

**ROLE OF FORENSIC EVIDENCE IN CRIMINAL
INVESTIGATIONS AND TRIALS IN INDIA :
A CRITICAL STUDY**

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CERTIFICATE

This is to certify that the dissertation titled, “**Role of Forensic Evidence in Criminal Investigations and Trials in India :A Critical Study**” is the work done by **Km Apurva Soni, Roll no. 1220997020**, under my guidance and supervision for the partial fulfilment of the requirement for the Degree of **Master of Laws** in School of Legal Studies Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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(Criminal and Security Law)

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LIST OF ABBREVIATIONS

| | |
|--------------|---|
| A.F.I.S. - | Automated Fingerprint Identification System |
| A.I.R. - | All India Reports |
| A.L.I.A.S. - | Aircraft Laser Infrared Absorption Spectrometer/ Advanced Ballistic |
| BPRD - | Bureau of Police Research and Development |
| CCMB - | Centre for Cellular and Molecular Biology |
| CDFD - | Centre for DNA Fingerprinting and Diagnostic |
| CFSL - | Central Forensic Science Laboratory |
| CID - | Criminal Investigation Department |
| Cr. App - | Criminal Appeal |
| DNA- | Deoxyribonucleic Acid |
| FSL - | Forensic Science Laboratory |
| mtDNA- | Mitochondria Deoxyribonucleic Acid |
| RI - | Rigorous Imprisonment |
| S.B.B.L - | Smooth Bore Breech Loading Gun |
| SASR - | South Australian State Reports |
| SBML - | Single barrel muzzle loading |
| SCC - | Supreme Court Cases |
| SCR - | Supreme Court Reports |

LIST OF CASES

1. Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantayal (SC 14 July, 2020)
2. Ashish Jain v. Markand Singh SC 2023
3. Baso Prasad and ors. V. State of Bihar AIR 2007 SC 1019
4. Daubert v. Merrel Dow Pharmaceuticals Inc 509 US 579 (1993)
5. Kunhiram v. Manoj Kerala HC (1991)
6. Gautam Kundu v. State of West Bengal AIR 1993 SC 2295
7. Kanchan Bedi v. Gurpreet Singh Bedi Delhi HC 2003
8. Mukesh and Anr. V. State for NCT of Delhi and Ors (2017) 6 SCC
9. Neeraj Alias Kamal Grover v. State and Anr. (2015)
10. Nupur Talwar v. State of UP and Anr. (1984) 2 SCC
11. Pratim alias Peter Mukherja v. UOI and Anr Case no RC . 12(s)/ 2015
12. Pathumma v . Veersha (1988) K.L.T 798
13. Rajesh Talwar and Anr. V. CBI (CRL) No. 45 of 2012
14. State v. Sushil Sharma (2007) Cr LI 4008
15. Selvi v. State of Karnataka AIR 2010 SC 1974
16. State of Bombay v. Kathi Kalu Oghad and Anr. ,(1961) AIR 1808, 1962 SCR (3) 10
17. Sushil Mandal v. The State (Madras HC 2014)
18. S Gopal Reddy v. State of A.P. AIR 1996 SC 2184
19. Vasu v. Santha (1975) KLT 533
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CHAPTER-1

INTRODUCTION

"Forensic evidence is often the key to solving a crime. Whether it is DNA analysis, ballistics testing, or fingerprint analysis, forensic evidence can provide valuable clues that help investigators identify suspects and build a case against them."

- Justice Stephen Breyer

1. INTRODUCTION

Defining crime has proven challenging as its meaning varies depending on the historical and geographical context. There is no specific definition of crime, but some criminologists have attempted to define it in their research and academic work.

Expressing his view on the definition of crime, *Roscoe Pound* commented that "a final definition of crime is impossible because the law is a living and changing thing, which may at one time be based on the sovereign will and at another time on juristic science, which may at one time be uniform and at another time give much room for judicial discretion, which may at one time be more specific in its prescription and at another time much more general."

Blackstone states, "A crime is an act committed or omitted in violation of a Public Law either forbidding or commanding it".

Later, *Stephen*, editor of *Blackstone's* commentaries, modified his definition and said that "a crime is a violation of a right, considered in reference to the evil tendency of such violation as regards the community at large."

Crime is part of human psychology, and thus it is co-related to criminal science, that is, 'Criminology'.

Criminology is a multidisciplinary approach towards behavioural and social sciences. Criminologists have provided a more precise definition of it,

- Dr . Kenny defines it as "the branch of criminal science which deals with crime-causation, analysis, and prevention of crimes".

- Edwin Sutherland and Donald Cressey define it as "the body of knowledge regarding crime as a social phenomenon" It includes the process of making laws, breaking laws, and reacting towards breaking of laws.

Ultimately it involves answers for,

- Aetiology and
- Phenomenology

In order to ensure harmony, peace and justice within the society, the State has been granted powers to utilize the criminal justice system to control crime through various agencies, which helps to investigate the case more precisely.

1.1. SYSTEM INVOLVED IN CRIMINAL JUSTICE SYSTEM

The criminal justice system comprises four significant sub-systems, namely the police, prosecution, judicial and correctional services. At the same time, each sub-system is responsible for carrying out its own statutory role to achieve the overall objectives of the criminal justice system. They are also expected to coordinate each other's roles.

- **INVESTIGATING AGENCY**

the police forces are responsible for registering cases, analyzing them according to the Code of Criminal Procedure, and sending them for trial. In addition to state police forces, there is a central investigating agency called the Central Bureau of Investigation (CBI) that has parallel jurisdiction in Union Territories and can investigate cases within states with prior consent from state governments.

- **COURTS**

cases are adjudicated by a four-tier court structure, starting with the Court of Judicial Magistrates and culminating in the Supreme Court of India, which is the apex court in the country and hears appeals against High Court decisions.

- **PROSECUTION**

The State is responsible for prosecuting cases in the courts of law, and public prosecutors are appointed to prosecute cases at various levels.

- **CORRECTION**

the prisons and correctional services in India are under the control of the state governments.

In cases of cognizable offences, criminal investigation commences upon the filing of the First Information Report, while in non-cognizable offences, it begins after the magistrate's order. The criminal investigation begins and ends with the magistrate's order.

1.1.1 TRADITIONAL MODE OF INVESTIGATION

There are traditional tools of investigation consisting of the 3 I's, information, instrumentation, and interrogation.

- **INFORMATION**

The first step of investigation involves the collection of pertinent information and relevant evidence to the crime, such as witness testimonies and physical evidence. This also entails gathering information from various sources such as relevant records, special police contacts and sources, interviews etc. During the course of an investigation, it is essential to assess and analyze the gathered information to gain insight into various aspects of the case. The information must be thoroughly verified, documented and analyzed in order to make it admissible before the court of law as relevant evidence as per parameters of the Indian Evidence Act 1872.

- **INTERROGATION**

Interrogation is a crucial component of the investigation. Becoming proficient in using this tool requires a significant amount of time and practice. It is the primary tool used by investigators to collect and gather information, especially in cases where no physical evidence has been found. Witnesses and victims are interviewed while suspects and criminals are interrogated. However, confessions made before the police are not admissible under Indian Evidence Act 1872 still help in solving cases. It is a time taking process as it is based on the intellect of the person interrogating, which is rarely found in a single person; thus, torturing is used as the tool to make a person confess.

- **INSTRUMENTATION**

It is a method used to extract information from physical clues present at the crime scene. This process can help to establish a connection between a suspect and a crime scene, the suspect and the victim or the victim and the location. Its scope is not limited but goes beyond the mere identification of physical witnesses. It involves different technical instruments used to track down the accused, such as fingerprints, criminal record computerization, X-ray screening etc.

1.1.2 CONTEMPORARY MODE OF INVESTIGATION

Advancement in science and technology has caused the pace in modus operandi of criminals, which is the reason for the emergence of new trends to commit the crime. This is why the traditional methods need to be revised to solve the case.

The rapid advancements in science and technology have completely changed the way crimes are committed, resulting in the emergence of new forms of criminal activity facilitated by factors such as mobility, fast communication, anonymity, and technology availability. The perpetrators of crimes are using the latest scientific and technological inventions to carry out their activities, leading to an increase in the severity of traditional crimes and the development of new ones. The reliability of traditional modes of evidence, such as eyewitness accounts, confessions, and witness statements, has become questionable as these witnesses are either unavailable or unwilling to testify. However, properly collected and analyzed scientific evidence is reliable, specific, objective, universal in scope, and verifiable, making it the only reliable solution. Forensic Science is the scientific discipline that deals with the collection, preservation, and analysis of material evidence for use in legal proceedings.

The criminal investigation is a multi-layered mystery-solving challenge that is considered to be done with due care and precaution. It is the primary duty of the investigating officer to preserve the crime scene and apply logical reasoning in the case.

Orthman and Hess stated in the book 'Criminal Investigation' that "Criminal investigation is a procedure that entails determining who committed a crime and what evidence was left at the scene of a crime by examining criminal investigation as a process".

Section 2 (h) of CrPC, 1973 also states, “investigation includes all the proceedings under this Code for the collection of evidence conducted by a police officer or by any person (other than a Magistrate) who is authorized by a magistrate in this behalf”.

1.2 TYPES OF EVIDENCE COLLECTED FROM CRIME SCENES

- I. **DIRECT EVIDENCE:** such as eyewitness or victim statements can be complemented by other types of evidence, such as DNA typing, which can help reveal the accuracy and truth of the case.
- II. **CIRCUMSTANTIAL EVIDENCE OR INDIRECT EVIDENCE:** This process entails matching and identification of evidence with a reference or control sample obtained from the victim, suspect, or crime scene database. It is crucial that these types of evidence are handled with care to prevent the possibility of contamination, destruction, or loss. Two categories can be distinguished in this regard,
 - a. Physical evidence; these are non-biological sources, which include evidence such as fingerprints, footprints, shoe/tire impressions, fibres, paint, soil, dirt, glass, headlamps or arson debris, explosives, gunshot residues, and visible injuries like bite marks and scratches.
 - b. Biological evidence; this type of evidence is derived from biological sources, typically from the perpetrator or the victim, and includes samples such as semen, vaginal fluid, oral fluid, sweat, blood, hair, and other bodily fluids. The study can also be done by using forensic ‘Forensic Anthropometry’ which helps forensic experts to establish identity of an unknown body.

Circumstantial evidence is utilized when there is a lack of visible or audible evidence or when the available evidence is insufficient to support a conclusion.

The success of a criminal investigation is reliant upon the collection and analysis of various types of evidence. Forensic scientists have categorized evidence in numerous ways, including the distinction between physical and biological evidence. Physical evidence originates from non-living sources, while biological evidence always has a connection to a living individual. Examples of physical evidence include fingerprints, tire marks, footprints, shoe prints, fibres, paint, building materials, weapons, bullets, and shell casings. Trace evidence falls under the category of physical evidence, such as fingerprints on glass or footprints in the yard.

1.3 ROLE OF FORENSIC EVIDENCE IN INVESTIGATIONS AND TRIAL

Word 'Forensic' has been originated from the Latin term 'Forensis', which means an 'open court'. Forensics is a branch of study associated with the scientific approach of law and its application in the same. It helps in extracting information and evidence by using scientific methods.

Forensic practices were not standardized in ancient times, which made it easier for criminals to avoid their liability and punishment. Forensic evidence is gathered by the experts at the crime scenes during an investigation, and each piece of evidence is distinct and requires individual testing and analysis to draw a conclusion.

Forensic evidence refers to the utilization of one or multiple scientific techniques in the field of Forensic Science to aid in legal or criminal judicial proceedings. It involves several teams of experts with specialized knowledge in the same field to examine and provide an analysis of collected data.

The forensic investigation involves collecting evidence from various fields of forensic science, such as clinical Forensic Medicine, Forensic Pathology, Forensic Thanatology, Forensic Toxicology, Forensic Anthropology, Forensic Entomology, Forensic Geology, Forensic Taphonomy, Forensic Identification of Biological Fluids and Stains, and Forensic DNA analysis, Forensic Footwear Evidence, Forensic Tire Impression and Track Mark.

The expert witness presents forensic evidence, which is considered circumstantial since it aims to establish events that the witness did not directly observe.

Typologies for forensic evidence have been developed by various authorities, such as Fisher (2004), Gardner (2004), and Lee, Palmbach, & Miller (2004). These typologies cover the different types of forensic evidence collected at crime scenes, including fingerprints, impression evidence, hair, fibres, firearms, biological evidence, drug evidence, and entomological evidence. Based on Fisher (2004) and Lee, Palmbach, & Miller (2004) and in conjunction with the parallel Study by Peterson and Sommers, the following classification framework was employed for the present study;

1.4 SUB DIVISION OF FORENSIC

- Forensic Accounting
- Forensic aerial photography
- Computational forensics
- Criminalistics
- Forensic dactyloscopy
- Digital forensics
- Forensic document and examination

1.5 FORENSIC EVIDENCE : INDIA

Forensic Science has become a vital component of the criminal justice system, and its development in India can be traced back to British Rule. However, it came into progress after independence. The first Forensic Science laboratory was established in Calcutta in 1952, followed by another in Mumbai in 1958. There was a rapid expansion in establishing Forensic Institutions which led to the set up of four Central Forensic Science Laboratories and three laboratories for Government Examiners of Questioned Documents. " Institute of Criminology and Forensic Science" in New Delhi provides in-service training for forensic scientists, police, and judiciary in India.

The Bureau of Police Research and Development plays a crucial role in coordinating all Forensic Science activities in the country, with the aim of ensuring quick and efficient scientific aid to the criminal justice system.

