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FORENSIC INVESTIGATION OF CRIMINAL OFFENCES

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1.INTRODUCTION

Criminal offences are actions committed against the state, threatening public safety and welfare. In India, these offences are governed by laws such as the Indian Penal Code, the Criminal Procedure Code, and the Indian Evidence Act. These laws outline which acts are considered crimes because they harm society, and they also lay down the punishments for those offences.

"The Criminal Procedure Code specifically defines the penalties for various criminal acts and clearly states which behaviors are prohibited by the government for the safety and well-being of the public".

Forensic science plays an important role in the criminal justice system by applying principles from natural and physical sciences — like ballistics, DNA analysis, hair examination, and Polymerase Chain Reaction (PCR) — to help solve crimes.

A few key figures shaped the foundation of forensic science. **Mathieu Orfila**, often regarded as the father of modern toxicology, developed methods in early 19th-century Paris for detecting poisons through chemical analysis — some of which are still in use today. **Francis Galton**, a British scientist, was the first to conduct a systematic study of fingerprints, creating a method to classify them for identification purposes. [137]In 1892, he published *Fingerprints*, a groundbreaking book that provided scientific proof of the uniqueness of fingerprints as a reliable form of personal identification.

In the 19th century, natural sciences advanced rapidly, but at the same time, the justice system struggled with unreliable evidence, tampered proof, and coerced testimonies. Criminals often took advantage of these weaknesses to avoid punishment. It was this gap that led to the emergence of forensic science, offering a much-needed, reliable way to gather and present evidence in court.

Interestingly, the idea of using science in crime-solving was popularised by **Sir Arthur Conan Doyle** through his fictional detective **Sherlock Holmes**, who showcased how forensic techniques could help uncover the truth. This inspired real-life investigators to realise that physical and natural sciences could be valuable tools in criminal investigations. Many of the most significant early breakthroughs in forensic science came from Europe, though countless contributors worldwide played important roles in shaping the field.

[137] Houck, M. M. and Siegel, J. A., (2015). Fundamentals of forensic science (3rd ed.). Academic Press.

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2.METHODOLOGY

The purpose of this research paper is to explore and understand the concept of forensic science through a **doctrinal research method**, focusing specifically on its application within the Indian legal system. The study aims to explain what forensic science is, trace the roots of its development in India, and examine the various forensic techniques used by investigative agencies in the country.

This paper also looks into the role forensic science plays in criminal investigations, highlighting its importance and necessity in solving crimes. It discusses the legal framework that governs crime investigations in India, as well as the laws that mandate the use of forensic methods in certain cases. A major focus of this paper is to analyse why, despite its value, forensic investigation is sometimes resisted or avoided in criminal cases. Taking a qualitative approach, it identifies existing flaws in India's forensic investigation system and suggests practical ways to improve it. Supported by several case laws, the paper showcases how forensic science has been crucial in solving crimes and identifying criminals. It also emphasizes how forensic evidence assists judges and magistrates in delivering fair and accurate justice.

Forensic science is a modern tool designed to tackle crimes and keep up with the evolving tactics of today's criminals. As technology advances, criminals too have adopted new, sophisticated methods to break the law. In response, forensic science has become an essential asset in criminal investigations. However, in India, this field often remains underutilized. Investigating agencies, particularly the police, still tend to rely on traditional methods, believing them to be quicker and more reliable than forensic techniques.

Unfortunately, this mindset sometimes leads to justice being served based on incomplete or flawed investigations, which can ultimately harm the integrity of the legal system. In many areas of India, there's a serious lack of properly equipped forensic labs and trained forensic teams. In situations like these, the police are often left with no choice but to proceed without forensic support, which weakens the quality of the investigation.

With India's high crime rate, the number of forensic experts and available labs is nowhere near sufficient to meet the growing demand. This shortage is one of the biggest obstacles to the effective use of forensic science in the country.

A basic but crucial step in any forensic investigation is preserving the crime scene and collecting evidence properly. However, in India, it's common for crime scenes to be disturbed either by people, bystanders, or even animals — making it difficult to gather reliable evidence. Even when evidence is collected, delays in examination can lead to its deterioration over time.

Adding to these challenges, there are instances within the Indian criminal justice system where courts and judges overlook forensic reports, limiting their influence on case outcomes. All of these factors combined highlight the serious issues facing the use of forensic science in India today.

4.UNDERSTANDING THE CONCEPT OF FORENSICS-

"Forensic science can be broadly described as **the application of physical and natural sciences to matters of criminal and civil law**, typically enforced by police and legal authorities within the criminal justice system. It involves using scientific tools, techniques, and principles to aid legal investigations. [138]The examination of evidence in forensic science makes use of various fields including medicine, physics, forensic chemistry, biology, DNA profiling, computer science, and engineering."

4.1Forensic Science History

[138] . Sharma, B. R. (2020). Forensic Science in Criminal Investigation and Trials (6th ed.). Universal Law Publishing

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The judicial system used to rely exclusively on oral evidence, confessions and eyewitness accounts before the invention of forensic science. Recall the details of the crime scene is beyond the ability of mortals; hence, their testimony is not fully dependable. The development of forensic science would assist in overcoming the boundaries which have oral testimonies and adequately serve the jurisprudential system (Forensic Science in 21st Century Criminal Justice). Ever since, people fidgeted trying to figure out what allegedly brought about someone's death and who the suspected killer is. Thus, Germanic and Slavic civilizations were the first to implement and recognize a law to summon a medical practitioner qualified to assist in homicide investigations as early as the fifth century. Forensic science was invented by the Chinese around the sixth century (Patel et all., 2016). [139]Over the course of the next 10 centuries, advances in clinical and scientific understanding broaden the application of medical testimony in criminal investigations and judicial proceedings. And the first book on forensic medicine came out in China in 1247, containing guidelines to follow in a murder investigation.

In the Ancient Rome Civilization, people associated their videos in form of pictures that were motioned to one another. The Greate Walking Figures, had a form of documntary called the Forum where a perosn would be charged with a crime. A criminal offence, or a claim regarding illegal act, a forum would hold. Accusations were made by a certain group of people called the Fisher (2009). An arrest was made and trial would begin from there. Each of the accused and the accuser acts in an elaborate fashion attempting to clarify all the necessary facts of the statements provided infront of the jury.

The argument that was the most powerful and believable won the case. It was this reason that the term 'forensic' in the 19th century evolved to represent both public speeches and evidence provided in a court of law. During the 19th century, several types of civil and criminal cases were solved using different forms of forensic scientific evidence. The majority of those people regarded as experts was self-educated. This is because there were no specialized institutions, courses, or professional training programs (Fisher, 2009).[140] In the 20th century, forensic science came to be recognized as an academic discipline. One of its earliest milestones was in 1902, when Swiss professor R. A. Reiss introduced a program in forensic science. Then came the founding of the world's first crime laboratory in Lyon, France in 1910 by Edmond Locard.

Forensic evidences can be classified into two types: physical and biological.

Physical evidence includes things that are not alive, like fingerprints, fibers, glass, drugs, and bullets. On the other hand, biological evidence comprises blood, saliva, urine, sperm, and hair which are all organic substances.

In India, forensic investigation holds immense importance within the criminal justice system, though it operates within certain limitations set by legal frameworks. The main aim of forensic science is to guide criminal investigations and provide judges and magistrates with accurate, evidence-based information, which helps them fairly resolve cases.

Essentially, forensic science uses knowledge and techniques from physical sciences to uncover the truth, whether through social customs or formal investigations. It answers critical questions by applying all available scientific methods, making it an essential part of delivering justice. In both criminal and civil cases, forensic science offers advanced investigative tools that increase the accuracy of evidence analysis and help ensure fair verdicts. Techniques like fingerprint analysis, DNA testing, ballistics, and firearm examination play key

[139] Saferstein, R. (2018). Criminalistics: An introduction to forensic science (12th ed.). Pearson Education.

[140] South, R. (2019) The use of forensic science in criminal justice: Challenges and reforms. Journal of Criminal Law and Criminology, 109 (2),

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roles in identifying both the guilty and exonerating the innocent.

4.1.1Fingerprint Evidence

Fingerprint evidence serves as an indispensable aid in establishing a person's identification in criminal investigations because no fingerprint is similar to any other. Shared DNA within identical twins does not erase the fact that they each possess different fingerprints. Their distinctness enables fingerprints to be applied in various contexts such as criminal investigations, security identification systems, biometrics, and other fields. In forensic science, fingerprints have long been accepted as a benchmark for human identification. They are extensively relied upon in determining identification by evaluating an individual's uniqueness (Fingerprints: A Forensic Tool For Criminal Investigation). The hands which are the single most vital component of the human physique are required to commit almost all crimes. Biometrics, including fingerprint data, are everlasting. In addition, fingerprints as biometrics are absolute because they are impossible to tamper with, change, or simulate those of another person. Of course, most criminals attempt to conceal their fingerprints by putting on gloves, but fingerprints are typically left at the scene of so-called 'opportunistic' crimes. Fingerprints aid in the identification of suspects and verifying their presence in the scene during the commission of the offense.

4.1.2Strands of Hair and Fibers

Numerous crimes insist on physical contact between the perpetrator and the victim. In such cases, hair and fibers may get exchanged. For any crucible case, forensics calculate hair as one of the pieces of physical evidence. Every individual possesses a unique hair pattern which can identify a person if their hair is retrieved from the scene of a crime. The hair contains infallible bindings of DNA that shingles cannot be cryogenically preserved or cloned (Kingsly, 2015). Supporting documentation from the laboratory of hair samples is essential for them to be deemed conclusive evidence in the claim. In the case where devoid hairs are available, chances are they definitely set a target at hand whom the DNA testing gives full evidence to. Likewise, fibers from a certain brand shirt, sweater, coat or other articles of clothing would also implicate certain suspects if found on the victim's body or around the crime scene.

4.1.3Computer Evidence

Computer evidence encompasses any information available on electronic gadgets. This evidence is safeguarded and collected through a blend of security techniques, engineering, and legal acumen. Digital forensics, sometimes referred to as cyber forensics, is a meticulous and time-consuming process. Initially, forensic investigators scavenge for evidence from various technological gadgets and copy the information onto a secure drive. Subsequently, the data is analyzed, and pertinent evidence is documented. After preparation, the digital evidence is forwarded to the relevant investigative body for further examination to identify and subsequently prosecute the criminal. Computer forensics enables the systematic investigation and analysis of computer-generated data to determine what transpired and who executed the act. Furthermore, it assists in preserving the integrity of the electronic evidence in judicial proceedings. With the growing prevalence of computers and other data recording devices in society, the need for digital proof and forensic methods to collect, secure, and scrutinize electronic evidence has grown exponentially, especially for addressing criminal and legal issues.

4.1.4DNA Examinations

DNA, as a form of evidence, is one of the most reliable since it contains genetic information. There is DNA evidence in the collected blood, hair, and skin cells. Additionally, it can also be used to solve crimes that occurred prior to the development of DNA analysis technology. DNA is

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an essential instrument in investigations because no two people have the same DNA, except for identical twins. Thus, the DNA evidence found at a crime scene can be used to either link a suspect to the crime or identify a suspect.[141] Understanding dna evidence, a guide for victim service providers. Also, DNA extraction is the first step of any forensic DNA study. A good output can typically be achieved with one nanogram of DNA (Norrgard, n.d.). For example, samples taken from a crime scene may be matched to a suspect's DNA. Furthermore, it may prove that the suspect was present at the crime site, however, it does not prove they committed the offence. Usually, a prosecution's case relies on other evidence alongside the DNA evidence.

