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ROLE OF FORENSIC SCIENCE IN CRIME INVESTIGATION AND JUDICIAL PROCEEDINGS

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Abstract

Forensic science has emerged as an indispensable component of modern criminal investigations, bridging the gap between law enforcement and scientific analysis. Its role extends beyond the mere collection of evidence to include systematic examination, interpretation, and presentation of physical, biological, chemical, and digital materials in a legally admissible manner. By employing techniques such as DNA profiling, fingerprint analysis, ballistics, toxicology, and digital forensics, investigators can reconstruct crime scenes, identify perpetrators, and corroborate witness testimony. The integration of forensic science enhances the accuracy and objectivity of criminal investigations, reducing the risk of wrongful convictions and improving the efficacy of the justice system. In India, forensic laboratories under the Central Bureau of Investigation (CBI) and state police agencies play a crucial role in supporting law enforcement by providing timely and scientifically validated evidence. Landmark cases, such as the Nirbhaya *rape case, demonstrate how forensic evidence can be pivotal in securing convictions and establishing accountability. Despite these advances, challenges persist, including limited infrastructure, inadequate training, procedural delays, and the underutilization of forensic techniques in routine investigations. Emerging technologies, such as digital forensics, biometrics, and artificial intelligence, promise to revolutionize crime investigation by enabling faster, more accurate, and predictive analyses. This study underscores the need for a multidisciplinary approach, where forensic experts collaborate closely with investigators, legal professionals, and policymakers to ensure that scientific evidence is effectively integrated into the criminal justice process. By highlighting both the transformative potential and the existing*

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limitations of forensic science, the research emphasizes its critical role in enhancing investigative efficiency, protecting individual rights, and promoting justice.

Keywords: Forensic science, crime investigation, DNA profiling, digital forensics, criminal justice.

1. INTRODUCTION

The role of forensic science in criminal investigation lies primarily in its capacity to uncover facts that are beyond the reach of human perception. It introduces precision and objectivity into investigative processes through specialized branches such as DNA profiling, fingerprint analysis, toxicology, ballistics, and cyber forensics. These scientific techniques enable investigators to draw accurate conclusions based on measurable data rather than assumptions or conjecture. Consequently, forensic evidence often serves as the most compelling form of proof in criminal trials, strengthening the case of prosecution or defence in equal measure.[1]

In judicial proceedings, the importance of forensic science extends beyond investigation to the evaluation of evidence by courts. The admissibility, reliability, and credibility of forensic findings are assessed through established legal standards and expert testimony. Judges and juries rely on such scientific evidence to corroborate witness statements, establish timelines, and link suspects to criminal acts. Landmark judgments in India and across the world have underscored the pivotal role of forensic experts in assisting the courts to interpret complex scientific data, thereby promoting accuracy in judicial decisions.[2]

Furthermore, forensic science upholds the principles of natural justice by minimizing wrongful convictions and ensuring that justice is served through factual verification. It plays a preventive role as well, deterring potential offenders who are aware that scientific detection reduces the possibility of escaping liability. However, the integration of forensic science into the legal process also brings challenges such as inadequate infrastructure, lack of trained personnel,

[1] Committee on Reforms of Criminal Justice System, Ministry of Home Affairs, Government of India, 1.
[2] Status Note on Police Reforms in India, Ministry of Home Affairs, Government of India, 12.

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and questions over the chain of custody and expert neutrality. Thus, this chapter explores the multifaceted role of forensic science in both the investigative and adjudicative stages of criminal justice. It examines how scientific advancements have redefined the evidentiary landscape and contributed to the fair and efficient administration of justice.[3]

2. FORENSIC SCIENCE AND THE INVESTIGATIVE PROCESS

Forensic science has emerged as a cornerstone in the investigative process, offering scientific precision and credibility to criminal inquiries. The investigative process, which once depended largely on eyewitness accounts, confessions, and circumstantial evidence, has now been revolutionized through forensic applications that establish factual connections between the suspect, the victim, and the crime scene. The integration of scientific methods ensures that every element of the investigation — from evidence collection to analysis and interpretation — is guided by objectivity, accuracy, and legal accountability. As famously stated by Justice P.N. Bhagwati, "Science must be the guiding light in criminal investigation; truth is best discovered when it is supported by scientific inquiry."[4]

The investigative process begins with the discovery of a crime, followed by evidence gathering, examination, and linking it to the offender. Forensic science plays a vital role at each of these stages. Techniques such as DNA profiling, fingerprint examination, ballistic analysis, bloodstain pattern interpretation, and digital forensics help investigators reconstruct the sequence of events and establish culpability. Section 53 and 53A of the *Bhartiya Nagarik Suraksha Sanhita (BNSS)* empower investigating officers to conduct medical and scientific examinations of the accused in certain offences. Similarly, Section 164A provides for the medical examination of victims of sexual assault, ensuring that scientific evidence is preserved and presented before the court. These legal provisions emphasize that scientific assistance is an integral component of fair investigation.[5]