Sir William Herschel, a member of the Indian Civil Services, was the first to utilize Fingerprint Identification in 1858. The Indian government then adopted this method and established a Finger Print Bureau in Bengal in 1897. The technique was later introduced in Scotland Yard in July 1901. The police system of crime investigation was implemented in India in 1861, while the Coroners System was introduced in 1871 in the presidency towns of Bombay and Calcutta.

1.6 SCOPE

Forensic Science encompasses various fields, including serology, fingerprints, documents, forensic chemistry, DNA analysis, forensic psychology, ballistics, toxicology, and more. These areas can assist in answering questions related to a crime, such as identifying individuals

present at the scene, determining what occurred and who is responsible, uncovering motives for the crime, and establishing the timeline of events.

Forensic Science enables the connection of the accused with the crime scene through the examination of evidence such as DNA fingerprinting, blood grouping, or fingerprints. Additionally, forensic science can establish a connection between an object and its source, such as matching a fired bullet to a firearm or a shoeprint to a shoe using tool marks.

Chemical and physical analysis can also aid in identifying suspicious substances found at the crime scene, such as determining whether an unknown liquid or powdery substance is a prohibited drug or illicit substance. The ultimate aim of the recognition process in forensics is individualization, specifically to say that a particular piece of evidence originates from a specific scene or person.

Fingerprints and DNA are examples of evidence that can be uniquely matched to a specific individual. However, for identifying other types of evidence, specialized techniques and expertise are necessary to link them to their specific source. Various standardized databases and advanced technologies have been developed over several years. Forensic Science plays a crucial role in investigating criminal cases like murder, rape, kidnapping, assault, theft, and robbery and civil cases like forgeries. It is also involved in regulating laws and policies related to food, petroleum products, drug manufacturing, and automobile discharge compliance, among others, to determine if any such regulations have been breached. Additionally, it encompasses forensic medicine and toxicology, personal identification, ballistics and firearm identification, soil examination, and the identification and association of human hair, blood, serum, saliva, etc.

There are various fields relating to forensic Science like Criminalistics, Chemistry, Biology, Entomology, Odontology, Medicine & Toxicology, Anthropology, Engineering Sciences, Cyber Forensics, Questioned Documents and Psychiatry & Behavioural Science.

1.7 AIM OF THE RESEARCH

The motive of this study is to assess the importance of forensic evidence in the decision-making process at critical junctures during a trial based on the evidence that is available.

The study will categorize various types of evidence that are typically encountered in specific types of crimes. By analyzing the collected data, the research will aim to identify which types of crimes have the most significant dependence on particular types of forensic evidence.

Apart from establishing the significance of forensic evidence in criminal trials, this research will also identify any challenges associated with scientific evidence. Scientific evidence, while critical in modern criminal investigations, can be complicated to understand and interpret. The study will identify the difficulties encountered while collecting, preserving, and analyzing scientific evidence and suggest strategies to address them.

The findings of this research will be beneficial for law enforcement agencies, forensic scientists, and legal professionals involved in criminal investigations and trials. It will provide insights into the types of evidence that are most useful in particular types of crimes and help them prepare more effectively for trials. Furthermore, identifying the challenges related to the application of scientific evidence can assist in resolving any potential issues that may arise during the collection, preservation, or analysis of evidence, thereby improving the overall reliability of forensic evidence in criminal investigations.

1.8 HYPOTHESIS

- Whether DNA evidence satisfies hypothesis in paternity cases?
- Whether application of recent forensic techniques infringes the right against self incrimination?

1.9 METHODOLOGY

The approach used in this study for research is based on the doctrinal method. The sources of data consulted during the research process include a range of resources such as juristic writing, law books, government reports, and decisions made by the Supreme Court as well as High Court decisions.

1.10 OBJECT OF THE RESEARCH PROBLEM

- a. To investigate the evolution and progress of Forensic Science over time.
- b. To focus on the role of forensic science in the administration of justice, specifically within the criminal justice system.

- c. To evaluate and analyze novel methods utilized in a criminal investigation.
- d. To investigate how Forensic Science is legally applied in the administration of justice.

CHAPTER-2

FORENSIC EVIDENCE CONCEPTUAL FRAMEWORK

In the last few decades, the infusion of technology in crime investigation has been a major breakthrough in the process of advancement of criminal justice. Police utilize forensic and scientific tools & techniques to detect a crime, reconstruct the crime scene, identify the alleged offender and establish vital links; the courts, on the other, take account of these physical Evidences, otherwise infallible, and determine with enhanced accuracy the innocence or guilt of the offender. Somewhere, the efficiency and effectiveness of the criminal justice functioning has come to be intertwined with the extent of use of technological tools in crime investigation.¹

With the advancement in science and technology, or we can say 'scientific era', the scientists have tried and experimented many methods to aid in investigation of crime. The aim of such search is to find out short-cut direct methods, which may produce quick results on one hand and on the other hand which may disguise inefficiency of investigating agency. The importance of forensic science to criminal law lays its potential to supply vital information about how a crime was committed and who committed it.²

The science that has put man on the moon and mars is also trying to help the mankind in stemming the increasing tide of crime rate. In order to achieve the primary objective of forensic science in criminal investigations which is identifications of the criminal with certainty, so that it can help the courts in administering justice has developed various techniques in the name of lie detector/Polygraph, Brain Mapping, narco-analysis and many more.

Forensic science is a discipline that functions within the parameters of the legal system. Its purpose is to provide guidance to those conducting criminal investigation and to supply to courts accurate information upon which they can rely in resolving criminal and civil disputes.

Forensic Science and forensic scientists generate data, reports and opinions that all can be used as Evidence, but only if the court allows such Evidence to be admitted in the first place. How

¹ Chakraborty, Manisha "*Applicability of Forensic Science in Criminal Justice System in India*" Available at vips.edu/wp-content/uploads/2017/07/Forensic-Science.pdf (Last Accessed on 14.04.2023)

² Setia, Himanshu, "*Evidentiary Value of Forensic Reports in Indian Courts*" Research Journal of Forensic Sciences, Vol. 4(6), 1-7, June (2016) Available online at: www.isca.in, www.isca.me (Last Accessed on 14.04.2023)

this decision is reached is a critical aspect of forensic science. The Evidence part of the concept of forensic science refers to a distinct set of procedures that are unique to the litigation process.

Forensic science involves the application of scientific theory accompanied by laboratory techniques involving a wide variety of traditional academic natural sciences, such as anthropology, DNA analysis etc. Increasingly, circumstantial proof presented in criminal trials comes in the form of forensic Evidence.

The researcher has attempted to discuss in detail about the various modern as well as conventional scientific techniques, how they have evolved over the time and also the manner in which they are being used in the investigation of the crime. The dissertation work majorly focused on the relevancy and admissibility of these techniques as they have become instrumental in detecting the crime and as well as in the process of investigation of the crime.

The researcher has briefly discussed about the history of forensic science and how it have developed over the period of time. The researcher has also dealt with the constitutionality of the scientific and forensic tools of investigation and also with the other legislations pertinent thereto. The advantages of the forensic science over the conventional Evidence along with the role of forensic science in criminal investigation have also been discussed in the dissertation.

The dissertation also discusses the legislative measures or statutory provisions pertaining to Forensic Evidence under the Indian Law such as *Constitution of India*, *Indian Evidence Act* and *Code of Criminal Procedure*. The process and working of various scientific techniques and an analysis of evidentiary value i.e. relevancy and admissibility of such techniques has also been discussed in the dissertation work. And in the end the researcher would write up the ‘Conclusion’ which would recapitulate the nodal points of the discussion followed by humble suggestions.

2.1 DEFINITION:

The word ‘Forensic’ is derived from the latin word *forensis* which means forum for “public”.³ In ancient Rome, the Senate met in the Forum, a public place where the political and the policy issues of the day were discussed and debated; Technically, “forensic” means as applied to public or legal concerns. Together, “forensic science” is an apt term for the profession of scientist whose work answers questions for the courts through reports and testimony. ‘Forensic

³ Oxford English Dictionary,2005

Science' would, therefore, mean the science which is used in the courts of justice. The National Institute of Justice ⁴defines forensic science as “application of scientific knowledge to the legal system”. More broadly it can be defined as that scientific discipline which is directed to the recognition, identification, individualization and evaluation of physical evidence by the application of the principles and methods of natural sciences for the purpose of administration of criminal justice. In other words it is the application of a broad spectrum of sciences and technologies to investigate situations after the fact and to establish what occurred based on collected evidence.

A synonym of forensic science is also termed as “Criminalistics”. The word “Criminalistics” was imported into English from a German word “kriminalistic” . It is also known as the science of individualization). The process of individualization is traditionally called identification, as in fingerprint identification, but is more appropriately termed as individualization or source attribution. “Evidence” means and includes-- (1) all statements which the Court permits or requires to be made before it by witnesses, in relation to matters of fact under inquiry; such statements are called oral evidence; (2) all documents produced for the inspection of the Court including electronic records; such documents are called documentary evidence Richard Saferstein writes a more specific definition than what was previously given in his book *Criminalistics: An Introduction to Forensic Science*, which says that forensic science is the “application of science to those criminal and civil laws that are enforced by the police agencies in a criminal justice system.” The origin of this type of science cannot be accurately pinpointed. According to H. J. Walls' article “Whither Forensic Science?” it started as a hobby of a few scientists who liked to become mixed up in the proceedings of the police and “enjoyed the kind of problems this association brought them.

In India, the growing awareness among the police and the judiciary, regarding the role of science played in scientific evaluation of material clues, led to setting up of forensic science laboratories in the State as well as the Centre. After a considerable thought given by the forensic science forums to build comprehensive forensic science facilities under one roof, most of the new laboratories came up with comprehensive facilities by amalgamating scientific sections and chemical examiner's laboratory into forensic science laboratory. The existing position of the forensic science laboratories and other allied forensic science institutions in the country,

⁴ (NIJ, 1908)

offering scientific service in the administration of criminal justice can be studied under two heads.

2.2 NATURE AND CONCEPT OF FORENSIC SCIENCE

The word “Forensic” is rooted from the Latin word ‘Forensis’. It means ‘relating to Court of Law or of Public Debate or Discussion’. In other words, it concerns with legal proceedings in the Court of Law in the shape of Evidences. The Evidence may be achieved from the scientific or forensic examination. It is recognised as persuasive Evidence to prove guilt or innocence of a person. The person who performs such examination is called Forensic Expert or Forensic Scientist.⁵

According to ‘Oxford Companion of Law’ authored by David M. Walker, “Forensic Science” means a branch of science concerned with the application of those bodies of knowledge to legal purposes, particularly to eliciting and interpreting facts which may be of significance in legal inquiries. “Forensic Science” deals with such matters as weapons and ballistic, explosives and examination of altered documents etc.

“Forensic Science” is also known as “Public Science” or “Criminalistics” in United States of America. In France, it is known as Criminalistique” and in Germany, it has got a nomenclature of “Kriminalistik”.

Forensic Science is the application of various scientific method and principles to investigate civil and criminal Actions which are of interest to the legal systems. All the clues collected from the crime scene are analyzed by forensic scientists in a forensic laboratory and are converted into Evidence worth producing in the courts of law. Physical Evidence may include body fluids like blood and saliva, hair, impression of shoes and types, fingerprints and footprints etc. all are valuable Evidences. Forensic science can be applied in civil cases to provide for the validity of signatures and handwriting.

Forensic Science uses the basic principles of all physical and natural sciences and has evolved many domain of its own for example, Ballistics, Handwriting, Fingerprint, Computer, Brain Mapping, DNA, Narco-analysis, and Polygraph etc. The basis sciences are associated with forensic science in the name of Forensic Biology and Serology, Forensic Chemistry, Forensic

⁵ Jand, Sarita “Forensic Science and Law” New Era Publications, Faridabad, First Edition, 2017, p-6

Physics, Toxicology, Odontology, Forensic Psychology, Forensic DNA, Cyber Forensics which all provide a full prove scientific aid to criminal justice system.

In criminal investigation, use of forensic science is the need of the modern times. In India, the investigation of rime and prosecution of the criminals who have committed the crime are not up to the mark. Even in heinous crime, large no of criminals could not be prosecuted and also the conviction rate is low as a result of which crimes as well as number of criminals are increasing day by day. The frequent acquittals are also mainly due to the obsolete techniques of investigation which leave many loopholes. Moreover the means of transport and the high density of population have facilitated the escape of the criminals after the commission of crime. Also the criminals are using the science as the technical knowledge of an average man has increased tremendously in recent years. The investigating officer needs scientific and forensic methods to combat the modern scientific criminals.

Forensic Science helps the criminal justice system in providing leads to the investigation, establishing whether the scene is real or fake, locating hidden clues and also proper samples for comparison and establishing the sequence of events. Last but not the least; it helps the innocent by de-linking him with the clues, from victim or from the scene of the crime.

2.3 TYPES OF FORENSIC EVIDENCE

Although, 'Forensic Science' clinches all branches of physical and natural sciences, chief among them being chemistry, biology, physics, broadly there are two areas of forensic science. They are Identification and Individualization. In Identification the parent field is mostly chemistry, though principles are drawn from physics or biology. The goal of these specialties typically is to identify a substance and to quantitate it. So the method is also called quantitation. For example, what chemical is certain powder, and how much of it is present? Does a cadaver contain poison, what kind, and how much? These fields based on conventional science, are considered highly reliable and are rarely challenged in court unless a new technique is presented or evidence of negligence or fraud exists.