Bringing DNA evidence to light becomes most useful when mixed with other evidence such as fingerprints, footprints, a detailed inspection of the crime scene, and testimonies from people who saw the crime being committed. Patterns of blood splatter and microbiological information are also examples of further physical evidence**.**

4.1.5Autopsies

An autopsy is a surgical examination of a deceased person which includes the inspection of the body and external features. It also includes dissecting the organs within the thoracic cavity, abdomen, and neck region which involves opening the skull to extract the brain along with preserving certain materials for supplementary examinations. The goals of any autopsy include identifying the deceased individual, determining the cause of death, verifying or invalidating the reported modality of death, and approximating the time elapsed since death. Based on the outcome, an autopsy can either be medial or forensic. A medicolegal or forensic autopsy is conducted when the death is violent, suspicious or unclear, moreso to identify whether a natural cause led to the death. For clinical or medical autopsies conducted in hospitals, next of kin's authorization is required to obtain an autopsy to learn about the cause of death.

4.1.6Dentistry

In criminal investigations, pieces of teeth can be very important. Forensic examinations can provide valuable information from teeth since they are located deep within the mouth and serve as a protective barrier that during death or violence may indicate connection to a mortality case. Even in bodies that are severely decomposed or fragmented, the remains of teeth might contain DNA and serve as postmortem evidential DNA (Gaytmenn, 2003). Hence, the application of dental proof within the scope of law is referred to as forensic odontology. This could be discovering sexual violence, recognizing a corpse, and estimating the age of the corpse found. Forensic dentists have knowledge from various fields because they are claimed to provide information about a person's identity or identification through his case based on his dental documents (Adams et al., 2013). From bite marks or other unidentifiable remains, odontologists may assist in establishing the identity of the victim. A forensic odontologist may be contacted by the medical examiner or the police officer in charge of the ongoing investigation.

4.2Common Methods Used in Forensic Investigations:

4.2.1Forensic Odontology

This method involves examining dental evidence, especially in cases where a person's identity cannot be established by other means.[142]By analysing the teeth, their alignment, and the overall condition of the mouth, forensic dentists (odontologists) can identify victims. " It's also used for bite mark analysis in certain criminal cases."

4.2.2Controlled Substances Analysis

Controlled substances are chemicals or drugs

[141] Singh, A., & Kumar, V. (2021). Advances in Forensic Technologies and their Role in Criminal Justice Delivery in India. Indian Journal of Law and Justice,

[142] Adams, C., Carabott, R., & Evans, S. (2013). *Forensic odontology: an essential guide*. John Wiley & Sons

that are regulated by law due to their potential for abuse. These include illegal street drugs like heroin or ecstasy, as well as prescription medications such as oxycodone. The ability to detect and identify these substances is crucial in helping law enforcement tackle drug-related crimes and violence.

4.2.3Forensic Anthropology

"This branch deals with examining human remains — particularly skeletons — to determine characteristics like age, height, gender, and ancestry. It also helps estimate the time since death by examining injuries or conditions of the remains. This method is especially helpful in identifying victims when bodies are severely decomposed or damaged."

4.2.4Forensic Pathology & Medico-Legal Death Investigation

Forensic pathology focuses on determining the cause of death by examining the body. Medico-legal investigations involve collecting and analysing medical evidence for use in court. For example, examining wound patterns can reveal the type of weapon used, and studying gunshot wounds can determine entry and exit points. This process helps establish whether a death was natural, accidental, or criminal.

4.2.5Trace Evidence Analysis

"This involves examining small, transferable materials such as fibres, hair, soil, gunpowder residue, wood particles, and pollen. Because these materials can easily be transferred between people, objects, and locations, they often serve as vital links between suspects, victims, and crime scenes. For example, soil found on a suspect's shoe might match the soil from a crime scene, offering a valuable clue."

4.2.6Cyber Forensics (Digital Forensics)

This area focuses on recovering, analysing, and preserving evidence from digital devices such as computers, mobile phones, and storage media. It plays a crucial role in investigating cybercrimes, including hacking, online fraud, and digital identity theft, as well as in civil cases where digital evidence is relevant.

4.2.7Ballistics

Ballistics deals with the study of the motion and effects of projectiles like bullets, bombs, and rockets. In criminal cases, ballistics experts can examine bullets found at crime scenes to identify the type of firearm used and check whether the weapon is connected to previous crimes. Details from ballistics tests are stored in large databases accessible to law enforcement worldwide.[143]

4.2.8Criminal profiling

This technique involves analysing crime scenes in detail, studying similar past incidents, reviewing the victim's background and activities, and considering possible motives. Investigators then create a profile of the likely suspect based on these findings, comparing it with existing records or unsolved cases to narrow down potential culprits.

5.ROLE OF FORENSICS IN CRIMINAL INVESTIGATION-

In the criminal justice system, **forensic science plays a vital and indispensable role**. It works by collecting evidence from crime scenes or witnesses, helping to establish not only who committed the crime but also important details about how and when it happened. The evidence gathered provides crucial information about the nature of the offence, while other incidental clues can help determine the exact time of the crime.

Forensic science also aids in identifying the method used to carry out the crime, which often reveals the motive behind it. Throughout the investigation process, forensic experts and investigating agencies carefully maintain the privacy and rights of both the victim and the suspect. The evidence collected — whether physical items from the crime scene or testimony from eyewitnesses — is sent to forensic laboratories for analysis before being presented as proof in court.

[143] Forensic Science in 21st Century Criminal Justice | AntiEssays. (n.d.). Forensic Science in 21st Century Criminal Justice | AntiEssays

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As the saying goes, **"every crime scene is unique and presents its own challenges."** Forensic science plays an essential role in establishing the facts of a case through scientific research and analysis. It helps link the offender to the crime using evidence such as fingerprints, footprints, bloodstains, or skin samples found at the scene. If these clues match the accused, their guilt is confirmed; if not, forensic evidence can just as powerfully establish the person's innocence.

One of the most important advances in this field is **DNA sequencing** — a technique that provides investigators with highly reliable information to identify culprits and gather solid evidence against them in court.

The legal system widely recognises the importance of forensic evidence in the trial of criminal offenders. The reason for this is clear: when scientific tools and procedures are applied, the risk of bias or injustice is significantly reduced. [144]Techniques like **DNA profiling and other forensic methods** are now commonly accepted in courts around the world.

Interestingly, the idea of forensic identification can be traced back to **ancient Chinese civilisation**, marking the long history of science being used to solve crimes. Today, forensic evidence is used globally, not just to convict the guilty but also to protect the innocent. In recent decades, forensic laboratories have expanded rapidly across the world. In fact, special laws have been introduced in countries like **the United States, Canada, and Australia** to enhance the quality and delivery of forensic services — improving the accuracy of crime detection and strengthening the criminal justice system.

5.1Forensic Science in Relation to Criminal Investigations

Forensic science assists in solving murders since it provided numerous techniques to aid in solving crimes.[145] It has been helpful in the reconstruction of the crime scene, authentication and corroboration of alibis while tracing leads towards the identification of suspects in order to render justice. In India, forensic evidence is increasingly being used to decide cases both in courts and during the investigations.

5.1.1Management of Crime Scene

Collection of forensic evidence starts right from the crime scene. Management of the crime scene must be done according to ensure that no pieces of evidence are destroyed or altered.

5.1.2Actions of The First Responders

The first arriving at the crime scene are the police. The choices that the first responders make in the initial steps around the crime scene, for example in the area control, evidence inspection, scene visual grapher contacting the laboratory, can greatly affect evidence. Many scenes are ruined because of lack of crowd control, intrusion of the media, or even untrained police officers.

5.1.3Forensic Documentation

With the help of notes, sketches and photographs it is easy to capture and store clues and evidence which can be used at a crime scene. The guide does give general instructions on how to protect a crime scene but it is followed with a lot of in uproar.

5.1.4Evidence Collection

The crime scene can offer numerous objects of forensic value like hair strands, bloodstains, bullet casings, and even footprints. Indian Forensic Science Laboratories (FSLs) suggest sterile implements and sealed containers to prevent contamination, but many police stations do not have basic kits or trained staff to handle this properly.

[144] De Forest, P. R., & DeForest, P. R. (1983). *Forensic science: an introduction to criminalistics*. New York

[145] Gaytmenn, R., & Sweet, D. (2003). Quantification of forensic DNA from various regions of human teeth. *Journal of forensic sciences*

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5.1.5 Investigation and Evidence Collection

Science strengthens investigations by moving the process from dependance on witness testimony or confessions to tangible evidence.

5.1.6Forensic Support to Investigators

After the collection of evidence, forensic specialists study the samples in specialized labs. These include:

- Matching DNA profiles of identified perpetrators using rape or murder.

- Toxicology report in case of suspected poisoning to confirm cause of death.

- Digital forensics to extract permanently deleted text messages, emails, or GPS information.

- Ballistics to reconstruct the firing instruments from the bullets.

Such work is done at the Central Forensic Science Laboratories (CFSLs) and State Forensic Science Laboratories (FSLs). However, many of these laboratories are slow in completing their workloads because of a shortage of staff and mounting work, sometimes undermining the usefulness of the evidence.

5.1.7Chain of Custody

In Indian law, there are specific processes tied to the admissibility of evidence in court, such as the list of evidence that has been handled, traced, and monitored, which is referred to as a 'chain of custody'. In the Indian Evidence Act, Section 65B(paragraph on electronic evidence) or in Section 45(expert opinion), if such processes are insufficient or lost entirely documented gaps will deem this evidence unreasonably excluded.

5.1.8Legal Proceedings and Trial

As part of the charge sheet, which is drafted during the proceedings of the Code of Criminal Procedure (CrPC), forensic reports are included and subsequently employed in the trial for the determination of guilt or innocence. [146]

5.1.9Expert Testimony

Forensic scientists could potentially be called to the court under expert witness and section 45 of the Indian Evidence Act, 1872[147] brings into light an unique role of explaining the more elaborate evidentiary details to the decision makers - the judge and members of jury.

To outline, Judiciaries in India make use heavily rely seek the assistance and opinion of in aelaborate bombardment of numerous people known trust expertis cross-examination. Oftentimes, Defense attorneys get utilization of the expert reports to disprove the expert's analysis because of a superficial lag, imprecise witnesses, or confused arrangement of transactions.

5.1.10 Impact on Judicial Outcomes

In the modern world, correctness of presentation and logic, when mixed, sharpen forensic evidence sharply and in right hands can be determinable. As an example consider:

- Convincement's in the Nirbhaya (2012). Accompanying them with forensics medicine, DNA allied forensics was used to successfully secured.
- In the case of the Aarushi Talwar, the abuse and the abuse of forensic details led to skepticism and later, years down the line, the individual was acquitted.

5.1.11 Exonerating the Innocent

Forensic science is not only used to convict the guilty—it plays an equally important role in exonerating innocent individuals.

Here's how I would attempt recasting the provided text and ensure accuracy in foremost aspects like meaning, structure, and word length:

[146] Criminal Procedure Code (CrPC), 1973. Retrieved from: https://legislative.gov.in

[147] Indian Evidence Act of 1872. Retrieved from: https://legislative.gov.in

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5.1.12Role In Preventing Miscarriages of Justice

In India, there have been numerous cases of wrongful detainment due to fabricated statements, wrong perpetrator identification, or undue witness influence. CLEO– particularly DNA– has played an incredibly helpful role in such wrongful conviction cases.[148] Although there is no officially recognized in 'Innocence Project' as in the US, increasingly over time courts have acknowledged the importance of forensics in the upholding of laws relating to the dignity of a person.

5.1.13Notable Examples

DNA analysis has exonerated various defendants, particularly in rural or politically sensitive regions, during rape trials.

