

JUDICIAL GATEKEEPING OF SCIENTIFIC EVIDENCE AND EXPERTS IN CRIMINAL ADJUDICATIONS

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The Daubert trilogy stipulates a general criterion for the scrutiny of scientific evidence and has also been referred to by experts in many US Courts and other jurisdictions, including India. Yet, a similarly precedential judgement or explicit regulation is starkly missing from the Indian jurisprudence and related laws of evidence. Using some judicial decisions from various Indian courts, this paper analyses the discerning process by which Indian judges arrive at conclusions concerning the material elements of the case, specifically with regards to scientific evidence and opinion. With the help of certain judgments, the paper illustrates that in the absence of legal guidance, the approach adopted by judges to assess probative worth of scientific evidence is not scientifically correct. Although there are instances where Indian courts have credibly entertained science and scientific opinion in the courtrooms, assessment of the reliability of expert opinions is not uniform, and thus, found highly wanting in the present legal landscape. The paper makes a case for the judiciary to bear more responsibility than the adversarial parties in their gatekeeping function. While the main aim is to petition for developing guidelines to improve judicial approach to admissibility jurisprudence, this paper also highlights the challenges and limitations within which such reforms must be constituted.

Keywords: *Daubert Standards, Expert Opinion, Scientific Evidence, Judicial Gatekeeping, Admissibility Standards, Forensic Evidence.*

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I. INTRODUCTION

The role of science and law within the criminal justice system is vastly different. Law functions within limitations of time - cases must be decided within a certain span of time, on the principles of finality and relying on the best available scientific knowledge.¹ Science, on the other hand, is constantly evolving with time; existing knowledge continues to be in a constant state of revision as advances in research challenge, or even overturn, former scientific knowledge. As such there can be conflicts when the legal culture attempts to assimilate the scientific culture in the courtroom. Law bestows upon scientific evidence an ideology of certainty and accuracy that may not always be met. As new research develops, it may discredit previously consolidated scientific beliefs, or new advances in methodology may improve on the accuracy of existing techniques, drawing attention to the fallacies of previous methods. For example, the identification of people using their dentition was heuristically established and considered a reliable method in forensic practice until research proved that such identification was not immune to subjectivity, and such examinations had variable accuracy rate.²

In the wake of the National Academy of Science (NAS) reports,³ the findings of the Innocence Project⁴ globally and the incorporation of several changed science statute provisions in the legislation of some countries, it is often seen that legal decisions can be rendered invalid on the grounds that past scientific ‘truths’ that were presented as evidence were disrupted by later scientific discoveries. Thus, the nature of scientific evidence demands that the rules of admissibility adopted by the courts are pragmatic; that they appropriately accommodate ‘established’ knowledge in answering the

¹ Simon A. Cole, “Changed Science Statutes: Can Courts Accommodate Accelerating Forensic Scientific and Technological Change” 57 *Jurimetrics* 443 (2017).

² Gorza, Ludovica, and Scheila Mânica, "Accuracy of dental identification of individuals with unrestored permanent teeth by visual comparison with radiographs of mixed dentition." 289 *Forensic science international* 337-343 (2018).

³ Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council, “Strengthening Forensic Science in the United States: A Path Forward” (National Academies Press, 2009).

⁴ The Innocence Project, founded in 1992 by Peter Neufeld and Barry Scheck at Cardozo School of Law, exonerates the wrongly convicted through DNA testing and reforms the criminal justice system to prevent future injustice, available at <https://innocenceproject.org> (last visited on Feb. 7, 2021).

questions of law while making allowances for re-evaluation when needed as the knowledge changes.

A. Legal Framework within which Forensic Evidence and Experts function in Criminal Adjudications

Since the last few decades, scientific evidence and expert witnesses have played a critical role in assisting the judiciary in determining culpability. As an increasingly integral part of criminal adjudication, forensic evidence provides assistance in both the investigation and trial of a case.⁵ Naturally, the two stages employ forensic sciences differently; the standards involved in trial are generally more stringent than those used during the investigation. That is the reason why, in some instances, Deception Detection Techniques (DDTs) have been allowed during investigation, leaving it to the discretion of the judge to decide its admissibility at trial.⁶

Laws governing the screening of scientific evidence in court are generally linked by three closely connected concepts, namely – relevance,⁷ admissibility⁸ and weightage. For a piece of evidence to be eligible for consideration in decision making, it must pass through the above-mentioned stages, in this order. After evidence is found to be relevant and admissible, the question of weightage arises.⁹ Admissibility in Indian proceedings is contingent on relevance (must prove or disprove an important fact of the case) and reliability (reliability of the source used as evidence).¹⁰ In terms of scientific evidence, the concept of admissibility can be interchangeable with permissibility, and includes primarily of factors that define non-admissibility and exclusion from the case file, for example, problems with chain of custody, poor storage or packaging of evidence etc.¹¹ Weightage refers to the persuasive value that an evidence has in the decision making process which is, in turn, dependent on multiple factors - the correctness of the

⁵ President's Council of Advisors on Science and Technology, "Report to the President Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods" (2016).

⁶ *State of Gujarat v. Inayat Ismail Vohra*, Gujarat High Court, 2015; *Jaga Arjan Dangar v. State of Gujarat*, MANU/GJ/0824/2018.

⁷ S. L. Phipson, J. H. Buzzard, *et.al.*, *Phipson on evidence* (Sweet & Maxwell, 1982).

⁸ J. Davies, "Admissibility of scientific evidence in courts" 24 *Med. & L.* 243 (2005).

⁹ R. Glover and P. Murphy, *Murphy on evidence* (Oxford University Press, 13th ed., 2013).

¹⁰ Anton Koshelev and Ekaterina Rusakova. "The problem of admissibility of evidence in Indian civil proceedings." *SHS Web of Conferences. EDP Sciences* 106 (2021).

¹¹ *Supra* note 3.

report, the reasons given in support of the conclusions,¹² exactness of the science, and expertise in the field.¹³ The judge determines weightage when considering the final rulings of a case in terms of how compelling the evidence is, and how far it goes in proving the matter under question.¹⁴

B. The NAS Report 2009: Expose' on Bad Forensics

In 2009, the National Research Council of the National Academy of Sciences, USA released a critical report, henceforth referred to as NAS Report,¹⁵ on the use of forensic science in criminal trials in USA, which, among other things, highlighted the lack of scientific method and scientific validation prevalent in some forensic disciplines. The report is said to have been epiphanic to the end-users of the scientific reports – primarily lawyers and judges - who were confronted with persuasive evidence that expert witnesses had been overstating the significance and certainty of the scientific analyses in the courtroom.

Its main criticism had been against fields like tool marks, bite marks, fibres and hair analysis etc., which involved professionals with very little training in science.¹⁶ Such techniques have unknown error rates and using them in determining criminal culpability is imprudent, especially when they are likely to have a huge influence on case findings.¹⁷ Moreover, their continued admittance in courts snowballed into creating precedents that strengthened their credibility in courtrooms despite lack of scientific rigour in these techniques. There were no questions whether these branches of forensic science met the core values of scientific culture – ‘empiricism, transparency and an ongoing critical perspective’.¹⁸ The reason stated in the NAS Report for the Courts’ failure to take note of shortcomings in forensic evidences are:

- rules that presently govern the admissibility of forensic evidence are lacking,
- rules governing review of admissibility decisions is lacking or missing,

¹² *Malay Kumar Ganguly v. Dr. Sukumar Mukherjee*, AIR 2010 SC 1162.