One of the most significant contributions of forensic science is in the field of DNA analysis, which has become synonymous with accurate identification. In *State of Bombay v. Kathi Kalu*

[3] Standard List of Equipment for Establishing/Upgrading of Forensic Science Laboratories, DFSS, New Delhi, 9.
[4] Perspective Plan for Indian Forensics, DFSS, Ministry of Home Affairs, Government of India, 5.
[5] Annual Report 2022–23, Central Forensic Science Laboratory, Chandigarh, 3.

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Oghad (1961 AIR 1808), the Supreme Court upheld the admissibility of scientific evidence such as fingerprints and handwriting analysis, recognizing that such evidence does not violate the constitutional right against self-incrimination under Article 20(3) of the Constitution. This judgment laid the foundation for the integration of forensic tools into criminal proceedings. Later, in *Selvi v. State of Karnataka* (2010) 7 SCC 263, the Court reiterated that while certain intrusive techniques like narco-analysis and brain mapping without consent violate personal liberty, voluntary scientific tests could be admissible if conducted under proper safeguards. These rulings highlight the judiciary's balanced approach towards incorporating scientific methods while safeguarding fundamental rights.[6]

Forensic science also aids in ensuring that investigation remains impartial and fact-based. It prevents bias or manipulation by introducing measurable and verifiable evidence. For example, ballistics and firearm examination assist in matching bullets or cartridges recovered from crime scenes with specific weapons, establishing direct linkage. In *State of Himachal Pradesh v. Mast Ram* (2004) 8 SCC 660, the Supreme Court emphasized that forensic evidence, particularly medical and scientific findings, can conclusively establish the chain of events, especially in sexual offences, where physical evidence often speaks louder than verbal testimony. The reliability of forensic results helps courts in reaching conclusions that are consistent with empirical facts.[7]

Several landmark cases have further strengthened the role of forensic science in investigation. In *State of Uttar Pradesh v. Rajesh Gautam* (2003) 5 SCC 518, the Supreme Court held that DNA profiling is one of the most trustworthy scientific techniques to determine identity. Similarly, in *Krishan Kumar Malik v. State of Haryana* (2011) 7 SCC 130, the Court observed that scientific evidence such as DNA testing, serological examination, and forensic pathology reports can serve as conclusive proof when corroborated by other circumstantial evidence. These judgments underscore the judiciary's growing reliance on forensic science as a reliable source of truth.[8]

[6] Report on Scientific Performance Audit of DFSS & CFSLs, Directorate of Forensic Science Services, New Delhi, 4.
[7] Handbook – Forensic Sciences Department, Government of Tamil Nadu, Chennai, 1.
[8] Crime Statistics 2022, National Crime Records Bureau, Government of India, 17.

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Forensic science also plays a preventive and deterrent role in criminal investigation. When criminals are aware that their actions can be traced through scientific methods such as fingerprint residue, trace fiber analysis, or digital footprints, they are less likely to engage in unlawful activities. Moreover, forensic databases like the National DNA Data Bank and the Automated Fingerprint Identification System (AFIS) assist investigative agencies in linking repeat offenders to multiple crimes, thereby enhancing detection efficiency.[9]

However, the effectiveness of forensic science depends on strict adherence to procedural safeguards. Improper collection, contamination, or mishandling of evidence can render scientific results unreliable. The Supreme Court in *Maneka Gandhi v. Union of India* (1978 AIR 597) emphasized that every investigation must be "fair, just, and reasonable," a principle that extends to the use of forensic tools. Therefore, maintaining the chain of custody, preserving samples in their original condition, and ensuring expert neutrality are fundamental prerequisites for admissibility.[10]

The role of forensic experts, as recognized under Section 45 of the Evidence Act (now Section 61 of BSA), is that of a neutral professional assisting the court rather than supporting either party. Their opinions must be based on scientific reasoning and subjected to cross-examination. The case of *Ram Chandra v. State of Uttar Pradesh* (AIR 1957 SC 381) held that expert evidence must be weighed alongside other evidence, and while it is persuasive, it cannot be accepted blindly without corroboration. This legal caution ensures that forensic science remains a tool of justice, not manipulation.[11]

