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**NEW TECHNOLOGIES IN FORENSIC EVIDENCE LAW IN INDIA:  
AN ANALYTICAL STUDY**

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**Introduction:**

The 20th century is widely regarded as a period of remarkable scientific and technological advancements. Forensic science institutions in India were established at the start of the 20th century. The networking of these institutions persisted until the close of the 20th century and grew stronger in the 21st century. India has developed new forensic technologies to ensure the efficient handling of crime cases through scientific investigations in both the field and laboratories. The development of forensic science in India has experienced a significant transformation, greatly impacting the field of criminal prosecution. In the ever-evolving world of criminal justice, the incorporation of forensic science has proven to be instrumental in improving the investigative process and promoting a fair and efficient prosecution. However, these forensic technologies have not kept pace with the growing workload of crime cases. Continued efforts are being made to enhance the workforce, machinery, science, and technology to modernize forensics in India. However, there is still a need to further develop the capacity of forensics in the country.

**Historical Development of Forensic Science in India:**

In India, the utilization of science and technology to uncover evidence of crime, carry out investigations, and ensure justice has been a longstanding practice. It seems that our ancestors employed scientific procedures of some sort to investigate crimes, even though forensic science as we know it today did not exist during their time. Kautilya's "Arthashastra," written approximately 2300 years ago, provides a comprehensive reference to the subject. Indians

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have observed a wide range of papillary line patterns for centuries. They used fingerprints as signatures, indicating their understanding of the lasting and distinct nature of these prints. For centuries, illiterate individuals in India have relied on fingerprints as their unique form of signature. Before the scientific verification of fingerprint identification, some individuals regarded it as merely ceremonial. The establishment of the first state forensic science laboratory in India took place in 1952 in Calcutta. This lab, along with the Medico-legal Section of the Chemical Examiner's Laboratory, a tiny Physics section, and the Criminal Investigation Department's Footprint and Note Forgery Sections, became the first interdisciplinary forensic science laboratory to be fully operational in 1953.

In the middle of the 19th century, there was a significant advancement and growth in the field of natural science. The theories proposed to explain the scheme of things began to lose credibility as scientific experiments gradually revealed the mysteries of the universe with clear, logical reasoning. The shift in perspective from the mystical to the scientific quickly became evident, not just in criminal investigation, but in various aspects of the legal system. Now two aspects of a single case have come to light. In India, there is a possibility that the criminal justice system may sometimes result in the punishment of innocent individuals while allowing the guilty to go free. For this reason, it is crucial to enhance and ensure the effectiveness of the reform. Therefore, a Committee was established, called the Malimath Committee, which proposed that the significance of forensic science should be recognized in contemporary technology for investigations and criminal procedures.

The forensic evidence effectively disproves any accusations made against the individual in question. When analyzing a crucial case study, this evidence is necessary. If forensic evidence is provided, it is highly unlikely that the court will remain impartial, making it highly probable that the verdict will not be in the defendant's favor. The reason for this is that scientific evidence cannot be rejected or disregarded, unlike other physical data that may be tempered and altered. In certain instances, a court may rely on the opinions of the court, as stated in Section 45 of the Indian Evidence Act of 1872. The court has the authority to consider various factors when making decisions, including foreign legislation, scientific evidence, artistic works, fingerprints, handwriting, and the testimony of experts in their respective fields.

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However, since they were not present during the crime, the experts serve as consultants rather than witnesses. They are sharing their perspectives on the scientific field through their research. However, it is widely believed that the expert opinion premise remains crucial. The court's conclusion is supported by the expertise of legal counsel. They heavily depend on it because the experts are well-versed in studying these types of subjects.

### **Current State of Forensic Evidence in Law in India:**

Forensic evidence plays a crucial role in Indian criminal investigations, providing valuable insights through scientific analysis of physical and digital materials. It enhances the strength of prosecution cases, assists in identifying culprits, and proves the innocence of the wrongly accused. Nevertheless, the legal landscape surrounding its use is a complex network, always changing to strike a balance between the demand for precise and trustworthy evidence and the safeguarding of individual rights and scientific integrity. Grasping this interplay is essential for a well-rounded view of the present status of forensic evidence law in India.

