceivably go on *ad infinitum*" i.e., forever.¹⁷⁵ Legal process is the focal point of Bator's taxonomy.¹⁷⁶ According to Bator, the efficacy of outcomes produced by the criminal justice system (such as jury verdicts and trial court decisions) require the application of a procedural model that provides "a reasoned and acceptable probability that justice will be done."¹⁷⁷ When faced with post-conviction challenges, therefore, process thinkers ask such questions as: did the measures and processes of the trial court give the petitioner a full and fair opportunity to challenge the case against him and present his own case? If so, the legal process vision dictates that the outcome is legitimate (whether it is substantively accurate or not).¹⁷⁸

Consequently, the process model simultaneously protects finality interests by restricting the means to usurp a rationally processed conviction. This approach underpins post-conviction frameworks across America, and pervades the rationales

of appellate judges considering challenges to evidence post-conviction. It is now widely accepted that finality is an umbrella term used to cover a variety of interests including ensuring respect for criminal judgments and victims' rights, conserving state resources, furthering the efficiency and deterrent and educational functions of the criminal law, satisfying the human need for closure, incentivising defense counsel to "get it right first time" and preventing a flood of non-controversial claims from masking the fewer, credible ones.¹⁷⁹ As such, finality is a reductionist concept; boiling down many complex and varied considerations into single headlines.

Again, this reductionist approach has the result of divorcing science from its social context in the criminal justice process. For instance, in an article published in 2014,¹⁸⁰ the author examined case law where courts had rejected challenges to the veracity of firearms identification evidence. The author identified that the courts tended to rely on two particular finality interests, namely preventing non-controversial claims from flooding the system and incentivising defense counsel, when rejecting these challenges. In relation to preventing non-controversial claims flooding the system, the author identified that courts often conclude the admission of such evidence was "non-prejudicial" in light of other evidence against the petitioner. In other words, courts are terming the (legally sound or unsound) admission of firearms identification evidence as non-controversial. In relation to incentivising defense counsel, the courts emphasize the importance of the adversarial system, i.e., defense counsel's ability to weed out frailties in forensic evidence via cross-examination.¹⁸¹ Notably, the author has also found that this finality interest is also predominantly used to rationalise rejections to challenges to the veracity of fingerprint identification evidence.¹⁸² In those cases, the courts indicate a belief that that the adversarial system will function to resolve and neutralize any post-NRC Report concerns about the reliability of fingerprint evidence.¹⁸³ In light of these findings, lawyers should shape challenges to the veracity of forensic science evidence with a view to addressing judicial reliance on these finality interests. This idea is discussed in more detail in Part III, *infra*.

In both instances the courts are oversimplifying the tension that has resulted from, in particular, the progressive scientific thought contained in the 2009 NRC Report; boiling the uncertainty about forensic science created down to an issue that is to be resolved by the adversarial process. Again, this approach divorces science from its social context. This is because it overlooks the difficulties that the social actors involved in the adversarial model – in particular lawyers and jurors - have in handling scientific evidence accurately. More specifically, it overlooks the difficulties lawyers have in resourcing, making and understanding challenges to forensic evidence, the high impact scientific evidence has on jurors, and the difficulty they have in accurately evaluating scientific evidence.¹⁸⁴

Notably, judges can experience similar difficulties to jurors and lawyers, which can also be sidelined by the desire of the legal process to achieve rationality through the favouring of finality interests. This is demonstrated by the interpretation of newly discovered evidence rules when petitioners claim there has been a shift in scientific opinion in a forensic science discipline that qualifies as newly discovered evidence. To safeguard finality interests, newly discovered evidence rules employ high thresholds that typically involve "...some combination of showings that the new evidence could not have been discovered prior to trial with the exercise of

reasonable diligence; that the evidence is relevant and not cumulative or merely impeaching; and that the new evidence creates a sufficient probability of a different result at a new trial.”¹⁸⁵ When applying these rules, appellate courts largely avoid a detailed examination of the questions raised when a petitioner argues there has been a shift in scientific opinion with regards to the identification capabilities of a forensic science discipline; therefore avoiding the tension generated by scientific progress.¹⁸⁶

This avoidance is reflected beyond newly discovered evidence cases. Numerous courts considering admissibility related challenges to forensic science identification evidence, on the basis of the 2009 NRC Report, have also avoided an examination of the report’s contents. These courts have taken a reductionist approach by minimizing the report’s impact to single, generic issues. These issues are that the report did not conclude that there should be a wholesale exclusion of forensic science individualization evidence, and did not intend to answer the question whether forensic evidence in a particular case is admissible under applicable law.¹⁸⁷ This approach to rationality allows the courts to sideline the findings of the NRC Report with relative ease, and thus avoid the progressive thought it represents. This approach is unsurprising because there is “a natural judicial tendency to avoid any deep confrontations with science.”¹⁸⁸ Rather, courts prefer to prioritize legal process ideals over substantive accuracy, and these ideals may have “little or no application to science.”¹⁸⁹

Moreover, courts suffer from a number of institutional deficiencies (in addition to those suffered by lawyers and jurors) when it comes to accurately assessing progressive scientific thought. For example, returning to a consideration of newly discovered evidence rules, appellate courts are used to (and therefore generally good at) assessing legal error, as opposed to factual error. Newly discovered evidence rules, however, are primarily “fact based”¹⁹⁰ and require a factual assessment of the qualification, timing, quality, relevance and impact of ‘new’ facts. Consequently, they require courts to step outside of their comfort zone, particularly in the context of assessments relating to progressing science. Additionally, the fact-based assessments associated with newly discovered evidence claims can be onerous and ill-suited for comity and efficiency based institutional agendas, and, indeed, the expertise of judges. Newly discovered evidence rules typically require at least five factual assessments: Is the evidence a new fact? Was the new fact discoverable before trial? Did the petitioner exercise reasonable diligence in discovering and presenting the new fact? Is the new fact relevant and probative? And, does the new fact have verdict changing capacity?¹⁹¹