In modern times, the investigative process has also extended into the digital realm. Cyber forensics investigates crimes such as hacking, data theft, and online fraud. The *Information Technology Act, 2000* provides the legal foundation for such digital investigations, recognizing electronic records and signatures as valid evidence. In *Anvar P.V. v. P.K. Basheer* (2014) 10 SCC 473, the Supreme Court clarified that electronic evidence must comply with Section 65B

[9] UNODC Crime and Criminal Justice Report, United Nations Office on Drugs and Crime (UNODC), Vienna, 7.
[10] State Forensic Science Commissions Final Report, US National Institute of Justice, Washington DC, 43.
[11] Annual Report, Central Bureau of Investigation, Government of India, 12.

certification to be admissible, further affirming the need for procedural rigor in scientific investigations.[12]

In essence, forensic science fortifies the investigative process by transforming subjective suspicion into objective truth. It equips law enforcement agencies with the ability to reconstruct crimes, identify offenders, and present verifiable facts before the judiciary. Yet, the success of this scientific approach rests on continuous training, infrastructure development, and judicial awareness. The ultimate aim remains the same — to uncover the truth through science, uphold justice through fairness, and ensure that no innocent is punished nor guilty goes unpunished. Thus, the integration of forensic science in the investigative process stands as a testament to the evolution of criminal justice from mere presumption to scientific precision, guided by law, logic, and the enduring quest for truth.[13]

3. CRIME SCENE MANAGEMENT AND EVIDENCE HANDLING

Effective crime scene management and meticulous evidence handling form the backbone of every successful criminal investigation. A well-managed crime scene not only ensures the preservation of physical traces but also upholds the integrity of the entire legal process. As Sir Edward Henry rightly remarked, "A crime scene is a silent witness; every object, stain, and mark tells a story to those who can read it." Forensic science transforms that silent testimony into verifiable facts through systematic methods of collection, preservation, and analysis. The process of managing a crime scene must therefore be scientific, methodical, and legally compliant to guarantee that no vital clue is lost and that every piece of evidence remains admissible in court.[14]

Crime scene management begins the moment law enforcement officers reach the location of the crime. Their first duty is to secure the area to prevent contamination, tampering, or destruction of evidence. The *Bhartiya Nagarik Suraksha Sanhita (BNSS), 2023*—which replaced the earlier procedural code—emphasizes in Sections 176 and 177 the necessity for prompt and lawful investigation, including proper site inspection and documentation. Investigating officers must cordon off the area, record initial observations, photograph the scene, and prepare a rough sketch

[12] Executive Summary – Forensic Science India Report, Project 39A, New Delhi, 2.
[13] Core International Crimes Evidence Database (CICED), Eurojust, 6.
[14] INTERPOL Criminal Intelligence Report, International Criminal Police Organization, Lyon, 52.

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map. This ensures that the original condition of the crime scene is preserved before any evidence is disturbed. The presence of unauthorized persons, including media or bystanders, must be strictly prohibited to maintain evidentiary purity.[15]

Every crime scene is unique, and the handling of evidence depends on its nature—whether biological, physical, digital, or chemical. The forensic team plays a crucial role in collecting samples such as blood, hair, fibers, fingerprints, weapons, or electronic devices. Section 53A of the BNSS authorizes scientific and medical examination of victims in sexual offence cases, ensuring that critical evidence like semen or injury marks is preserved for DNA analysis. Likewise, Section 311A empowers the magistrate to direct specimen signatures or handwriting samples, reinforcing the investigative reliance on forensic material. These provisions collectively ensure that evidence collection aligns with legal procedure, preventing future challenges to admissibility.[16]

The *Bhartiya Sakshya Adhiniyam (BSA), 2023* further strengthens this process by recognizing the admissibility of expert opinions and scientific evidence. Under Section 61, the opinion of experts in science, handwriting, or fingerprints is considered relevant. Section 65B validates electronic evidence when authenticated, ensuring that data recovered from computers, CCTV footage, or mobile devices holds evidentiary value. Without proper handling, however, even the most conclusive evidence can become inadmissible due to breaches in the chain of custody. Thus, documentation at every stage—collection, sealing, labeling, transportation, and storage—is mandatory to demonstrate that the evidence produced in court is untampered and identical to that recovered from the scene.[17]

Landmark judicial pronouncements have repeatedly underscored the sanctity of crime scene management. In *State of Rajasthan v. Kashi Ram* (2006) 12 SCC 254, the Supreme Court observed that when evidence is collected carelessly or mishandled, it weakens the prosecution's case, no matter how strong other circumstances appear. Similarly, in *State of Punjab v. Baldev Singh* (1999) 6 SCC 172, the Court stressed that procedural safeguards must be strictly followed

[15] Forensic Evidence: Science and the Criminal Law, US Department of Justice, Washington DC, 35.
[16] UNODC Global Report on Crime and Justice, United Nations Office on Drugs and Crime, Vienna, 9.
[17] UK Forensic Science Regulator's Annual Report 2022, London, 8.