¹³ *Parappa v. Bhimappa*, MANU/KA/0059/2008.

¹⁴ A. L-T Choo, *Evidence* (Oxford University Press, 2nd ed., 2009).

¹⁵ *Supra* note 2.

¹⁶ D. M. Risinger, (2010), “The NAS/NRC report on forensic science: A path forward fraught with pitfalls” *Utah Law Review* 225 (2010).

¹⁷ *Supra* note 2 at 176.

¹⁸ J. L. Mnookin, “The Need for a Research Culture in the Forensic Sciences” 58 *UCLA Law Review* 725 (2011).

- shortcomings of adversarial processes, and
- the lack of competency to handle scientific matter among both judges and lawyers.

The NAS Report reiterates eleven times that ‘lawyers and judges often have insufficient training and background in scientific methodology, and they often fail to fully comprehend the approaches employed by different forensic science disciplines and the reliability of forensic science evidence’. The PCAST report found that there was need to attend to two important gaps– 1) clarity on the meaning of terms such as “reliable principles and methods” and “scientific validity” and, 2) evaluation of these methods.¹⁹ These specific concerns raised by the NAS Report (2009), PCAST Report (2016), Silverman (2011)²⁰ and others on research and development in forensic sciences are universal concerns that are heavily tied in with the legal systems of all national and international jurisdictions. Scientific knowledge, especially as it pertains to forensic examinations, unlike law, does not change as a consequence of geographical changes.²¹ Therefore, the concerns of the NAS Report are transposable to the Indian legal and forensic systems that derive from the same pool of scientific knowledge. The critique provided by the American, Canadian and Australian scholars referred to in this paper is crucial in informing on how to critically examine the limitations and deficiencies within Indian legislation and criminal adjudications in practice.

II. EVIDENTIARY STANDARDS IN INDIAN CRIMINAL ADJUDICATIONS

In this section, the evidentiary regime functioning within Indian jurisdiction is unpacked via existing legislation, case laws and case judgements. While the existing legislation enables the court to entertain scientific evidence and expert opinion, it can also be seen that the understanding of reliability and relevance of evidence is extremely broad and

¹⁹ *Supra* note 2.

²⁰ B. Silverman, “Research and Development in Forensic Science: A Review”, *Forensic Science Research and Development* (2011), available at: <https://www.forensicdentistryonline.org/wp-content/uploads/2011/07/forensic-science-review-report.pdf> (last visited on Feb. 05, 2021).

²¹ C. P. Rajendran, “A day to embody the true spirit of science”, *Hindu*, Feb. 28, 2022.

flexible among the judiciary, leading to non-uniform scrutiny of such evidence in their gatekeeping duties.

A. Legislative Guidelines

One of the primary legislations governing the evidentiary regime in India is the Indian Evidence Act, 1872²² (hereinafter referred to as IEA); Section 45 of which deals with relevancy of expert witnesses' opinions –

When the Court has to form an opinion upon a point of foreign law or of science or art, or as to identity of handwriting or finger impressions, the opinions upon that point of persons specially skilled in such foreign law, science or art, or in questions as to identity of handwriting or finger impressions are relevant facts. Such persons are called experts.

The list given above is not exhaustive but illustrative. In theory, as defined by the IEA, the standard of proof that is applied to the admission of scientific evidence and expert testimony is the same for both civil and criminal cases; however, in praxis, the degree of proof required might differ in civil and criminal trials.

Section 47 of the IEA states that the evidence pertaining to handwriting may be admissible from anyone who is not professionally trained, provided that they are acquainted with the handwriting in question. This implies that expertise is not necessarily guaranteed by academic qualifications, but also by acquisition of special skills which can come from informal training, experience, practice, observation etc.²³ Section 46 of the IEA extends upon the significance of expert opinion by stating that facts that are otherwise irrelevant, shall be considered relevant when found consistent with the opinion of experts. Section 51 of the IEA confirms that expert opinion is an exception to the rule against opinion evidence, but clarifies that such opinions do not go into evidence automatically without assessing reliability of the reasons on which such opinion is based, or examination of the expert.²⁴ Some statutory exceptions to this

²² Indian Evidence Act, 1872 (Act 1 of 1872), s. 45.

²³ M. Sati, "Evidentiary Value of Forensic Report in Indian Courts" *Scholarticles* (2016).

²⁴ R. Ratanlal and K. T. Dhirajlal, *The Law of Evidence* (Wadhwa and Co., Nagpur, 23rd ed., 2010).

are stated in the Criminal Procedure Code, 1973²⁵ in Section 509 (Medical Certificate) and Section 510 (Report of Chemical analyst).

In regard to the role of the judiciary in admitting evidence, Section 136 of the IEA says,

‘When either party proposes to give evidence of any fact, the Judge may ask the party proposing to give the evidence in what manner the alleged fact, if proved, would be relevant; and the Judge shall admit the evidence if he thinks that the fact, if proved, would be relevant, and not otherwise. If the fact proposed to be proved is one of which evidence is admissible only upon proof of some other fact, such last-mentioned fact must be proved before evidence is given of the fact first mentioned, unless the party undertakes to give proof of such fact, and the Court is satisfied with such undertaking. If the relevancy of one alleged fact depends upon another alleged fact being first proved, the Judge may, in his discretion, either permit evidence of the first fact to be given before the second fact is proved, or require evidence to be given of the second fact before evidence is given of the first fact.’

Among other things, it is worthwhile noting that the IEA mostly illustrates specific provisions in regards to document and handwriting evidence, with a few forays into medico-legal and electronic evidences (Sections 39, 47A, 65A & B, 85, 88A, 90A of the IEA), but no other type of evidence is explicitly considered in cognizance.

Other legislations also have similar provisions regarding expert evidence, such as Section 169(3) of the Motor Vehicles Act, 1988, that enables the judicial tribunal to ‘choose one or more persons possessing special knowledge of and matter relevant to the inquiry to assist it in holding the inquiry’.²⁶ Section 4 (1)(c) of the National Green Tribunal Act, 2010 has placed the expert on a higher footing with regard to their role in decision making, by mandating the inclusion of an environmental expert within the judicial bench of the tribunal.²⁷

Together, these laws highlight some crucial elements on how Indian courts look at experts: 1) the faith and trust that courts place on people with specialised knowledge

²⁵ Criminal Procedure Code, 1973 (Act 2 of 1973).

²⁶ Act 59 of 1988.

²⁷ Act 19 of 2010.

and skills of the facts concerning the case; 2) the reliance placed by courts on bonafide testimony of experts.²⁸

B. Judgements Defining Admissibility Standards

The purview of IEA extends to defining what evidence may be received by the court, the manner in which it must be handled and presented, and who is eligible to offer their expertise. The language does not inform, with any clarity, about a comprehensive criteria of admissibility for scientific evidences or experts.²⁹ For most part, the judiciary relies heavily on the adversarial process to execute the gatekeeping role for scientific opinions. *State of Uttarakhand v. Akhtar Ali*³⁰ noted that

‘No rules of evidence, as such, are in force in this country for accepting the expert evidence. It all rests upon the prosecutor as to how he introduces the expert, how he proceeds with the testimony of the expert, and, of course, it also depends upon the presiding judge, as to how he ensures that (the) truth is not suppressed.’