The individualization on the other hand seeks to associate an item of evidence found at a crime scene with its unique source, to the exclusion of all others and it is not derived from conventional sciences. Rather the methods and principles employed by the individualization

includes, comparison of such things as bite marks, bullets, fingerprints, footwear, hair, handwriting and so on. DNA typing is the exception. It is the first individualization science derived from traditional science.⁶ The term "forensic science" encompasses a broad range of forensic disciplines, each with its own set of technologies and practices. Some of the forensic science disciplines are Chemical examination, Fingerprints and footprints, mobile phone data, DNA test (Forensic Identification), Identification by photograph, identification by voice, Ballistics, Toxicology.⁷ Except these there are also various other classification of Forensic Science. They are, Forensic Entomology, Forensic Odontology, Forensic Pathology etc. Since, in the present study only four topics are dealt with such as DNA, ballistics, fingerprints and toxicology, only those four topics are discussed at length.

a) Ballistics:

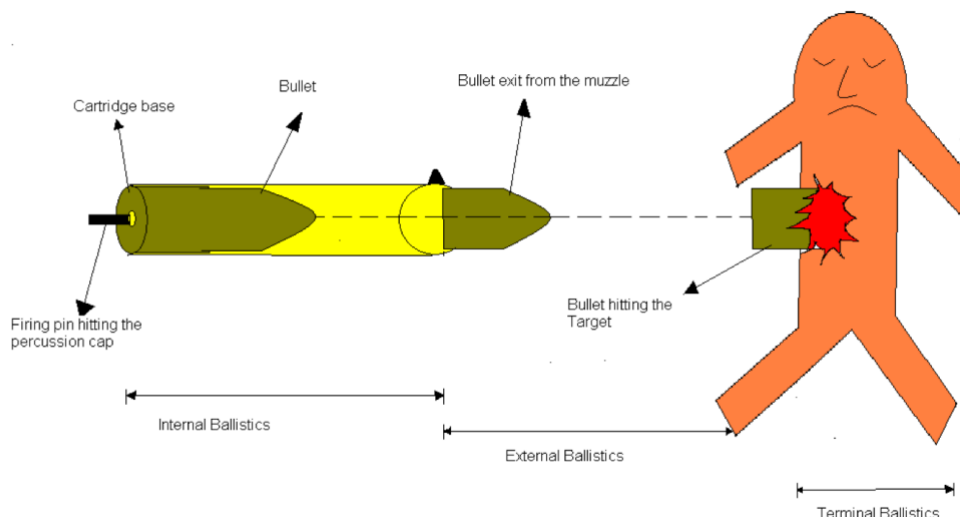
Ballistics is the use and study of firearms. The science of ballistics has been developed to facilitate the examination of firearms, ammunition and other related matter. As a term of art, ballistics technically refers to the study of a bullet's path from the firearm, through the air, and into a target. In criminal investigations, however, ballistics is a shorthand term for firearms identification: the art of matching recovered bullets and their casings to the firearm from which they were fired. Firearms identification is often treated as a subspecialty of tool mark identification. A tool mark expert attempts to match tools like screwdrivers and crowbars to the marks they make when used on objects. Ballistics experts are more than tool mark specialists. They are generally experts in many aspects of firearms and testify about topics ranging from whether a specific object is, legally, a firearm, to intricate reconstructions of crime scene evidence⁸. Forensic Ballistic was first invented by Calvin Goddard, a pioneer in this study.

⁶ Jane Campbell Moriarty, Michael J. Saks "Forensic Science, Grand Goals, Tragic Flaws & Judicial Gatekeeping" 44 Judges Journal 17 (2005)

⁷ Supreme Court Digest, 2011, 2010 and 2009

⁸ Ballistics, available

at:http://apps.americanbar.org/abastore/products/books/abstracts/5450051chap1_abs.pdf (Last visited on April22, 2023)



Ballistics can be categorized into three types:

- i. Internal Ballistics: Examines the behavior of a projectile within the firearm or launching device
- ii. External Ballistics: Studies the flight characteristics of a projectile from the barrel to the target.
- iii. Terminal Ballistics: Focuses on the impact and behavior of a projectile upon reaching the target.

Ballistic experts' opinions cannot be rejected solely because they did not take photographs of the cartridges. In the case of *S.G. Gundegowda v. State*⁹, the ballistic expert's report was considered admissible without calling the expert as a witness. Similarly, in *Rchhpal Singh v. State of Punjab*¹⁰, it was held that the opinion of ballistic experts is crucial in cases involving firearm injuries. Failure to present the expert opinion before the trial court affects its credibility.

b) Fingerprints

“Fingerprints are God’s own seals, given to us that we may recognize his greatest creation MAN.” The best and certain method in identification was fingerprints which were discovered during the fag end of the nineteenth century till the advent of a similar method DNA Fingerprinting. Pattern and impression evidence is one of the most common forms of evidence

⁹ Mirdhe (1996) Criminal Law Journal, 852.

¹⁰ Hegde S. (2000). AIR SC 2710,

that can be detected and collected from a crime scene. Impression evidence is created when two objects come in contact with enough force to cause an “impression”. Typically it is either two dimensional such as finger print or three-dimensional such as marks on a bullet caused by the barrel of a firearm¹¹. The fingerprints as evidence are important because of the following features of the fingerprints. They are unique, they are permanent, they are universal, they are inimitable, they are classifiable, and they are frequently available in crime situations as evidence.

There are three types of fingerprints which might be available in the scene of crime ;

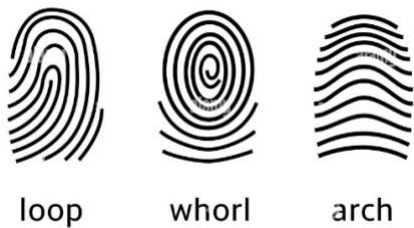
- Latent fingerprints
- Patent fingerprints
- Impressions

Latent fingerprints are invisible to human eyes as well crucial pieces of evidence used in criminal investigations that can link a suspect to a crime. They are extracted from crime scene by experts by using chemical or physical methods and using different chemical powders . Patent fingerprints are visible to the human eyes as they can be formed due to blood, grease, dirt etc. An impression refers to the mark left by an object or material on a surface. This category of evidence includes various types of impressions, such as shoeprint impressions, tire tracks, and tool marks. The fingerprint images could then be photographed, marked up for distinguishing features by latent fingerprint examiners, and used to search an automated fingerprint identification system (AFIS). An AFIS is a computer system (not available in India) that stores fingerprint images in an organized, searchable data structure that is widely used by criminal justice agencies to maintain databases of the fingerprints of individuals who are arrested or incarcerated. There is a controversy regarding the inventor of fingerprint. It is accepted by many that Henry Faulds is the true inventor of Fingerprint. Although evidence were found that the use of fingerprint existed from the pre-historic times, the English first began using fingerprints in July, 1858, when Sir William Herschel, the Chief Magistrate of the Hoogly District, first used fingerprints on native contracts.

¹¹ Impression and Pattern Evidence, available at:
<http://nij.gov/topics/forensics/evidence/impression/pages/welcome.aspx> (Last visited on April 22, 2023)

- **Henry System**

In India, fingerprints are classified using the Henry System based on their prevalence in the population. Loop patterns are common in 60-65% of people, whorls in 25-35%, arches in 6-7%, and composites in 1-2%. Loops can be Ulnar or Radial, whorls can be Concentric, Spiral, Double Spiral, or Almond-shaped, and arches can be Plain, Tented, or Exceptional.



- **Features of Fingerprint**

- i. Unique
- ii. Universal
- iii. Permanent
- iv. Classifiable

According to the Kerala High Court in the case of *Pathumma v. Veerasha*¹², it was determined that no two individuals can have identical fingerprints. If no variations are found, it can be concluded that the fingerprints were made by the same person.

The Supreme Court's also observed in the case of *Ashish Jain v. Markand Singh*¹³ that the collection of fingerprints from the accused by the police is not considered illegal in the absence of a magisterial order authorizing it.

In *State of Haryana v. Vinod*¹⁴ the accused was dislinked from the offence on the basis of fingerprints

c) Lip Prints (Cheiloscopy)

Lip prints have the potential to be found on a range of surfaces like glasses, cups, or cigarette butts, and they can be utilized in forensic investigations to potentially connect a suspect to a

¹² 1988(1) K. L. T. 798.

¹³ SC Judgment 2019

¹⁴ SC 2023

crime scene. Forensic experts employ specific techniques to gather lip prints, such as applying lipstick or lip balm to the lips and then transferring the prints onto a suitable medium like adhesive tape or clear acetate. These collected lip print impressions are subsequently subjected to analysis and comparison with known lip prints to determine identification or exclusion.

Lip prints can be documented through:

1. Directly photographing the suspect's lips.
2. Recording lip prints on a non-porous flat surface like a mirror and creating overlay tracings of the grooves. or,
3. Applying transfer mediums to the lips and pressing them onto paper or cellophane tape to capture the lip prints.

Cheiloscopy studies conducted in Tamil Nadu, Maharashtra and Kerala population of India have shown that there is a predominance of different lip print patterns in different populations. Variations of the lip patterns in different populations will help in forensic odontology.¹⁵

d) DNA Evidence

DNA, short for Deoxyribonucleic Acid, is a unique genetic material found in every individual except identical twins. Sir Alec John Jeffreys pioneered DNA testing in 1984. DNA structure determines human characteristics, behavior, and body traits.

Biological evidence such as blood, hair, and semen contains DNA that can be compared to DNA samples from specific individuals to establish links. In essence, DNA can be likened to an identification card issued by nature itself. The identification provided by DNA is highly reliable and, to a large extent, unquestionable, as supported by numerous legal decisions worldwide.

• Methods Used for DNA Analysis

Advancements in technology have led to multiple changes in DNA analysis methods, enabling the extraction of more information from smaller samples. Modern DNA analysis relies on statistical calculations to assess the rarity of a profile within a population.

¹⁵ Gondivkar SM, Indurkar A, Degwekar S, Bhowate R. Cheiloscopy for sex determination. J Forensic Dent Sci. 2009;1:56–60.

Although primarily recognized for its vital role in forensic investigations, DNA profiling extends beyond forensics. It finds applications in non-forensic areas like paternity testing and human genealogy research.

- **STR Analysis**

STR analysis is a DNA profiling method that examines short tandem repeats, which are repeated DNA sequences. By analyzing the variations in the number of repeats at specific locations, it generates a distinctive genetic profile. This technique is utilized for identification purposes in forensics and other genetic testing applications.

Y-STR is related to Y chromosome only and is used to resolve the paternity or family disputes.

- **mtDNA Sequencing**

It is a specialized technique that uses mitochondrial DNA found in cells. It is inherited maternally and not unique to individuals. It is useful for degraded samples and where STR analysis is insufficient. mtDNA can be found in locations where autosomal DNA is absent, like hair shafts. Due to contamination risks, only a few labs handle mtDNA samples with strict protocols to prevent cross-contamination.

- **MPS**

Massively Parallel Sequencing also called next-generation sequencing, enhances STR analysis by directly sequencing the loci, providing the actual base pair sequence instead of repeat numbers. MPS has the potential to differentiate between identical twins by detecting random point mutations within repeat segments, which traditional STR analysis cannot identify. This advanced technique offers increased accuracy and the ability to uncover subtle genetic variations.

Kunhiraman V. Manoj¹⁶ is the first ever case decided by the court of law on paternity dispute on DNA.

e) Autopsy

An autopsy or postmortem examination is an external inspection of the complete body, and an internal examination comprises the removal and dissection of all thoracoabdominal and neck organs, the opening of the head, and the removal and examination of the brain and preserving a variety of materials for use in any specified further investigations. It is an entirely surgical

¹⁶ Kerala HC 1991

examination of the deceased person. And the primary goals of an autopsy are to establish the identification of the deceased, identify the cause of death, confirm or deny the reported way of death, and estimate the period since the death.

- **Classification of Autopsy**

It has been classified into two types:

- i. forensic or medicolegal autopsy and
- ii. clinical or medical autopsy.

A forensic or medicolegal autopsy is done when the cause of death is suspicious, violent, or unknown and its purpose is to identify whether or not natural causes caused the death. The clinical or medical autopsy is done in the hospital with the next of kin's permission to discover what caused the death and learn more about it.

The mere difference between autopsy and post mortem is that former is the surgical examination of the organs and cavities of the body while later is examination of body without dissecting it.

In *Anant Chintaman Lagu v. State of Bombay*¹⁷ The appellant was accused and found guilty of administering an unknown poison or drug to Laxmibai Karve with the intention of causing her death, which ultimately led to her demise with the help of autopsy report.

f) Dentistry (Odontology)

Teeth are very vital evidence in criminal investigations; they are helpful for forensic investigation because they are kept in the mouth's closed chambers, and in a dangerous situation, they create an obstruction that may establish a link to the crime or death. Even in a highly decomposed or injured body, teeth may preserve DNA content and provide post-mortem DNA evidence.¹⁸ Therefore, the process of applying dental evidence to the field of criminal law is known as forensic odontology. This may involve detecting sexual abuse, identifying the deceased, and determining the deceased person's age. Due to the fact that dental records may be used to identify a person or provide authorities with the information necessary to establish

¹⁷ Criminal Appeal No. 73 of 1959 SC

¹⁸ (Gaytmenn, 2003).

the identification of a case, forensic dentistry involves knowledge of a variety of disciplines.¹⁹ Expert forensic odontologists can assist in determining the identity of a victim from bite marks and other unidentified remains. The medical examiner or the police officer conducting an investigation may seek the services of a forensic odontologist.