Forensic pathology has substantiated instances of torture in custodial death cases, disproving the claims made in police documents.

6.Importance Of Forensic Science

Forensic science is important in police work and court proceedings Help prosecute criminals and free innocent people by evaluating evidence from crime scenes and other places. Eliminate chances of wrongful incarcerations, ensuring multidimensional justice. Forensic science assists in identifying the perpetrator and ensuring that the justice system works effectively. Below is how it is valuable.

6.1Crime Tracking

The tracked telephone, computer, and email of the suspected criminal can be done with the help of forensic science and the Internet. It is also possible to track the criminals' IP address and identify the location from where he accesses the website. Computer forensics can also retrieve call and SMS records of people with whom he communicates.

Identifying the Suspicious Person

The person accused of a given crime is also involved in the crime. For almost every crime committed, some form of physical evidence, biometric fingerprints or other proof was left. Analysis of the physical evidence makes it possible to identify the perpetrator beyond reasonable doubt.

6.2Establishing Relationship Between the Criminal and the Crime

The relationship between a particular crime and the perpetrator is established using collection of materials and objects that are so small they can be inadvertently passed from person to person. And such evidence salvaged from a crime scene may significantly assist the working officer's investigation.

6.3Determine the cause and manner of death

A forensic scientist, as part of their area of specialty, is concerned with finding out the cause of someone's death by conducting an autopsy or postmortem examination which entails a detailed investigation of the body and looking for specific signs that can be clearly linked to injuries, illness, poisoning or death.[149] A possible cause of death can be determined by the collaboration of forensics specialists with police investigators. Moreover, forensic pathologists can seek help from anthropologists or entomologists to ascertain how and why a person died.

6.4Determining child abuse extent and sexual assault

Forensic investigation plays a significant role in deciphering the extent of abuse inflicted to children, the presence of defensive wounds on the victim, and gunshot wounds. Examination of the abused woman's body reveals certain physical features like self inflicted injuries, sexual assault, and remnants of sperm semen (Kingsly, 2015).

6.5.Determining child abuse extent and sexual assault

Forensic investigation plays a significant role in deciphering the extent of abuse inflicted to children and the presence of defensive wounds

[148] Houck, M. M., & Siegel, J. A. (2009). *Fundamentals of forensic science*. Academic Press.
International Crimes (tribunals) Act 1973 (

[149] Kaci, J. H. (2000). Criminal Evidence (4th ed.

on the victim, gunshot wounds, and the marriage of violence as well as dose of domestic violence (Kingsly, 2015).

6.6.Identifying alcohol components

Forensic science is able to analyze body tissues from someone suspected to be a lawbreaker for the presence of drugs and drug metabolites as well as quantifying those drugs and their breakdown products. It is identified by examining the blood, urine, or other biological samples that were taken from the accused.

6.7Establish the guilt or innocence of possible suspects

Without an eyewitness, it is challenging to establish beyond a reasonable doubt whether the suspect did the act or was not engaged. But forensic science can ensure the presence or absence of the suspected person in the crime. It is possible to use it to aid in the identification of a suspect as well as to disclose substantial connections between the suspect and the crime. Thus it helps the court to ensure the guilt or innocence of possible suspects.

6.8Narrow the range of possible suspects

It is possible to operate forensic evidence to connect crimes suspected to be linked. For instance, DNA evidence might connect a criminal to several crimes. This connection of crimes assists the investigating officer in narrowing the number of possible suspects to identify and prosecute them

7.GROWTH OF FORENSIC SCIENCE IN INDIA

7.1The Growth Of Forensic Science In India-

Forensic science in India is commensurate with advancement of science and technology alongside the infrastructure provisions within the country's legal system. There's no doubt that 'forensic thinking', for example 'finger-printing' [150]is rooted within ancient times but the systematic use and incorporation of forensic science into the criminal justice system happened during the colonial era and it's been gaining track more so after independence.

7.2Colonial Root Developments

Some arms of forensic science and especially non-medical forensic science developed in India during the colonial rule. India was the first country in the globe to officially employ fingerprinting as a technique for identification in criminal inquiries during the 1890s. Being in the Bengal Police, Edward Henry developed this system and later went on to formulate the Henry Classification System that became widely adopted.

The first Chemical Examiner's Laboratory was set up in 1904 at Madras (now Chennai) with a focus on toxicology. This pioneering lab set precedents in drug testing, blood testing, poison analysis and in general contributed to the field's burgeoning growth.

7.3Developments After Independence

Developments in forensic science occurred post institutional and legal integration into the criminal justice system after India attained independence in 1947. The surge in socio-economic development post-independence propelled the need for science-based investigations to improve the evidentiary process and diminish the overreliance on confessions.

Some milestones are:

- Establishment of Central Fingerprint Bureau (CFPB) under the Ministory of Home Affairs in 1955.

- Establishment of Central Forensic Science Laboratories (CFSLs) in major metropolitan cities during the 1960s with the first instutution being set up in kolkata.

- Set up of the Directorate of Forensic Science Services (DFSS) under the Ministry of Home Affairs in 2002 to streamline the standardization, oversight and modernization of forensic facilities across the country.

[150] National Institute of Criminology and Forensic Science. (2022). Training Modules and Research Reports. Retrieved from: https://nicfs.gov.in

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7.4. Infrastructure at National and State-level

7.4.1. India has a multi-tiered forensic system.

- Central Forensic Science Laboratories (CFSLs) – situated in New Delhi, Hyderabad, Chandigarh, Pune and Kolkata, these are often referred to as forensic Genrals. [151]Each CFSL specializes in certain types of forensic services and offers support for cross-border or national level investigations.

. State Forensic Science Laboratories (FSLs) – Each state has at least one FSL, with larger ones hosting regional labs for smaller jurisdictions. These labs service local police departments and the courts.

. Mobile Forensic Units - A number of states have recently introduced mobile forensic vans to aid in evidence collection at crime scenes in remote locations.

7.4.2Education and Training

The expansion of readily available educational and training programs has ramped up in response to the emerging need for forensic science professionals. In New Delhi, the National Institute of Criminology and Forensic Science NICFS offers postgraduate degrees and specialized training for police and law enforcement. In addition, a growing number of universities are granting B.Sc. and M.Sc. in forensic science.

7.5Challenges in Growth

While there is some progress, advancement remains scarce. Many of the laboratories are underfunded, suffering from staffing shortages, and are burdened with a backlog of cases. The Bureau of Police Research and Development (BPR&D) reported in 2019 that the majority of the labs are overworked and frequently do not have modern technology available. Because of this, some states turn-around time for forensic reports is months or even years which causes a delay in justice delivery.

8.Obstacles and Shortcomings of Forensics in India

The American Institute of Forensic Sciences suggests that, like in other countries, forensic science could transform the world of crime investigation in India. However, its current application is riddled with challenges. These issues include gaps in infrastructure, training, ambiguous laws, and issues of ethics, among others. If these issues are not resolved, forensic evidence is unlikely to deliver timely and dependable justice.

8.1 Infrastructure and Resources -

8.1.1Inundated Laboratories

One of the biggest challenges is the lack of forensic infrastructure. BPR&D reports that there is a marked scarcity of forensic science laboratories (FSLs) in tier 2 and rural areas. Most of the existing laboratories have huge backlogs, which at times extend to months or even years when producing reports.

8.2Insufficient Funding

The forensic departments of a number of state governments have been assigned meager budget allocations. Without these vital resources, laboratories are unable to acquire new technologies, skilled personnel after, or meet the basic standards of texitad quality.

8.3Absence of Consistency

Collection of equipment, procedures, and even a report format, have no set exercises at the national level. It is, therefore, very possible that the level of forensic services offered by states greatly differ in both the quality and reliability.[152] This variability does not only render forensic services ineffective or unreliable, but questioned the adequacy of evidence and its acceptance as judicial proof within the court set up.

[151] India Forensic. (2023). Role of forensic accounting and digital forensics in India. Retrieved from: https://indiaforensic.com

[152] India Forensic. (2023). Role of forensic accounting and digital forensics in India. Retrieved from: https://indiaforensic.com

8.4Training and Capacity Building

8.4.1Police Training Deficiencies

As first responders to a crime, most police officers do not possess formal training in forensic science. This results in the crime scene being poorly managed. Evidence collection is routinely contaminated, misplaced or, non-existent.

8.4.2 Shortage of Experts

The nation suffers from a severe shortage of trained forensic scientists. Most FSLs function with open positions or less qualified staff. In some smaller labs, one person works in several different fields which increases errors.

8.4.3 Lack of Interdisciplinary Collaboration

Law enforcement, the judiciary including, and experts within forensics are required to work together for effective forensic science investigation. However, in India, the inter-agency communication is known to be sub-optimal and delays exchange and interpretation of forensic evidence.

8.5Ethical and Legal Dilemmas

8.5.1Consent and Privacy Concerns

DNA profiling, narco analysis, and brain mapping are techniques that pose ethical challenges. Oftentimes, [153]biological specimens are obtained without patients being appropriately briefed on the implications or the right to withdraw. Even with the 2010 Supreme Court ruling restricting involuntary use of such means, abuses continue.

8.5.2Lack of a Holistic DNA Law

As of now, India does not have a sophisticated legally binding structure governing DNA profiling technology. The collection, storage, and utilization of DNA data do not have requisite legal protection without this statute.

8.5.3Issues of Acceptability in Legal Proceedings

Warsaw's Indian Evidence Act, in Section 45, categorizes forensic reports as expert opinions and not direct evidence, hence there is a reasonable basis to discount them, provided the prosecution's evidence is unsupported. An unbroken chain of custody, broken by questioning established methodologies during cross-examination, casts doubt on the evidence.

8.6Trustworthiness and Prejudice

8.6.1Wrongful Identification

The burst of confidence in scientific evidence fails to cover the inadequacies in forensic evidence. There is the possibility that a sample was collected incorrectly or altered, humanly interfered with, or that the laboratory conditions are not sanitized which provide leads to incorrect identification, arrest, or even conviction.

8.6.2Excess Trust in Forensics

There is an argument that the forensics department of investigative agencies has moved too far away from the field. This reduction in active engagement or counterevidence collection creates one-sided narratives that are always detrimental to objectivity.

8.6.3Expert Bias

A forensic expert might face pressure, whether consciously or unconsciously, to tailor their findings to support the prosecution's case theory. Such bias, in expert testimony, erodes the objectivity in science that is expected from such professionals.

8.7Delays in the Justice System -

8.7.1Forensic Delays Lead to Trial Delays -

In many instances, incomplete forensic reports create a bottleneck in the trial process. Many criminal cases have their court dates postponed because some labs are running

[153] Patel, Ankita & Vaya, Shivarathna & Jasani, Nirali & Vasan, Margi & Sharma, Shweta. (2016). REVIEW OF THE ROLE OF FORENSIC EVIDENCE IN CRIMINAL JUSTICE SYSTEM

behind, particularly with DNA, ballistics, and toxicology tests.

8.7.2 Impact on Victims and Accused

Victims face prolonged trauma as a direct consequence of the dragging of court proceedings. For innocent accused, on the other hand, waiting for forensic evidence can mean enduring years of imprisonment. Both result in the absence of justice.

8.8Lack of Public and Judicial Awareness -

8.8.1Limited Understanding Among Judges

A considerable number of judges do not have basic instruction in forensic science. Therefore, they are likely to embrace the dramatized portrayal of forensic science—known as the "CSI effect"—or assume it lacks any credibility at all. [154]This has an adverse effect on the consistency of decisions on admissibility and weightage.