These sorts of questions are also “non-binary” in nature¹⁹² and courts are poorly situated to resolve them.¹⁹³ This is because “When a court is asked to resolve a question science itself has not resolved, it is simply unequipped to do so because legal values--and more particularly, the judicial process--do not employ the scientific method.”¹⁹⁴ Consider the following example:

Patrick is charged with murder in 1990. At his trial in 1991, the prosecution alleges Patrick set fire to a liquor store, killing three people inside. A state fire analyst testifies that the crime scene presented numerous “hallmarks of arson”, including brown stains on the floors and spider-webbed glass. As a consequence, the analyst testified that this was “definitely” an arson fire, i.e., a fire started by an accelerant.

The analyst testified that he followed guidelines produced by the National Fire Protection Agency (NFPA) when undertaking his investigation.¹⁹⁵ The record shows that the defense lawyer cross-examined him about his conformity with these deadlines, including the analyst's rejection of alternative, non-arson causes. The state also presents evidence that, when stopped for jay walking near to the liquor store, Patrick was found in possession of an accelerant in his trouser pocket. Patrick claimed the accelerant was for use on his home BBQ. In 2016, the State Justice Project (on behalf of Patrick) files a newly discovered evidence claim based on an allegedly "new" fact, namely that the hallmarks of arson have been discredited. In other words, they claim there has been a shift in scientific opinion that undermines Patrick's conviction. In fact, the project alleges the new evidence – in the form of an expert affidavit – proves there was no arson at all, and the fire was an accident. The project's interest in Patrick's case was triggered in 2009 by the NRC Report, which found that conclusions by fire investigators that a particular fire was arson, on the basis of rules of thumb, are not well founded.¹⁹⁶ Judge Schofield assesses Patrick's claim in appellate court.

Presented with the type of non-binary questions detailed above, Judge Schofield will likely struggle to address certain issues accurately. This is partly because some of the questions relate to scientific uncertainty. For instance, whether the criticism of arson indicators qualifies as new and was not discoverable before trial, requires an exploration of when the hallmarks were first criticised, and whether a unacceptable level of scientific uncertainty remains in the field. The answer to the first question may be linked to the year 1990 when the Lime Street Fire Experiment was conducted. In short, the Lime Street Fire Experiment demonstrated that so-called "arson hallmarks" could also present at a fire scene, absent the use of an accelerant.¹⁹⁷ The 2009 NRC Report lent support to the experiment's findings in 2009.¹⁹⁸ This experiment highlighted what is now a fundamental issue in arson investigations, namely that experts cannot, with certainty, determine that a fire was arson on the basis of the "hallmarks" alone, as they can be present in both accidental and incendiary fires. Moreover, such signs cannot alone prove conclusive of intent.

In addition, given Patrick was tried in 1991, evidence of the Lime Street Fire Experiment was arguably discoverable before trial. However, given Patrick's trial was so soon after the experiment, it is questionable whether the findings of the experiment were available to Patrick's lawyer and of sufficient weight to challenge the prosecution's case at that time.

As such, to make an accurate assessment of whether Patrick has brought a "new" fact to the court, which was not discoverable before his trial, the judge must engage in the near impossible task of resolving the remaining scientific uncertainty himself. The judge's task would be much easier if he was required to accurately determine binary questions, such as: has there been criticism of the hallmarks of arson? Or is there evidence that non-arson fires present evidence such as spider-web glass and brown stains? Faced with these binary questions, the judge could no doubt make an accurate determination without great difficulty. However, this is not the case.

There are also issues in relation to diligence. Over two decades have passed since the Lime Street Fire Experiment was conducted, and it has been seven years since the publication of the 2009 NRC Report. As such, Patrick will likely struggle to show

diligence in making the claim too. In addition, the fact that the state's expert at trial testified that he followed the NFPA guidelines, and defense counsel cross-examined the expert closely with regards to alternative causes, it will likely be difficult for Patrick to demonstrate that the "new" criticism has verdict changing capacity. This is because it is rational for an appellate judge to consider that alternative causes were considered and rejected by the jury at first instance, and therefore a retrial of those causes would be fruitless. In addition, given hallmarks of arson continue to be used as conclusive indicators of arson, scientific uncertainty remains in the discipline. There remains a lack of certainty about when investigators can associate certain signs at fire scenes with arson, and, indeed, when those signs are indicative of intent.

The law's desire to generate rationality through reductionist approaches, therefore, overlooks the social context of the criminal justice process and, in particular, the difficulties social actors in that process have in engaging with scientific evidence. The law's concern for social order "overrides what science deems to be the facts of the matter."¹⁹⁹ Ultimately, this approach sidelines substantive accuracy, supporting Midgley's point that, "errors in fact spring from an unduly narrow, monopolistic concept of rationality."²⁰⁰

Part III: Recommendations for Reform

The law must improve its approach towards integrating the fruits of scientific progress, in the context of the forensic science disciplines explored, into its procedures for determining and reviewing criminal liability. It must do this in order to improve its ability to generate substantively accurate results. There are – as set out below - a number of ideas by which this might be achieved.