Using the case *State of Maharashtra v. Sharma*³¹ as an example, Gaudet³² has shown how questionable evidence can infiltrate the courtroom when admissibility standards fail to keep it at bay. In India, evaluation of expert evidence is generally limited to assessing the credibility and qualifications of an expert witness.

The authors concede that it is not possible to find one set of uniform standards that would apply to all scientific evidence as each technique is at a difference stage of scientific inquiry in terms of tools, assumptions, methodologies, goals etc.³³ However, the provision for guidelines on how to navigate such scientific dilemmas can help judges understand the nuances of the expertise and evidence analysis better, thus bridging the gaps in scientific literacy. There have been some attempts at establishing admissibility

²⁸ *Supra* note 24.

²⁹ G. K. Varghese and B. J. Alappat, “National Green Tribunal Act: A Harbinger for the development of environmental forensics in India?” 13(3) *Environmental Forensics* 209-215 (2012).

³⁰ MANU/UC/0918/2019.

³¹ C.C., No. 508/07, Pune (decided on June 12, 2008).

³² L. M. Gaudet, “Brain fingerprinting, scientific evidence, and Daubert: A cautionary lesson from India” 51 *Jurimetrics* 293 (2010).

³³ M. M. Kapsa and C. B. Meyer, “Scientific Experts: Making Their Testimony More Reliable” 35 *California Western Law Review* 313 (1999).

criteria by various Courts. In *Ramesh Chandra v. Regency Hospital*,³⁴ the Supreme Court categorically laid out the conditions that govern the admissibility of expert evidence as:

1. Expert must be heard unless s. 293 of CrPC³⁵ applies (This provides that senior government experts may not be summoned. Also, some cases wherein foreign experts have been given the permission to testify through video-conferencing (*Malay Kumar Ganguly v. Dr. Sukumar Mukherjee*);³⁶
2. Area of expertise must be a recognised one;
3. The evidence must be based on reliable principles;
4. He must be qualified in the area of specialisation, either by education or by way of experience.

In *Anish Rai v. State of Sikkim*,³⁷ where an expert was asked to opine on the age of a person, the expert founded her opinion on the stages of fusion of the bone in the body, as was shown in the X-ray. While the Sikkim High Court conceded to the information, it criticised that the conclusion reached by the expert has not been elaborated with any further information – '(She) ought to have clarified and elaborated on what the various stages of fusion of bone signified and how consequently she has reached her finding of the bone age of the victim to enable the court to reach a decision with clarity and to appreciate her efforts'. This implies that an expert's opinion, given without adequately providing supplementary reasoning that is based in foundational scientific knowledge and illustrates how they arrived at the findings, is deemed to be of no value to the case. The evidence, although admissible, would be excluded from consideration in deciding the case as it does not carry enough information on which the judge can determine weightage. This also illustrates that although a judge can choose to not rely on an expert opinion, they are at no liberty to substitute it freely without grounds on which to question the reliability of the evidence. But if they do rely, it shall be done for reasons that are justifiable. This insistence on corroboration is a matter of caution and prudence (*Murali Lal v. State of M.P.*).³⁸ For example, footprints (*Pritam Singh v. State of Punjab*)³⁹

³⁴ (2009) 9 SCC 709.

³⁵ The Criminal Procedure Code, 1973 (Act 2 of 1974).

³⁶ (2009) 9 SCC 221.

³⁷ MANU/SI/0045/2018.

³⁸ AIR 1980 SC 531.

³⁹ AIR 1956 SC 415.

& tracker dog evidence (*Abdul Rajak Murtaza Dafedar v. State of Maharashtra*)⁴⁰ are not backed by established science and therefore, were used as corroborative evidence in the respective cases i.e., with less weightage, only to reinforce the conclusion drawn from other evidence.

One of the laws that has attracted serious debate in terms of admissibility of evidence is Article 20(3) of the Constitution of India, that guards against self-incrimination by providing for *nemo tenetur seipsum accusare*. While the scope of the immunity explicitly includes oral and documentary evidence, in its constitutional essence, the clause is actually a safeguard against testimonial compulsion. The Bombay High Court in *Ramachandra Reddy and Ors. v. State of Maharashtra*,⁴¹ upheld the legality of the use of narco-analysis, P300 brain-mapping, polygraph test on the grounds that in these tests, no statement is made involuntarily towards testimony, in oral or written form. In *Kathi Kallu Oguhad v. State of Maharashtra*,⁴² the Apex Court limited the scope of Art. 20(3) by observing that self-incriminatory information is admissible if there is no compulsion. The presumptions defining the admissibility of such scientific evidence was eventually overturned in *Selvi v. State of Karnataka*,⁴³ where the Supreme Court held that the above-mentioned scientific processes were unconstitutional as they violated rights against self-incrimination, and cannot be conducted without the consent of the accused. It is interesting to note that the Supreme Court chose to discredit these scientific procedures on the grounds of constitutionality alone, but did not comment upon the reliability of such science or the accuracy of interpretation made by the expert. In contrast, collection of handwriting and signature specimens, evidence gathered from medical examination of the accused, voice samples, DNA, blood, pubic hair etc. was not considered violative of Art. 20(3) because these evidences were considered to be tamper-proof to manipulation or concealment.

C. International Admissibility Rules: Daubert Standards

One of the earliest frameworks for determining admissibility stemmed from the 1923 federal district court ruling in *Frye v. United States*, which held that expert evidence was

⁴⁰AIR 1970 SC 283.

⁴¹Cr. W. P. (c) No. 1924 (2003).

⁴²AIR 1961 SC 1808.

⁴³AIR 2010 SC 1974.

admissible if it was produced by methods that were generally accepted by the scientific community to be reliable.⁴⁴ In 1993, the US Supreme Court, in its landmark judgment *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,⁴⁵ had identified four non-definitive and non-exhaustive factors that were thought to be illustrative of characteristics of reliable scientific knowledge. They are –

- testability or falsifiability,
- peer review,
- a known or potential error rate, and
- general acceptance within the scientific community.

Essentially, *Daubert* requires that the judge shall delve into the scientific field concerned and examine its reliability,⁴⁶ assessing ‘whether the reasoning or scientific methodology underlying the testimony is scientifically valid and whether that reasoning or methodology can be properly applied to the facts in issue.’⁴⁷ In *General Electric Co. v. Joiner*, the same Supreme Court held that the standards of review by appellate courts shall not differ unless the trial court is manifestly erroneous or if there is abuse of discretion.⁴⁸ In *Kumho Tire Co. v. Carmichael*, it was held that *Daubert* applies not only to scientific knowledge but also testimony based on “technical” and other specialized knowledge, such as engineering, blacksmith, etc.⁴⁹ The three rulings together are referred to as *Daubert* trilogy. Most scholars are of the opinion that the *Daubert* ruling increased judicial attention on reliability of science and experts, and led to a tightening of admissibility standards.⁵⁰ This is also the reason that in this paper, the Indian evidentiary jurisprudence is compared to the standards established by *Daubert*, and later incorporated into Federal Rule of Evidence 702 (1).

⁴⁴ Timothy L. O’Brien, “Beyond reliable: Challenging and deciding expert admissibility in US civil courts.” 17(1) *Law, Probability and Risk* 29-44, (2018).

⁴⁵ 509 U.S. 579 (1993).

⁴⁶ Boaz Sangero and Mordechai Halpert, ‘Scientific Evidence v. Junk Science’ 431 *Alei Mishpat, Isr.* (2014).

⁴⁷ *Supra* note 12 at 592.

⁴⁸ 522 U.S. 136, 146 (1997).