8.8.2Public Misinformation

The forensics that the entertainment industry showcases is often mistaken for absolute reality. In actuality, forensic science is multifaceted and its real-world implementation is anything but straightforward. This untrue information greatly alters the expectations that the public, jury members (in rare jury trials), and media .

9.CONFINEMENT OF FORENICS IN INDIA-

"The fundamental purpose of forensic investigation is to examine all available evidence, theories, and doubts, and convert them into concrete, evidence-based conclusions that establish either the guilt or innocence of a suspect. According to a study conducted in 2011 by the Supreme Court of India and various High Courts, only 47 cases relied on forensic investigation, and of those, 23.4% were referred by the Delhi High Court alone. Another study highlighted that Indian courts are increasingly depending on forensic evidence in cases of a sexual nature. However, forensic science in India has yet to fully evolve and integrate into the mainstream criminal justice system.

It is often observed that lawyers, judges, attorneys, and even the police lack a comprehensive understanding of the potential offered by forensic science. There's a need to integrate forensic methodologies with modern research and advanced technology. The multi-disciplinary nature of forensic science requires greater internal support and recognition to operate at its full potential.[155]"

A committee set up to assess and improve India's criminal justice system pointed out a significant shortfall: only about 5-6% of criminal cases are referred to forensic science laboratories and fingerprint bureaus. This is a serious gap, as forensic science plays a critical role in ensuring accuracy and fairness in criminal trials.

Several reasons contribute to this limited use of forensics in India — negligent evidence collection at crime scenes, poor preservation practices, and weak storage management have often been highlighted by Indian courts. Any negligence during evidence collection and forensic examination can easily lead to courts disregarding such evidence altogether.

Due to India's slower technological progress in this field, forensic investigations often get delayed, especially when it comes to examining bio-evidence. In cases involving alcohol abuse or homicide, biological samples sometimes deteriorate due to improper storage, making it harder for forensic surgeons to draw precise conclusions during autopsies.

Additionally, modern forensic techniques and tools have not been sufficiently introduced to investigating agencies. As a result, police departments continue to rely on traditional investigative methods. Moreover, the forensic laboratories that do exist are typically operated under police departments or state governments, which compromises their

[154] Role of Forensic Science in the Criminal Justice System | The Protector. (n.d.). The Protector | Promoting Peace.

[155] Terence. F. Kiely, Forensic Evidence-Science And Criminal Law (CRC Press, Washington D.C 2001), Pg101 210 , available at google.books.com

independence. Many of these laboratories also face serious issues like lack of trained personnel, inadequate infrastructure, insufficient equipment, and chronic underfunding.

Alarmingly, there is often a lack of coordination and cooperation between police forces and forensic departments, further reducing the efficiency of forensic investigations.

Recognising these systemic issues, a criminal justice policy committee highlighted the need for enhanced attention toward scientific expertise, training, research, and technological advancement in the justice system. The Malimath Committee also recommended establishing more well-equipped research facilities for handling DNA samples and forensic evidence, along with clear legal guidelines for the safe and ethical handling of genetic material, to prevent potential misuse.

Similarly, the Justice Verma Committee emphasised the importance of proper storage and preservation of DNA evidence, especially in cases involving sexual offences. Effective forensic investigation is crucial to uncover facts that can help solve complex criminal cases and identify the actual culprits.

The investigative process heavily relies on scientific tools and techniques to analyse evidence collected from crime scenes. To improve the forensic system in India, the National Accreditation Board for Testing and Calibration Laboratories (NABL) was established, and it proposed several key recommendations:

1. Improvement of forensic laboratories across the country.
2. Establishing clear standards to ensure that forensic examinations are conducted within an appropriate and reliable timeframe.
3. Strengthening the overall functioning and operational capacity of forensic labs.
4. Providing investigating agencies with a free, impartial, and objective forensic support system.
5. Increasing the number of forensic laboratories to match the country's growing crime rate.

These reforms are essential to modernise India's forensic infrastructure and to ensure that the criminal justice system remains fair, reliable, and based on solid scientific evidence.

10.Forensic Science's Ethical, Legal, and Judicial Factors Pertaining to India

Forensic science is not divorced from its context. The application of forensic investigation techniques within the framework of criminal law must be ethically justifiable, legally permissible, and judicially upheld. [156]In India, it is often challenging to achieve this equilibrium because of legislative gaps, rapidly changing technology, and conflicts between state authority and civil liberties.

10.1Forensic Practice's Ethical Issues

10.1.1Consent and Autonomy over the Body

Forensic practices ethically begin with consent. In India, biological specimens (blood, saliva, semen, and hair) are often taken without acquiring appropriate consent, particularly from the marginalized or illiterate demographic.

- The use of polygraph tests and narco-analysis is reportedly employed in investigations despite being ruled inadmissible without consent (Selvi v. State of Karnataka, 2010).

- DNA samples are taken even prior to arrest or without court orders which contravenes privacy and autonomy parameters.

10.1.2Prejudice and Social Inequality

There are some accounts that substantively document the disproportionate application of various forensic procedures on the Dalit, tribal, and even politically active opposing groups. This raises the issue of enforcement bias and

[156] V.V.Pillay ,Textbook of Forensic Medicine & Toxicology(Paras Medical Publisher, 17 edn, 2016)

the politically motivated use of science to provide support to spurious arguments.

11.LEGAL PROVISIONS SUPPORTING CRIMINAL INVESTIAGTION"

As mentioned earlier, forensic science in India operates within certain legal and constitutional boundaries. The Indian Constitution outlines several provisions that guide the investigation of crimes. Notably, Article 20(3) of the Constitution states that no person accused of an offence can be compelled to testify against themselves. This is a vital legal safeguard, built on the principle that a person is presumed innocent until proven guilty. It protects individuals from being pressured or tortured into giving statements during investigations or detention. In criminal law, unless proven guilty beyond reasonable doubt, the accused remains legally innocent.

Similarly, Article 11 of the Universal Declaration of Human Rights reinforces this idea, affirming that anyone accused of a crime has the right to be presumed innocent until a fair and public trial determines their guilt, with all legal protections for their defence.

The protection against self-incrimination under Article 20(3) extends not just to court trials, but also to the pre-trial investigation stages. However, it only covers situations involving compulsion — it does not prevent an accused person from voluntarily confessing to a crime.

Under the Indian Evidence Act of 1872 (Section 73), courts have the authority to require any person, including the accused, to provide fingerprint impressions. The Supreme Court has ruled that asking someone to give such physical evidence — like fingerprints — does not violate Article 20(3). For instance, in the State of Bombay vs. Kathi Kalu Oghad & Others, the court ruled that collecting fingerprints, signatures, hair strands, or blood samples from an accused does not infringe upon their constitutional rights.

In another case, State of Maharashtra vs. R. Reddy and Others, [157]the Bombay High Court upheld the legality of investigative techniques like brain mapping (P300), narco-analysis, and lie detection (truth serum tests). The court directed investigating agencies to use these methods where necessary to uncover the truth and confirmed that the results of such tests could be considered in court. It was also clarified that undergoing these tests does not amount to giving testimony under compulsion.

However, this view was reconsidered in the landmark Selvi & Ors. vs. State of Karnataka [158]case, where the Supreme Court raised concerns about the constitutionality of using such scientific methods without the consent of the accused. The court observed that techniques like brain mapping and polygraph tests could not be considered conclusive or reliable and their involuntary use would violate fundamental rights.

The Code of Criminal Procedure (CrPC), 1973, also governs forensic investigations in India. Section 53 of the CrPC allows for medical examination of an arrested person if it is believed to help in the investigation. An important amendment in 2005 broadened this provision, especially in cases of sexual offences, to include procedures like blood tests, semen swabs, hair and fingernail collection, and DNA profiling. The CrPC Section 164A mandates that a rape victim must undergo a medical examination within 24 hours, which includes the collection of DNA samples.

This section also specifies that DNA collection should only be done by a qualified medical practitioner registered under the Indian Medical Council Act, 1956. This precaution ensures that evidence is properly collected, preserved, and protected from contamination, which is critical for its reliability in court.

[157] 969 WRIT PETITION NO.495 OF 2020 HIGH COURT OF JUDICATURE AT BOMBAY
BENCH AT AURANGABAD
[158] **AIR 2010 SUPREME COURT 1974, 2010 (7) SCC 263**

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The Indian Evidence Act of 1872 recognises forensic reports as expert opinions, with forensic experts being those who have gained experience and skill through training and practice. Their role is to analyse evidence using scientific methods and provide clear, unbiased reports based on their findings, to assist the court in reaching a decision. However, it is important to note that while forensic reports hold significant weight, the final judgment rests with the court, which may choose whether or not to rely on such evidence.

Overall, the Code of Criminal Procedure, 1973, and the Indian Evidence Act, 1872, together form the backbone of India's criminal justice system. These laws outline the entire process, from the registration of a crime to the final judgment, ensuring that justice is delivered while safeguarding constitutional rights.

11.1Legal Framework for Forensics in India

11.1.1Indian Evidence Act, 1872

As mention in Section 45, expert opinions like forensic reports are admissible in evidence.

• They are not irrefutable evidence and require corroboration.

• Cross-examination can contest the qualifications of the expert and the techniques employed.

11.1.2Criminal Procedure Code (CrPC), 1973

CrPC stipulates the manner in which forensic evidence is extracted and admitted:

• Section 53 & 53A: Permit the medical examination of accused to include bodily sample collection.

• Section 164A: Pertains to the medical examination of rape victims to include forensics.

These provisions are permissive concerning the police employing forensic apparatus, but do not prescribe requisites, timelines, and standards resulting in gaps in procedural policies.

11.1.3Information Technology Act, 2000

Due to the increase in cyber crimes, digital forensics has become increasingly important. In this act:

• Electronic documents/journals are permitted under Section 65B of the Evidence Act so long as prerequisites (certification) are fulfilled.

• It has been established by the courts that electronic evidence with no appropriate certification is inadmissible (Anvar P.V. v. P.K. Basheer 2014[159]).

Pending Legislation: **DNA Technology Regulation Bill**

The DNA Technology (Use and Application) Regulation Bill, 2019 intends to:

- Construct a national DNA database.

- Govern collection, usage, and destruction of DNA profiles.

- Maintain privacy and consent.

However, it has faced scrutiny from rights groups due to its sweeping authority and scope for maleficence particularly in the absence of a national data protection law.

11.2.Judicial Interpretation of Forensic Evidence

11.2.1Balancing Science and Law

For the most part, Indian courts support the employment of forensics, but do so with circumspection:

- In State of Maharashtra v. Damu (2000)[160], the Supreme Court ruled that DNA evidence is sufficiently conclusive to obviate other pieces of evidence.

- However, courts also require the proof of the chain of custody and the appropriate credentialing of the experts and their analysis being free of partisanship.

11.2.2 Forensics in Sexual Assault

Forensic evidence is often critical in rape cases. Courts have been harsh concerning the

[159] AIR 2015 SUPREME COURT 180

[160] 992-993 of 1999

collection, or lack thereof, the handling of evidence and the treatment of victims. As an example:

- In Tukaram v. State of Maharashtra (1979) [161](Mathura rape case), the accused was found was acquitted because there was no medical evidence to support the claim which resulted in an outcry and legal reform.

- Now, courts have been more proactive in stipulating the need for forensic examination in cases of sexual assault including MHA-Form 100.

11.2.3Narco-analysis and Polygraph Tests

In Selvi v. State of Karnataka (2010), the Supreme Court held:

•They infringe on Article 20(3): Right against self-incrimination and Article 21: Right to life and personal liberty.

• Any information obtained from these tests is out of bounds until possibly disclosed willingly afterward.