Open-mindedness to Change and Multi-Stakeholder Collaboration

The starting point for meaningful change is for stakeholders in the criminal justice system to meaningfully and uniformly admit that there are deficiencies in current practices related to forensic science. As Midgley suggests, when it comes to making meaningful change and eradicating error, particularly in relation to ideas that are deep in our psyche, (or, indeed for law, entrenched in decades of precedent, robust procedural rules and social ordering polices), we must admit error and initiate change "aloud."²⁰¹

Ultimately, judges, lawyers, law enforcement, forensic scientists, policy-makers and law-makers, must engage a revised philosophy about the system's handling of scientific progress. To change the wider reality, all of these stakeholders must work together to improve the criminal justice system's use of forensic science. They must accept some basic yet fundamental ideas. This includes the notions that scientific progress is inevitable; individualization claims by numerous forensic science disciplines are not scientifically valid; social actors in the criminal justice process often struggle to accurately assess scientific evidence; and rational procedures can produce substantively erroneous results. Moreover, they must accept that all of these current ideas are subject to revision. Further research might eventually prove them wrong.

One way to encourage stakeholders to accept these ideas is to create forums where they can be discussed openly and collectively. The creation of formal forums (perhaps labelled forensic science commissions), which allow cross-collaboration between judges, lawyers, law enforcement, forensic scientists, policy-makers and law-makers, could help improve cultural boundaries between stakeholders who have diverging interests.²⁰² Innocence Commissions provide a good example of how such an approach can be successful. Innocence Commissions generally aim to combat wrongful conviction by bringing together representatives from across a state's criminal justice system. The rationale for requiring such varied membership is so when problems are discussed and reforms proposed, the differing viewpoints of the stakeholders are taken into account. This, in turn, injects legitimacy into the workings and products of the commission.²⁰³ It is not easy to get usually autonomous actors to engage in coordinated and uniform change, given how sceptical they might be about each other's agendas. However, it has been shown such scepticism can be a key ingredient to ensuring success. Scepticism often leads to stakeholders not wanting to be isolated from discussions and decisions, and therefore more amenable to developing long-term, open dialogues.²⁰⁴ These sorts of forums offer a 'safe' environment for stakeholders to deliver candid opinions and listen to different perspectives. They provide a platform for understanding and compromise.

The creation of state-focused forensic science commissions that have a diverse membership would provide stakeholders with this opportunity. Basing these commissions within states would also allow for the idiosyncrasies of each state's laws, resources, procedures and practices to be taken into consideration. The work of these commissions could also inform national efforts to improve forensic science practices, such as the work of the National Commission on Forensic Science,²⁰⁵ and provide a mechanism for supporting nationally recommended or prescribed policies.

In addition, it is known that multi-agency concern about, and challenge to, the reliability of forensic science can instigate change that is aimed at ensuring the legal process remedies substantive error. The system's experience with CBLA evidence, as discussed earlier, is example of this. A more recent example is the FBI's ongoing review of several thousand cases involving microscopic hair analysis.²⁰⁶ This review was instigated by concerns from across the criminal justice system about the reliability of this forensic discipline, and is part of a collaboration between the FBI, The Innocence Project, the National Association of Defense Lawyers and the U.S. Department of Justice.²⁰⁷

Increased Training for Relevant Institutions and Social Actors

The idea that non-scientists involved in the legal process would benefit from increased training in the methods, analysis and interpretation of scientific evidence is not new. Two ideas lie at the heart of this urgent need. First is the law's heavy reliance on forensic science evidence and, second, is the fact that social actors in the legal process (especially lawyers, judges and jurors) struggle to engage accurately with scientific evidence.²⁰⁸

Despite this, efforts to implement mechanisms for providing training for these social actors remain limited. There "is no uniform curriculum, standardized training model, or set of training material on a national level that can be easily accessed."²⁰⁹ To help resolve this issue, the National Commission on Forensic Science's sub-committee

on Science and Law Training has recommended (in the format of a draft Directive Recommendation) the implementation of such a curriculum.²¹⁰

It is recommended by the sub-committee that the curriculum include the following topics: the law governing expert opinion and scientific and technical evidence; probabilities and statistics; an articulation of the strengths and limitations of forensic evidence, including forensic medicine; issues concerning quality assurance, and forensic science service providers and forensic medicine service provider management, accreditation, and certification; issues related to human factors; and specific forensic and social science disciplines likely to come before the courts.²¹¹ The sub-committee suggests that the curriculum be developed by organizations that are independent of the Department of Justice,²¹² and makes use of expertise from “both outside of and within forensic disciplines as appropriate.”²¹³ The sub-committee wants the curriculum to be completed within 1 year (i.e., in 2016),²¹⁴ and intends that its initial focus be judges and lawyers.²¹⁵

The development and implementation of such a curriculum is a step in the right direction. It is a long time coming, given the NRC Report gave an initial such recommendation in 2009,²¹⁶ and the National Commission of Forensic Science was established in 2013. However, in light of the issues explored in this article, the author would urge the following:

1. The development and implementation of the curriculum should be delivered as soon as is practically possible. The lack of expertise amongst social actors in the criminal justice process is a continuing issue that impacts the accurate adjudication of guilt. The sub-committee should make every effort to comply with its relatively strict deadline.
2. The curriculum should include material about how scientific evidence is investigated. It should also take into consideration the work of the sub-committee on Reporting and Testimony, which is recommending that both the scientific and legal communities identify appropriate language, which may be used by experts to express conclusions and opinions to the trier of fact, based on observations of evidence and data derived from evidence.²¹⁷
3. The sub-committee should make use of a wide range of expertise to build the curriculum. This is in order to ensure all relevant stakeholders’ needs are catered for and to inject legitimacy into its final product. The sub-committee should include members from the academic community who can offer advice on how best to convey complex material successfully in classrooms.
4. The needs of law enforcement should be considered from the beginning, whether that be as a main consumer of the curriculum above, or a specially designed curriculum. Law enforcement should not be side-notes in this endeavour because they represent the front-end of the criminal justice system. It should follow that the better equipped law enforcement are to assess the validity and reliability of scientific evidence during investigations, the less likely prosecutions based on erroneous science will go ahead.
5. The needs of jurors should also not be sidelined. Jurors play a pivotal role in assessing the reliability and weight of scientific evidence. Moreover, as

discussed earlier, appellate courts routinely defer to jury assessments about such evidence. Thought needs to be given to how jurors can be supported to accurately undertake this role. Given that jurors are not criminal justice professionals, they will likely need bespoke training programmes that suit their temporary (yet fundamental) role.

6. The sub-committee on Science and Law Training has not addressed questions about how the development and implementation of the curriculum will be resourced.²¹⁸ This issue needs to be addressed from the start. This is because, given the budgetary constraints of the criminal justice system, the lack of a long-term resource plan (that governments and providers are committed to) inevitably leads to initiatives failing.

Focused Lawyering Strategies

This article has included case law examples concerning both admissibility challenges to forensic science identification evidence, and newly discovered evidence claims that argue that criticism of certain forensic science methodologies is a new fact warranting relief. These examples suggest that lawyers should be approaching these types of claims in a particular way.

With regards to admissibility claims, case law demonstrates that appellate courts routinely reject challenges to the veracity of forensic science evidence. The author has previously identified that courts often do this on the basis that counsel had the opportunity to weed out frailties in the evidence at trial, and any such admission was not prejudicial to the petitioner, as, in the view of the court, the evidence would not have had a significant impact on the jury. With these judicial approaches in mind, lawyers should focus their claims. For instance, it is clear that appeals arguing for a blanket ruling of inadmissibility are very likely to fail.²¹⁹ Rather, lawyers need to counter judicial reliance on the above finality interests. They can do this by underpinning appeals with (1) full reference to the efforts of trial counsel to challenge the expert evidence at trial, demonstrating where counsel omitted to make potent challenges; and (2) information about how persuasive jurors find such expert evidence. This requires lawyers to keep up to date with relevant literature, and public defender offices would be well-served to build depositories for such information. Also, given current concern about the lack of meaning and impact encompassed in such terminology, lawyers should also be cautious about requesting courts to curtail expert language in line with cases such as **Green, Monteiro, Diaz, Glynn and Taylor**. Lawyers should monitor both research that seeks to better understand the impact of allegedly diluted phrases, and that which seeks to offer solutions for presenting more appropriate expert terminology to jurors in this context.

With regards to newly discovered evidence claims, an examination of the case law suggests that lawyers should consider three approaches. First, they should explore and present any multi-agency efforts to either acknowledge or initiate a shift in thought about the relevant forensic science evidence. This is because the courts handling of such claims about CBLA evidence show they are persuaded by multi-agency efforts. Second, lawyers should challenge the significance of any earlier research studies critiquing the forensic science discipline they are challenging, which are cited in the NRC Report. This is because courts used these citations to reject the idea that the criticism is new. Third, lawyers should address how the NRC Report's

findings are relevant to the case at hand. This is because courts are quick to reject the relevance of the report to specific cases.

Harnessing the Institutional Strength of the Courts

The courts must acknowledge their unique position to engender change, as it is their constitutional role to review the law.²²⁰ As such, courts should harness their existing institutional strengths for handling scientific evidence accurately.

This might include embracing the law's naturally adaptive qualities that allow it to change according to progressing social, political and economic landscapes,²²¹ and shape the law to be in line with progressing science. To do this, courts need to be more critical of forensic science. For instance, judges need to interrogate the usefulness of precedent more closely, and not allow the passage of time to dictate scientific validity and reliability. Judges must also accept that science has a general application. Rejecting criticism like that contained in the NRC Report, on the basis it does not have application to a specific case and/or legal issue, lacks sense. In fact, it demands the impossible.

It might also include employing more practical mechanisms. For example, judges can use procedures to narrow disputed scientific issues; conduct hearings where the court can examine potential experts; and appoint independent experts, special masters, and specially trained law clerks.²²² Courts also have a convening power,²²³ namely the ability to bring together the various actors needed to craft effective solutions to multi-dimensional problems, like, for example, progressing science. Courts should demand that lawyers and experts, for both the prosecution and defense, collaborate (to the extent most possible) to ensure scientific evidence is explained accurately and clearly to juries. Courts need to do what they can to neutralize the polarization of science naturally caused by the adversarial system.

None of these recommendations in isolation will remedy the current situation. Stakeholders in the criminal justice system need to confront current deficiencies in forensic science from multiple angles, and in a collaborative way.

Part IV: Conclusions

The case law examined in this article demonstrates that there is significant tension at the intersection of law and science in the context of forensic science identification evidence. This tension has been generated by the discovery of DNA analysis and material criticism of forensic science methodologies. These forms of scientific progress have undermined convictions produced by the law's rational procedures for identifying the perpetrators of crimes around the world. The American criminal justice system's response to this uncertainty, however, provides a particularly compelling example of the institutional tensions between law and science.