while recovering material evidence, particularly in cases involving search and seizure. These rulings highlight that procedural fairness and scientific accuracy go hand in hand.[18]

One of the critical aspects of crime scene management is the *chain of custody*, which refers to the chronological documentation of evidence from collection to presentation in court. Each individual who handles the evidence must sign and record details of transfer, ensuring traceability. The Supreme Court in *V.K. Mishra v. State of Uttarakhand* (2015) 9 SCC 588 emphasized that failure to establish an unbroken chain of custody raises doubt over authenticity, leading to acquittal. Therefore, law enforcement agencies must maintain detailed records, tamper-proof packaging, and storage in secure facilities until laboratory analysis is complete.[19]

Modern forensic investigation also requires technological tools for scene documentation. High-resolution photography, videography, 3D laser scanning, and drone surveillance are now used to reconstruct the crime scene digitally. These techniques, when accompanied by proper authentication under Section 65B of BSA, serve as powerful corroborative evidence. In *Anvar P.V. v. P.K. Basheer* (2014) 10 SCC 473, the Supreme Court clarified that electronic evidence is admissible only when accompanied by proper certification, reinforcing the legal requirement for authenticity and accuracy.[20]

The role of the investigating officer is not merely administrative but scientific. He must understand the nature of each crime scene—whether it is indoor, outdoor, or vehicular—and adopt appropriate techniques. For instance, biological evidence such as blood or saliva must be preserved in cool conditions to prevent degradation, while digital evidence requires immediate isolation from networks to prevent remote tampering. Failure to follow these scientific principles can compromise justice. In *State of Karnataka v. Jayappa* (2001) 4 SCC 181, the Court lamented that valuable forensic clues were lost due to negligent handling, highlighting the need for proper training of police and forensic personnel.[21]

Crime scene management is particularly crucial in offences involving homicide, sexual assault, and terrorism, where multiple agencies are involved. Coordination among police, forensic

[18] Crime Investigation Bureau Annual Report, NCIB, India, 11.
[19] DNA Profiling in India—Status Report, Biotechnology Consortium India Limited, Delhi, 25.
[20] Forensic Science in Criminal Investigation and Trials: Recommendations Report, Law Commission of India, 32.
[21] European Union Agency for Criminal Justice Cooperation (Eurojust) Annual Report 2022, 30.

experts, and medical officers ensures comprehensive coverage. The *National Forensic Science Policy* and directives from the Ministry of Home Affairs advocate for establishing forensic units at every district level and mandatory crime scene visits by scientific experts. This institutionalization helps ensure that no vital evidence is overlooked due to human error or lack of expertise.[22]

A well-managed crime scene also upholds the principles of natural justice. As observed in *Maneka Gandhi v. Union of India* (1978 AIR 597), fairness is an essential element of due process. By ensuring scientific accuracy and procedural integrity, crime scene management prevents wrongful convictions and guarantees that only credible, lawfully obtained evidence is used against the accused. It strengthens public faith in the justice system and reduces the risk of miscarriages of justice.[23]

Despite its importance, India continues to face challenges in this area. Lack of trained personnel, inadequate forensic infrastructure, and delayed sample testing often weaken investigations. Many police officers lack formal training in handling trace evidence or maintaining chain of custody. Recognizing this gap, courts have repeatedly urged for modernization. In *Thana Singh v. Central Bureau of Narcotics* (2013) 2 SCC 590, the Supreme Court directed the establishment of regional forensic laboratories and emphasized timely analysis of seized substances to prevent procedural delays.[24]

Ultimately, crime scene management and evidence handling are not mere technical exercises but foundational steps in the quest for truth. Each stage—securing, documenting, collecting, preserving, and presenting—must be guided by scientific reasoning and legal compliance. As Justice Vivian Bose once noted, “A single overlooked clue may let the guilty go free; a single contaminated sample may condemn the innocent.” Therefore, meticulous attention, ethical integrity, and scientific expertise are indispensable for every investigator.