11.2.4Data Privacy and Surveillance Issues

Absence of a Data Protection Law

India is without a unified data protection law. The Digital Personal Data Protection Act of 2023 offers some protection, but does not adequately address forensic and criminal databases.

11.2.5 Surveillance Risk

The unregulated expansion of CCTV, face recognition and biometric profiling heightens the risk of mass surveillance. Lack of legal restrictions could turn forensic instruments into tools of state oppression instead of justice.

11.3International Guidelines and India's Alignment

India subscribes to numerous human rights treaties including the International Covenant on Civil and Political Rights (ICCPR) which provides:

• Privacy provisions.

• Right to fair trial.

• Protection from forced confessions.

Aside from custodial interrogations that are politically sensitive, India is increasingly known for inadequate forensic standards.

12.Recommendations and their Prospects

While Forensic Science has an important place in the system of a Modern Criminal Justice in India, the most concerning fact is that there continues to be little to no progress being made in some areas. Even with the evolving nature of crimes happening in the country, there still exists a wide gap between implementation and all other provided opportunities. This part aims to give possibilities for betterment of Forensic Science, along with setting proper order towards the system problems looking at in prior segments, taking into consideration what remains unaddressed.

12.1Strategic Vision for Forensic Science in India

From the information provided, one can make out clearly that there is huge growth potential of Forensics in India if provided with a proper comprehensive national policy. More importantly, the roadmap must be juxtaposed with what is considered to be the best worldwide benchmarks as well as the conditions provided from Social, Legal and other Institutions specific to India they define the environment in which Science and Technology Policy operate.[162]The systemic environment around Australia for Forensic Science need to promote development by creating a robust forensic science infrastructure that is scientifically defensible, ethically responsible and supportable within legal frameworks accepted in investigative and judicial systems.

12.2Shaping Public Trust and Transparency

The Level of Autonomy Bias requires a greater consideration of impact on outcomes and baased on objectivity and bias. Its paradigm is on bias paradigms and encompasses

[161] **1979 AIR 185, 1979 SCR (1) 810**

[162] M.Fanetti, W.O. Donohue, et al, Forensic Child Psychology; Working In Courts And Clinic(John wiley and Sons publications, 2015), page no.3

everything that is non-traditional bias on forensic science. When widening exposure, increasing autonomy, order, including publishing guidelines/labs and independent control agencies build trust not only in the system but the public as a whole.

12.3 Enhancing the Integration of Science into the Administration of Justice

Forensics must not continue being regarded as a non-core element or secondary support document as it is evidence of physical violence, cyber abuse, sexual assault, terrorism, etc. Instruments of the court should know and incorporated in advocacy training sessions judicial orientation programs.

12.4 Institutional Change and Infrastructure Development

12.4.1 Increase and Upgrade Forensic Laboratory Facilities

There is an urgent need to increase the number of forensic laboratories in India, especially at the state and district levels. The government should:

• Establish one regional forensic science laboratory (RFSL) per district.

• Update resources with current technologies (e.g., automated fingerprint identification system, next generation DNA sequencing, 3D crime scene reconstruction).

12.5Setting up a National Forensic Sciences Authority

The sole independent authority which could manage the planning, providing funds, monitoring, and standardization of forensic services could function in India.[163] After studying the UK Forensic Science Regulator, this body would be responsible for:

- Formulate criteria and protocols

- Lab accreditation

- Supervision of education and compliance with ethics.

- Interaction of police and judiciary with forensics professionals.

12.6Capacity Building and Human Resources Strategy

Integration of Advanced Training for Law Enforcement Officers and Investigators

Forensic investigation commences at a crime scene. The best of laboratories will not be able to deliver reliable results if evidence is not carefully collected and preserved.

- From basic police training, moderate level educational courses, integrate modules of forensic science.

- Develop mobile forensic units with replenished tools of on-site evidence collection and preliminary evidence analysis.

12.7Teaching and Vocational Training

- Support initiatives of public universities to set up Bachelors and Masters degrees alongside doctoral studies in Forensic Science.

- Launch special grants initiatives designed to attract students who are willing to pursue careers in forensics.

- Cultivate policies that will advance education which integrates law, technology, medicine alongside forensic science.

12.8Forensic Fellowship and Exchange Programs

- Collaborate with global institutions for best practices, exposure, and collaborative research.

- Establish national fellowships for forensic specialists to undertake specialized educational or research activities.

12.9Legal and Policy Reforms

Enactment of Comprehensive Forensic Legislation

India urgently needs to adopt a Forensic Science Regulation Act which:

- Requires specific procedures for evidence collection, preservation, and reporting.

[163] Ann Wolbert Burgess, Albert R. Roberts, Cheryl et al, Learning: Victimology : Theories and Applications 2009,

- Defines minimum legal prerequisites for expert testimony.

- Guarantees rights to individuals associated with evidence collection (e.g., consent, privacy).

- Establishes the legal acceptance of novel forensic techniques.

12.10DNA Technology Regulation Bill

This upcoming bill requires modifications and addition of stronger constraints, then must be passed:

- Restrict the scope of DNA databases to serious crimes only. [164]

- Require a court order prior to sample collection.

- Ensure the maintenance, access, and deletion of DNA profiles is done by independent data protection bodies.

12.11Explaining Rules on Evidence Admissibility

The existing Indian Evidence Act should be amended to:

•Set criteria for the admissibility of particular forensic techniques like digital evidence, DNA, and ballistic evidence.

•Provide more detail on the grounds and procedure for challenging expert witness testimony.

•Encourage tamper-proof protocols for the chain of custody of evidence.

12.12.Technological Advancements and Digital Forensics

Investment in New Forensic Technology

Forensic science will gain from investments in fast, scalable, and accurate technologies, including:

• On-site rapid DNA test kits.

• Voice, handwriting, and image forensics pattern recognition through AI and machine learning.

• Cyber forensic labs for the analysis of data dumps from large-scale firewall breaches, mobile device logs, and digital user traces.

12.13 Development of a National Digital Forensics Infrastructure

India needs to create a national infrastructure for digital forensics because of the increasing thicket of cybercrimes like online financial fraud:

• Integrate cyber forensics units at the central and state levels.

• Build a system for instant data sharing among the police, CERT-In, RBI, and telecom authorities.

• Provide training in blockchain, cryptography, and cross-border data retrieval to cyber forensic specialists.[165]

12.14Human Rights, Accountability and Ethics

Creation of the Ethics Review Committee

Each national authority and forensic laboratory shall be managed by an ethics review committee which will:

-Oversee procedures of the research and testing.

-Examine claims of ethical misconduct.

-Guarantee that all subjects are provided fair and just treatment without bias, discrimination based on caste, gender, or economic rank.

12.15.Safeguarding Privacy in the Era of Technology

With greater reliance on biometrics, surveillance footage, as well as analytical processing in the cloud, privacy protective measures become very critical. The Digital Personal Data Protection Base Law must be:

-Enhanced to include forensic and law enforcement databases.

-Enforced with defined restrictions on punitive measures for misuse or unauthorized access.

[164] Manoj .H. Parekh and S.P. Singh Parmar ,Crime Investigation and Medical Science,(Allahabad Deviwedi Company),2008

[165] Pranam Kumar Rout, DNA Test A Forensic Boon, Criminal Law Journal, 2003

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12.16.Judicial and Forensic Interrelationship

Judges Training and Awareness

Judges do not have sufficient information pertinent to the subject matter which allows them to make informed decisions regarding the evaluation of the forensic evidence presented. Therefore:

-Run compulsory induction courses on forensics for the judiciary on reading forensic documents.

-Publish forensic science benchbooks for the use of trial courts.

12.17 Use of Court-Appointed Neutral Experts

In particularly intricate matters, courts should have the authority to appoint neutral forensic specialists:

- From an already certified pool.

- To fulfill public contracts to ensure impartiality.

- Give the information in relation to judicial reasoning.

12.18Public Awareness and Citizen Engagement

12.18.1 Legal Literacy Campaigns -

To the man on the street, forensic science is often shrouded in mystery. Legal literacy campaigns need to:

- Inform the populace about their rights regarding the gathering of evidence.

- Explain the importance of forensics to the adjudicative process.

- Warn against media trials and sensationalism.

12.18.2Community Forensics Initiatives

Local police stations can collaborate with local NGOs and universities to:

- Organize workshops on evidence capture, teaching citizens active participation.

- Inspire the public to report using forensic elements like anonymous mobile video submissions.

13.Role of Forensic Science in High-Profile Criminal Cases in India

Case Studies from India -

13.1Aarushi Talwar Murder Case (2008)[166]

Overview:

The investigations surrounding the double murder of 14-year-old Aarushi Talwar and her family's domestic help, Hemraj, have been quite ruthless, and remains one of India's most controversial cases to this date. The investigation was roundly critiqued due to conflicting evidence, inadequate scene management, and questionable forensic analysis.

Forensic Involvement:

• Samples of DNA were taken from Aarushi's body and the vicinity as well. The development of a foreign DNA theory was put into question after no alien DNA was discovered.

• Forensic Odontology: Initially assumed bite marks turned out to be ruled out and thus ceased to be a concern.

• Luminol Testing: There was too much delay conducting this test. The previously claimed blood cleanup alleged by the investigators was thoroughly put into consideration which claljada required indentation of already declared blood traces.

Impact:

According to conflicting expert reports that resulted from the CBI's alleged forensic mismanagement, forensic evidence went brutal. In 2017, the Allahabad High Court had no other option but to acquit the parents, citing insufficient evidence formulated alongside meticulous procedures. This heart-wrenching tale marks tangible mismanagement of forensic evidence.

[166] Rajesh Talwar & Another v. State of U.P., 2017 SCC OnLine All 837

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13.2Vyapam Scam Deaths [167]

Overview:

An extensive admission and employment racket operating in Madhya Pradesh was connected with a series of unexplained deaths, many of which were suspected to be outside natural causes.

Forensic Involvement:

- Autopsies and Toxicology: Conducted for probe into deaths of some of the whistleblowers and other suspects.

- Digital Forensics: Studied data from devices, documentation of exams, and correspondence of the masterminds with the top- brass of the syndicate.

Challenges:

Accusations of forged documents and reports from politically exposed individuals became rife. In some instances, there was a disparity between the forensic files and police reports, prompting the need for an external investigation.

Impact:

While inescapable proof of murder for every single one was lacking, forensic scrutiny put a question mark on the accepted explanations and exposed the flaws in the systems dealing with sensitive cases.

13.3Nirbhaya Case (2012)[168]

The detal examination of the forensic aspects of rape cases was revolutionized by the horrific gang rape and murder of a 23 year old woman in Delhi.

Overview

• A gang rape incident occured on a moving bus, and later the victim's body was discarded outside.

• There were many protests that took place demanding immediate punishment of the accused along with legal changes.

Forensic Innovations

• The DNA tests conducted on semen samples provided by the accused were very important.

• Forensic bite mark analysts matched bite marks to the dental molds of the accused.

• The timeline in forensics along with the medical records and injuries corroborated the prosecution's arguments.

Result and Consequences

• Forensic evidence provided by the examination resulted in the death penalty for the four defendants.

• Changed the law to include the establishment of fast-track courts and the Criminal Law Amendment Act 2013, which included the use of forensic evidence in rape cases.

• It underlined the fact that there needs to be provided well trained staff along with Sexual Assault Forensic Examination kits in hospitals.

Indrani Mukerjea is charged with the murder of her daughter, Sheena Bora, whose skeletal remains were found in a forest, which also led to other murder charges against Mukerjea, also known as the Sheena Bora Murder Case.