In 1991 when *Rajiv Gandhi (bomb blast) case*²⁰ took place and the dead bodies got shattered into tiny pieces and mingled with the other bodies the science of odontology was used to identify the body of the former Prime Minister with the confirmation of his personal dentist.

g) Forensic Toxicology

Forensic toxicology is the use of toxicology and other disciplines such as analytical chemistry, pharmacology and clinical chemistry to aid medical or legal investigation of death, poisoning, and drug use. The primary concern for forensic toxicology is not the legal outcome of the toxicological investigation, but rather the technology and techniques for obtaining and interpreting the results. A toxicological analysis can be done to various kinds of samples. The first comprehensive work on forensic toxicology was published in 1813 by Mathieu Orfila. He was a respected Spanish chemist and the physician who is often given the distinction of "father of toxicology." His work emphasized the need for adequate proof of identification and the need for quality assurance. It also recognized the application of forensic toxicology in pharmaceutical, clinical, industrial and environmental fields.

One way to conduct toxicological analysis in cases where human remains are extensively decomposed and traditional tissue, organ, or blood samples are not viable is through the field of Entomotoxicology.

- **Entomology**

This specialized branch of toxicology utilizes insects, particularly maggots, as valuable sources of evidence for drug analysis. Various studies have demonstrated the effectiveness of insects in detecting drugs such as Barbiturates, Benzodiazepines, opiates, and Cocaine.²¹

¹⁹ (Adams et al., 2013).

²⁰ Assassination of Rajiv Gandhi, available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4439663/> (Last visited on April 22, 2023)

²¹ (Dimaio and Dimaio, 2011).

In *Poloniswamy V. State*²² if the cause of murder is suspected to be poison and medical evidence is inconclusive, a conviction can still be made based on other evidence, such as witness testimony or circumstantial evidence, that establishes the guilt of the accused.

(h) Cyber Forensic

The rapid advancements in technology have presented significant challenges to traditional methods of evidence collection and generation. Digital evidence, due to its intangible nature, combined with the fragile and vulnerable nature of the internet, has created inherent obstacles in the collection and preservation of such evidence. The insufficient presence of necessary techno-legal skills and expertise in gathering this type of evidence has undoubtedly contributed to an increase in cyber-crimes within the country.

When the term 'cyber' is mentioned, it often evokes associations with the internet, technology, and the virtual world. However, for professionals such as lawyers and technicians, it encompasses a broader range of elements. These include computers, networks, data storage, software, cell phones, ATMs, and other peripherals. In essence, 'cyber' encompasses anything and everything that is connected to technology or has a connection to the overarching term 'computer' and its related aspects. This collective and generic realm is commonly referred to as 'cyberspace'.

Criminals leverage advanced technologies to commit crimes that are inaccessible and incomprehensible to the average person. Tracing the origins of these crimes becomes a daunting task for individuals lacking expertise in the field. This has given rise to the concept of cybercrime, which encompasses offenses where computers (or cyberspace in general) are either utilized as tools or targeted directly.

• Position in India

For electronic evidence to be deemed admissible, it must adhere to the principles of the "best evidence rule" and maintain a proper "chain of custody" to ensure there has been no tampering. The "best evidence rule" essentially implies that the original form of the evidence is considered the most reliable. However, in the case of data stored in a computer or similar device, a printout or any other visible output that accurately reflects the data can be accepted as an original.

²² AIR 1968 Bom. 127

A duplicate of the original evidence can be admitted on the same grounds as the original, unless

(1) there is a genuine doubt about the authenticity of the original, or

(2) it would be unfair to admit the duplicate instead of the original under the given circumstances.

• **Types of Cyber Forensic**

Different types of forensic examinations play a crucial role in addressing cybercrimes, and some notable ones include:²³

- i. **Database forensics:** This involves analyzing databases and associated metadata to uncover evidence and gain insights into cybercrime activities.
- ii. **Email forensics:** It entails examining the source, content, and metadata of emails to establish the authenticity of senders and recipients, identify transmission details, and interpret sender intent.
- iii. **Malware forensics:** This focuses on locating, analyzing, and studying various aspects of malicious software (malware) to determine its origin, impact, and propagation methods, including code analysis, entry detection, and system impact assessment.
- iv. **Memory forensics:** It involves examining volatile data stored in a computer's memory dump to investigate and detect security breaches or malicious activities that may not leave obvious traces on hard drives.
- v. **Mobile forensics:** This subset of digital forensics focuses on retrieving digital data or evidence from mobile devices such as phones, tablets, and GPS devices, often under specific conditions.
- vi. **Network forensics:** Unlike other digital forensics fields, network investigations deal with dynamic and volatile data. Network forensics involves proactive analysis of network traffic to identify and investigate potential security incidents or cybercrimes.

Each of these forensic examinations contributes to the understanding, investigation, and resolution of cybercrimes, helping professionals uncover valuable evidence and identify the perpetrators.

²³ <https://www.techtargget.com/searchsecurity/definition/computer-forensics>(Last visited on April 22, 2023)

• Techniques used for Investigation

Industrial experts employ various techniques to enhance their forensic investigations. Here are some examples:

- i. **Reverse steganography:** This technique focuses on uncovering hidden information within digital files, allowing both the secret data and the original file to be extracted by the intended recipient. It enables experts to identify and analyze concealed data, such as messages or files, that may be used for illicit purposes.
- ii. **Stochastic forensics:** This method is used to reconstruct digital activities without conventional artifacts by analyzing emergent properties resulting from the stochastic (random) nature of modern computers. It helps forensic investigators trace and identify potential perpetrators involved in intellectual property theft or other illicit activities, particularly when insider threats are involved.
- iii. **Cross-drive analysis:** This approach involves simultaneously considering information from multiple data sources, such as disk drives and solid-state storage devices. By analyzing data from various sources, investigators can establish connections, patterns, or evidence that may not be apparent when examining each drive individually. It allows for a more comprehensive and holistic investigation.
- iv. **Live analysis:** This technique involves examining computers and their data from within the operating system, using specialized forensic tools or existing software. By analyzing a system while it is running, investigators can gather real-time information and capture volatile data that may be lost once the computer is shut down. It helps in extracting valuable evidence and understanding the activities occurring on the system.
- v. **Deleted file recovery:** Experts use professional data recovery tools to recover files that have been deleted or lost, even if the drive has been reformatted or repartitioned. These tools enable specialists to retrieve and reconstruct deleted files, providing crucial evidence that may have been intentionally or accidentally removed.

By employing these techniques, industrial experts enhance their ability to conduct thorough and effective forensic investigations, uncovering evidence and identifying relevant information for legal proceedings.²⁴

²⁴ ibid

In *Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal*²⁵ The Supreme Court's judgment provides clarity on the mandatory requirement of certification for admissibility of electronic evidence under Section 65B(4) of the Evidence Act. It addresses conflicting views and offers practical options for parties unable to obtain the certificate, helping them overcome objections to the admissibility of electronic evidence.

2.4 ROLE OF FORENSIC SCIENCE IN CRIMINAL JUSTICE SYSTEM

Forensic evidence is characterized by its objectivity, lack of bias, and foundation in scientific principles. It offers a degree of certainty and accuracy that surpasses other types of evidence. The inclusion of forensic evidence in criminal trials also fosters transparency and accountability within the criminal justice system. It plays a vital role in ensuring that justice is upheld and the rights of both the accused and the victims are safeguarded. In the criminal justice system, various institutions and processes are involved to maintain the social order of peace by delivering the justice to all. It can also be redefined as the system which deals with those people who is of ill mentality and those who are harmful for the society at all. On the basic note, there are four basic parts of this system namely courts, prisons, police and punishment. These four parts are responsible for maintaining the social order in the region by delivering justice to the victims by punishing the offender through prosecution of the criminals. An ideal criminal justice system delivers a peaceful society. Accordingly, the peacefulness of a society depends on its criminal justice system as how it delivers its justices to all.²⁶

If we talk about the roles of its parts, the important role is of the Judges and the Hon'ble courts as they are obliged to deliver justice to all without discrimination of any type. This type of process is complex since facts of every case are different and charges have to be proved. The institutions and various agencies help the courts in deciding its matters. Every investigation has to be supported the evidences. Justice can only be served when foundations of the evidences becomes strong.

he extensive use of the technology in the last few decades has become a deciding factor in various different cases. Both police and courts use this forensic technology to recreate the scene

²⁵ SC 14 July, 2020

²⁶ Committee on Reforms of Criminal Justice System (Ministry of Home Affairs, Government of India, New Delhi 2003)

and identifying the various links of the criminals. The effectiveness of the technological evidence has great efficiency and accuracy in deciding the cases.

2.5 SCIENTIFIC INVESTIGATION

The criminals use coercion to influence the eye witness of the cases and thus it becomes difficult to get witnesses. People become afraid of providing evidences to the investigation agencies.²⁷ Most of the times, criminals give life threats to the witnesses also. Thus, the general public gets afraid of criminals and makes distance from the courts. Some crimes are thus taken place in a manner in which no direct evidence can be given to the investigating agencies. In these types of conditions, the importance of these forensic investigations rises exponentially. Various methods are used nowadays like examining the persons medically and physically, by taking fingerprints of the persons, through footprints and by many other ways. A well qualified person has to be enrolled to make effective use of these forensic instruments. The authenticity of the forensic evidences depends upon the conditions on which it is based and the efficiency of making arguments.²⁸

Although in the act of evidence it is nowhere mentioned the requirement of authentic evidence but the courts prefer them than preferring other in general as per their policy. The courts will look into the matter in depth where the expert cannot have in its mind the facts of the case or the condition when they cannot form a conclusion. The evidence will become less effective if two different experts have different opinions over it. In that condition the opinion of expert should not be prevailed. The court will look upon the matter in depth before taking it in the consideration. These types of evidences can also not be taken into consideration when they are in the gross violation of the provisions of the Evidence Act, 1872 or the provisions of the Constitution of India. Some controversies are there in the present over some provisions like the one in which fingerprints should be excluded from the category for being violation of constitution. The courts have also upheld the validity of Section 27 of the Indian Evidence Act, 1872.²⁹

In the case of *State of Maharashtra v. Natwarlal Damodardas Soni*³⁰, the Hon'ble court has taken into consideration the matter of illegally occupied evidences. It was held that although

²⁷ Krishna DeoGaur, Criminal Law & Criminology,491 (Deep and Deep Publications, New Delhi 2002)

²⁸ *Emperor v. Sahadeo*, 15 CrLJ 220, 230

²⁹ *State of U.P. v. Deoman Upadhyaya*, AIR 1960 SC 1125; *State of Bombay v. Kanthi Kalu*, AIR 1961 SC 1808

³⁰ 1980 AIR 593, 1980 SCR (2) 340

the evidences have been occupied illegally but they are equally maintainable in the court and it doesn't affect its validity in the court of law. In the sensitive matter, the court will carefully look upon the validity of evidence at large and nothing more. This view has also been supported by the apex court in other decisions.³¹The Hon'ble court gives a good response towards the evidence provided through the use of modern technologies. The courts have considered the superimposed photographs, oral evidences etc. as the evidence.

2.6 SIGNIFICANCE OF FORENSIC SCIENCE IN CRIMINAL INVESTIGATION

Technology is playing an important role in today's era. Forensic Science also plays vital role in the criminal justice system. It identifies the physical and scientific evidences in an criminal investigation. This technology finds the person who has done the crime and also it accurately measures what type of crime has been done. It also gives findings of when it is done. It can also reveal the place where crime has been taken place. This type of investigation also reveals the method of crime i.e. modus operandi. To conclude, it can be said the forensic science has completely changed the type of evidences and their accuracy. It reveals the clear connection between the criminal and the crime.

The process of the investigation is like, collecting the evidence from the place where crime has been done or collecting the evidences from the person with whom crime has been done and then the outcomes of the investigations has been presented in the court of law. Although, facts of every case remains different and it creates new difficulties before the courts. This type of technology plays a pivotal role in identifying the persons personal gadgets, identity, fingerprints, blood, hair, weapons and other things. It mainly gets the identification through the objects used by the criminal in the crimes. It also plays an pivotal role in identifying the innocence of the accused because of its accurate results. Thus, forensic Science not only helps in identifying the criminal but it also plays an important role in proving the innocence the persons. It is because of this technology only, the investigation has become easy because of the accuracy of results and they plays vital role in criminal justice system.³²

Forensic Science plays an pivotal role in the criminal justice system specifically related to evidence on certain important point, proving innocence of accused and in the identification of suspect. The pivotal role of the investigating officer is to collect pivotal evidence from the

³¹ *Bai Radha v. State of Gujarat*, AIR 1970 SC 1936; *R.M. Malkani v. State of Maharashtra*, AIR 1973 SC 157

³² Jyotirmoy Adhikary, *DNA Technology in Administration of Justice* (LexisNexis, Butterworths, 2007)

crime site. Such officer has immunity from the damage if any caused to the evidence in collecting or packaging. Evidence has to be collected with precautions and any attempt of damaging it has to stop at any cost. In some cases, on the basis of evidences like DNA the accused has been awarded with punishment up to 10 years for specific type of murder and sometimes the punishment has been increased to death penalty also.

In other case, where brutality overlaps its limits and the humanity was ignored where a rape of a four-year girl child was done who lived in slums of Delhi. The investigation team of the Delhi police with the help of accurate results from the DNA report identified the criminal for its sexual acts. The court after considering many of the findings and reports approved the findings based upon DNA report and other findings and thus punished the accused accordingly as per the law.

In the other case of same facts, the court finds the technology of Forensic Science as the key evidences in the way to uphold the conviction of the accused for murder, kidnapping and rape of a small girl.