⁴⁹ 119 S.Ct. 1167 (1999).

⁵⁰ Edward K. Cheng and Albert H. Yoon, “Does Frye or *Daubert* matter? A Study of Scientific Admissibility Standards.” 91 *Virginia Law Review* 471-513 (2005).

D. Indian Courts on Daubert Standards

Often, Indian courts have taken help of legal transplants and international precedents from other jurisdictions, most predominantly, *Daubert*, to define admissibility criteria within Indian jurisprudence. *Mukesh and another v. State (NCT of Delhi) and others*;⁵¹ *Dharam Deo Yadav Harjinder Kaur*; *Rajli v. Kapoor Singh*,⁵² and many others.

In *Selvi*,⁵³ the Court looked closely at several US judgements on narco-analysis and brain-fingerprinting in pre-and post-Daubert era to inform itself on how to legally analyse the contentious issues in the case. *Dharam Deo Yadav v. State of U.P.*⁵⁴ held that, in addition to *Daubert* criteria, relevancy and reliability could be tested on the basis of additional factors – whether the technique used relies on methods whose reliability has been established, the qualifications of the expert witness testifying matches the methodology used, the non-judicial uses of the method, logical or internal consistency of the hypothesis, consistency of the hypothesis with accepted authorities and presumption of the hypothesis or theory. In *Harjinder Kaur v. State of Punjab*,⁵⁵ the Court reasserts the gatekeeping responsibility of the judges in encouraging a thorough evaluation of criteria determining admissibility of scientific evidence and expert opinions, and also recommended that such inquiry must not be influenced by the conclusions generated by such scientific analysis. In *Nnadi K. Iheanyi v. Narcotics Control Bureau*,⁵⁶ the Court exhibited a nuanced understanding of *Daubert* by excluding expert's testimony as it failed to explain sufficiently the reasons on which the conclusion was drawn.

Daubert itself emphasizes that the factors listed to assist judges in determining 'whether the reasoning or methodology underlying the testimony is scientifically valid' were neither exclusive nor decisive.⁵⁷ The non-exclusive checklist set forth by *Daubert* has come under great scrutiny for the lack of being "codified" into specific factors. As

⁵¹ (2017) 6 SCC 1.

⁵² (2014) 174(2) PLR575 (P&H HC).

⁵³ *Supra* note 44.

⁵⁴ (2014) (86) ACC 293 (SC).

⁵⁵ (2013) (2) RCR (Criminal) 146 (P&H HC).

⁵⁶ (2014) 145 DRJ 267.

⁵⁷ Edward K. Cheng and Albert H. Yoon, "Does Frye or Daubert matter? A Study of Scientific Admissibility Standards." 91 *Virginia Law Review* 471-513 (2005).

mentioned earlier, the scope for any legislative guideline to be specific enough to be applicable to all forensic evidence, existing and futuristic, is an irresolvable contention. Factors relevant for evaluating reliability of expert testimony will vary between different expertise, as they involve different methodologies and techniques, each operating on different assumptions and to different degrees of scientific development.⁵⁸ In the case laws above, it has been shown that in some cases, Indian judges have demonstrated high standards of admissibility of expert opinion grounded in an accepted body of learning or experience in the expert's field. However, this understanding of admissibility criteria is often non-uniform amongst the judiciary, exhibited more nuancedly at the higher courts than in the lower courts, where most cases are primarily dealt with. Secondly, courts tend to revere an idealistic assimilation of science in law, without considering the social, institutional, psychological constructs within which science and the scientific expert exists in the courtroom.

III. CRITIQUE OF THE GATEKEEPING FUNCTION OF THE JUDGES

In this section, few judgements involving different types of forensic evidence have been critically examined to deconstruct the potential oversights in judicial gatekeeping.

A. Brain Fingerprinting

In *Jaga Arjan Dangar v. State of Gujarat*,⁵⁹ where the use of brain-fingerprinting technology was being considered, the Court cited three sources to corroborate the worthiness of the technique, two of which were from the same expert, Lawrence A. Farwell, who had invented and patented the Concealed Information Test protocol P300+MERMER. Farwell's tutorial review points out that the P300+MERMER technique 'has 0% rate of error and 100% of the determinations have been correct'. Further along in the ruling, the Court explains 'that this is simply a report of the actual data to date; no science can be generally characterized as "100% accurate" without qualifications or reference to a specific data set.' Here, the Court shows clear understanding that claims that are scientifically indefensible, worded as

⁵⁸ *Supra* note 34.

⁵⁹ MANU/GJ/08/2018.

*zero/vanishingly small/ essentially zero/negligible/minimal/microscopic or virtually no error rates, or as 100 percent certainty or proof to a reasonable degree of scientific certainty; identification to the exclusion of all other sources; or a chance of error so remote as to be a practical impossibility, should never be allowed to influence the decision-making process.*⁶⁰

However, the Court also goes on to support the claims that brain fingerprinting surpasses the standard of reliability, set at less than 1% error rate overall, and less than 5% error rate in every individual study. This is based on the claim that “In brain fingerprinting using the P300-MERMER, all tests have resulted in a definite determination with a high statistical confidence. There have been no indeterminates. In brain fingerprinting using the P300 alone, in less than 3% of cases, the data analysis algorithm has concluded that insufficient information is available to make a determination in either direction with a high statistical confidence, resulting in an indeterminate outcome (not an error).” It is unclear which research literature the Court has relied upon to inform themselves about the accuracy of technique, but given the protocol mentioned, the conclusions and previous mention of Farwell’s works, the authors assume that they have referred to either Farwell (2011)⁶¹ or Farwell et. al. (2012).⁶² Farwell’s work has been critiqued by peers for being misleading and misrepresenting the scientific status of brain fingerprinting technology because it has selectively dismissed relevant data, presented conference abstracts (non-peer reviewed) as published data, and deliberately duplicated participants and studies.⁶³ The Court also claims that the P300+MERMER technique is resistant to usual countermeasures used, however, several scholars have challenged the use of P300 in real life as it may be vulnerable to learnable countermeasures⁶⁴ or maybe responsive to irrelevant

⁶⁰ D. M. Risinger “The NAS/NRC report on forensic science: A path forward fraught with pitfalls” *Utah Law Review* 225 (2010).

⁶¹ L.A. Farwell, D. C. Richardson, *et.al.* “Brain fingerprinting field studies comparing P300-MERMER and P300 ERPs in the detection of concealed information” 48 *Psychophysiology* 385-388 (2011).

⁶² LA Farwell “Brain Fingerprinting: A comprehensive tutorial review of detection of concealed information with event-related brain potentials” 6 *Cognitive Neurodynamics* 115-154 (2012).

⁶³ Ewout H. Meijer, Gershon Ben-Shakhar, *et.al.* “A Comment on Farwell (2012): brain fingerprinting: a comprehensive tutorial review of detection of concealed information with event-related brain potentials” 7 *Cognitive Neurodynamics* 155-158 (2013).

⁶⁴ G. Lukács, B. Weiss, Dalos, *et.al.*, “The first independent study on the complex trial protocol version of the P300-based concealed information test: Corroboration of previous findings and highlights on vulnerabilities” 110 *International Journal of Psychophysiology* 56-65 (2016).

information.⁶⁵ No peer reviewed data shows that Farwell's technique is highly resistant to these countermeasures.⁶⁶

This illustrates that some courts struggle in engaging with novel and complicated science, such as brain-fingerprinting, and complex data-driven and/or statistically based opinions from experts or even with applying the *Daubert* guideline of general acceptance within the scientific community. This deficiency in judicial understanding of how to assess the value of an expert opinion, whether for admissibility or weightage, is a major stumbling block in correct comprehension and application of expert testimony.⁶⁷ While the court is not expected to read scientific literature as critically as experts; in order to essay their gatekeeping responsibilities well, the courts should pay more emphasis in referring to peer-reviewed sources of information whose assessments are independent and free from any prejudice.