Timeline

The year is 2012 and this murder case was revealed in 2015. Underlying indicative evidence exposed in the investigation of unearths that bore resemblance in bodies uncovered for years.

Narrative

Forensic science played an essential role in the discovery of evidence and suppression of this criminal act.

Infra Forensics utilized in shedding light to the case include:

[167] HIGH COURT OF MADHYA PRADESH: JABALPUR- MCRC No. 26749/2017

[168] Mukesh & Anr vs State for NCT of Delhi & Ors, (2017) 6 SCC 1.

- Mobile phone tracking alongside analysis of calling data which was later proven to assist with recollection of timelines of account given.

- With the help of DNA obtained from the Sheena's mothers and sibling, the body was powered matched up to other faint DNA parts in the shed portion of the body.

Indictment

This changed everything surrounding unresolved murders. Due to the inefficiency of police crimes haled the dead-end alley of a long unresolved case without the aiding beige shade of forensics, unironically dubbed the blunders of process provided By police.

13.4Sunanda Pushkar's Death Case (2014)[169]

The death of Pushkar Sunanda, an Indian businesswoman and wife to prominent politician Shashi Tharoor, re-sparks intrigue every few years due to the complexities witness and constant public discussion sparked across the board.

Overview

- The initial stage death, not one leading to murder, of Sunanda start off as highly suspicious after her being found in a luxury hotel in Delhi.

- The cause remained undetermined as well, whether it was chilling oneself (commonly referred to as suicide), administering poison, undergoing a natural demise, or otherwise.

Forensic Controversies

- The forensic investigation already had a life-plan on when - at what age to die. First structured plan designed by the AIIMS institute provided the specify the cause as an autopsy=drowning in a sea of self inflicted wounds on her body revealed the frame and cabin of a ship, which later was disproven through self-inflicted poisoning as promised within the contract signed with the Union of Forensic Sciences of Canada.

-Subsequently outsourced agencies were even more bizarrely constricted under the contract stating ailment means lax/passed herbs and fertilizers of gasoline lead, install uranium monitoring technology models ditto, inflicting poisonous concoctions worth their weight in gold, freon and numerous radiological elements'.

Impact

- Subphases of this investigation alone showcased self-ttioth – stark obvious factors waiting planning, agency dealing exist lacked guiding cuts corrishment and different clarity into basis arrangement order- result planning bashy0.

-Concentration layout remained clearly died alongside narrative insertion through forth outlining empty separation corpse dissected from bones of the body adopted build, four – without them being mashed construct (implative/real body narrative corpse strand logic cut).

- The prime outcome clearly showcases highlighted previous hints underscore predecesors incarnating med-political hypnosis had were policy invocation alliance build aips genome cuts simple both what clear and structured medically approximation for bio-legislature lies reprises essential virtue polishing helpless while lacking distinctions delineating emthods deliberate (consolette academic dissection combo feign me shells body own me as logical). anyways."

13.5.-26/11 Mumbai Terror Attacks (2008)[170]

The most devastating terrorist attack in India came with the application of forensic science at a global scale to ascertain cross-border complicity.

Overview

• A collective of 10 terrorists from Pakistan launched a coordinated assault on several sites across Mumbai.

[169] HIGH COURT OF DELHI AT NEW DELHI- W.P.(CRL) 1938/2017 & Crl.

[170] Ajmal Amir Kasab v. State of Maharashtra, (2012) 9 SCC 1

• An excess of 160 civilians lost their lives along with hundreds more sustaining injuries.

Forensic Evidence

• A digital forensic analysis of the attackers' GPS units and the satellite phones available to them showed the attackers had received instructions from Pakistan.

• Identifying the arms utilized and their accompanying routes was made possible with the aid of ballistic tests and CCTV footage.

• The only attack survivor, Ajmal Kasab, provided voice samples and DNA which were instrumental for his identification.

Global Impact

• India provided international and cross border unions with forensic evidences to strengthen their position.

• Daily multi-national forensic collaboration in India was markedly showcased to the rest of the world.

• Foresightable shifts in the forensic and anti-terrorism approaches of Mumbai became visible.

13.6Sushant Singh Rajput Death (2020)[171]

The actor's passing brought to light deep-rooted issues concerning media attention and forensic examination regarding prominent figures in the country.

Overview

- Initially considered a suicide, it triggered numerous conspiracy theories and political drama.

- Multiple agencies (Mumbai Police, Bihar Police, CBI, AIIMS) were involved.

Forensic Role

- The AIIMS panel noted absence of homicide signs but highlighted "missing links" during the initial autopsy.

- Questions about the forensic analysis timelines, missing timestamps, vandalized crime scene, and inadequate crime scene preservation protocols raised concerns.

Outcome

- Underscored the need to protect forensic scientists from media sensationalism.

- Added to the calls made for uniform policies regarding forensic investigations into high-profile cases to require official video documentation of every stage.

13.7. Lessons from Prominent Cases

These case studies are encouraging, owing to the promise and potential they provide, but also troubling due to numerous unethical and procedural blunders. In summary:

Need for Evidence to be Collected in a Timely manner -

•The conducting of forensic analysis is predicated on the fact that evidence has been collected within the first 24 – 48 hours.

•Justice can be irrevocably impaired through delays, contamination, or mishandling.

Need for Consolidated Policies Governing a Crime Scene

•The bulk of blunders occur at the crime scene, not at the laboratory.

•India does not possess a centralized policy on crime scene management or certification for first responders as the nation.

Need for Cooperation from Various Fields -

- Incorporating a variety of specialists—balistic, digital, legal, as well as ones dedicated to medicine and forensics—tends to make investigations more successful.
- With supporting frameworks at the institution, and real-time data available for sharing, this becomes possible.

Media Management

- Forensic media trials have negative consequences, such as leaking

[171] SUPREME COURT OF INDIA- Transfer Petition (Crl.) No.225 of 2020

evidence, investigator harassment, and sabotaged trials.

- Legally binding policies regarding the forensic confidentiality of reports, coupled with ethical reporting from the media, are a must.

Expert Witness and Training

- Forensic reports are frequently part of complex interdisciplinary work that requires higher-order thinking, leading to difficulties for court representatives.
- Judges, lawyers, and police officers need to be trained in forensics to increase comprehension and understanding, as more funding in this domain would greatly improve the literacy gap surrounding it.[172]

Suggestions for Reform Using the Case Studies Above-

From these particular case studies, it is evident that the following reforms are paramount:

1.From the National Crime Scene Management Protocol – A protocol that requires all states and union territories to check off standardized checklists.

2 Forensic Oversight Body – An independent body created to avoid interference in politically sensitive cases.

3.Autopsies – Mandatory videotaped autopsies in cases of unnatural deaths, custodial fatalities, or in deaths of public figures.

4.Forensic Review Panels – Review panels must be created for cross examination of findings in high profile cases.

5.Mobile Forensic Units and Rapid DNA Technology – Decreased response time for sexual violence, missing persons cases, or disasters will be achieved with these technologies.

6.Public Repository of Forensic Standards – Improved investigation and transparency will be achieved with the open access repository of forensic best practices.

[172] . https://www.shiksha.com/science/forensic-science-chp

Use of Narco Analysis and Polygraph in India

Summary :

In India, techniques like narco analysis or brain mapping, polygraph, and others have been controversially employed in criminal matters for obtaining confessions or verifying statements.

Legal and Forensic Issues:

- In the Abhishek Manu Singhvi CD case and narco analysis was applied in the Bombay serial train blasts (2006) as well.

- In Selvi v. State of Karnataka, the Supreme Court in 2010 consented such treatment might be inflicted, but no results are usable as evidence.

Ethical Issues:

These methods are considered unreliable and ethically disturbing. For instance, the Indian Forensic Labs, Forensic Science Laboratory, Bangalore, has used them under judicial direction, but their scientific credibility is greatly disputed.

14.Comparative analysis - Forensic Science in India and Other Countries

Forensic science is globally driven by the same scientific principles, but each country's legal system, infrastructure, training, and governance mold it differently. India's jurisdictional boundaries make it a hotchpotch system and ailing forensic tools are increasingly being integrated into criminal investigations in India. However, India is still behind compared to the United States, United Kingdom, Canada, Japan, and Australia, especially with regards to standardization, capacity, admissibility and ethical along regulation. [173]

14.1Forensic System in the United States

The United States is both practical and regulatory when dealing with Forensic systems. The level of sophistication is unmatched in the

[173] https://www.cgc.ac.in/blog/why-build-a-career -in-the-exponentially-growing- field-of-forensicscience

whole world.Can be Divided in Districts but Best When It Comes To Technology-

•Forensic services are offered at federal, state and local levels.

•High-end facilities like the Quantico Laboratory are part of the Federal Bureau of Investigation (FBI).

•There is also the Combined DNA Index System (CODIS) which runs as a national DNA database for comparing DNA profiles from different jurisdiction

Accreditation and Quality Control

•Labs are to comply with the ISO/IEC 17025 protocols.

•Accrediting body is The American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB).

•Mandatory to undergo peer evaluation, blind testing, and routine audits.

14.2Lessons for India

•India does not have an overarching DNA database or uniform system for providing accreditations.

•To improve consistency and reliability, a national forensic lab with regional satellites should be constructed similar to the FBI.

14.3United Kingdom's Forensic Science Regulator Model

The United Kingdom previously had a publicly financed Forensic Science Service (FSS) which was abolished in 2012 due to budgetary constraints. Forensic services are now outsourced, although provisions are made within the Forensic Science Regulator (FSR) for maintaining stringent requirements.

14.3.1Role of the Forensic Science Regulator

•A non-public body monitoring the quality of forensic science processes.

•Issues Codes of Practice and defines the necessary degree of technical detail. [174]

•Carries out investigation of failings, makes recommendation on punishment, and dictates steps for enhancement.

14.3.2Integration with the Legal System

•Judicial systems within the UK use heavily rely on witness specialists but is subject to set procedures, statement disclosure beforehand.

•Witness specialists are predominantly provided by the court which minimizes bias from police-sided witnesses.

14.4Takeaways for India

- India requires a statutory authority to monitor standards, conduct, and and professional competencies.

- The use of court-approved expert witnesses is one way to reduce bias in the courts in the UK and can increase impartiality in judicial proceedings.

14.5Japan's Integration of Robotics and AI in Forensics

Japan is noted for the application of cutting-edge technology and attention to detail in criminal investigative procedures.

Advanced Requirements for technology trainingik

- Employing robotics to reconstruct crime scenes.

- The use of artificial intelligence supplied face and gait identification for cameras.

- Higher standards of voiceprint analysis done during terrorism and ransom incidents.

Focus on Training

- Forensic practitioners are mandated to undertake training on a regular basis.

- There is active cooperation between the police, the laboratories, and universities to

[174] https://educationasia.in/article/career-and-job- prospect-for-forensic-science-in-india

ensure they have many adequately skilled personnel.

14.6Lessons for India

- There is a practical focus for Japan which balances the importance of cross disciplinary integration like with engineering and AI research alongside forensic sciences.[175]

- This same model can be applied to India's IITs and other AI research centers where sufficient collaboration would enable devising appropriate resources for the country's legal system alongside its culture.

14.7 Learning from Australia and Canada

Both countries are noted for their unique approaches, particularly with respect to standardization, Indigenous rights, and policing based on evidence.

14.7.1 Australia - The ANZPAA Model

- The establishment of the Australia New Zealand Policing Advisory Agency (ANZPAA) has set forensic protocols to achieve consistency across jurisdictions.

- Specialized forensic services comprise disaster victim identification, forensic odontology, and chemical forensics.

14.7.2 Canada – Ethical Governance

- Canada has also incorporated an Indigenous perspective into forensics, particularly in the context of missing and murdered Indigenous women, which is important.