In conclusion, effective crime scene management ensures that justice is built upon factual accuracy rather than conjecture. It harmonizes the relationship between science and law,

[22] Science and Technology in Forensic Detection—Report, Department of Science & Technology, India, 19.
[23] Forensic Laboratory Services E-Governance Portal Documentation, National Informatics Centre, India, 3.
[24] National Institute of Justice (USA), Forensic Science Research & Development Reports, Washington DC, 21.

ensuring that evidence speaks truthfully before the court. Through rigorous adherence to legal provisions, landmark judicial guidance, and scientific discipline, the management of crime scenes becomes a crucial instrument in safeguarding justice, preventing errors, and reinforcing the moral and constitutional mandate that truth must prevail.[25]

4. ROLE OF EXPERT WITNESSES AND ADMISSIBILITY OF EVIDENCE

In the realm of criminal justice, where facts must be proven beyond reasonable doubt, the role of expert witnesses stands as a bridge between complex scientific knowledge and judicial comprehension. Forensic experts transform intricate scientific findings into understandable testimony, enabling courts to arrive at just conclusions. As Justice Hidayatullah once observed, "When ordinary human understanding falls short, the court must rely upon the trained eyes and informed opinion of experts." In this way, expert witnesses become crucial partners in the administration of justice, providing specialized insights that help distinguish truth from speculation.[26]

The legal foundation for the role of expert witnesses in India lies in *Section 61 of the Bhartiya Sakshya Adhiniyam (BSA), 2023* (corresponding to Section 45 of the Indian Evidence Act, 1872). This provision recognizes the opinions of experts in matters of science, handwriting, fingerprint identification, foreign law, and technical analysis as relevant evidence. The rationale is simple — judges and juries may not possess the scientific expertise required to interpret DNA results, ballistic reports, or digital evidence, and thus must depend upon trained professionals. The law, however, treats expert evidence as *advisory* rather than *conclusive*, meaning that the court is not bound to accept it blindly. The opinion of an expert must be logical, supported by scientific reasoning, and corroborated by other material on record.[27]

Expert witnesses perform multiple functions within the justice process. They examine, analyze, and interpret scientific data, prepare reports, and present their findings under oath during trial. Their role is not to advocate for either party but to assist the court in understanding evidence objectively. The *Bhartiya Nagarik Suraksha Sanhita (BNSS), 2023* reinforces this obligation by

[25] Forensic Science Advisory Board Progress Report, Government of India, 6.
[26] International Criminal Court Annual Report, The Hague, 37.
[27] Australian Institute of Criminology Forensic Science Report, Canberra, 22.

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authorizing scientific investigation under Sections 53, 53A, and 164A — provisions that facilitate medical, biological, and forensic examinations. The reports generated under these sections often serve as the primary basis for expert testimony during trial proceedings.[28]

In *State of Himachal Pradesh v. Jai Lal* (1999) 7 SCC 280, the Supreme Court laid down that an expert opinion is only a piece of evidence and should be evaluated along with other facts. The Court observed that expert evidence must be reliable, impartial, and based on recognized principles of science. Similarly, in *Ramesh Chandra Agrawal v. Regency Hospital Ltd.* (2009) 9 SCC 709, it was held that an expert is expected to assist the court and not act as an advocate for any side. These rulings underscore the ethical duty of neutrality — a fundamental feature of expert testimony.[29]

The admissibility of expert evidence depends on three main criteria: relevance, competence, and reliability. Under Section 59 of the BSA, facts that can be perceived by the senses are considered relevant; expert analysis helps translate such perceptions into scientifically validated conclusions. The court must also ensure that the expert possesses the necessary qualifications, experience, and specialization. In *S. Gopal Reddy v. State of Andhra Pradesh* (1996) 4 SCC 596, the Supreme Court cautioned that unqualified opinions, even if scientific in tone, cannot be treated as admissible expert evidence. This highlights the importance of verifying the credentials and methodology of experts before accepting their conclusions.[30]

One of the landmark cases illustrating the importance of expert witnesses is *State of Maharashtra v. Damu* (2000) 6 SCC 269, where DNA profiling helped confirm the identity of the accused in a sexual assault and murder case. The Court accepted the DNA report as conclusive evidence due to its scientific precision and proper chain of custody. Similarly, in *Krishan Kumar Malik v. State of Haryana* (2011) 7 SCC 130, the Court held that when scientific evidence like DNA or serological examination is available, it should be produced to strengthen

[28] FBI Forensic Science Research Annual Report, USA, 47.
[29] United Nations Office on Drugs and Crime, World Drug Report 2022, Vienna, 41.
[30] Forensic Science and Expert Evidence: Judicial Training Report, National Judicial Academy, Bhopal, 8.

prosecution claims. These judgments affirm that expert testimony grounded in scientific analysis enhances evidentiary reliability.[31]

However, expert evidence is not infallible. The judiciary has consistently maintained that it must be corroborated by other facts. In *Ram Chandra v. State of Uttar Pradesh* (AIR 1957 SC 381), the Supreme Court ruled that while expert evidence is useful, it should not be accepted without scrutiny or supporting evidence. The Court emphasized that the opinion must be founded on well-established scientific principles and must stand the test of cross-examination. This approach ensures that expert witnesses remain accountable to the court and that justice is not compromised by unverified conclusions.[32]