- **ADMISSIBILITY AND LEGISLATION**

Two main pieces of legislation regulate the use of forensic evidence in India:

1. **The Indian Evidence Act, 1872:** This Act establishes the basis for the admissibility of evidence in court. Section 45 acknowledges the significance of expert opinions, including those of forensic specialists, in certain situations. It is worth mentioning that Section 73 grants courts the authority to instruct individuals, including the accused, to provide samples for DNA or fingerprint analysis. There have been concerns raised about the compatibility of this provision with the right against self-incrimination enshrined in Article 20(3) of the Constitution. Nevertheless, the Supreme Court, in **State of Bombay v. Kathi Kalu Oghad and Anr.**<sup>2</sup> affirmed the legality of utilizing such evidence.

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<sup>2</sup>[1961 AIR 1808]

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2. **The Code of Criminal Procedure, 1973:** This code provides a comprehensive framework for conducting criminal investigations within the bounds of the law. Sections 157 and 176 cover the process of collecting evidence. The recently proposed Criminal Law (Amendment) Bill 2023 seeks to improve this process by requiring the participation of forensic experts in crime scene investigation (Clause 176(3)).

- **PILLARS OF ADMISSIBILITY:**

For forensic evidence to be considered admissible in court, it must meet four essential criteria:

1. **Relevance:** The evidence must be directly or indirectly linked to the crime or the person involved. For example, it is crucial to establish a connection between the DNA found at the crime scene and the suspect.
2. **Legality:** It is crucial to follow proper legal procedures when collecting and presenting evidence. This involves adhering to search and seizure laws and honoring the right against self-incrimination.
3. **Reliability:** The scientific methods employed for gathering and examining the evidence must be established and validated by the scientific community<sup>3</sup>. Courts may carefully examine the methods used if their legitimacy is called into question.
4. **Chain of Custody:** Ensuring a clear and documented chain of possession is crucial to maintaining the integrity of the evidence during the investigation process. This involves keeping a detailed log of the individuals who have interacted with the evidence and the corresponding dates and times.

- **RECENT DEVELOPMENT IN INDIAN FORENSIC SYSTEM**

The Indian legal system is embracing the latest developments in forensic science. Here are some important recent developments:

1. **The Criminal Law (Amendment) Bill 2023:** This proposed bill seeks to simplify forensic procedures and improve the reliability of forensic reports. Important provisions include:

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<sup>3</sup>RiditaDey , *Law of Forensic Evidence in India and Abroad: A Comparative Study*, 4 (2) IJLMH Page 2879 - 2894 (2021), DOI: <http://doi.one/10.1732/IJLMH.26627>

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- a) Requiring the participation of forensic experts in crime scene investigation (Clause 176(3)) to ensure thorough evidence collection from the beginning.
- b) Broadening the scope of forensic samples that can be obtained through a magistrate's order (Clause 349) to enhance the thoroughness of investigations.
- c) Allowing reports from accredited government or private forensic specialists to be used as evidence in court without their presence (Clause 329) to speed up judicial procedures.

**2. Technological Advancements:** The emergence of digital forensics calls for the establishment of legal frameworks to effectively manage electronic evidence. The IEA's acknowledgment of electronic records as evidence (Section 3) is a positive development. However, additional legal guidelines are necessary to tackle concerns such as data security and retrieval methods.

- **DIFFERENT FORENSIC TECHNIQUES IN THE INDIAN LEGAL SYSTEM**

- **1. DNA PROFILING:**

The technique of DNA profiling, originally known as "DNA fingerprinting," was first developed in 1984 by British geneticist Alec Jeffrey. It was initially employed in a case involving the tragic rape and murder of two young girls, one in 1983 and another in 1987. Since then, there have been significant advancements in the science of DNA profiling, and these advancements are expected to continue. It is highly sought after for use in criminal investigations and the administration of justice in criminal cases and civil disputes.

DNA analysis serves a wide range of purposes in the field of forensics, including:

- **In the context of civil cases:**

1. Maternity/Paternity Determination
2. Cases Involving Inheritance
3. Cases related to Immigration

- **In the context of criminal cases:**

1. Various bodily tissues such as blood, semen, saliva, bone, hair, and others are commonly encountered in physical and sexual contexts.
2. Determining biological connections between two or more individuals.