B. Odontological Identification

In *Chellappan v. State of Kerala*,⁶⁸ the question in issue was whether the partial denture found at the scene of a homicide belonged to the accused. The prosecution presented three expert witnesses and their reports for consideration, of which two experts (PW24 and CW1) concurred in their opinion of match to the accused, whereas one, PW16, differed initially, but later revised their opinion to concur with that of PW24. This revision was made on the basis that PW16 had arrived at his conclusion prematurely without conducting the necessary procedures. Additionally, they also admitted that as an oral and maxillofacial surgeon, they did not have the adequate expertise (of CW1 who was a prosthodontist) to ascertain whether the artifact was used by the accused.

In this case, the prosecution had initially only presented the testimony by PW24-CW1 as that was the opinion that led to the arrest of the accused. When the report made by PW16 came into discussion, the Court was fortunately not made to choose between the two experts in order to decide whose expertise would be most apt in answering the

⁶⁵ R. Brandom, "Is 'brain fingerprinting' a breakthrough or a sham?" *The Verge* (2015).

⁶⁶ J. P. Rosenfeld "P300 in detecting concealed information" In B. Verscheure, G. Ben-Shakahar, *et.al.* (eds.) *Memory detection: theory and application of the concealed information test.* (Cambridge University Press, 2011).

⁶⁷ H. L. Korn, "Law, fact, and science in the courts" 66(6) *Columbia Law Review* 1080-1116 (1966).

⁶⁸ MANU/KE/2361/2012.

question in issue, as the issue resolved itself when PW16 retracted their contradicting opinion, leaving only the report by PW24 and CW1 in play. It is unclear how the Court would have decided between the two duelling experts if the situation had arisen, but seeing how they positioned the prosthodontist's testimony as fatal to determining whether the findings of the report are 'acceptable and conclusive', they seemed well informed on the aspect of expertise that was qualified to answer the questions being asked.

In their testimony, PW24, who professionally specialized as an oral pathologist and had been a forensic odontologist for 20 years, supported their opinion of match by stating that 'In this particular case, there was a loss of bone while extracting the tooth and there is a depression in the patient's mouth as well as the cast. This depression is seen as an elevated area in the denture. Similar depression and projection will never ever [be] see[n] in another person.' The Court witnessed considerable arguments from the defense regarding the acceptability of the evidence from this witness. The testimony of the prosthodontist CW1 was thus considered pivotal to determining the evidentiary value of the report and so they were invited for cross-examination by the Court.

When asked if it was possible for a similar depression in the edentulous space to occur in two persons, he noted that 'A depression may occur in such extractions. However, the depression will vary from person to person. It can never be similar.' This statement, however, was not supported by any evidence-based research. CW1 further offered that although he was not aware of the use of artificial dentures in identification of perpetrators, identification by dentures was known to be done for bodies in mass calamities. There was no consideration made by either the Court or the expert to understand the difference in standards of admissibility for evidence submitted for criminal adjudication versus humanitarian forensics. When the stakes are of life and freedom, as opposed to psychological closure and ethical practice, it is common practice for the Courts to demand high reliability and low error rates for the identification techniques used. CW1's testimony did not clarify if the technique met such stringent standards, nor did the Court make any attempts to inquire along those lines. However, the Court did concede that the lower court had confirmed that the method chosen to

arrive at the conclusion was appropriate, and they accepted the lower court's due diligence in the matter.

The Court also allowed the experts to express extremely confident opinions such as 'never been seen in another person' and 'can never be similar' without matching them with probabilistic likelihood ratios or providing any validated study or peer-reviewed and evidence-based research in support of their strong claims. Such exaggerated conclusions were proffered despite the fact that the denture could no longer be inserted in the mouth of the accused, due to mesial migration of the adjacent teeth. The slightest consideration of an alternative possibility where the denture might indeed be a mismatch to the accused was completely absent, this goes against prevalent practice amongst forensic practitioners.

Secondly, the Court's opinion relied heavily on that of the key witness, CW1, who, at the time of the examination, was undergoing his post-graduation degree at the Government Dental College, Kozhikode. There was no evidence that the Court had verified CW1's experience in the field of forensic odontology, or more specifically, in the ability to make accurate identifications based on prosthodontics. The court did not seem to assume any skepticism with regards to the accuracy of the expert's opinion, despite his limited experience and lack of information regarding ongoing critiques of the field of forensic odontology. Nor did the Court appear to consider the possibility that the assessment of a postgraduate student may not be objectively free from partisanship and motivational bias, especially when working in collaboration with an expert who was a senior faculty and principal of the same college in which the student was pursuing his degree at the time of examination, and subsequently was still in hierarchically senior position, at the time of the testimony (CW1 was working as Senior Lecturer, Department of Dentistry in the college where PW24 was Principal). It is unclear whether the lower court, in its assessment of procedure, had considered the provision of countermeasures to limit the influence of any such cognitive bias from affecting the conclusion.

Thirdly, in his testimony, CW1 also made claims that forensic odontology was a reliable discipline, which he supported by citing medical literature and research journals that have recorded its use for decades for unique identification. The court admitted the

expert opinion, supporting this decision by citing excerpts from popular scholarship in the field of medical jurisprudence and odontology, however, the research literature seems to have been limited to those affirming the expert witness' opinions. Both the Court and CW1 seemed to be unaware of that the discipline of forensic odontology was, even at the time of the appeal, under severe scrutiny within the scientific community post the NAS Report 2009. The uniqueness of individual dentition has been since revisited by the scientific community and is not considered a validated fact.⁶⁹ The scientific community, both within and outside of forensic odontology, are critical of the extent to which they can comment on individuality of dentition to be used as an identification tool. This concern is absent in the literature discussed by both the judge and experts themselves. Moreover, three of the four excerpts cited referred to the use of teeth in identification and did not specifically speak of (partial) dentures, which is the artifact in issue here. In this, the Court seemed to struggle to find the right kind of research to inform and support their gatekeeping responsibility. In accepting the expert's answers and the sources cited, the Court also failed to recognize that the standards for scientific evidence are more stringent for criminal than for humanitarian forensics; meaning that accepted procedures in mass-disaster identification may not necessarily hold up to scrutiny in criminal trials. Here, overt reliance on precedence of accepting ambiguous sciences has compromised the gatekeeping duty of the judiciary.

C. Fingerprints

The well documented and highly credential NAS Report 2009 has questioned the admissibility of evidence from forensic disciplines such as bitemark and fingerprints pattern analysis for evolving outside of a traditional scientific environment and lacking sufficient validation.⁷⁰ Despite all these criticisms, it is found that in *Sunil Kumar v. State N.C.T. of Delhi*,⁷¹ the High Court of Delhi held fingerprint examination to an exalted evidentiary standard it did not scientifically merit.

⁶⁹ Gorza, Ludovica, *et.al.*, "Accuracy of dental identification of individuals with unrestored permanent teeth by visual comparison with radiographs of mixed dentition." 289 *Forensic science international* 337-343 (2018).