- There are stringent ethical policies and culturally appropriate procedures for investigation that are followed.

14.8 Lessons for India

- Adoptions of sensitive cultural approaches to forensic science could be implemented in India, especially considering its caste and tribal and religious diversity.

- Indian policy should formulate community specific national guidelines for ethical forensic involvement in marginalized populations.

14.9Recommendations for India Based on Global Comparisons

India can make these notable reforms based on global best practices discussed above.

Establish a National Forensic Authority

- The UK's Forensic Science Regulator serves as a model; India needs to create a central agency, by law endorsed, with power to establish uniform standards across the nation.[176]

National Governance of DNA and Biometrics Databases - India is encouraged to create a judicially supervised, overarching DNA database with stringent privacy controls limiting its scope.

Court Ordered Experts -Courts should have a list of certified forensic professionals to appoint, in order to mitigate prosecution or defense biases within the trial.

Collaboration on Technology and R&D - Partner with IITs, NITs, and private firms for the creation of India-focused forensics tools in areas like digital forensics, AI, and environmental forensics.

Forensic Guidelines Sensitive to Culture - Formulate strategies on evidence preservation and collection for tribal, sacred, and caste-affected spatial areas where more nuanced sociological factors might disturb investigations.

Limitations of Using a Western Model

Despite perhaps having advantages, systems of derivatives stand to fail when:

- The police force in India is already stretched thin.

- There are infrastructural deficits in rural and semi-urban regions.

[175] https://collegedunia.com/courses/forensic-science/ forensic-science-subjects#d

[176] http://www.legalserviceindia.com/legal/article-1310-forensic-science-in-criminalinvestigation.html,last accessed on 19 Aug 2020

- The socio-political factors that surround them, which are absent in much of the Western world.

This is why India needs to customize: the fix needs to adjust to .federal system, diversity, and available resources.

15."LAND MARK JUDGEMENTS ON FORENSIC INVESTIGATIONS"-

In criminal cases that rely primarily on circumstantial evidence, forensic science plays an indispensable role. It helps in establishing the occurrence of a crime, identifying the suspect, and determining either the guilt or innocence of the accused. One of the most important responsibilities for forensic experts and investigating officers at a crime scene is the careful search and collection of crucial physical evidence that holds evidentiary value.

To maintain the integrity of evidence, forensic professionals must take preventive measures against contamination, tampering, or damage during collection, packaging, and transportation. Proper precautions ensure that the materials gathered remain authentic and admissible in court.

"The Nitish Katara case serves as a strong example. In this case, the victim's identification was extremely difficult, as only a small part of a hand and some fingers were recovered. Through DNA profiling, authorities were able to match the DNA with that of the victim's parents, which enabled the Delhi High Court to uphold the conviction of the accused."

In State vs. S. Mandal[177], where the CBI represented the State, a forensic report and DNA profiling were challenged by the deceased boy's father. The boy had reportedly fallen into a conflict involving a schoolgirl and her family, leading to his disappearance. A week later, an unidentified body was found. Despite the applicant's refusal to accept the body as his son's, DNA profiling was conducted, matching the deceased's remains with the DNA of the parents. A skull superimposition examination further confirmed the identity. Although the father objected to these scientific findings, the High Court placed reliance on the DNA profiling and other forensic evidence to resolve the matter.

Similarly, in State of Maharashtra vs. A.S.S. Jabbed,[178] DNA evidence played a crucial role alongside other material evidence. This case involved the murder of a young female engineer by a colleague. In another brutal rape case involving a four-year-old girl in a Delhi slum, forensic DNA testing was pivotal in linking the accused to the crime. After careful examination of the forensic evidence, the court convicted the suspect.

Forensic science has also been instrumental in solving cases involving abduction, rape, and murder. In one instance, a ten-year-old girl was kidnapped and murdered by an auto-rickshaw driver, who disposed of her body in a drain. Forensic investigation and DNA evidence confirmed the identity of the victim and the involvement of the accused.

"In Krishna vs. State of Haryana,[179] the court's decision heavily relied on the forensic investigation and the report submitted by the Forensic Science Laboratory (FSL). Based on this report, the accused was convicted under Sections 376 (rape) and 506 (criminal intimidation) of the Indian Penal Code."

In the case of vs. M.H. Gohil VS State[180], the court acknowledged the increasing importance of DNA technology in modern forensic investigations. The Bench, after reviewing multiple cases and authoritative references, observed that courts both in India and worldwide have progressively begun to rely on DNA results. The judgment noted that advancements in DNA testing technology have made it a reliable tool in either securing a conviction or dismissing baseless allegations.

[177] COURT OF ADDITIONAL SESSIONS JUDGE-05,- CENTRAL DISTRICT, TIS HAZARI COURTS, DELHI-SCC 799/2024

[178] HIGH COURT OF JUDICATURE AT BOMBAY- BAIL APPLICATION NO. 3537 OF 2021

[179] 1994 AIR 2536 1994 SCC (4) 703 JT 1994 (5) 477 1994 SCALE (3)100

[180] AIR 1961 SC 843

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15.1The Bhiwani Double Murder Case (2023): The Role of Forensic Science in Criminal Justice system -

Introduction

On February 16, 2023, a double murder case rocked the town of Bhiwani in Haryana, India. The bodies of two young men, **Junaid and Nasir**, were discovered in a burnt car in a remote area of Bhiwani district. The case quickly attracted widespread media attention due to the brutality of the crime and the apparent hate motive involved. Forensic science played a crucial role in solving this case, providing investigators with the scientific evidence needed to connect the accused to the crime.

The investigation relied heavily on **DNA analysis**, **bloodstain pattern analysis**, and **crime scene reconstruction**, ultimately leading to the identification of the perpetrators—members of a cow vigilante group who had abducted, tortured, and killed the two men. This case highlights the role of modern forensic techniques in providing accurate and reliable evidence that can be used to solve complex criminal cases.

Background and Victims

Junaid and Nasir were both residents of **Gurugram**, a bustling city near Delhi, and had been close friends for years. The two were in their early twenties, with bright futures ahead of them. However, their lives were tragically cut short when they were abducted, tortured, and killed in February 2023.

The victims had gone missing on the night of February 15, 2023, after leaving their homes in Gurugram. According to family members, Junaid and Nasir had plans to go to a nearby town for some work. However, they never returned home. Their families filed missing person reports, but it wasn't until the following day that the authorities discovered their bodies in a burnt car on the outskirts of Bhiwani.

The car was found charred, and the bodies of the two young men were almost unrecognizable. The horrific nature of the crime, along with the fact that both men appeared to have been severely beaten and tortured before being killed, immediately drew public attention. The case raised alarm bells regarding the increasing instances of cow vigilantism and the dangers it posed to people, especially Muslims, in rural areas.

The Initial Investigation and Challenges

The discovery of the bodies was just the beginning of a complex investigation. Initially, the police faced numerous challenges in trying to solve the case:

No Immediate Witnesses: There were no immediate eyewitnesses to the crime, and the location where the car was found was remote, with little activity.

Burnt Bodies: The bodies were badly burned, making it difficult to identify the victims quickly. This also posed a challenge for the forensic experts trying to collect vital evidence from the bodies and the vehicle.

Lack of Clear Motive: At first, the police were unsure of the motive behind the crime. While there were suspicions about cow vigilantism, the authorities had to piece together the events leading up to the murders through forensic evidence and circumstantial details. Despite these challenges, the police remained determined to crack the case, and forensic science soon became central to solving it.

Role of forensic-

The investigation into the Bhiwani double murder case saw the effective use of several forensic methods to identify the perpetrators and establish a clear connection to the crime. The police worked closely with forensic experts to analyze the evidence and build a case against the accused. The key forensic techniques used in this case included:

1. **DNA Analysis**: DNA analysis played a pivotal role in identifying the victims and establishing the link between the perpetrators and the crime scene. Once the bodies were identified as Junaid and Nasir, forensic teams collected DNA

samples from the charred remains to confirm their identities. DNA samples were also taken from the car and surrounding area. [181]

Further, blood found in the car was tested to confirm whether it matched the victims' DNA. The results showed that the blood found in the vehicle was indeed from Junaid and Nasir, confirming that they had been transported in the car while alive before being killed.

DNA samples from the perpetrators were also collected from various sources, such as the crime scene and the suspects' clothing. These samples were compared with DNA from the victims' blood, confirming the identities of the individuals involved in the murders.

2. **Bloodstain Pattern Analysis**: Bloodstain pattern analysis is a crucial forensic tool used to reconstruct violent crimes. Investigators were able to analyze the bloodstains found at the crime scene and in the vehicle to determine the sequence of events leading up to the murders.

The patterns of blood splatter indicated that the victims had been beaten and tortured been restrained while in the car, and that the perpetrators had used forceful actions to subdue them before committing the brutal killings. Blood was found both inside the car and on the exterior, indicating that the victims had been moved from one location to another, and possibly subjected to further torture.

Forensic experts used these patterns to reconstruct the timeline of events leading up to the murders. The analysis also provided critical evidence that helped identify the manner in which the victims were killed and offered insights into the sequence of events. The bloodstain patterns also helped establish the level of violence involved, which further corroborated the brutality of the crime.

3. **Crime Scene Reconstruction**: Forensic experts worked closely with police investigators to reconstruct the sequence of events at the crime scene. They carefully examined the area where the burnt car was found and noted the surroundings. The analysis of tire tracks, footprints, and the burn marks on the vehicle gave crucial information regarding the circumstances of the crime.

By analyzing the crime scene in detail, forensic investigators were able to deduce that the perpetrators had likely tortured the victims for several hours before killing them. They had then set the car on fire to destroy evidence and cover their tracks. The vehicle itself was an essential piece of evidence, as it helped investigators trace the movements of the suspects leading up to the discovery of the bodies.

4. **Analysis of Charred Remains**: The bodies were severely burnt, making traditional identification methods challenging. Forensic pathologists had to work diligently to extract DNA and other evidence from the charred remains. Despite the severe burns, they were able to recover enough tissue and hair samples to establish the identities of Junaid and Nasir. This was confirmed through DNA testing, which conclusively linked the remains to the victims' families.

The bodies were also examined for signs of torture, including burn marks, fractures, and other injuries. The pathologists determined that the victims had been subjected to brutal physical violence before being killed. These findings were critical in linking the crime to the larger issue of hate crimes and cow vigilantism.

5. **Digital Evidence and Surveillance Footage**: Another key piece of evidence came from digital sources, such as mobile phones and CCTV footage. Investigators obtained footage from nearby cameras that showed the movements of the victims on the night of the abduction. The footage revealed that the two young men were last seen in a car with the

[181] Shali, Sonia Kaul, Applicability of Forensic Science in Criminal Justice System in India with Special
Emphasis on Crime Scene Investigation (June 25, 2018

perpetrators, who later became the prime suspects in the case. [182]

Mobile phone data also provided valuable leads. Investigators were able to track the locations of the suspects' phones before and after the crime. This digital evidence corroborated the physical evidence collected from the crime scene, establishing a timeline of the events and confirming the involvement of the accused in the murders.

The Arrest and Identification of the Perpetrators

The breakthrough in the case came when the forensic evidence linked a group of **cow vigilantes** to the crime. The police discovered that the accused men had a history of targeting Muslims and had previously been involved in violent acts against individuals suspected of cow smuggling. After analyzing the DNA and bloodstain evidence, the police identified the perpetrators as members of a local vigilante group that had become increasingly active in the region.