This article has provided an independent critique of relevant American case law, and demonstrated how three themes emerge from the jurisprudence. These themes are (1) the law's misuse of science; (2) law's scepticism towards change; and (3) law's

narrow construction of rationality, which generates reductionist concepts, and divorces science from its social context. As such, this article has demonstrated how current judicial approaches to forensic science evidence provide a contemporary illustration of key institutional tensions between law and science. To help resolve these tensions, the author has suggested a number of reforms. These reforms are calling for the law to be more open-minded about change in the light of progressing science; the development of forensic science commissions that allow for multi-stakeholder collaboration to improve the use of forensic science in the criminal justice system; increased training for relevant social actors, including lawyers, judges, law enforcement and jurors; focused lawyering strategies that seek to counter judicial concerns about challenges to forensic science evidence; and a more proactive harnessing of the institutional strengths of the courts by judges, when it comes to making use of reliable scientific evidence. Collectively, these reforms aim to facilitate the criminal justice system to utilize the most scientifically valid and reliable forensic science evidence possible, and, thus, improve the efficacy of the outcomes it generates.

The growing number of exonerations in America makes the need for change all the more urgent.²²⁴ Error will never be eradicated from social enterprises like law or science, but “Pragmatism is preferable to helplessness.”²²⁵ The fact that “we can build law and science so well should inspire our determination to make them even better.”²²⁶ As such, the law must start to overcome the “imaginative difficulties” associated with being on the cusp of a paradigmatic shift,²²⁷ upon which, in the context of forensic science identification evidence, the criminal justice system is unquestionably standing.

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3 *Id.*

4 For instance, there is much debate about the reliability of the medical diagnosis for 'shaken baby syndrome.' See, for examples of this debate, Deborah Tuerkheimer, *The Next Innocence Project: Shaken Baby Syndrome and the Criminal Courts*, 87 Wash. U. L. Rev. 1 (2009), and Joelle Anne Moreno & Brian Holmgren, *The Supreme Court Screws Up The Science There Is No Abusive Head Trauma/Shaken Baby Syndrome "Scientific Controversy"*, 2013 Utah L. Rev. 1357 (2013).

5 For instance, the discovery of DNA technology contributed to discrediting preformationism theory. See *21st Century and a New Epigenesis*, Stanford Encyclopedia of Philosophy (Oct. 11, 2005), <http://plato.stanford.edu/entries/epigenesis/#8>. In addition, progressive psychology study has discredited the theory that autism is caused by so-called 'refrigerator mothers.' See *Refrigerator Mothers - A Discredited Cause of Autism*, Autism Help, <http://autism-help.org/points-refrigerator-mothers.htm> (last visited Mar. 20).

6 See generally The Comm. on Identifying the Needs of the Forensic Sci. Cmty., Nat'l Research Council of the Nat'l Acads., *Strengthening the Forensic Sciences in the United States: A Path Forward* (2009) [hereinafter NRC Report].

7 *Id.* at 187-88.

8 For example, studies have been undertaken with regards to firearms identification. See Thomas G. Fadul, Jr. et al., *An Empirical Study to Improve the Scientific Foundation of Forensic Firearm and Tool Mark Identification Utilizing Consecutively Manufactured Glock EBIS Barrels with the Same EBIS Pattern* (Dec. 2013), available at <https://www.ncjrs.gov/pdffiles1/nij/grants/244232.pdf>. There has also been further study into fingerprint identification techniques. See, e.g., Matthew B. Thompson, Jason M. Tangen & Duncan J. McCarthy, *Human Matching Performance of Genuine Crime Scene Latent Fingerprints*, 38 Law & Hum. Behav. 84, 85 (2014). Also consider the initial work of the National Commission of Forensic Sciences' sub-committee on scientific enquiry and research, detailed at: *Scientific Enquiry and Research*, US Dep't Just. (Mar. 10, 2016), <http://www.justice.gov/ncfs/scientific-inquiry-and-research>.

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10 Jeffrey Toobin, *The CSI Effect: The Truth about Forensic Science*, *The New Yorker*, May 7, 2007, at 30-35. (Quoting Professor Michael J. Saks).

11 For an overview of the techniques used in these disciplines see generally the NRC Report, *supra* note 6, at 127-83.

12 See generally Sarah Lucy Cooper, *The Collision of Law and Science: American Court Responses to Developments in Forensic Science*, 33 Pace L. Rev. 234 (2013).

13 Michael J. Saks, *Merlin and Solomon: Lessons from the Law's Encounters with Forensic Identification Science*, 49 Hastings L.J. 1069, 1081-82 (1998).

14 See generally NRC Report, *supra* note 6. Consequently, some scholars consider the individualization claims made by examiners in relevant disciplines to be fallacies, and refer to such practices as "faith based science." See Toobin, *supra* note 10 (Quoting Professor Michael J. Saks).

15 For examples of the variety of evidence admitted in America see generally Cooper, *supra* note 12.

16 Donald E. Shelton, Young S. Kim & Gregg Barak, *A Study of Juror Expectations and Demands Concerning Scientific Evidence: Does the "CSI Effect" Exist?*, 9 Vand. J. Ent. & Tech. L. 331, 333 (2006).

17 See generally Cooper *supra* note 12.

18 NRC Report, *supra* note 6, at 87.

19 *Id.* at 7.

20 *Id.* at 42.

21 See *The Causes of Wrongful Conviction*, Innocence Project, <http://www.innocenceproject.org/causes-wrongful-conviction> (last visited Jan. 29, 2016).

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23 NRC Report, *supra* note 6, at xix.

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25 Melendez-Diaz v. Massachusetts, 557 U.S. 305, 319 (2009).

26 David L. Faigman, *Legal Alchemy: The Use and Misuse of Science in the Law* 56 (1999).

27 Deborah M. Hussey Freeland, *Speaking Science to Law*, 25 *Geo. Int'l Envtl. L. Rev.* 289, 295-96 (2013).

28 *Id.* at 296.