In our country, the use of technologies such as forensic science has gained a lot of importance in the trails and findings. From the finds of the government formed for research on reforms in criminal justice has held that these type of modern technologies can give a great edge to the justice system in findings and can become deciding factor in the justice system. The required amendments are done as per the time required for the better use of forensic investigations. But some loopholes are always there in the system that has to be addressed accordingly. The justice system relays mostly on these scientific investigations as their results are accurate and their authenticity cannot be questioned normally. The forensic science has given an edge to the justice system to work more efficiently.

It has to be ensured that that we should make good use of forensic investigations and such technologies in the future to get better results and opens a path for such technologies to enter into the system for better functioning of the criminal justice system. Also, we have to ensure that these technologies are used effectively to get better results. In the murder case of *Vishal Yadav v. State of Uttar Pradesh*³³, the identification of the victim, Nitish Katara becomes a great problem since only a palm of victim was left. In this case, the identification of the victim

³³ (2014), SCC Online Del. 1373

has been done through DNA test of the victim and his parents and then the accused has been rewarded with the punishment by the Hon'ble High court of Delhi.

In the case of *Sushil Mandal v. The State*³⁴, the petitioner challenged the proving of DNA. Relationship of friendship has been their between the boy and the girl. After this, the body of a boy has been obtained from the lake after he was missing from a month. The petitioner doesn't identifies the belongings of the boy. The father of the boy accuses the girl's father and demanded investigation by the central government authorities. The DNA report of the body gets matched with the parents of the boy. The petitioner declined the results of the test and thus test has been done again from which same result was obtained again. The Hon'ble court by considering the DNA report and its accuracy closed the matter.³⁵

In the case of *Anmolsingh Swarnsingh Jabbal v. The State of Maharastra* ³⁶, the Hon'ble court awarded life term rigorous punishment to a boy for doing murder of his lady colleague by relying upon DNA evidence .

2.7 THE GLOBAL STORY OF FORENSICS: TRACING ITS EVOLUTION OVER TIME

The history of Forensic science dates back to the 17th century with Archimedes, who detected the fraudulence of a fake golden crown through the principle of density and buoyancy. During the 19th and 20th centuries, it became more popular with a scientific approach.

Among the lot, a person who initiated the practical aspect of the scientific or forensic application for criminal investigation was Sir Arthur Conan Doyle. Through his fictitious character Sherlock Holmes, he popularized the scientific method of investigation.

- **Autopsy**

The earliest documented autopsy took place in 44 BC when Roman physician Antistius conducted an examination of the body of Julius Caesar, the renowned Roman politician and

³⁴ Madras HC 2014

³⁵ Inspector of Police v. John David, (2011) 5 SCC 509

³⁶ Decided on 21 March, 2014 (CRIMINAL APPEAL NO. 276 OF 2011)

general who got assassinated. Despite sustaining 23 stab wounds, the autopsy revealed that it was ultimately a single chest wound that caused Caesar's demise. This significant historical event marked a milestone in the practice of forensic examination, shedding light on the true cause of his death.³⁷

- **Pathology**

The book "Xi Yuan Lu" (The Washing Away of Wrongs) was published in 13th-century China by Song Ci. It stands as one of the earliest written records that discuss the application of medicine and entomology in solving crimes.

It addressed important topics such as:

- a. Preserving evidence during the examination process.
- b. Creating antiseptics for forensic purposes.
- c. Extracting hidden injuries from deceased bodies and bones.
- d. Estimating the time of death based on weather conditions and insect activity.
- e. Procedures for washing a deceased body for examination.

- **Lie detector or Polygraph test**

The early origins of lie detection methods can be traced back to various ancient cultures. For instance, in ancient India, a suspect's mouth would be filled with dry rice, while in China, rice powder was used. The suspect would then be asked to spit it out. In certain Middle Eastern cultures, the accused would briefly lick heated metal rods. These practices were based on the belief that a guilty person would produce less saliva. Therefore, if rice got stuck in their mouths or their tongues were severely burnt, they were deemed guilty.

These methods utilized observations of saliva, mouth, and tongue conditions as indicators of innocence or guilt. They can be considered precursors to the modern polygraph test. However, it's important to note that these early methods lacked the scientific basis and accuracy of contemporary lie detection techniques.

³⁷ <https://historycollection.com/julius-caesar-complicit-death-re-examining-earliest-autopsy-history/> (Last visited on April 22, 2023)

- **Forensic Ballistic**

In 1835, Henry Goddard, a Scotland Yard investigator, achieved a significant milestone by connecting a bullet to a murder weapon through physical analysis, marking an early advancement in forensic ballistics.³⁸

During the 1920s, the field of bullet examination saw further advancements when American physician Calvin Goddard invented the comparison microscope. This innovation greatly enhanced the precision of bullet analysis by allowing forensic experts to compare bullets to the shell casings they were fired from, establishing crucial connections in criminal investigations.

In the 1970s, scientists at the Aerospace Corporation in California made another breakthrough by developing a method to detect gunshot residue using scanning electron microscopes. This technique enabled the identification of trace evidence left behind by discharged firearms, aiding forensic investigations in determining the presence of gunshot residue on individuals or objects.

2.7.1 PRESENT SCENARIO

(a) DNA- DEVELOPMENT

The human hereditary material known as deoxyribonucleic acid, or DNA, is a long molecule containing the information organisms need to both develop and reproduce. DNA is found in every cell in the body, and is passed down from parent to child.

Although the discovery of DNA occurred in 1869 by Swiss-born biochemist Fredrich Miescher, it took more than 80 years for its importance to be fully realized. And even today, more than 150 years after it was first discovered, exciting research and technology continue to offer more insight and a better answer to the question: why is DNA important?

Credit for who first identified DNA is often mistakenly given to James Watson and Francis Crick, who actually just furthered Miescher's discovery with their own ground breaking research nearly 100 years later. Watson and Crick contributed largely to our understanding of

³⁸ [https://www.guinnessworldrecords.com/world-records/118955-first-forensic-bullet-comparison#:~:text=In%201835%20Henry%20Goddard%20%28UK%29%20of%20the%20early,bullet%20comparison%20to%20solve%20an%20active%20murder%20enquiry.\(Last visited on 22 April 2023\)](https://www.guinnessworldrecords.com/world-records/118955-first-forensic-bullet-comparison#:~:text=In%201835%20Henry%20Goddard%20%28UK%29%20of%20the%20early,bullet%20comparison%20to%20solve%20an%20active%20murder%20enquiry.(Last%20visited%20on%2022%20April%202023))

DNA in terms of genetic inheritance, but much like Miescher, long before their work, others also made great advancements in and contributions to the field.

- 1866 – Before the many significant discoveries and findings, Gregor Mendel, who is known as the “Father of Genetics,” was actually the first to suggest that characteristics are passed down from generation to generation. Mendel coined the terms we all know today as recessive and dominant.
- 1869 – Friedrich Miescher identified the “nuclein” by isolating a molecule from a cell nucleus that would later become known as DNA.
- 1881 – Nobel Prize winner and German biochemist Albrecht Kossel, who is credited with naming DNA, identified nuclein as a nucleic acid. He also isolated those five nitrogen bases that are now considered to be the basic building blocks of DNA and RNA: adenine (A), cytosine (C), guanine (G), and thymine (T) (which is replaced by uracil (U) in RNA).
- 1882 – Shortly after Kossel’s findings, Walther Flemming devoted research and time to cytology, which is the study of chromosomes. He discovered mitosis in 1882 when he was the first biologist to execute a wholly systematic study of the division of chromosomes. His observations that chromosomes double is significant to the later-discovered theory of inheritance.
- Early 1900s – Theodor Boveri and Walter Sutton were independently working on what’s now known as the Boveri-Sutton chromosome theory, or the chromosomal theory of inheritance. Their findings are fundamental in our understanding of how chromosomes carry genetic material and pass it down from one generation to the next.
- 1902 – Mendel’s theories were finally associated with a human disease by Sir Archibald Edward Garrod, who published the first findings from a study on recessive inheritance in human beings in 1902. Garrod opened the door for our understanding of genetic disorders resulting from errors in chemical pathways in the body.
- 1944 – Oswald Avery first outlined DNA as the transforming principle, which essentially means that it’s DNA, not proteins, that transform cell properties .
- 1944 – 1950 – Erwin Chargaff discovered that DNA is responsible for heredity and that it varies between species. His discoveries, known as Chargaff’s Rules, proved that guanine and cytosine units, as well as adenine and thymine units, were the same in double-stranded DNA, and he also discovered that DNA varies among species.

- Late 1940s – Barbara McClintock discovered the mobility of genes, ultimately challenging virtually everything that was once thought to be. Her discovery of the “jumping gene,” or the idea that genes can move on a chromosome, earned her the Nobel Prize in Physiology.
- 1951 – Roslind Franklin’s work in X-ray crystallography began when she started taking X-ray diffraction photographs of DNA. Her images showed the helical form, which was confirmed by Watson and Crick nearly two years later. Her findings were only acknowledged posthumously.
- 1953 – Watson and Crick published on DNA’s double helix structure that twists to form the ladder-like structure we think of when we picture DNA.³⁹

The future of DNA has great potential. As researchers and scientists continue to advance what we know about the complexities of DNA and the insights it codes for, we can imagine

a world with less and better-managed disease, longer life spans, and a personalized view of medicine that’s specifically applicable to individuals rather than the population as a whole.

DNA insights are already enabling the diagnosis and treatment of genetic diseases. Science is also hopeful that medicine will advance to be able to leverage the power of our own cells to fight disease. For example, gene therapy is designed to introduce genetic material into cells to compensate for abnormal genes or to make a therapeutically beneficial protein.

Researchers also continue to use DNA sequencing technology to learn more about everything from combating infectious disease outbreaks to improving nutritional security.

Ultimately, DNA research will accelerate breaking the mold of the one-size-fits-all approach to medicine. Every new discovery in our understanding of DNA lends to further advancement in the idea of precision medicine, a relatively new way doctors are approaching healthcare through the use of genetic and molecular information to guide their approach to medicine. With precision or personalized medicine, interventions take into consideration the unique biology of the patient and are tailored individually to each patient, rather than being based on the predicted response for all patients. Using genetics and a holistic view of individual genetics, lifestyle,

³⁹ <https://www.lunadna.com/blog/history-of-dna/>, (Visited on. 18-05-2023).

and environment on a case-by-case basis, doctors are better able to not only predict accurate prevention strategies, but also suggest more effective treatment options.

We've come leaps and bounds from where we were in terms of our understanding of DNA 150 years ago. But still, there is much to learn. And with the potential that a deeper understanding of DNA will improve human health and quality of life across our world, no doubt, the research will continue. A full understanding of DNA of and between all living things could one day contribute to solving problems like world hunger, disease prevention, and fighting climate change. The potential truly is unlimited, and to say the least, extremely exciting

There are so many treatments and cures to diseases that are close to being discovered, and one's unique DNA data can help revolutionize the future of medicine.

DNA has only come to be understood over the last century. The technology has been improving and has allowed scientists to not only map out entire genomes of many species, but they also use computers to compare those maps. By entering genetic information of different species, it is easy to see where they overlap and where there are differences.

In *Gautam Kundu v. State of West Bengal*⁴⁰ section 112 was upheld the validity of DNA test in this landmark case. It was said that in order to show the birth during marriage is conclusive proof of legitimacy unless non access of parties to each other is shown.

(b) Brain Mapping

Human functional brain mapping as we presently know it began when the experimental strategies of cognitive psychology were combined with modern brain-imaging techniques (first positron emission tomography and then functional magnetic resonance imaging) to examine how brain function supports mental activities. Although much of this work has transpired over the past couple of decades, its roots can be traced back more than a century.⁴¹

Over the past 30 years the field of cognitive neuroscience has emerged as an important growth area in neuroscience. Cognitive neuroscience combines the experimental strategies of cognitive psychology with various techniques to actually examine how brain function supports mental activities. Leading this research in normal humans are the techniques of functional brain

⁴⁰ AIR 1993 SC 2295

⁴¹ . [https://www.cell.com/trends/neurosciences/fulltext/S0166-2236\(08\)00265-8](https://www.cell.com/trends/neurosciences/fulltext/S0166-2236(08)00265-8),(Visited on. 18-05-2023

imaging: positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) along with electroencephalography (EEG), electrocorticography (ECoG), magnetoencephalography (MEG) and, most recently, optical imaging with near infrared spectroscopy (NIRS).⁴²

The majority of functional brain imaging with PET and MRI, in addition to earlier non-tomographic techniques, is made possible because blood flow changes locally in the brain in relation to changes in cellular activity. The idea that local blood flow within the brain is intimately related to brain function is surprisingly old. Angelo Mosso, a prominent Italian physiologist of the 19th century, had ingeniously monitored the pulsations of the brain in adults through neurosurgically created bony defects in the skulls of patients. He noted that when his subjects engaged tasks such as mathematical calculations the pulsations of the brain increased locally. Such observations led him to conclude, presciently, that blood flow to the brain followed function⁴³. The actual physiological relationship between brain function and blood flow was first explored in 1890 by Charles Roy and Charles Sherrington⁴⁴. Despite this promising beginning, interest in the relationship between brain function and brain blood flow almost ceased during the first quarter of the 20th century. Undoubtedly, this was owing, in part, to a lack of tools sufficiently sophisticated to pursue this line of research. In addition, the work of Leonard Hill, Hunterian Professor of the Royal College of Surgeons in England, was probably influential. His eminence as a physiologist overshadowed the inadequacy of his own experiments that wrongly led him to conclude no relationship existed between brain function and brain circulation. There was no serious challenge to Leonard Hill's views until a remarkable clinical study of a patient Walter K. was reported by John Fulton in the 1928 issue of the journal *Brain*. During the course of his evaluation and treatment for a vascular malformation lying over his visual cortex, Walter K. remarked to his physicians that a noise that he perceived in the back of his head increased in intensity when he was using his eyes.