The suspects were arrested after investigators traced their involvement through the forensic evidence and digital leads. They were interrogated, and during questioning, they confessed to abducting Junaid and Nasir, believing they were involved in cow smuggling. The perpetrators claimed that they had detained the victims, tortured them for several hours, and then killed them in an attempt to enforce their own form of justice.

The confessions, combined with the forensic evidence, were sufficient to bring the suspects to trial. The police were able to charge the accused with **murder**, **kidnapping**, **torture**, and **destruction of the increasing incidents of mob justice in rural and semi-urban areas. The case garnered significant attention not only due to the brutality of the crime but also because of the role forensic science played in solving it. The use of DNA analysis, bloodstain pattern analysis, and other forensic methods was central in piecing together the events of the crime and providing irrefutable evidence that led to the identification and arrest of the perpetrators.

The legal proceedings began with the presentation of the forensic evidence in court. The prosecution introduced the DNA results, the bloodstain pattern analysis, and the crime scene reconstruction as critical pieces of evidence to establish the guilt of the accused. The defense, however, argued that the confessions made by the accused were coerced, and questioned the reliability of the forensic analysis.

Despite these challenges, the forensic evidence was strong enough to uphold the charges against the accused. The presence of the victims' blood in the car, the DNA match, and the bloodstain pattern analysis, which provided insight into the nature of the attack, all corroborated the testimonies of the investigators and the witnesses. Additionally, the digital evidence from mobile phones and surveillance footage confirmed the suspects' involvement and provided a clear picture of the events leading up to the murders. [183]

As the trial progressed, the victims' families were given an opportunity to speak in court. Their testimony, along with the forensic evidence, created an emotional and compelling narrative that painted a picture of the brutality of the crime and the devastating impact on their lives. The families of Junaid and Nasir demanded justice and called for the harshest possible punishment for the perpetrators.

The Conviction and Sentencing

After a thorough trial, the court found the accused guilty of **murder**, **kidnapping**, and **torture**, as well as **attempted destruction of evidence**. The forensic evidence played a crucial role in securing the conviction, as it provided clear, scientific backing for the allegations against the accused. The DNA

[182] Borah U. Role of Forensic Science in Crime Scene Investigation. Austin J Forensic Sci Criminal.
2020; 7(1): 1083,.

[183] Jasmine Kaur Ahluwalia, Dr. Ranjana Sharma. The Role of Forensic Science in Criminal Investigation. IJFMR 2023 5(6).

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analysis confirmed the identity of the victims, while the bloodstain pattern analysis demonstrated the brutal nature of the attack, and the crime scene reconstruction gave a detailed account of how the events unfolded.

In August 2023, the court sentenced the accused to **life imprisonment** for their roles in the double murder. The verdict was met with mixed reactions from the public. While some saw it as a step toward justice for the victims and their families, others believed that the sentence was not harsh enough given the brutality of the crime. However, the case was widely regarded as a significant example of how modern forensic science can be used effectively in criminal investigations to bring perpetrators to justice.

Implications of the Case on Forensic Science and Crime Investigation

The Bhiwani double murder case serves as an example of the transformative role that forensic science can play in modern criminal investigations. Traditional methods of investigation, such as eyewitness testimony and circumstantial evidence, were supplemented by advanced forensic techniques, making it possible to solve a case that might otherwise have remained unsolved.

1. **Advances in Forensic Science**: The case underscored the importance of forensic science in ensuring justice. **DNA analysis**, which was instrumental in confirming the victims' identities and linking the perpetrators to the crime, is one of the most powerful tools available to law enforcement today. Similarly, **bloodstain pattern analysis** helped investigators understand the nature of the crime, the sequence of events, and the level of violence involved. These techniques are now indispensable in modern criminal investigations. [184]

2. **The Role of Digital Forensics**: The role of **digital evidence** in the case was equally crucial. Mobile phone data and surveillance footage helped investigators establish a timeline of the events and pinpoint the locations of both the victims and the suspects. Digital forensics is becoming an increasingly important part of criminal investigations, as more and more crimes leave behind digital footprints that can be traced and analyzed.

3. **The Importance of Crime Scene Reconstruction**: The meticulous **crime scene reconstruction** in the Bhiwani case helped investigators understand how the crime unfolded, the movements of the perpetrators, and the relationship between the different pieces of evidence. Crime scene reconstruction not only aids in identifying the perpetrators but also helps in understanding the methods and motivations behind the crime, providing a clearer picture of the events leading to the crime.

4. **Public Awareness and Legal Reforms**: The case also sparked widespread discussions about the growing issue of **cow vigilantism** in India and the dangerous consequences of such acts of mob justice. The brutal murder of two young men in the name of "protecting cows" highlighted the need for better legal safeguards against such acts of violence. It also prompted calls for stronger laws and penalties to deter vigilante justice and ensure the safety of individuals from targeted violence based on communal or religious grounds.

Challenges and Criticisms

Despite the success of forensic techniques in solving the Bhiwani double murder case, there were several challenges and criticisms that arose during the investigation and trial.

1. **Coercion and Forced Confessions**: One of the key challenges raised by the defense was the issue of coerced confessions. The accused claimed that they were forced to confess under duress, a common issue in many high-profile criminal cases. While the court ultimately relied on the forensic evidence to convict the accused, the defense argued that the

[184] . Sathyanarayana Rao TS. Psychiatrist and the science of criminology: Sociological, psychological and psychiatric analysis of the dark side. Indian J Psychiatry. 2007

confessions should be scrutinized more carefully, as forced confessions have been shown to undermine the integrity of the criminal justice system.

2. **The Reliability of Forensic Evidence**: Another point of contention was the reliability of forensic evidence in criminal cases. Although the forensic methods used in the Bhiwani case were highly effective, there is always the potential for human error, contamination, or misinterpretation of evidence. In the future, it will be essential for forensic professionals to continue to improve their methods and ensure that they are applied in a way that minimizes errors and ensures the accuracy of the findings.[185]

3. **The Role of Media**: The media's involvement in the case, especially given its widespread coverage, raised concerns about the potential for **trial by media**. While the media played a role in highlighting the severity of the crime and bringing attention to issues of cow vigilantism, it also created pressure for quick results. In some instances, media coverage can interfere with the impartiality of the legal process, leading to bias and influencing public opinion.

16.CONCLUSION-

The Bhiwani double murder case is a landmark example of how forensic science can revolutionize criminal investigations. The use of advanced forensic techniques such as **DNA analysis**, **bloodstain pattern analysis**, **crime scene reconstruction**, and **digital forensics** played a pivotal role in solving the case and securing convictions. These tools helped investigators establish the sequence of events, identify the perpetrators, and gather evidence that was crucial for the trial.

The case also highlights the challenges faced by law enforcement in investigating and solving violent crimes, especially those with complex motives. Despite these challenges, forensic science continues to provide invaluable support to criminal investigations, ensuring that justice can be served even in the most difficult cases.

These cases stand as landmark judgments by Indian courts, which have helped establish the importance and legitimacy of forensic science in the Indian legal system. According to a study conducted by the Hon'ble Supreme Court of India and various High Courts, it was observed that the use of forensic science in criminal investigations, particularly in sensitive cases, has become increasingly significant.

Notably, in recent years, Indian courts have made forensic investigations mandatory in cases involving sexual offences. This important shift highlights the growing reliance of the Indian criminal justice system on forensic science as an essential tool for delivering justice. The insistence on scientific evidence in such cases reflects a broader acceptance of modern investigative techniques and forensic methodologies within India's legal framework, marking progress towards more reliable and evidence-based adjudication.

Forensic Science is the branch of science that incorporates law and justice. In a subcontinent like India, which has an immense population along with an intricate legal structure and a variety of crimes, its role in criminal investigations has become increasingly vital and intricate. It is through this broad paper that we have covered the development, scope, problems, and possibilities of forensic science in the Indian penal system.

• The Enhancements: In India, forensic science has come a long way. During the colonial rule, it was reduced to just providing post-mortem reports. Currently, it encompasses applications like cyber forensics, DNA profiling, and digital imaging.

• Its Application in Laws: With time, certain sections from the IPC, CrPC, and Indian Evidence Act have integrated forensic science into the legal framework as one of its foundation. Unfortunately, there is still lacking of more

[185] Ribaux, O, Walsh, SJ and Margot, P. The contribution of forensic science to crime analysis and investigation-forensic intelligence. Forensic Sci. Int. 2006;

reforms which fortify the use of forensic evidence from procedural nullation.

• Range of Forensic Methods: The listed methods are also some of the most widely used techniques in forensic science: DNA examination, Ballistics, Toxicology, Entomology, Digital Forensics, etc. However, due to infrastructural limitations, many of these methods are subject to delays and inaccuracies for uniformity.

• Impact of Study Cases: The infamous Nirbhaya case, the Mumbai attacks of 26/11, and the Aarushi-Hemraj case spotlight how forensic evidence can either guide one towards attaining justice or, if mishandled, subvert it altogether. Such cases have been instrumental in learning forensic best practices.

• Challenges: From a lack of resources in forensic laboratories to understaffed units, India is riddled with challenges. Additional problems include ethical and legal gaps concerning procedures. Also, due to the sensitive nature of politics, many cases are tampered with and forensic evidence is left to the judgement of untrained civil servants.

• Possible Developments: The professionalization of individuals in charge, the digital modernization, heightened awareness among civilians, and strict regulations are what will propel the future of forensic science in India. Forensic reforms are necessary on a national and local scale to streamline the process of delivering justice in a timely, systematic, and objective manner.

16.1The Primary Importance of Forensics in Achieving Justice

In this day and age where people are losing their trust in institutions and crime is rapidly advancing in its severity, Forensic Science offers a means to arrive at the truth through an impartial method of evidence. When applied correctly, forensic science is not a biased, emotional, or corruptible practice. Instead, it must rely heavily on scientific examinations. Modern day investigations must always have forensic science logic put in place, while the justice system must make sure it understands how to utilize it.

Forensics serves as an powerful equalizer in an oftentimes unequal justice system. It gives the poor and the marginalized an opportunity to receive justice based on facts regardless of their influence. On the other hands, powerful perpetrators that escape justice because of a lack of eyewitnesses or manipulated stories will be unable to escape the scrutiny used in forensic investigation.

16.2Forensic science and reform in criminal justice

There is a need to shift focus from technology to structure. Ethics aside, India needs to put funds into these sectors:

• A centralized authority of legal forensics with regulatory powers.

• Integration of AI and real-time data systems with forensic labs.

• Transparent and ethical frameworks, especially regarding digital surveillance and DNA databases.

• Reforming legislation to make forensic evidence a core component rather than supplementary in trials.

• Instruction for all ranks of police on decision making and dealing with crime scenes and evidence.

These reforms shouldn't be reactionary based on protests from the public. Instead, they should be proactive and integrated into comprehensive plans for the nation's future.

16.3A Vision for the Future

Envision a not-so-distant future where:

• Mobile forensic kits are available at every police station across India.

• Basic forensic terminology is understood by all judges and prosecutors.

• Rape survivors are able to achieve justice within months with the use of DNA analysis.

• Pertinent information is extracted from corpses and is articulated in a scientifically accurate manner.

This dream might not be so far fetched if we make proper investments, focus our intent, and invest in the necessary training.

16.4Final Thoughts

Forensic science goes beyond being merely a method; it is the very approach taken when considering the investigation of crimes. It's focused on evidence, logic, and objectivity, all of which need to be deeply rooted when adopting new practices in India. India needs to focus it's forensic science implementation, not just on technological improvements, but also on justice, human rights, and societal trust.

India's criminal justice system is undergoing change, and with the right reforms, other branches of forensic science can aid in evolving the structure into something more efficient, unbiased, and one that aligns with sociational truth.

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