29 *Id.*

30 *Id.* at 303.

31 *Id.*

32 *Id.* at 323.

33 Sheila Jasanoff, *Just Evidence: The Limits of Science in the Legal Process*, 34 *J.L. Med. & Ethics* 328, 330 (2006).

34 D. Michael Risinger, *The Irrelevance, And Central Relevance, Of The Boundary Between Science And Non-Science In The Evaluation Of Expert Witness Reliability*, 52 *Vill. L. Rev.* 679, 711-12 (2007).

35 *Id.*

36 Jasanoff, *supra* note 33, at 330.

37 *Id.*

38 *Id.*

39 *Id.*

40 Freeland, *supra* note 27, at 293-94.

41 *Id.* at 301.

42 Emily Hammond Meazell, *Scientific Avoidance: Toward More Principled Judicial Review of Legislative Science*, 84 *Ind. L.J.* 239, 255 (2009).

43 Faigman, *supra* note 26, at 54.

44 *Id.* at 65.

45 Val McDermid, *Forensics: The Anatomy of Crime* 276-80 (2015).

46 Freeland, *supra* note 27, at 290.

47 Jasanoff, *supra* note 33, at 329.

48 *Id.*

49 Peter Fitzpatrick, *The Mythology of Modern Law* 167 (1992).

50 *Id.*

51 Jasanoff, *supra* note 33, at 329.

52 *Id.* at 328.

53 *Id.*

54 *Id.*

55 *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993). In that case, the Supreme Court created a flexible, factor-based approach to analysing the reliability of expert testimony. These factors include: (1) whether a method can or has been tested; (2) the known or potential rate of error; (3) whether the methods have been subjected to peer review; (4) whether there are standards controlling the technique's operation; and (5) the general acceptance of the method within the relevant community. *Id.* at 593-94.

56 *Brooks v. State*, 748 So. 2d 736 (Miss. 1999).

57 *Stubbs v. State*, 845 So. 2d 656 (Miss. 2003).

58 *Brooks*, 748 So. 2d at 740.

59 *Id.*

60 *Id.* at 739. Note that Justices Banks, Waller and Sullivan did not agree with this approach in their concurring judgment. *Id.* at 747 (Banks, J., concurring). Justice McRae did not agree with this approach in his dissenting judgment. *Id.* at 748 (McRae, J., dissenting).

61 *Id.* at 740.

62 *Id.* at 739 (quoting *Howard v. State*, 701 So. 2d 274, 288 (Miss. 1997)).

63 *Id.* at 747-48 (McRae, J., dissenting).

64 *Id.* at 748.

65 *Id.*

66 *Id.* at 749.

67 *Id.* at 749-50.

68 *Id.* at 750.

69 *Stubbs*, 845 So. 2d at 662.

70 *Id.* at 669. In 2006, the same court followed suit in *Howard v. State*, 945 So. 2d 326 (Miss. 2007) when reaffirming Eddie Howard's death sentence. In that case, West had testified that to a

“reasonable degree of certainty Howard's teeth matched a bite-mark on the victim. The court found Howard's claims were procedurally barred and without merit.

71 *Levon Brooks Exonerated in Mississippi, Forensic Reforms Underway*, Innocence Project (Mar. 13, 2008),

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73 Freeland, *supra* note 27, at 309.

74 Although it should certainly be noted that the implementation and following of “standardized procedures” in forensic science identification methods does not automatically produce scientifically valid or reliable results. The NRC Report made this very conclusion in relation to the ACE-V procedure used by fingerprint examiners. (“...merely following the steps of ACE-V does not imply that one is proceeding in a scientific manner or producing reliable results.”) NRC Report, *supra* note 6, at 142. The NRC Report made a similar conclusion in relation to the AFTE protocol associated with tool-mark examination. (“This AFTE document, which is the best guidance available for the field of toolmark identification, does not even consider, let alone address, questions regarding variability, reliability, repeatability, or the number of correlations needed to achieve a given degree of confidence.”) NRC Report, *supra* note 6, at 155.

75 Jennifer E. Laurin, *Criminal Law's Science Law: How Criminal Justice Meets Changed Scientific Understanding*, 93 Tex. L. Rev. 1751, 1765 (2015).

76 Fitzpatrick, *supra* note 49, at 162.

77 *Id.*

78 *Id.* at 168.

79 *United States v. Hicks*, 389 F.3d 514 (5th Cir. 2004).

80 *United States v. Mitchell*, 365 F.3d 215 (3d Cir. 2004).

81 *United States v. Baines*, 573 F.3d 979 (10th Cir. 2009).

82 *Hicks*, 389 F.3d at 526.

83 *Mitchell*, 365 F.3d at 241; *Baines*, 573 F.3d at 991.

84 NRC Report, *supra* note 6, at 143.

85 *Id.* at 144.

86 *Id.* at 155.

87 *Id.* at 154.

88 Jasanoff, *supra* note 33, at 334.

89 *United States v. Crisp*, 324 F.3d 261 (4th Cir. 2003).

90 *Id.* at 269-70.

91 *United States v. Aman*, 748 F. Supp. 2d 531 (E.D. Va. 2010).

92 *Id.* at 541.

93 *Id.*

94 *Id.* at 540.

95 *Crisp*, 324 F.3d at 269-70; *Aman*, 748 F. Supp. 2d at 540.

96 Jasanoff, *supra* note 33, at 333.

97 *Id.*

98 See generally Sarah Lucy Cooper, *Judicial Responses to Shifting Scientific Opinion in Forensic Identification Evidence and Newly Discovered Evidence Claims in the United States: The Influence of Finality and Legal Process Theory*, 4 Brit. J. Am. Legal Stud. 649 (2015).