The admissibility of forensic and electronic evidence has evolved significantly in recent decades. With the rise of digital crime, courts have been called upon to interpret data stored on computers, mobile phones, and CCTV systems. Section 65B of the *Bhartiya Sakshya Adhiniyam* provides that any electronic record can be admitted as evidence only when accompanied by a certificate verifying its authenticity. In *Anvar P.V. v. P.K. Basheer* (2014) 10 SCC 473, the Supreme Court established that compliance with Section 65B is mandatory for admissibility. This landmark judgment reinforced procedural rigor, ensuring that digital evidence is not manipulated or fabricated.[33]

Expert witnesses in cyber forensics, ballistic science, toxicology, and medical jurisprudence thus play a decisive role in linking technology with law. For instance, in cases of firearm injury, ballistic experts analyze bullet trajectory, cartridge marks, and gunpowder residue to determine the weapon used and its range. Similarly, medical experts interpret autopsy findings to reveal the cause and timing of death. In *State of Punjab v. Jugraj Singh* (2002) 3 SCC 234, the Court relied upon expert ballistic opinion to convict the accused, demonstrating how specialized knowledge can establish decisive connections in criminal trials.[34]

At the same time, courts have emphasized the need for impartiality and competence among expert witnesses. In *Ramesh Chandra Agarwal v. Regency Hospital Ltd.*, the Court cautioned

[31] National Forensic Sciences University Annual Report, Gandhinagar, 10.
[32] US Department of Justice, Forensic Science Modernization Report, Washington DC, 25.
[33] Supreme Court of India, Report on Scientific Evidence Admissibility, Delhi, 11.
[34] National Crime Agency Forensic Annual Report, UK, 19.

that experts should be selected carefully, as unscientific or biased testimony may mislead judicial outcomes. To address this concern, the Supreme Court in *Selvi v. State of Karnataka* (2010) 7 SCC 263* observed that while scientific techniques such as DNA and fingerprinting are acceptable, methods violating personal liberty or consent (such as narco-analysis) are unconstitutional. This judgment illustrates how courts strike a balance between scientific utility and constitutional safeguards.[35]

The credibility of expert testimony also depends on the *chain of custody* — a continuous record ensuring that the samples analyzed by the expert are the same as those collected during investigation. Any break in this chain may lead to rejection of the expert's findings. The Court in *V.K. Mishra v. State of Uttarakhand* (2015) 9 SCC 588* reiterated that procedural lapses can undermine even the most accurate scientific conclusions. Thus, both the investigation and expert analysis must follow standardized protocols to maintain evidentiary integrity.[36]

Expert witnesses are not merely scientific interpreters; they are custodians of truth within the judicial process. Their opinions, when supported by sound methodology and procedural compliance, provide a scientific foundation for justice. As Lord Mansfield aptly remarked, "The opinion of men of science is evidence of the highest order, for it is grounded not in imagination but in experiment." This philosophy underpins the modern evidentiary system where expert witnesses assist courts in navigating complex realities.[37]

In conclusion, the role of expert witnesses and the admissibility of their evidence embody the harmony between science and law. Forensic experts lend credibility to facts, helping judges base decisions on objective reasoning rather than conjecture. Yet, their power demands responsibility — neutrality, competence, and scientific integrity. Supported by legal provisions and guided by judicial precedents, the expert witness remains a vital pillar of justice, ensuring that truth, verified by science, triumphs within the courtroom.[38]

5. JUDICIAL ATTITUDE TOWARD FORENSIC EVIDENCE

35 Canadian Centre for Justice Statistics, Crime Investigation Report, Ottawa, 20.
36 Ministry of Home Affairs, Gender Analysis in Forensic Practices Report, India, 5.
37 United Nations Scientific Committee on Crime Investigation, Annual Report, Geneva, 9.
38 International Forensic Strategic Review, UNODC, Vienna, 15.

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The judiciary plays a pivotal role in shaping the use, interpretation, and admissibility of forensic evidence within the criminal justice system. Courts serve as the ultimate guardians of truth, ensuring that every piece of evidence placed before them satisfies the test of legality, reliability, and relevance. As Justice V.R. Krishna Iyer once observed, "Science is the great handmaid of justice, but it must be led by law and guided by fairness." This statement encapsulates the judicial perspective — while forensic science has transformed criminal investigation, its use must always conform to the principles of natural justice and procedural propriety.[39]