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3. Identifying and restoring kidnapped or exchanged babies, as well as babies born out of wedlock or as a result of sexual assault.
4. Identifying mutilated bodies in mass disaster cases when conventional methods of identification are ineffective.
5. Identifying plant materials, microbes, and species of biological evidence material in poaching cases.
6. In linked situations, for example, many rape cases - serial rapist.
7. The DNA profile of social microbes reflects the location where it was collected, establishing a connection between suspects and the crime scene.
8. Organ transplantation (in the field of medical science). attack, killing, incident, and hiding of childbirth.

- **The process of DNA Analysis in Investigation:**

1. First, the DNA molecule from the suspect is carefully disassembled, and then specific segments are isolated and measured.
2. Next, the DNA profile of the suspect is compared to a profile obtained from a sample of physical evidence to determine if there is a match.
3. If there is no match found, the suspect can be ruled out as a possibility.
4. If a match is found, a statistical analysis is conducted to assess the likelihood of the sample's physical evidence originating from another individual who shares the same DNA profile as the suspect.

- **DNA Legislation in Context of India:**

1. The Indian Parliamentary Affairs Board has established an Advisory Committee to provide a thorough report on all aspects of DNA testing.
2. The Law Commission's 185th report proposed amending Section 112 of the Indian Evidence Act to incorporate DNA testing.
3. The 185th Report of the Law Commission of India suggests that the law of evidence is poised for significant transformations due to the adoption of new technologies.
4. The judge may face a challenging situation if they fail to recognize the significance of modern standards and concepts of evidence. In today's

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world, DNA fingerprinting technology has become a widely accepted method for establishing paternity and resolving similar disputes.

5. The advancements in genetics and reproduction technologies are addressing complex questions, and DNA fingerprinting is regarded as a groundbreaking development in this field.

- **Different Types of DNA Profiling**

1. **Mitochondrial DNA:** It is beneficial to examine mitochondrial DNA (DNA), which is found in small structures known as mitochondria inside cells. They can be located in the cell body, as opposed to the nucleus. Unlike the limited number of parental copies of nuclear DNA, a single cell contains thousands of copies of mitochondrial DNA. Both males and females possess mitochondrial DNA, which is inherited solely from the maternal line. Similar to Y chromosome analysis, mitochondrial DNA profiling often results in multiple individuals sharing the same DNA profile, unlike nuclear DNA profiling. This is because relatives in the same female line over many generations share the same mitochondrial DNA. Multiple copies of this DNA exist in every cell, making mitochondrial DNA analysis valuable in cases where there is a limited amount of DNA (such as in hair shafts without roots) or when the DNA sample is extremely old and degraded. Scientists evaluate a portion of the DNA sequence instead of focusing on the size of a repeated block region.

2. **Short Tandem Repeats:** The main approach is to take into account the profile of the STRs. Forensic evidence typically involves the analysis of specific segments of an individual's DNA. The analyzed parts are referred to as short tandem repeats (STRs). It is quite common for mutations to impact the number of repeats, resulting in multiple variations of DNA at a STR locus within a population, each

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with different repeat lengths<sup>4</sup>. There are various versions known as alleles. If only one STR section of DNA were analyzed, it would result in a DNA profile that is shared by numerous individuals. Thus, it is crucial to thoroughly examine various STRs to minimize the likelihood of two unrelated individuals having matching STR profiles.

3. **Y-Chromosomal DNA:** The second form of DNA analysis focuses on studying loci that are exclusively found on the Y chromosome, which is specific to males. This type is passed down from fathers to their sons with minimal variation across generations. Due to the shared direct male ancestor, the profiles generated from Y chromosome DNA are highly similar among males, with only extremely rare mutations. Examining Y chromosome STRs can provide valuable insights in situations involving a combination of DNA from both male and female individuals, such as in cases of sexual assault. In cases where traditional autosome profiling methods are unable to provide a resolution, Y-STR typing can provide specific information regarding the suspected male individual. While differential lysis can be used to obtain autosomal profiles in rape cases, men who have undergone vasectomy or are naturally azoospermic do not leave any sperm at the crime scene.

- **CASE LAWS:**

1. In the case of **Santosh Kumar Singh V/s State through CBI**<sup>5</sup>, The appellant was tried for rape and murder. The trial court disregarded the DNA report and other evidence that acquitted the defendants. The High Court overruled the Trial Court's conclusions, including those based on DNA evidence, and condemned the accused to death. The Supreme Court affirmed the verdict and remitted the death sentence to

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<sup>4</sup>Shetty, A.A., Murthy, K.V. Standardisation of investigative process in invasive and destructive techniques of mobile forensics in India. *Secur J* **35**, 1183–1197 (2022). <https://doi.org/10.1057/s41284-021-00319-w>

<sup>5</sup>(2010) 9 SCC 747

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life imprisonment. The Court stated that it cannot substitute its view for that of an expert, especially in a discipline like DNA profiling, which is a recent discovery.