⁷⁰ D. M. Risinger, "The NAS/NRC report on forensic science: A path forward fraught with pitfalls" *Utah Law Review* 225 (2010).

⁷¹ MANU/DE/0916/2010.

‘Science of identification by thumb impression has advanced to a great leap. Supreme Court has regarded the said science "as an exact science and does not admit of any mistake or doubt" (vide *Jaspal Singh v. State of Punjab*).⁷² It was once thought that there must at least be 12 identical characteristics between the questioned finger impression and the standard one for reaching, a conclusion that both belong to the same finger. But, in later years, it was found that 6 points of identical characteristics between the two were sufficient for the conclusion regarding identity (vide *Mohan Lal v. Ajith Singh*).’⁷³

In forensic analysis of fingerprints, the point system of matching is subject to multiple factors, especially the quality of the print and experience of the analyst, and six points in agreement is no longer a universal minimum standard to establish a match.⁷⁴ The 2010 ruling referred to a 1978 judgment, but in doing so, reiterates scientific knowledge and process that are no longer valid. This is an example of how measuring reliability of science via precedence only can perpetuate obsolete or misinformed forensic knowledge amongst the decision makers.

In another instance, the Punjab and Haryana High Court in *Ami Chand v. Partap*⁷⁵ went on to claim that -

‘The science of identification of fingerprints being absolutely reliable and almost perfect as compared to (the) imperfect nature of the science of the identification of handwriting and signatures, it cannot be disputed that it is permissible for the court to base conviction solely upon the opinion of an experienced fingerprint expert.’

Here, the Court misunderstands the long-held precedence of using fingerprint science for identification to mean reliability of the science. At the time of this judgement in 2002, there were not enough empirical studies conducted to measure the error rates in the field of latent print analysis to assess foundational validity and assess reliability, something that will later be highlighted as a concern in the NAS Report 2009 and

⁷² AIR 979 SC 1708.

⁷³ MANU/SC/0127/1978.

⁷⁴ N. Singla, M. Kaur, *et.al.*, “Automated latent fingerprint identification system: A review.” 309 *Forensic Science International* (2020).

⁷⁵ MANU/PH/0754/2002.

PCAST Report 2016.⁷⁶ Studies conducted since have found that the reliability of a latent print examiner lacks in reliability in about 10% of the conclusions. This means that the same examiner, looking at the same print, will arrive at a different conclusion 10% of the time.⁷⁷ Furthermore, the performance of Automated Fingerprint Identification Systems in caseworks also seems to be influenced heavily by the conditions in which prints were made.⁷⁸ The lack of understanding or research regarding the error rates of a particular analysis cannot, and should not, be interpreted as an ‘absolutely perfect’ science. When relying on single evidence towards conviction, the judge should take into consideration the reliability of both the science and the expertise when deciding upon the weightage to be placed on the expert opinion. *Daubert* standards highlights this aspect of reliability in the consideration of admissibility criteria better than is currently provided for under the IEA.

D. Comments

Through the analyses offered on the cases mentioned above, it is clear that Indian courts are largely unclear on how to independently assess the validity and reliability of the scientific technique employed i.e. is the method of analysis suitable for the purpose for which it is employed.⁷⁹ Judges and lawyers usually and expectedly lack training in science or statistics; the Indian law is not particularly clear or considerate of their limitations in dealing with criteria of admissibility of scientific matters.⁸⁰ Therefore, it is not unsurprising that in the lower courts, judges often adopt a practical/pedantic approach in the gatekeeping function by relying on precedents rather than being scientifically rigorous in their assessment of evidence. Where the rate of error of these techniques is not known or the technique itself is not based on reliable science, using

⁷⁶ Daniel C. Murrie, Brett O. Gardner, Sharon Kelly & Itiel E. Dror. “Perceptions and estimates of error rates in forensic science: A survey of forensic analysts.” 302 *Forensic science international* (2019).

⁷⁷ Bradford T. Ulery, R. Austin Hicklin, JoAnn Buscaglia & Maria Antonia Roberts “Repeatability and Reproducibility of Decisions by Latent Fingerprint Examiners” 7(3) *PLoS ONE* (2012) <https://doi.org/10.1371/journal.pone.0032800>.

⁷⁸ Arent de Jongh & Crystal M. Rodriguez “Performance Evaluation of Automated Fingerprint Identification Systems for Specific Conditions Observed in Casework Using Simulated Fingermarks” 57 (4) *Journal of Forensic Science* 1075-1081 (2012).

⁷⁹ Aman Jantan, H. Arshad, *et.al.*, “Digital Forensics: Review of Issues in Scientific Validation of Digital Evidence” 14(2) *Journal of Information Processing Systems* 346-376 (2018).

⁸⁰ M. P. Kantak, M. S. Ghodkirekar, S.G. Perni., “Utility of Daubert guidelines in India” 26(3) *Journal of Indian Academy of Forensic Medicine* 110-112 (2004).

such techniques in courts, particularly when unsubstantiated by other forensic evidence, pose a danger of unduly influencing the case findings.⁸¹ This demonstrates how Indian courts continue relying on outdated precedents, and risking wrongful convictions and miscarriage of justice. Under the current legislative provisions, the legal doctrine of finality makes it difficult for those wrongfully incarcerated to challenge unreliable science without new evidence.⁸²

IV. NEED FOR IMPROVED ADMISSIBILITY STANDARDS

The 277th Law Commission of India Report took note of the present state of forensic science in the country and pronounced that chances of exoneration based on DNA technology in the country are very limited, given the fact that the use of DNA technology is not adequately advanced in Indian courtrooms.⁸³ Gupta (2016)⁸⁴ and Dinkar (2015)⁸⁵ assert that, compared to their counterparts in the US and UK, the Indian courts have failed to exhibit the confidence and scientific temper to deal with forensic evidence substantially and therefore, conveniently consider them as secondary evidence that help in corroborating other evidence, such as circumstantial evidence or eye-witness testimony. Even the judiciary rues the immediate need to include more scientific evidence in trial, especially in the light of the alarmingly high acquittal rate.⁸⁶ Thus, facilitating scientific literacy in the courtroom seems inevitable in the near future.

The gatekeeping function performed by Indian Courts based on current laws may share the same principles of relevance and reliability as *Daubert*, however they lack in definition and guidance towards application, and so may be leading to prejudiced decision making. In a country that dearly upholds principles such as ‘the right to fair trial’, material discrepancies can erode the credibility of the system. The courts are

⁸¹ *Supra* note 2.

⁸² *Ibid.*

⁸³ Law Commission of India, “277th Report on Wrongful Prosecution (Miscarriage of Justice): Legal remedies” (August, 2018).

⁸⁴ R. Gupta, S. Gupta, and M. Gupta, “Journey of DNA Evidence in Legal Arena: An Insight on Its Legal Perspective Worldwide and Highlight on Admissibility in India” 2(2) *Journal of Forensic Science and Medicine* 102 (2016).

⁸⁵ V. R. Dinkar, “Forensic Scientific Evidence: Problems and Pitfalls in India” 3(2) *Int J Forensic Sci Pathol* 79-84 (2015).

⁸⁶ J. N. Bhatt, “A Profile of Forensic Science in Juristic Journey” 8 *Supreme Court Cases* 25 (2003).

unwilling to bear the burden of overhauling the established *status quo* and pursue a rigorous agenda to confirm the evidentiary reliability of methodologies used in forensic disciplines. The rules of evidence designed decades ago are now inadequate in meeting the pace of scientific advancement,⁸⁷ and the legal community also supports the demand that appropriate provisions dealing with the legislative gaps in evaluation of forensic evidence be enacted.⁸⁸ This is the first step towards scientific literacy in courtrooms.