99 Cole & Edmond, *supra* note 1, at 595.

100 Cooper, *supra* note 98, at 666.

101 *Johnston v. State*, 27 So.3d 11 (2010).

102 *Enderle v Iowa*, 847 N.W.2d 235 (Table), 2014 WL 956018 (Iowa App.).

103 *Pennsylvania v Edmiston*, 619 Pa. 549, 65 A.3d 339 (2013).

104 Cooper, *supra* note 98, at 666.

105 Jasanoff, *supra* note 33, at 333.

106 Fitzpatrick, *supra* note 49, at 164.

107 *Id.*

108 *Id.*

109 Mary Midgley, *The Myths We Live By* 30 (2004).

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- 112 Brooks v. State, 748 So. 2d 736 (Miss. 1999).
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- 116 *Id.*
- 117 United States v. Mitchell, 365 F.3d 215, 238 (3d Cir. 2004).
- 118 Freeland, *supra* note 27, at 323.
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- 122 See generally Paul C. Giannelli, *Forensic Science: Polygraph Evidence: Part II*, 30 Crim. L. Bull. 366 (1994).
- 123 Jennifer L. Skeem, Kevin S. Douglas & Scott O. Lilienfeld, *Psychological Science in the Courtroom: Consensus and Controversy* 80 (2009).
- 124 See Cavazos v. Smith, 132 S. Ct. 2, 10 (2011) (per curiam) (Ginsburg, J., dissenting); State v. Edmunds, 746 N.W.2d 590 (Wis. Ct. App. 2008) (in this case the appellant was granted a new trial on the basis she presented newly discovered evidence in the form of advances in medical science relating to the diagnosis of 'Shaken Baby Syndrome.').
- 125 Freeland, *supra* note 27, at 323.
- 126 United States v. Llera Plaza (*Llera Plaza I*), 2002 WL 27305 (E.D. Pa. Jan. 7, 2002).
- 127 *Id.*
- 128 Tamara F. Lawson, *Can Fingerprints Lie?: Re-Weighing Fingerprint Evidence in Criminal Jury Trials*, 31 Am. J. Crim. L. 1, 34-5 (2003).
- 129 United States v. Llera Plaza (*Llera Plaza II*), 188 F. Supp. 2d 549 (E.D. Pa. 2002) at 572. (vacating and superseding the prior decision upon reconsideration).
- 130 Midgley, *supra* note 109, at 6.
- 131 See generally Cooper, *supra* note, 12.
- 132 Midgley, *supra* note 109, at 6.
- 133 *Id.*
- 134 Kulbicki v. State of Maryland, 53 A.3d 361, 377 (Md. Ct. Spec. App. 2012), *rev'd*, 99 A.3d 730 (Md. 2014).
- 135 Cooper, *supra* note 98, at 666-68.
- 136 See generally Cooper, *supra* note 98.
- 137 Laurin, *supra* note 75, at 1777-78.
- 138 Nat'l Research Council Of The Nat'l Academies, Report In Brief, *Forensic Analysis: Weighing Bullet Lead Evidence*, 1 (2004).
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- 140 United States v. Green, 405 F. Supp. 2d 104 (D. Mass. 2005).
- 141 *Id.* at 108-109.
- 142 *Id.*
- 143 United States v. Monteiro, 407 F. Supp. 2d 351 (D. Mass. 2006).
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- 145 United States v. Diaz, No. 05-cr-00167 (WHA), 2007 WL 485967 (N.D. Cal. Feb. 12, 2007).
- 146 *Id.* at *1.147 United States v. Glynn, 578 F. Supp. 2d 567 (S.D.N.Y. 2008).
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- 149 *Id.* at 568-69.
- 150 United States v. Taylor, 663 F. Supp. 2d 1170 (D.N.M. 2009).
- 151 *Id.* at 1180.
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- 153 See, e.g., Brooks v. State, 748 So. 2d 736 (Miss. 1999).
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- 163 *Id.* at 332.
- 164 Thompson and Newman, *supra* note 161, at 346.
- 165 United States v. Gutierrez-Castro, 805 F. Supp. 2d 1218 (D.N.M. 2011).
- 166 *Id.* at 1228.
- 167 *Id.*
- 168 *Id* at 1220-21.
- 169 Simon A. Cole, *Grandfathering Evidence: Fingerprint Admissibility Rulings From Jennings to Llera Plaza and Back Again*, 41 Am. Crim. L. Rev. 1189 (2004) (general proposition that jurors are easily seduced).
- 170 Charles Illsley, *Juries, Fingerprints, and the Expert Fingerprint Witness, Address at the International Symposium on Latent Prints* (July 7-11, 1987) (finding ninety-three percent of jurors agree that fingerprint identification is a science; only two percent disagree), *available at* http://www.nlada.org/forensics/for_lib/Documents/1056493657.7/Illsey.pdf.
- 171 *See, e.g.*, the sub-committee's "Views Document" concerning the phrase "reasonable scientific certainty" *available at* <http://www.justice.gov/ncfs/file/795336/download>.
- 172 *Id.*
- 173 *Id.*
- 174 Paul M. Bator, *Finality in Criminal Law and Federal Habeas Corpus for State Prisoners*, 76 Harv. L. Rev. 441 (1963).
- 175 Sigmund G. Popko, *Putting Finality in Perspective: Collateral Review of Criminal Judgments in the DNA Era*, 1 L.J. Soc. Just. 75, 76 (2011).
- 176 So much so it has been referred to as "Bator's Process View."
- 177 Bator, *supra* note 174, at 448.
- 178 Gabriel A. Carrera, *Section 1983 & the Age of Innocence: The Supreme Court Carves a Procedural Loophole for Post-Conviction Dna Testing in Skinner v. Switzer*, 61 Am. U. L. Rev. 431, 440 (2011).
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- 183 *Id.*
- 184 *See generally* Cooper, *supra* notes 180 and 182.
- 185 Keith Findley, *Defining Innocence*, 74 Alb. L. Rev. 1157, 1161 (2011).
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187 See, e.g., *Commonwealth v. Gambora*, 933 N.E.2d 50, 58-60 (Mass. 2010). 272; *United States v. Rose*, 672 F. Supp. 2d 723, 726 (D. Md. 2009).