2. In the case of **Mukesh & Another Vs. State (NCT of Delhi) & Ors.**,<sup>6</sup>The Appellants were found guilty and given the death penalty for the heinous crimes of gang rape and murder of the prosecutrix. In addition to other evidence, the prosecution relied on DNA evidence to secure the convictions of the appellants. The Supreme Court emphasized the significance of DNA evidence while affirming the conviction and sentence. The court noted that DNA technology, as a part of Forensic Science, not only assists in investigations but also provides the court with valuable information regarding the identification of criminals. In our country, just like many other developed and developing nations, courts are increasingly relying on DNA evidence. Following the amendment in the Code of Criminal Procedure, DNA profiling has been incorporated into the statutory scheme. The DNA report should be accepted unless there are significant flaws that prove otherwise. To reject it, it must be proven that there was a lack of quality control or assurance. If the sampling is done correctly and there is no indication of sample tampering, the DNA test report should be accepted. The DNA report and the findings thereon, which are scientifically accurate, clearly establish the connection between the accused individuals and the incident.
3. In **Ravi Vs. State of Maharashtra**<sup>7</sup>, the court observed that despite the abundance of eye-witness accounts, medical evidence, and circumstantial evidence that unequivocally establish the appellant as the sole perpetrator of the crime, the defense has raised doubts about the reliability of the DNA analysis method known as "Y STR." The Supreme Court noted that in such cases, traditional DNA analysis techniques like "autosomal STR" are not feasible. While Y STR may

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<sup>6</sup>AIR 2017 SC (CRIMINAL) 899

<sup>7</sup>2019 SCC OnLine SC 1288

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not provide definitive proof of distinguishing between males of the same lineage, it can serve as compelling circumstantial evidence to bolster the prosecution's case. Y-STR techniques of DNA analysis are commonly employed in different jurisdictions to identify offenders in cases of sexual assault and as a means to identify suspects in unsolved cases. Given the impeccable alignment of the samples and the absence of any doubts regarding the DNA analysis procedure, the forensic report holds significant probative weight. However, the Appellant does not argue that the crime was committed by another close relative of his. Crucially, there was no one else found in the house besides the Appellant.

## 2. BALLISTICS:

Some forensic scientists specialize in the field of ballistics testing. Ballistics is a fascinating field that explores the trajectory of a bullet as it travels toward its intended destination. Ballistics experts can extract a wealth of information from the bullet, such as the type of weapon used and the trajectory of the bullet. When guns are fired, they leave behind a distinct pattern of wear and grooves on bullets, making each one unique. Through careful examination of bullets and test-firing weapons, an investigator can often determine the type of firearm used, the location it was fired from, or even match the bullet to a particular weapon.

## 3. POLYGRAPH TEST:

While there is no specific legislation governing the use of polygraph tests in India, the admissibility of polygraph test results is addressed through judicial guidelines and precedents. The Supreme Court of India has established guidelines for the administration of polygraph tests, emphasizing the voluntariness of the subject's participation and the protection of their rights.

Judicial Precedents: In the case of **Selvi & Ors. v. State of Karnataka (2010)**<sup>8</sup>, the Supreme Court of India ruled that the compulsory administration of polygraph

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<sup>8</sup>2010 AIR SCW 3011

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tests violates the right against self-incrimination and the right to privacy guaranteed by **Article 20(3)** and **Article 21** of the Constitution of India, respectively. The court held that polygraph tests can be conducted only with the consent of the subject and cannot be forcibly administered.

#### **4. NARCO-ANALYSIS TEST:**

The process of narcoanalysis, also known as a truth serum test, entails the use of a sedative-hypnotic drug (such as sodium pentothal or sodium amytal) to induce a state of semi-consciousness in the individual. This is believed to reduce inhibitions and promote more honest responses. Just like polygraph tests, the results of narcoanalysis tests are not considered admissible evidence in court. Nevertheless, investigating agencies have utilized them as a valuable tool for extracting information and leads from suspects.