It was not until the close of World War II that Seymour Kety and his colleagues (University of Pennsylvania and National Institutes of Health) opened the next chapter in studies of brain circulation and metabolism. Kety developed the first quantitative method for measuring whole

⁴² Raichle, Marcus E. "A brief history of human brain mapping." *Trends in neurosciences* 32, no. 2 (2009): 118-126.

⁴³ Mosso, A. (1881) *Ueber den Kreislauf des Blutes im Menschlichen Gehirn*. Verlag von Veit & Company

⁴⁴ Roy, C.S. and Sherrington, C.S. (1890) On the regulation of the blood supply of the brain. *J. Physiol.* 11, 85–108

brain blood flow and metabolism in humans⁴⁵. Because their measurements were confined to the whole brain they were not suitable for 'brain mapping'. However, their introduction of an in vivo tissue autoradiographic measurement of regional blood flow in laboratory animals provided the first glimpse of quantitative regional changes in blood flow in the brain related directly to brain function. Derivatives of this technique many years later became important for the measurement of blood flow in humans when PET provided a means of quantifying the spatial distribution of radiotracers in tissue without the need for invasive autoradiography (see later). Following on the heels of the work by Kety and colleagues, David Ingvar (University of Lund, Sweden), Neils Lassen (University of Copenhagen, Denmark) and their Scandinavian colleagues introduced methods applicable to humans that permitted regional blood-flow measurements to be made using scintillation detectors arrayed like a helmet over the head. They demonstrated conclusively that brain blood flow changed regionally in normal human subjects during task performance.⁴⁶

In case of *Dr. Rajesh Talwar and Another v. Central Bureau Investigation*⁴⁷ in which Arushi, a 14-year-old girl, was found dead in her home. Her parents reported the incident to the police. The prime suspect in the murder was the housemaid, Hemraj. Two days later, Hemraj's body was discovered on the terrace of the same building. The police arrested Arushi's parents, who were considered suspects. Despite their objections, the accused individuals were subjected to Narco-Analysis, Polygraph, and Brain Mapping tests.

(c) Forensic Ballistics

Ballistics is the study of the flight path of projectiles. And when used in criminal investigations, forensic ballistics or ballistic fingerprinting (also called forensic firearm examination) helps in the reconstruction of a crime scene involving a firearm. It also enables the tracing of the weapon used and thus provides significant leads to identify the suspect(s). Forensic ballistic relies heavily on evidence such as bullets, gunpowder residues, shell casings, firearms, etc. recovered from the crime scene.

⁴⁵ 11 Kety, S. and Schmidt, C.F. (1948) The nitrous oxide method for the quantitative determination of cerebral blood flow in man: theory, procedure and normal values. *J. Clin. Invest.* 27, 107–119

⁴⁶ . 12 Landau, W.M. et al. (1955) The local circulation of the living brain: values in the unanesthetized and anesthetized cat. *Trans. Am. Neurol. Assoc.* 80, 125–129

⁴⁷ [Criminal Appellate Jurisdiction Transfer Petition (CRL.) No. 45 of 2012]

Forensic ballistic professionals are adept at examining such evidence to draw conclusive inferences on the exact weapon used, the distance, velocity, and angle of firing, and ultimately the shooter himself. In crime scene investigations, forensic ballistics has now become synonymous with the matching of the recovered bullets and their casings to the firearms from which they were discharged. However, while the modern-day crime drama series may make the application of such techniques look quite contemporary, the fact is that such ballistic work has its roots way back in time.

- **First Use of Ballistics in Forensics**

Before the mass manufacturing of guns began, barrels and bullet molds were handmade by gunsmiths. Thus, the exclusivity of each firearm was unavoidable. This meant that the bullets fired always bore some exclusive impressions which were unique to a specific firearm. Thus began the first instances of the careful examination of a bullet in order to trace it back to the gun used to fire it. And this laid the foundation of what is now called as forensic fingerprinting – the forensic examination of firearms and other evidence (bullets, cartridges etc.) recovered from the crime scene to link them to suspects or the specific weapons used in a crime.

The first case of forensic firearm examination to be documented was in 1835. That was when Henry Goddard applied ballistic fingerprinting to link a bullet recovered from the victim to the actual culprit. On careful inspection, he found that the bullet had a defect on its surface which did not seem to be from the barrel or the result of an impact. It seemed more like a defect acquired during its manufacturing. Anticipating that the shooter would have made the bullet himself, he realized that recovering the bullet mold would easily help him confirm the shooter. He was thus able to exactly zero in on the shooter when the mold found at the suspect's home matched the marks on the bullet. This proved as a crucial evidence in convicting the shooter though he did also confess to the crime eventually.

Back in 1860, the case of *Regina v Richardson*⁴⁸ showcases another example of the early application of firearm identification. The major evidence, in this case, was a newspaper wadding. Back in the era before cartridges came into existence, such wadding was used to create a seal between the bullet and the gunpowder. The wadding that was found in the two-barreled muzzle-loading pistol recovered from the murder site matched the wadding found in

⁴⁸ (1994)98 Cr App R 174 . England and Wales Court of Appeal May 1993

the victim's wound. Additionally, a wadding that was discovered at the suspect's home was found to be made up of the same material (London Time's newspaper) as the waddings recovered before. This helped to confirm that he was the shooter and led to his conviction.

The first notably case law on forensic ballistic was *Frye v. United States*⁴⁹ in which they set a precedent for the admissibility of scientific evidence in court. Although it did not directly involve forensic ballistics, it established an important standard for the acceptance of scientific techniques in legal proceedings.

- **The Birth of Magnification**

Over time, as the mass production of guns and ammunition gained pace, the process of rifling became standardized. Thus, whereas a forensic examiner could specifically match the rifling marks on a bullet recovered from the crime scene to those on the firearm's barrel, it became increasingly difficult to match a bullet to a specific firearm made by a specific manufacturer through simple observation. And as they say, necessity is the mother of invention! So eventually, this paved the way for the magnified observation of bullets.

In 1902, Oliver Wendell Holmes, who later became the justice of the US Supreme Court, is said to have used a magnifying glass to examine a test bullet that he fired into cotton wool to compare its striations with those found on the bullet recovered from the victim during an autopsy.

Later in Paris (1912), Professor Balthazard took numerous photographs of the circumferences of the bullet found at the crime scene. He then enlarged these photographs to compare the markings with those obtained on the bullet that he had test-fired from the suspect's weapon.

- **Development of Comparison Microscope**

Eventually, magnification became a crucial part of firearm examinations. However, even though microscopes did exist back then, it was quite challenging to compare two bullets simultaneously. While examining one bullet under the microscope, forensic examiners had to

⁴⁹ 293 F. 1013 (D.C. Cir. 1923)

retain the mental image of the other bullet meant for comparison. This posed obvious risks to the validity and reliability of the investigations.

In fact, a major flaw involving ballistic fingerprinting almost led to the conviction of an innocent Charles F. Stielow in 1915 in the United States. He was convicted and sentenced to death for shooting his employer and employer's housekeeper using a pistol of 0.22 caliber. However, when investigator Charles E. Waite reevaluated the evidence with microscopy expert, Dr. Max Poser, he confirmed that the bullets recovered from the crime scene couldn't have been fired from Stielow's gun. Stielow was then acquitted and released.

Embarrassed and perturbed at the possibilities of such blunders in the future, Waite began cataloguing the manufacturing data on guns and ammunition. He also made sure to include foreign sources upon realizing that a majority of firearms back then were imported. In due course, Waite along with physicist John Fisher, Major Calvin Goddard, and chemist Philip Gravelle, established the Bureau of Forensic Ballistics in New York City. Philip Gravelle eventually developed the comparison microscope (two microscopes connected by an optical bridge) solving the challenges of simultaneous comparison.

The first significant application of this microscope was in the investigations of the Saint Valentine's Day Massacre in 1929. By examining the bullets and cartridge cases recovered from the site, he was able to identify the exact weapons used – a 12-gauge shotgun and two Thompson submachine guns. Furthermore, he was led to the suspect by matching the evidence recovered to the gun retrieved from his home. In 1932, when the FBI laboratory was established, Goddard got to train its first firearm identification professional.

(d) NARCO

Narcoanalysis is a technique where a person is administered barbiturates to induce a sleep-like state, allowing repressed feelings and thoughts to be released. It is also known as narcosynthesis or truth serum. The method combines hypnosis and narcosis, enabling the collection of detailed information in a short time.

The term "narcoanalysis" was coined in the 20th century, and its use gained popularity in 1922 when the drug scopolamine was employed by Robert House for interrogating prisoners. The

success of these experiments led to the term "truth serum" being associated with these drugs.⁵⁰ Narcosis can be achieved using various substances like cocaine, ether, alcohol, scopolamine, barbiturates, or hallucinogens. The technique has been used in psychoanalysis and psychotherapy to uncover repressed memories and experiences.

Its effectiveness has been observed in abreactive memory activation and the treatment of neurotic disorders. The procedure involves injecting a drug while the patient lies in a darkened room, followed by sessions of interview and discussion. The patient's experiences under the drug's influence provide insights for treatment. Narcoanalysis has been used in different contexts, including psychiatric patients, war neurosis, and civilian cases, but its use has declined with the development of other therapeutic approaches and medications. The dosage of the drug varies based on the individual's characteristics. It is noted that around 20% of individuals subjected to narcoanalysis are found to be innocent, making it useful for identifying both perpetrators and innocents in criminal cases.

- **Procedure of NARCO analysis test**

The narcoanalysis procedure involves several stages and interviews conducted by forensic psychologists and psychiatrists.

- **Before the test begins**, the individual is given a detailed explanation of the entire procedure, and their informed consent is obtained.
- **During the pre-test stage**, an anesthetic (truth serum) is administered to induce and maintain a pre-narcotic state. The drug is injected until the person appears relaxed and in a state of good contact.
- **In the semi-narcotic state**, the individual may exhibit flushed skin and experience slowing and slurred speech. At this point, the person is allowed to sleep and subsequently awakened. The anesthetist checks their condition and may offer them coffee or tea to help them wake up fully.

The NARCO interview itself is conducted while the individual is in the semi-narcotic state. The entire interview is audio-video recorded and also documented in writing for reference.

⁵⁰ P. Sivananda Reddy, SP, Cyber Crimes, in online Journal of CID visited on October 5,2008

Following the test, a post-test interview takes place. This includes checking the individual's memory to assess their recall of the interview. They are also informed about what they spoke during the interview. It is common for individuals to experience a more relaxed and anxiety-free state after the procedure.

It's important to note that the phrasing used in this response is intended to provide a general understanding of the narcoanalysis procedure and should not be considered as a recommendation or endorsement of such practices. The ethical and legal implications of narcoanalysis vary by jurisdiction, and it is crucial to consult local laws and guidelines before considering or conducting such procedures.

1963, the U.S. Supreme Court ruled, in *Townsend v. Sain*⁵¹, that confessions produced as a result of ingestion of truth serum were “unconstitutionally coerced” and therefore inadmissible.

(e) FINGERPRINTS

Ancient artifacts with carvings similar to friction ridge skin have been discovered in many places throughout the world. Picture writing of a hand with ridge patterns was discovered in Nova Scotia. In ancient Babylon, fingerprints were used on clay tablets for business transactions.

- **BC 200s – China**

Chinese records from the Qin Dynasty (221-206 BC) include details about using handprints as evidence during burglary investigations. Clay seals bearing friction ridge impressions were used during both the Qin and Han Dynasties (221 BC - 220 AD).

The 14th century Persian book "Jaamehol-Tawarikh" (Universal History), attributed to Khajeh Rashiduddin Fazlollah Hamadani (1247-1318), includes comments about the practice of identifying persons from their fingerprints.

⁵¹ 372 U.S. 293 (1963)

- **1600s**

In the "Philosophical Transactions of the Royal Society of London" paper in 1684, Dr. Nehemiah Grew was the first European to publish friction ridge skin observations.

- **1685 - Bidloo**

Dutch anatomist Govard Bidloo's⁵² introduced descriptions of friction ridge skin (papillary ridge) details. In 1686, Marcello Malpighi, an anatomy professor at the University of Bologna, noted fingerprint ridges, spirals and loops in his treatise. A layer of skin was named after him; the "Malpighi" layer, which is approximately 1.8 mm thick. No mention of friction ridge skin uniqueness or permanence was made by Grew, Bidloo or Malpighi.

German anatomist Johann Christoph Andreas Mayer wrote the book Anatomical Copper-plates with Appropriate Explanations containing drawings of friction ridge skin patterns. Mayer wrote, "Although the arrangement of skin ridges is never duplicated in two persons, nevertheless the similarities are closer among some individuals. In others the differences are marked, yet in spite of their peculiarities of arrangement all have a certain likeness".⁵³ Mayer was the first to declare friction ridge skin is unique.

- **1823: Mention of Nine Fingerprints Patterns**

In 1823, Jan Evangelista Purkinje, anatomy professor at the University of Breslau, published his thesis discussing nine fingerprint patterns. Purkinje made no mention of the value of fingerprints for personal identification. Purkinje is referred to in most English language publications as John Evangelist Purkinje.

German anthropologist Hermann Welcker of the University of Halle, studied friction ridge skin permanence by printing his own right hand in 1856 and again in 1897, then published a study in 1898.