188 Emily Hammond Meazell, *Super Deference, The Science Obsession, and Judicial Review as Translation of Agency Science*, 109 Mich. L. Rev. 733, 734 (2011).

189 Fitzpatrick, *supra* note 49, at 165 (referencing Nelken 1989:21).

190 Daniel S. Medwed, *Up The River Without A Procedure: Innocent Prisoners And Newly Discovered Non-Dna Evidence In State Courts*, 47 Ariz. L. Rev. 655, 664 (2005).

191 I have generated these questions using Findley's generic formula for newly discovered evidence rules.

192 Meazell, *supra* note 42, at 256.

193 *Id.*

194 *Id.*

195 The guidelines are known as the NFPA 921. NFPA 921 is a three-hundred-page manual originally published in 1992 and updated periodically thereafter. NFPA 921 was developed by the Technical Committee on Fire Investigations, which includes dozens of fire investigators from local, state, and national agencies. As the list of committee members suggests, and as confirmed by Robbins's own testimony, NFPA 921 has been peer-reviewed and is generally accepted in the community of fire investigators. The NFPA 921 has been widely disseminated in the field of fire investigation. *United States v. Aman*, 748 F. Supp. 2d 531, 535 (E.D. Va. 2010). The NFPA 921 guide details how fire patterns, burn damage, and other evidence can be used to explain the cause and origin of a fire, but it also requires investigators to exclude nine non-arson causes for certain fires before reaching a conclusion that the fire was incendiary.

196 NRC Report, *supra* note 6, at 173.

197 John. J. Lentini, *The Lime Street Fire: Another Perspective*, 1 (1992), available at <http://www.firescientist.com/Documents/TheLimeStreetFire-AnotherPerspective.pdf>.

198 NRC Report, *supra* note 6, at 172-73.

199 Jasanoff, *supra* note 33, at 334.

200 Midgley, *supra* note 109, at 32-33.

201 Midgley, *supra* 109, at 250-51.

202 The overcoming of cultural boundaries, particularly between lawyers and scientists is of particular importance. See Freeland, *supra* note 27, at 332-33.

203 See generally Sarah Lucy Cooper, *Innocence Commissions in America: Ten Years After in Controversies in Innocence Cases in America* 197 (Sarah Lucy Cooper ed., 2014).

204 *Id.* at 214-15.

205 The National Commission on Forensic Science was established in 2013. In partnership with the National Institute of Standards and Technology, the Commission is charged with enhancing the practice of forensic science and improving its reliability. See *National Commission on Forensic Science*, US Dep't Just., <http://www.justice.gov/ncfs> (last visited Mar. 20, 2016).

206 See *Innocence Project and NACDL Announce Historic Partnership with the FBI and Department of Justice on Microscopic Hair Analysis Cases*, Innocence Project (July 18, 2013, 12:00 PM), <http://www.innocenceproject.org/news-events-exonerations/pressreleases/innocence-project-and-nacdl-announce-historic-partnership-with-the-fbi-anddepartment-of-justice-on-microscopic-hair-analysis-cases>.

207 *Id.*

208 See National Commission on Forensic Science, *Forensic Science Curriculum Development*, available at <http://www.justice.gov/ncfs/file/795351/download>.

209 *Id.*

210 *Id.* The curriculum aims to address both forensic science and legal issues as they will be presented in court—highlighting the discipline and its limits and reasonably and neutrally presenting arguments that would support or challenge that evidence.

211 *Id.*

212 *Id.* Notably a public response asked this position to be reconsidered, but the sub-committee rejected it.

213 *Id.*

214 *Id.*

215 *Id.*

216 NRC Report, *supra* note 6, at 28.

217 See generally *Reporting and Testimony*, US Dep't Just., <http://www.justice.gov/ncfs/reporting-and-testimony> (last visited Mar. 20, 2016).

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- 218 See National Commission on Forensic Science Subcommittee on Training on Science and Law, *Adjudication of Public Comments on Draft Document*, available at <https://www.justice.gov/ncfs/file/795356/download>.
- 219 See generally Cooper, *supra* note 12.
- 220 Mezell, *supra* note 42, at 283.
- 221 Freeland, *supra* note 27, at 323.
- 222 Gen. Elec. Co. v. Joiner, 522 U.S. 136, 149-50 (1997) (Breyer, J., concurring).
- 223 Michael C. Dorf, *Legal Indeterminacy and Institutional Design*, 78 N.Y.U. L. Rev. 875, 945 (2003).
- 224 *Browse the National Registry of Exonerations*, The Nat'l Registry Of Exonerations, <http://www.law.umich.edu/special/exoneration/Pages/browse.aspx> (last visited Nov. 25, 2015).
- 225 Freeland, *supra* note 27, at 340.
- 226 *Id.*
- 227 Midgley, *supra* note 109, at 184.