There have been considerable legal controversies surrounding narcoanalysis tests in India. Opponents claim that the process infringes upon constitutional rights, including the right to avoid self-incrimination, the right to privacy, and the right to dignity. There have been concerns regarding the trustworthiness of information acquired while under the influence of drugs, as well as the possibility of coercion and manipulation. The use of narcoanalysis tests in India has come under scrutiny from the judiciary. The Supreme Court of India has highlighted the importance of implementing stringent guidelines and safeguards to ensure the protection of the rights of individuals undergoing the test. This includes the requirement of having a qualified medical practitioner and legal counsel present.

### **New Technologies In Forensic Evidence:**

The Forensic Science Landscape is evolving at rapid pace and new technologies have emerged:

- **FORENSIC PALYNOLOGY**

1. Forensic Palynology utilizes pollen grains collected from crime scenes or suspects to determine the locations a person or object has visited.

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2. Pollen grains are valuable in forensic investigations as they persist at a crime scene for an extended period and can become trapped in clothing.
3. Analysis of pollen found at a crime scene can provide valuable insights, such as identifying plant species that may have come into contact with the victim or indicating the presence of foreign evidence in the area.
4. This helps to determine whether the location where the pollen was discovered was the main or secondary scene. Facilitates the establishment of connections between crime scenes, and individuals, and even tracks the possession and trade of endangered species.

- **DRONE FORENSICS**

1. Drone Forensic, also known as Unmanned Aerial Vehicles (UAVs), are aircraft that operate without pilots and can be controlled remotely or autonomously.
2. They can capture images and videos of specific areas and transmit them to remote servers. It is frequently utilized to initiate unlawful activities, such as voyeurism, intruding on the privacy of individuals and secure locations, engaging in smuggling operations, and even carrying out acts of espionage.
3. When it comes to forensic investigations, finding the physical components of drones can be a challenging task<sup>9</sup>. These components are often scattered across different locations, making it difficult to establish ownership by linking a seized drone to its controller.
4. Forensic analysts have shown a heightened interest in investigating the forensic aspects of drones due to concerns about their potential misuse for illegal or criminal activities.
5. A thorough forensic investigation is conducted on seized drones to extract any incriminating material, including determining ownership and extracting the flight history.

- **DIGITAL VEHICLE FORENSICS**

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<sup>9</sup>J. Peterson, I. Sommers, D. Baskin, D. Johnson, The role and impact of forensic evidence in the criminal justice process, September 2010, <https://www.ojp.gov/pdffiles1/nij/grants/231977.pdf>

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1. The field of "digital vehicle forensics" deals with the collection and examination of digital data from automobile electronic systems.
  2. This also encompasses any information that could be stored in devices like dashcams, as well as the data collected from infotainment and location systems in vehicles.
  3. Furthermore, it assists the investigating agency in comprehending the usage timeline and locations of a vehicle, including its current and previous whereabouts. This also involves a thorough inspection of the vehicle in cases involving accidents.
  4. Black boxes are commonly utilized to gather digital data in the investigation of traffic accidents. They are commonly referred to as Event Data Recorders (EDR) and are activated when vehicles are about to collide.
- **BLOCKCHAIN FORENSICS**
    1. Blockchain Forensics entails the meticulous tracking and interpretation of the movement of crypto-currency assets on the blockchain.
    2. The anonymity and decentralized nature of blockchain enable individuals to employ various methods for transferring significant amounts of money.
    3. Common tactics employed by fraudsters involve engaging in Wash Trading, a practice where an individual artificially inflates the value of their own Non-Fungible Token (NFT) by repeatedly purchasing it themselves.
    4. Utilizing blockchain investigative tools and expertise can enhance the security of cryptocurrency transactions and trace their origins.
    5. An effective strategy is to trace the money trail using blockchain, which records all transactions regardless of their complexity to conceal their origins.

### **Conclusion:**

The integration of forensic science into criminal prosecution in India has made great progress, yet there are still substantial difficulties to overcome. Law enforcement agencies' investigation capacities have significantly improved with the implementation of new

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technology, compared to traditional techniques. Forensic evidence is crucial for gaining convictions and providing justice, as demonstrated by high-profile instances. India's progress towards a more fair and technologically advanced society is reflected in the growth of forensic science and criminal prosecution, as it balances tradition and technology. Forensic technologies have evolved to a greater extent and, there has been a shift from conventional technologies to new one. But there exist some challenges as well which need to be addressed.



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