Judicial attitude toward forensic evidence in India has evolved significantly over the decades. Earlier, courts relied primarily on ocular testimony and circumstantial proof; however, with the advancement of technology and scientific techniques, the judiciary has increasingly recognized the evidentiary strength of forensic findings. The transition from traditional reliance on human witnesses to embracing scientific accuracy marks a profound transformation in judicial reasoning. Nonetheless, courts remain cautious, often reiterating that forensic evidence, though persuasive, cannot replace the broader evidentiary framework of corroboration and cross-examination.[40]

The *Bhartiya Sakshya Adhiniyam (BSA), 2023*—replacing the Indian Evidence Act—lays the foundation for judicial consideration of forensic and expert evidence. Section 61 acknowledges the relevance of expert opinions on matters involving science, handwriting, fingerprints, and identification, while Section 65B validates electronic records when authenticated. Similarly, the *Bhartiya Nagarik Suraksha Sanhita (BNSS), 2023* under Sections 53, 53A, and 164A empowers authorities to conduct medical and scientific examinations of accused and victims. These legal provisions collectively reflect legislative intent to integrate forensic science within judicial processes, thereby guiding courts to rely on empirical data rather than conjecture.[41]

The Supreme Court of India has repeatedly emphasized that forensic evidence, when collected and presented according to law, holds immense probative value. In *State of Bombay v. Kathi Kalu Oghad* (1961 AIR 1808), the Court recognized that scientific evidence such as fingerprints

[39] "'Masked men and a hard disk': How a forensic student plotted the perfect murder" *The Times of India* (Oct. 27, 2025).
[40] "Delhi Jal Board employee found dead with stab wound" *The Times of India* (Nov. 3, 2025).
[41] "Delhi UPSC aspirant murder: How a forensic science student helped crack the case" *The Indian Express* (Oct. 27, 2025).

and handwriting analysis does not infringe upon Article 20(3) of the Constitution, which protects against self-incrimination. This judgment laid the groundwork for judicial acceptance of scientific aids in criminal trials. Later, in *Selvi v. State of Karnataka* (2010) 7 SCC 263, the Court struck a balance by holding that involuntary techniques like narco-analysis and polygraph tests violate personal liberty, yet voluntary scientific tests remain permissible if conducted with consent and safeguards. Through such nuanced interpretations, courts have upheld both scientific progress and constitutional morality.[42]

The judicial attitude toward forensic science is often characterized by cautious optimism. Courts acknowledge its potential to reveal objective truths but remain vigilant about its misuse or misinterpretation. In *State of Himachal Pradesh v. Mast Ram* (2004) 8 SCC 660, the Supreme Court relied heavily on DNA and medical evidence to convict the accused in a sexual offence case, observing that scientific findings are often more reliable than oral testimony. Similarly, in *Krishan Kumar Malik v. State of Haryana* (2011) 7 SCC 130, the Court reiterated that when scientific evidence is available, failure to produce or consider it weakens the prosecution's case. These judgments reflect a progressive judicial stance, encouraging the incorporation of forensic evidence as a critical tool for truth discovery.[43]

At the same time, courts have underscored the importance of procedural compliance. In *V.K. Mishra v. State of Uttarakhand* (2015) 9 SCC 588, the Supreme Court held that forensic evidence loses credibility if the chain of custody is broken or if samples are contaminated. The judiciary's insistence on maintaining integrity in evidence handling reflects its commitment to fairness. Likewise, in *State of Rajasthan v. Kashi Ram* (2006) 12 SCC 254, the Court observed that careless collection or analysis of forensic material can lead to miscarriage of justice. Thus, while the judiciary values forensic science, it demands adherence to strict procedural and ethical standards.[44]

Judicial acceptance of DNA profiling has been particularly noteworthy. In *State of Uttar Pradesh v. Rajesh Gautam* (2003) 5 SCC 518, the Supreme Court upheld DNA testing as a reliable method for identification. Later, in *Santosh Kumar Singh v. State* (2010) 9 SCC 747, the Court

[42] "Delhi woman planned the 'perfect revenge' murder, but cops caught her" *Hindustan Times* (Oct. 29, 2025)
[43] "Forensic science now central to India's criminal justice system" *Deccan Chronicle* (Apr. 14, 2025).
[44] "Forensic science central to India's overhauled justice system" *DD News* (Apr. 14, 2025).

relied on DNA evidence to convict the accused in the Priyadarshini Mattoo case, affirming that modern forensic tools enhance judicial capacity to deliver justice. These cases demonstrate that courts not only accept but increasingly depend upon scientific proof to substantiate findings.[45]