V. CHALLENGES AND LIMITATIONS

The challenges to improve overall judicial competencies in use of scientific evidence in courtrooms cannot be resolved simply by legislative reforms. It must be informed by an understanding of existing challenges and anticipated limitations of the legal system.

A. Lack of Awareness of Current Forensics Developments

A preliminary search of case databases from India revealed that reference to NAS Report 2009 or such similar works has never been broached by the judiciary nor the litigating counsels. The universality of such critiques and their implications for the Indian criminal justice system remains under-appreciated by legal practitioners in India. The Supreme Court in *Dharam Deo Yadav v. State of U.P.*,⁸⁹ has also raised the concern that, ‘...With emergence of new types of crimes and their level of sophistication, the traditional methods and tools have become outdated; hence there is necessity to strengthen forensic science....whereas forensic evidence is free from those infirmities [of power, observation, external influence, forgetfulness etc]. Judiciary should also be equipped to understand and deal with such scientific materials.’ Although international jurisdictions have shown cognizance of the problems in forensic science that these reports have highlighted, not all countries have been able to fully upend the systemic problems. Even US courts have been restrained in their engagement with NAS recommendations,⁹⁰ thus, it is not surprising that concerns and critiques of forensics in *praxis* has not yet

⁸⁷ Government of India, “Report of the committee on draft national policy on criminal justice” (Ministry of Home Affairs, 2007).

⁸⁸ *Supra* note 68.

⁸⁹ (2014) 5 SCC 509.

⁹⁰ S. A. Cole & G. Edmond, “Science without Precedent: The Impact of the National Research Council Report on the Admissibility and Use of Forensic Science Evidence in the United States” 4 *British Journal of American Legal Studies* 585 (2015).

warranted much attention in India. Meanwhile, their continued admissibility in courts creates precedents that are being followed without adequate scrutiny, thus consolidating their use in courtrooms.

B. Competency of the Trier of Facts to Assess Scientific Evidence

Kapsa and Meyer (1999)⁹¹ note that judges, in general, do not officially require any minimum standard of scientific qualification that is a *sine qua non* for evaluating scientific testimony. They differ amongst themselves in their respective level of scientific understanding, which is usually directly related to their professional experience. As seen from the case studies above, this makes one judge's comprehension of a scientific matter essentially different from another's. There are several instances where Indian judges have shown differently nuanced understanding of Daubert's admissibility guidelines as well. This could pose a serious problem in a legal system that demands application of uniform rules in the interest of fairness. Gatowski (2001) revealed that American judges also struggled in practically applying the explicit *Daubert* criteria, however the adoption of the criteria into Federal Rule 702 of Evidence has somewhat uniformized the interpretation of admissibility statutes.⁹²

C. Shortcomings of the Adversarial System

In the adversarial system, the obligation to contest dubious science lies solely with the defense. Lawyers often fail to ask the right questions and uncritically accept scientific assertions, allowing bad science to perpetuate in court.⁹³ Garrett & Neufeld (2009) noted that defense counsels do not cross-examine experts adequately, and rarely are they able to obtain qualified experts for themselves to counter opinions presented by the prosecution.⁹⁴ In the Indian criminal justice system, many defendants do not have the adequate backing, resources or funds to hire scientifically literate defense counsels or procure expert opinions to counter the prosecution's. Forensic evidence are

⁹¹ M. M. Kapsa, & C. B. Meyer, "Scientific Experts: Making Their Testimony More Reliable" 35 *California Western Law Review* 313 (1999).

⁹² S. I. Gatowski, S. A. Dobbin, *et.al.*, "Asking the gatekeepers: A national survey of judges on judging expert evidence in a post-Daubert world" 25(5) *Law and Human Behavior* 433-458 (2001).

⁹³ F. I. Lederer, "Scientific Evidence--An Introduction" 25 *William & Mary Law Review* 517 (1983).

⁹⁴ B. L. Garrett, and P. J. Neufeld, "Invalid forensic science testimony and wrongful convictions" *Virginia Law Review* 1-97 (2009).

challenged primarily on procedural grounds (see narcoanalysis in IIA) and less often on technical matters, allowing for bad science or poor analysis to persist in the courtroom. Another problem with the adversarial process is that it leads parties to ‘produce evidence favourable to their respective sides, regardless of the quality of that science’.⁹⁵ In the *Chellapan* case, a second opinion was sought from a different expert a year after the first expert had already issued an opinion of mismatch, the second opinion formed the basis of arrest and prosecution. The faults with the first testimony was only brought forth in the Appellate court by the defense, wherein it was withdrawn by the expert before being contested. This highlights a possibility of confirmation bias, where investigator and prosecution actively ignore evidence/opinion that does not align with their assumption of culpability. Also, in a majority of cases where an invalid evidence has been challenged in courts, judges hardly provide relief.⁹⁶ Studies also show that often the trial bench is exceptionally protective of evidence adduced by prosecutors, illustrating a pro-prosecution/pro-State bias.⁹⁷ It is difficult for the defense team to mount a promising appeal or counter-examination in the face of such institutional prejudices.

D. Legislations Inadequate for Changing Science

In some cases where problematic science has been used to determine an essential element of the case leading to incarceration, new scientific knowledge may later render the former verdict inaccurate. As such, the conventional forum to reverse conviction is to file an appeal based on ‘new science’ or ‘false evidence’ claim. This is not adequately provided for within the Indian legislative recourses. In cases where the Court may have to arbitrate between two or more duelling experts, they may be faced with a myriad of tricky questions regarding assessing scientific rigour which they have historically struggled with.⁹⁸

⁹⁵ E. H. Meazell, “Scientific avoidance: Toward more principled judicial review of legislative science” 84 *Ind. Law Journal* 239 (2009).

⁹⁶ J. L. Mnookin, “The courts, the NAS, and the future of forensic science” 75(4) *Brooklyn Law Review* 10 (2010).

⁹⁷ R. Dioso-Villa, “Is the Expert Admissibility Game Fixed?: Judicial Gatekeeping of Fire and Arson Evidence” 38(1) *Law & Policy* 54-80 (2016).

⁹⁸ E. H. Meazell, “Scientific avoidance: Toward more principled judicial review of legislative science” 84 *Ind. Law Journal* 239 (2009).

E. Systemic Resistance to Change

Despite anecdotal evidence from lawyers and judges that suggests that they are aware of the poor quality of science they receive in trials, they also admit that they are often too dependent on the superiority of scientific evidence to prove their case to acknowledge that the legal system is ill-equipped to correctly evaluate its deficiencies.⁹⁹ In some cases, the specific scientific research needed to answer the question in issue may not even be available, or the findings of such research may not have been adequately replicated or reviewed in order to be considered acceptable by the scientific community.¹⁰⁰ Even with funding and resources available, the time that the scientific community would need to conduct such validation and reliability studies for the lacunas observed in some forensic disciplines would have to come at the cost of ongoing and future trials.