⁵² 1685 book, "Anatomy of the Human Body"

⁵³ (Cummins and Midlo, 1943, pages 12-13)

- **1858: Use of Fingerprints in Native Contracts**

The English began using fingerprints in July 1858 when Sir William James Herschel, Chief Magistrate of the Hooghly District in Jungipoor, India, first used fingerprints on native contracts. On a whim, and without thought toward personal identification, Herschel had Rajyadhar Konai, a local businessman, impress his hand print on a contract.

Herschel's FPs recorded over a Herschel's fingerprints recorded over a period of 57 years. However as Herschel's fingerprint collection grew, he began to realize the inked impressions could, indeed, prove or disprove identity. While his experience with fingerprinting was admittedly limited, Sir William Herschel's private conviction that all fingerprints were unique to the individual, as well as permanent throughout that individual's life, inspired him to expand their use.

- **1892 : Recognition of Individuality and Uniqueness of Fingerprints**

Sir Francis Galton, a British Anthropologist and cousin to Charles Darwin, publishes the first book on fingerprints. In his book, Galton identifies the individuality and uniqueness of fingerprints. The unique characteristics of fingerprints, as identified by Galton, will officially become known as minutiae, however they are sometimes still referred to as Galton's Details.

- **1896** - International Association of Chiefs of Police (IACP), Establish National Bureau of Criminal Identification, for the exchange of arrest information

- **1901 : Classification of Fingerprints**

Sir Edward Henry, an Inspector General of Police in Bengal, India, develops the first system of classifying fingerprints. This system of classifying fingerprints. This system of classifying fingerprints was first adopted as the official system in England, and eventually spread throughout.

- **1903 – The William West –**

Will West Case at a Federal Prison in Leavenworth, Kansas, changed the way that people were classified and identified. When a man named Will West entered the Leavenworth Prison inmates. His face was photographed, and his Bertillion measurements were taken. Upon

completion of this process, it was noted that another inmate, known as William West, who was already incarcerated at Leavenworth, had the same name, Bertillion measurements, and bore a striking resemblance to Will West.

- **The First Trial in England that relied on Fingerprint Evidence**

It involved Inspector Charles Stockley Collins of Scotland Yard. Collins testified to an individualization made in a burglary case. That 1902 trial and subsequent conviction marked the beginning of fingerprint evidence in the courts of England⁵⁴. In October 1902, Alphonse Bertillon, made an individualization in Paris, France, with fingerprints: On October 17, 1902, he [Bertillon] was called to aid the investigation of the murder of Joseph Reibel. A glass panel from a nearby cabinet had been broken, and some bloody fingerprints were discovered on one of the broken pieces.

These were dutifully photographed and preserved. After determining that they did not match the victim's prints, Bertillon began a search of his anthropometric cards, upon which, by that late date, he had added fingerprint impressions as a routine matter in addition to his measurements. Eventually he found a card which contained fingerprint impressions that showed areas that matched the prints taken from the crime scene. The report of the case describes the isolation of three points of resemblance in the thumb-print, four in the index and middle finger, and six in the print from the ring finger. The murderer, Henri Leon Scheffer, was apprehended and brought to justice.⁵⁵

The incident called the reliability of Bertillion measurements into question, and it was decided that a more positive means of identification was necessary. As the Bertillion System began to decline, the use of fingerprints in identifying and classifying individuals began to rise. After 1903, many prison systems began to use fingerprints as the primary means of identification.

- **1905 – U.S. Military Adopts the Use of Fingerprints**

Soon thereafter, police agencies began to adopt the use of fingerprints. In 1905, Inspector Charles S. Collins of Scotland Yard testified to the individualization of a suspect's fingerprint on a cash box. The case involved the murder of a man and his wife. Two brothers, Alfred and

⁵⁴ (Lambourne, 1984, pp 67–68).

⁵⁵ (Kingston and Kirk, 1965, p 62)

Albert Stratton, were the defendants. Collins explained to the jury the classification of fingerprints and how to effect an individualization. Then, he demonstrated the characteristics he had marked on a chart as matching Alfred Stratton's right thumb. Collins claimed that in all his years of experience, he had never found two prints to have more than three characteristics in common. In this case, there were 11 characteristics in common. Supplementing eyewitness statements, the individualization of Alfred Stratton's right thumb impression was the strongest piece of evidence in the case. Both brothers were found guilty of the murders and sentenced to death. This case is referred to as the Deptford Murder Trial, in reference to the address of the crime, and it was the first murder trial in England in which fingerprints were used as evidence. Also in 1905, in the case of *Emperor v. Abdul Hamid*,⁵⁶ a court in India decided that no expert was required to testify to the individualization of prints, and an appellate court agreed. They believed that participants in the court could just as easily make a comparison as anyone else and that an expert was not necessary⁵⁷ other courts would later disagree with the position that no expertise is required to individualize fingerprints.

- **1911 - Fingerprints as a reliable means of Identification: US**

Dec. 21, 1911, The Illinois State Supreme Court upheld the admissibility of fingerprint evidence concluding that fingerprints are a reliable form of identification. Thomas Jennings was the first person to be convicted of murder in the United States based on fingerprint evidence.

Jennings appealed his conviction to the Illinois Supreme Court on the basis of a questionable new scientific technique. The Illinois Supreme Court cited the historical research and use of fingerprints as a means of reliable identification in upholding the conviction, and thus establishing the use of fingerprints as a reliable means of identification. As a result Jennings was executed in 1912.

- **1917 - First Palm print identification is made in Nevada.**

The bloody palm print, found on a letter left at the scene of a stage coach robbery and murder of its driver, was identified to Ben Kuhl.⁵⁸

⁵⁶ Patna HC 1922

⁵⁷ (Cole, 2001, p 170).

⁵⁸ *State v. Kuhl* 42 Nev. 195 175 PAC 190 (1918).

- **1924 – Formation of ID Division of FBI**
- **1980 – First computer data base of fingerprints was developed**

which came to be known as the Automated Fingerprint Identification System, (AFIS). In the present day, there nearly 70 million cards, or nearly 700 million individual fingerprints entered in AFIS.

- **1995: Latent Fingerprint Detection and Identification**

At the International Symposium the Israeli National Police Agency conducted latent fingerprint detection on, June, 1995, and Neurim Declaration was issued. The declaration states, "No scientific basis exists for requiring that a pre-determined minimum number of friction ridge features must be present in two impression in order to establish a positive identification."⁵⁹ The declaration was unanimously approved by all present, and later, signed by 28 persons from the following 11 countries: Australia, Canada, France, Holland, Hungary, Israel, New Zealand, Sweden, Switzerland, United Kingdom, and United States.

- **2012: INTERPOL's Automated Fingerprint Identification System**

The repository exceeds 150,000 sets of fingerprints for important international criminal records from 190 member countries. Over 170 countries have 24 x 7 interface ability with INTERPOL expert fingerprint services.

- **2015 - The International Association for Identification celebrated it's 100th Anniversary**
- **2020 - America's Largest Databases**
- **Department of Homeland Security Seal**

The Department of Homeland Security's Office of Biometric Identity Management, contains over 120 million persons' fingerprints, many in the form of two-finger records. The US Visit Program has been migrating from two flat (not rolled) fingerprints to ten flat fingerprints since

⁵⁹ (authored by Pierre Margot and Ed German)

2007. "Fast capture" technology currently enables the recording of ten simultaneous fingerprint impressions in as little as 15 seconds per person.

2.8 EXPERTS IN DIFFERENT FIELD OF FORENSIC SCIENCE

As modernization was coming, different scientists made significant developments in various fields of Forensics and came to be known as the Father of those particular fields. The origins of forensic science can be traced back to ancient Greek and Roman societies, where notable advancements were made in the field of medicine, particularly in pharmacology. These civilizations conducted research on the production, application, and effects of toxins, which laid the foundation for studying their use in historical cases of homicide.

- **Mathieu Orfila (1757-1853)**

Philippus Aureolus Theophrastus Bombastus von Hohenheim or 'Paracelsus' is credited as the Father of Toxicology for his achievements in Toxicology in the 16th century.

Mathieu Joseph Bonaventure Orfila was a Spanish Toxicologist and Chemist. He studied and published a book on the effects of poisons on animals and the ways of detecting a particular poison, a work that established 'Toxicology' as a legitimate scientific endeavor. For his publication in Forensic Toxicology in the 19th century he is known as the Father of Modern Toxicology.⁶⁰

- **Alphonse Bertillon (1813-1914)**

He devised the scientific system of personal identification. He started to develop scientific anthropometry which is a systematic procedure of taking a series of body measurements as a means of differentiating one individual from another. This has been later replaced by the Fingerprints.

However, for his achievements in creating the Bertillon system and identifying criminals through scientific processes, he is considered the father of criminal investigation.

⁶⁰ <https://historycollection.com/julius-caesar-complicit-death-re-examining-earliest-autopsy-history//> (Last visited on April 22, 2023)

- **Francis Galton (1822-1911)**

He developed the method of classification of Fingerprints. He is responsible for the present system of identification by Fingerprints. He laid a foundation for the acceptance of fingerprints as evidence in courts by publishing many articles, books, scholarly articles, interviews, etc.

Later, Henry Faulds used a classification system to classify various fingerprints in the police force, etc. and the classification system is still in use.

- **Hans Gross (1847-1915)**

Hans Gross was an Austrian criminologist popularly known as the Father of Criminalistics. His publication ‘Criminal investigation’ in 1893 helped to establish forensics in terms of transferring evidence from criminal to victim.

- **Edmond Locard (1847-1915)**

Edmond Locard was a French criminologist. He discovered the basic principle of Forensic Science i.e., Locard’s exchange principle which states that ‘Every contact leaves a trace’.

- **Albert S. Osborn (1858-1915)**

Albert S. Osborn is also known as the Father of questioned document examination. He made significant contributions to the field of questioned document examination. His first contribution was the book publication titled “Questioned Documents” in 1910 and the second edition of the same book in 1929.

His other publications were ‘The problem of proof’ (1922), The Mind of the Juror (1937), and Questioned Document Problems (1944).

- **Leone Lattes (1887-1954)**

Dr. Karl Landsteiner discovered the blood groups but Dr. Leone Lattes devised a relatively simple procedure for determining blood groups from a drop or from the dried bloodstain. The procedure developed by Dr. Leone Lattes is still in use today. She is credited as the ‘Father of Bloodstain identification’.

- **Calvin Hooker Goddard (1891-1955)**

He devised the technique of comparison of a fired bullet with a test bullet. It is also possible to determine if a particular weapon has been used for firing a bullet. It would be possible to get the exact identity of the weapon and the bullet from where it was fired. He is also known as the 'Father of Forensic Ballistics'.

- **Sir Alec Jeffreys (1950-present)**

He was a British Geneticist who developed the DNA profiling and genetic fingerprinting technique which is used currently all over the world in Forensic Science for the purpose of the law.⁶¹

2.8 A HISTORICAL OVERVIEW OF FORENSIC SCIENCE IN INDIA

The history of forensic science has evolved over time and can be categorised into ancient, medieval, pre and post independence period.

2.9.1 ANCIENT PERIOD

The ancient world lacked standardized forensic practices, which aided criminals in escaping punishment. Criminal investigations and trials relied on forced confessions and witness testimony. However ancient sources contain several accounts of techniques that foreshadow the concepts of forensic science that is developed centuries later, such as the "Eureka" legend told of Archimedes (287–212 BC).⁶²

In ancient India too, medical opinion was frequently applied to the requirements of the law. By law the minimum age for the marriage of girls was fixed at 12 years; the duration of pregnancy was recognized as being between 9 and 12 lunar months with an average of 10 months and there is evidence that doctors had to opine on such cases.⁶³

⁶¹ Ibid

⁶² Schafer, Elizabeth D. (2008). —Ancient science and Forensics ||. In Ayn Embarseddon, Allan D. Pass (eds.) Forensic Science. Salem Press p.40. ISBN 978-158765-423-7

http://www.princeton.edu/~achaney/tmve/wiki100k/docs/Forensic_science.html

⁶³ Herschel, William James (November 25, 1880). Skin Furrows of the hand. *Nature* 23(578):76

- **Charak Samhita**

During the 7th century BC, Maharshi Charaka authored the book "Charak Samhita," an ancient Ayurvedic treatise. It is the oldest known text on Ayurveda, covering diagnosis, treatment, anatomy, disease classification, and the philosophical principles underlying Indian medicine. Charaka's work emphasizes the significance of comprehending the rationale and philosophy behind the Indian medicinal system.

- **Sushruta Samhita**

Sushruta, an ancient Indian scholar, authored the "Sushruta Samhita" around the 6th century BC. This Ayurvedic text is a significant contribution to the field of surgery (shalya) and is considered pioneering. Sushruta is known as the father of plastic surgery and described various surgical procedures. His work also covered toxicology and categorized poisons into,

- Plant poison
- Animal poison, and
- Artificial poison

- **Arthashastra**

Kautilya, in his book "Arthashastra," mentioned the study of pupillary lines pattern thousands of years ago. The uniqueness of fingerprints made them commonly used for identification purposes, potentially serving as signatures. In the seventh chapter of the fourth book, Arthashastra discusses criminal investigation concepts and the modus operandi of criminals.

Similarly, the book "Ming Yuen Shih Lu" from China's earlier period around the 6th century also mentions the use of fingerprints. Indian scholars studied various patterns of papillary lines, demonstrating their understanding of the subject long ago.