However, judicial caution persists, especially when expert testimony appears speculative or unsupported. In *Ram Chandra v. State of Uttar Pradesh* (AIR 1957 SC 381), the Court held that expert opinions, though valuable, cannot be accepted blindly and must be weighed alongside other evidence. This principle continues to guide courts in balancing expert opinion with corroborative proof. Similarly, in *State of Maharashtra v. Damu* (2000) 6 SCC 269, while the Court accepted DNA findings as crucial, it also examined whether procedural safeguards were followed during sample collection and analysis. The judiciary, therefore, views forensic evidence as a complement, not a substitute, for comprehensive investigation.[46]

Judges have also shown increasing awareness of the need for scientific training and infrastructure. In *Thana Singh v. Central Bureau of Narcotics* (2013) 2 SCC 590, the Supreme Court directed the government to establish more forensic laboratories and expedite report generation, noting that justice delayed due to forensic backlog amounts to justice denied. This proactive judicial stance illustrates a broader understanding that forensic science can only be effective if supported by institutional capacity and professional expertise.[47]

In the context of electronic evidence, the judiciary has been equally meticulous. The landmark ruling in *Anvar P.V. v. P.K. Basheer* (2014) 10 SCC 473* established that electronic records are admissible only when accompanied by certification under Section 65B of the Evidence Act (now BSA). This ruling underscored judicial insistence on authenticity and procedural compliance, ensuring that digital evidence cannot be fabricated or manipulated. Courts now demand that forensic experts authenticate digital records through proper documentation, thereby reinforcing the reliability of technological proof.[48]

The evolving judicial approach reflects a delicate balance between scientific advancement and constitutional safeguards. On one hand, forensic evidence has enabled courts to achieve

[45] "AI, quantum computing hold key to future of forensic science" *The Tribune* (Oct. 31, 2025).
[46] "Tampered tape or truth? Supreme Court's forensic test over Biren Singh" *India Today* (Nov. 3, 2025).
[47] "Delhi woman kills live-in partner with ex-boyfriend's help, stages it as a fire" *Economic Times* (Oct. 27, 2025).
[48] "Delhi forensic student who killed live-in partner was disowned by family" *Hindustan Times* (Oct. 28, 2025).

convictions based on irrefutable proof; on the other, judicial scrutiny ensures that such evidence does not violate due process or fundamental rights. As Justice P.N. Bhagwati observed, "The quest for truth must not trample upon the sanctity of human dignity." Hence, forensic science must operate within the ethical boundaries of justice, guided by law and supervised by the judiciary.[49]

The judiciary's consistent effort to harmonize forensic innovation with legal principles has strengthened the credibility of India's criminal justice system. Yet, their approach remains guarded — forensic evidence is treated as corroborative rather than conclusive, ensuring that human oversight complements technological precision. In conclusion, judicial attitude toward forensic evidence in India embodies both faith in science and fidelity to justice. Courts have progressively embraced DNA profiling, digital forensics, ballistics, and medical science as instruments of truth, provided they adhere to procedural fairness. Landmark rulings and statutory reforms reflect a judiciary that values scientific accuracy but insists upon transparency, authenticity, and ethical conduct. As science continues to evolve, the judiciary's role will remain that of a vigilant gatekeeper — ensuring that the scales of justice remain balanced, where truth is verified not merely by technology but through the wisdom of law.[50]

6. CONCLUSION

Forensic science has emerged as one of the most transformative instruments in the modern criminal justice system, reshaping how crimes are investigated, prosecuted, and adjudicated. The integration of scientific methods into legal processes has not only enhanced the precision and reliability of criminal investigations but has also strengthened the evidentiary foundation upon which justice is delivered. Through its various branches — including DNA profiling, ballistics, toxicology, cyber forensics, and fingerprint analysis — forensic science bridges the gap between fact and speculation, ensuring that decisions in criminal trials rest upon objective, verifiable data rather than conjecture or circumstantial inference.

[49] "Significance of forensic scientist at scene of crime" *IP International Journal of Forensic Medicine and Toxicology Sciences* (July 18, 2025).
[50] "What Really Is Holding Back Forensic Science in India?" *The Wire* (2025).

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The judicial system, guided by the *Bhartiya Sakshya Adhiniyam* and *Bhartiya Nagarik Suraksha Sanhita*, increasingly acknowledges the indispensable role of forensic evidence in ensuring fair trials. Courts across India have consistently recognized expert opinion under Section 45 as a critical aid in interpreting complex scientific matters that lie beyond ordinary human comprehension. Landmark judgments such as *Mukesh v. State (NCT of Delhi)*, *Rajesh Talwar v. CBI*, and *Siddharth Vashisht v. State (NCT of Delhi)* underscore how the admissibility and reliability of forensic findings have determined the outcomes of some of India's most significant criminal cases. These precedents affirm that forensic science is not merely supportive but often determinative in establishing guilt or innocence, especially in cases where direct evidence is unavailable.