F. Re-trial of Closed Cases

It is obvious that the revision of forensic disciplines and expert opinions will have the most acute bearing on verdicts where individuals have been condemned on the basis of presently discredited science. While this is in the interest of justice, the present legal system is legislatively unequipped to filter and prioritise re-visitation of such cases on their merits. It is also lacking in resources - money, time, scientific equipment and experts, legal professionals – to handle redressals on the scales of the Innocence Project. This potential Pandora's box might be another reason why courts are hesitant to disturb the *status quo* of quasi-established sciences.

G. Lack of Equality of Experts

The implication that forensic analysts and practitioners, as with any other professional, will get better at their expertise with experience means that there is always scope for their opinions to change retrospectively.¹⁰¹ A younger novice may opine one way regarding a match for a particular evidence, and later in their career, opine differently

⁹⁹ *Supra* note 97.

¹⁰⁰ Abirami Arthanari, Nagabhushana Doggalli, Karthikeya Patil, H. P. Jai Shankar & A. Vidya. "Bite mark: Is it still valid??" 4(1) *International Journal of Forensic Odontology* 14 (2019).

¹⁰¹ Jade Cascun, *Developing Fingerprint Examination Expertise using Simultaneous and Sequential Presentations of Interleaved Practice* (2020) (Unpublished Dissertation Thesis, University of Adelaide).

for a similar evidence. This shift in opinion is more prevalent when assessments are subjective, where the reliance is more on the expert's knowledge and experience in analysing or interpreting the evidence. This may be resulting from new knowledge becoming available to the expert in the course of their profession or from them improving in their capability to find nuanced differences where they could not earlier. This poses a worrying impasse between science and law in upholding equality—is the system willing to risk subjecting some defendants to less expert scientific analysis than other, based on whether they draw a 'novice' or an 'experienced' analyst.¹⁰² It has also been noted that there is often an unequal disparity between the kinds of expertise that litigants have the capacity to produce. It is usually dependent on their resources and expenses, leaving the economically weakest party with limited access to a credible second opinion to support their case.

H. Cognitive Biases

Despite the fact that the scientific experts are supposed to opine objectively, the party-oriented approach of experts may make their testimony prejudiced. Forensic analysts are not immune to partisan bias or motivational bias.¹⁰³ Experts that work closely with police and prosecution may be more susceptible to the likelihood of bias; sensitive information such as confessions, identification by eye-witnesses etc. may be revealed to the experts by the police or the legal team, leading to presupposition of guilt and sacrificing the objective independence of the expert's opinion. As experts enjoy broad discretion in forming their opinions, they may depose in favour of the party hiring them and be able to rationalize their views in the courtroom without damaging their intellectually objective self-image.¹⁰⁴

¹⁰² S. A. Cole, "Changed Science Statutes: Can Courts Accommodate Accelerating Forensic Scientific and Technological Change" 57(4) *Jurimetrics* 443-458 (2017).

¹⁰³ Poulomi Bhadra, "Is Forensic Evidence Impartial? Cognitive Biases in Forensic Analysis." In S. P. Sahni, P. Bhadra (Eds) *Criminal Psychology and the Criminal Justice System in India and Beyond*. 215-227 (Springer, Singapore, 2021).

¹⁰⁴ O. Perez, "Judicial Strategies for Reviewing Conflicting Expert Evidence: Biases, Heuristics, and Higher-Order Evidence" 64(1) *The American Journal of Comparative Law* 75-120 (2016).

VI. SUGGESTIONS FOR REFORMS

The expectation that science exists objectively within legal jurisprudence is misleading, there exist socio-cultural, political, economic and psychological variables that influence scientific testimony and related decision-making. The intersection of law and scientific evidence is massively understudied in India, this paper focuses on the first steps that the legal profession can take to bridge the gap between the two disciplines. Once the gatekeepers are clear on how to assess for admissibility, only then can they further improve their understanding of how to allocate weightage to various scientific evidence. Some of the ways to guide the judiciary better in admitting science in the courtroom are listed below.

Existing legislation should be updated to keep up with current scientific dialogues on disciplinary critique and accepted practices within the field. In doing this, comparative analyses of global admissibility standards might guide the way, but it will have to be informed by relevant epistemology of Indian jurisprudence rather than acceptance of precedence or heuristics practices.

Another recommendation is to include exhaustive provisions within statutory reforms to entertain 'novel' or 'changed' scientific knowledge that challenges previous scientific forensic precepts. This will provide a definitive legal channel for revisiting the cases of miscarriage of justice, and also for filtering an overwhelming case load through various priority criteria.

Within the adversarial system of litigation, the provision for court-appointed experts should be made more prevalent, especially in cases where experts chosen or hired by the litigants do not endure against 'equality of arms' standards.¹⁰⁵ There are provisions for the employment of court-appointed experts u/s 135 of IEA in appropriate cases to play an active role in evaluation of scientific evidence.¹⁰⁶ The court may also have provisions that allows them to consult with experts even before trial, when deciding on admissibility of evidence. Murphy suggests that the assistance of court-appointed experts, supervised by the court, will provide more merit-based opinions and minimize

¹⁰⁵ S. Jasanoff, "What judges should know about the sociology of science" 32 *Jurimetrics* 345 (1991).

¹⁰⁶ Indian Evidence Act, 1872 (Act 2 of 1872), s. 135.

influence from any other agencies, financial or political.¹⁰⁷ This also does not undermine the safeguards of the adversarial system as both parties shall have the opportunity to cross-examine and present counter-evidence.

On a broader scale, there need to be additions and changes in the legal education system to train professionals to engage with other disciplines, especially science, from an early stage of their career. Judicial training should incorporate adequate forensic-centric modules. Apart from including demonstration of techniques, judges must also have a theoretical understanding of the scientific method and how to understand statistical inferences. This would include creating innovative pedagogical tools and curriculum that could be effective in training across disciplinary barriers.

In the long term, the legal and forensic capacities within the jurisdictions will need to be expanded and reviewing systems established to handle the extra workload that will come when revisiting cases potential miscarriage of justice.

VII. CONCLUSION

There are several studies and reports that demonstrate that an expert's report can no longer be presumed to be objective, which makes the responsibility of the judge to assess the credibility of the science presented in the courts more onerous. The situation is further impaired by the lack of statutory guidelines on evaluation of forensic evidence. While Indian Courts, on occasion, have referred to the *Daubert* standards, there is still a lack of proper understanding of scientific methods and validity/reliability assessments. Instead of adopting a cautious approach towards the use of forensic evidence,¹⁰⁸ the system needs to acknowledge this lacuna and support the judicial practitioners in fulfilling their roles.

The findings of the Innocence Project, now running in many countries, has aptly demonstrated the danger of not filling the holes in our criminal justice system.¹⁰⁹ The conviction of any innocent person would compromise the public's trust in the legal process. Society itself suffers harm from a wrongful conviction because the real

¹⁰⁷ R. Glover, and P. Murphy, *Murphy on evidence* (Oxford University Press, 13th edn., 2013).

¹⁰⁸ *Gutta Sriramulu Naidu And Anr. v. The State*, 1963 CriLJ 546

¹⁰⁹ Boaz Sangero & Mordechai Halpert, "Why a Conviction Should Not be Based on a Single Piece of Evidence: A Proposal for Reform", 48 *Jurimetrics* 43-46 (2007).

perpetrator remains at large. In the name of closing cases, the objectivity and certainty lend by scientific evidence cannot be compromised. It is pertinent that the Indian legal system adopts changes that would help in incorporating latest scientific developments. This may be initially disruptive but opening this Pandora's box cannot be delayed further. It is time to save our prisons from turning into zoo - a place where innocents are kept behind bars.