2.9.2 Medieval Period

During the Muslim period in India, the criminal laws were well-developed. The "Quasi-I-Mumalik" played a significant role in handling civil and criminal disputes. However, the Britishers abolished certain shortcomings in the Muslim criminal law. The first recorded

autopsy in India occurred on August 28, 1693, conducted by Dr. Edward Bulkley on Mr. Wheeler, a prominent figure in Chennai.⁶⁴

2.9.3 Pre Independence

Sir William Herschel was one of the first to advocate the use of fingerprinting in the identification of criminal suspects. While working for the Indian Civil Service, he began to use thumbprints on documents as a security measure to prevent the then-rampant repudiation of signatures in 1858. In 1877 at Hooghly (near Calcutta) he instituted the use of fingerprints on contracts and deeds and he registered government pensioners' fingerprints to prevent the collection of money by relatives after a pensioner's death. Herschel also fingerprinted prisoners upon sentencing to prevent various frauds that were attempted in order to avoid serving a prison sentence.

In 1897 a Fingerprint Bureau was established in Calcutta (Kolkata), India, after the Council of the Governor General approved a committee report stating that fingerprints should be used for the classification of criminal records. Working in the Calcutta Anthropometric Bureau, before it became the Fingerprint Bureau, were Azizul Haque and Hem Chandra Bose. Haque and Bose were Indian fingerprint experts who have been credited with the primary development of a fingerprint classification system eventually named after their supervisor, Sir Edward Richard Henry. The Henry Classification System, co devised by Haque and Bose, was accepted in England and Wales when the first United Kingdom Fingerprint Bureau was founded in Scotland Yard, the Metropolitan Police headquarters, London, in 1901. Sir Edward Richard Henry subsequently achieved improvements in dactyloscopy.⁶⁵

In the 19th century, it was discovered that almost any contact between a finger and a fixed surface left a latent mark that could be made visible by a variety of procedures (e.g., the use of a fine powder). In 1894 in England the Troup Committee, a group established by the Home Secretary to determine the best means of personal identification, accepted that no two individuals had the same fingerprints—a proposition that has never been seriously refuted. In 1900 another committee recommended the use of fingerprints for criminal identification. Fingerprint evidence was first accepted in an Argentine court in the 1890s and in an English

⁶⁴ Hopkins EW. Translated from Sanskrit with an introduction.

The ordinances of Manu. XLVII ed. New Delhi: Vedams ebook Pvt. Ltd. 1995.

⁶⁵ . Sodhi J.S.; Kaur, asjeed (2005). —The Forgotten Indian Pioneers Of Fingerprint Science||. Current Science 88 (1): 185-191.

court in 1902. Many other countries soon adopted systems of fingerprint identification as well.⁴ Forensic Science, an amalgamation of almost all faculties of knowledge is an essential and efficient enabler in the dispensation of justice in criminal, civil, regulatory and social contexts. Historically our forefathers in India have practiced forensic application in variety of forms. Present day Indian forensics, as chronicled, owes its genesis to several British initiated ventures such as Chemical Examiner's Laboratory (Madras, 1849), Anthropometric Bureau (1892), Finger Print Bureau (1897), Inspectorate of Explosives (1898), Office of Government Handwriting Expert (1904), Serology Department (1910), Foot Print Section (1915), Note Forgery Section (1917), Ballistics Laboratory (1930) and Scientific Section (1936). Having subsequently undergone clubbing / regrouping / spreading, as of now, there are 28 State / Union Territory Forensic Science Laboratories (State / UT FSLs) along with their Regional FSLs (32 RFSLs) and Mobile FSLs (144 MFSLs); they are mostly with the respective Home Department either directly or through police establishment⁶⁶

2.9.4 Post Independence

In 1968, the Ministry of Home Affairs, Government of India, set up a Forensic Science Laboratory for Delhi Police and the Central Bureau of Investigation under the administrative control of the Central Bureau of Investigation. This laboratory now provides expert opinion on various aspects of Forensic Science concerning crime investigation. Apart from Delhi Police and the CBI, it also provides assistance to the Central Government Departments, State Forensic Science Laboratories, Defence Forces, Government Undertakings, Universities, and Banks etc. in criminal cases. The laboratory has search and development set up to tackle special problems. The expertise available at the CFSL is also utilized in teaching and training activities conducted by the CBI, Lok Nayak Jai Prakash Narayan, National Institute of Criminology & Forensic Sciences, Police Training Institutions, Universities and Government Departments conducting Law Enforcement Courses etc.

2.10 ADVANCEMENTS IN FORENSIC SCIENCE : INDIAN CONTEXT

In India, there was the fingerprint bureau under the State Criminal Investigation Department [C.I.D] which provided the examination of fingerprints, footprints, and document analysis.

⁶⁶ Dr. Gopal Ji. Misra & Dr. C. Damodaran, —Perspective Plan For Indian Forensics||, Final Report presented to the Ministry of Home Affairs Government of India, New Delhi.

Chemical tests on biological evidence were also done such as with blood and other visceral tissues.

Due to the slow process and lack of systematic development, the Forensic Science Laboratory (FSL) was set up by various state governments. The first such State laboratory was set up in 1952 at Calcutta which became fully functional in 1953. Central Forensic Science Laboratory and Central fingerprint bureau were established in Calcutta in 1955 and 1957.

Later with the recommendation of the central advisory committee, other Forensic Laboratories were established in Bombay, Madras, Bihar, Punjab, Rajasthan, and Madhya Pradesh.

At present Bureau of Police Research and Development (BPRD) acts as a nodal agency for the central government. In states like Andhra Pradesh, Gujarat, Maharashtra, Tamilnadu, and U.P regional FSLs were set up. Other institutions like the department of explosives, and the Indian security press were also set up later.

Modern biological techniques were made available in the Centre for DNA fingerprinting and diagnostics situation in Hyderabad. It carries out DNA profiling, diagnostics, analysis, and bioinformatics. This centre has a database for all the casework that was entrusted to them for analysis and is the primary centre for DNA testing.

(a) Anthropometry Bureau

This was established in Calcutta in 1892. This bureau had adopted Bertillon's method of personal identification. This centre has got records of criminals such as photographs and other detailed descriptions of appearance.

(b) Fingerprint Bureau

William Herschel the collector of Hugli in West Bengal found that markings on the fingertips of an individual are unique and never change during their lifetime. He applied his knowledge and skill in devising a system of registration of finger and thumb impressions.

Edward Henry followed this principle of recording the fingerprints of criminals and thereby a fingerprint bureau was established in 1897 at Calcutta.

(c) Department of Explosives

During the British rule explosions and explosive-related activities became common and to detect the type of explosives and cause of explosions the department of explosives was set up in Nagpur and later established in 5 other regions of India i.e.,

- i. Calcutta
- ii. Bombay
- iii. Madras
- iv. Agra
- v. Gwalior
- vi. Government Examiner of Questioned Document (G.E.QD)

During the struggle for independence, the government of West Bengal created this post (to identify the handwriting of secret documents) in 1904. It was later shifted to Shimla in 1906 under the control of the criminal investigation department. During that time, Mr. CR Hardless was appointed to this post.

(e) Serologist to Government of India

When the science of examining human blood in India was started, it had also become possible to examine seminal stains in a criminal investigation in certain specific cases where it felt mandatory.⁶⁷

The serology department was first established in Calcutta in 1910. Although the department was not developed, it did support criminal investigations in India. It was renamed as Office of Serologist and Chemical examiner by the government of India.

(f) Footprint Section of C.I.D

It was established in Calcutta in 1915. The main duty was to collect, preserve and analyze the footprint for the identification of criminals.

⁶⁷ <https://forensicyard.com/forensic-science/>(Last visited on April 22, 2023)

(g) Forgery Section of C.I.D

In 1917, this section was set up under C.I.D. by the government of West Bengal. They detect cases of currency/coins and forgery notes/documents. Later on, the government security printing press was established in Nasik.

(h) Ballistics Division

In 1930, it was established in Calcutta for the examination of firearms as the incidents of firearms were increasing. Later, the ballistics division was added to many state forensic laboratories.

(i) Scientific C.I.D. Section

Some police are trained scientifically to help the department where technical photography, scientific surveillance and investigations, and other technical needs are existing.

(j) Cyber Forensics

Though the uses of computers in police organizations are limited still they have more significance in the collection, recording, and analysis of data in electronic form. This may be available in any crimes involving either the physical presence of the perpetrator or even in the absence of oneself.⁶⁸

It would be mandatory that no crime would be possible to be committed without the communication of the information in any form (such as calls through mobile phones, email, SMS messages, etc).

There is a possibility of retrieving all these data through the analysis done in this division. Not only the retrieval of the data but also the possible determination of the location of the specific data that has been generated.

⁶⁸ ibid

- **Mobile Forensic Laboratory**

Most of the states in India have got this facility for the purpose of surveillance.⁶⁹ The main function is to help police personnel in their investigation at a crime scene by helping them to locate, to collect, and preserve the evidence. The team will also provide a photographic facility to record a crime scene and valuable evidence.⁷⁰

Another important duty is to guide the police to collect an adequate and correct sample for comparison and also provide leads for further investigations.

⁶⁹ Monahan, Torin; Murakami Wood, David (2018). *Surveillance Studies: A Reader*. New York: Oxford University Press. ISBN 9780190297824.

⁷⁰ Lyon, David (2001). *Surveillance Society: Monitoring in Everyday Life*. Philadelphia: Open University Press. ISBN 978-0-335-20546-2.

CHAPTER-3

LEGAL FRAMEWORK FOR FORENSIC EVIDENCE IN INDIA

The aim of forensic science in criminal justice system is to link the potential offender to a crime scene with the help of physical evidence obtained from the suspect along with a similar sample recovered from the crime scene. The investigating officers and the courts place heavy reliance on such forensic evidence and testimony as it helps provide information about the crime, to the investigators.

3.1 CLASSIFICATION OF FORENSIC EVIDENCE

- a) **Class Characteristic Evidence-** which does not refer to a particular suspect. For example, a cartridge found at the crime scene belonging to a certain type of firearm.
- b) **Individual Characteristic Evidence-** which associates a particular individual with the crime. For example, the hair found on the body of victim or the fibres found on a victim's clothes are consistent with the fibres found on suspect's clothes.

Whenever a serious crime is committed, the police personnel devote many hours to collect and analyse forensic evidence from the scene of crime and other places, till the conclusion of the investigation. The application of forensic sciences and the collection of forensic evidence have become an important part of criminal investigations in India. Forensic evidence plays various roles in criminal investigations. It –

- proves whether or not a crime is committed;
- highlights the relation between the accused and the victim along with crime scene;
- establishes the identity of people involved in the commission of the said crime;
- exonerates the innocent person;
- corroborates a victim's testimony;
- assists in proving the facts which are connected to the crime.⁷¹

⁷¹ Peter White, Crime Scene to Court: The Essentials of Forensic Science, Second Edition

3.2 FUNDAMENTAL PRINCIPLES OF FORENSIC EVIDENCE

Forensic evidence plays a vital role in detection and investigation of crimes. However, the scientific evidence on which the criminal justice system depends is based on various sound principles which makes such evidence relevant and admissible in the court of law. They are -

- **Individuality:** Every object, natural in nature has an individuality. Neither the nature duplicates it nor the man. For example- fingerprints.
- **Locard's Principal:** Whenever two identities come in contact, there is an exchange of traces mutually. This is known as Locard's exchange principle.
- **Law of Progressive change:** Change in everything takes place with the passage of time. The crime scene, physical evidence, criminal involved in the crime undergo change as the time passes by.
- **Principles of Comparison:** Only those things which are similar in nature can be compared. This principle stresses upon the need of providing similar samples or specimen for the purpose of comparison.
- **Principles of Analysis:** For effective use of scientific evidence in trials, emphasis to be laid on correct sampling and packaging procedure.
- **Law of Probability:** It determines the change of occurrence of a particular event in a particular way out of a number of ways in which the event can take place or fail to take place with equal facility.
- **Facts do not lie:** Material evidence is more concretely based than oral evidence and holds more value. Hence, importance of circumstantial or scientific evidence is as good as oral or direct evidence.⁷²

3.3 ADMISSIBILITY OF FORENSIC EVIDENCE IN THE COURTS

- i. establishes the element of a crime i.e., it helps in proving the commission of crime;
- ii. associates or dissociates the accused with the crime; and
- iii. helps in reconstruction of scene of crime.

⁷² Richard Saferstein, Forensic Science: From the crime scene to the crime lab, second edition

The prosecutors seem to evaluate forensic evidence differently. One group finds forensic evidence always trustworthy and the second group views forensic science as corroboration for other evidence. However, their views are debatable.

- **Expert Opinion**

It is based on the principle that the court cannot form an opinion or come to a conclusion on a matter which is technically complicated and sophisticated, without the help and assistance from a person who possess special skill and knowledge on that matter. Such persons who have special knowledge and skill in the said area is called an 'Expert'. Medical, chemical, explosive, ballistic, fingerprint analysts are some of the examples of forensic experts.⁷³

However, following conditions are there for admitting an expert's opinion by the courts

- a) that the concerned dispute cannot be resolved without expert's opinion, and
- b) the person expressing opinion is fit to be called an expert.

The legal system world-wide faces many challenges when it comes to admissibility of expert evidence. The judges do not usually have special scientific knowledge and accordingly they are not expected to form independent opinion on matters of science, including the social sciences, involving complex quantitative and qualitative analyses. For that reason, the courts make use of experts who, due to their knowledge or training, can provide explanations which may be relied upon in decision making.

The expert evidence and the challenges it poses in the decision making by the courts is been discussed nationally and internationally for so many decades that it has become a 'talk of the town' pertaining to the issue of admissibility of expert evidence.

The expert witness's evidence should fulfil the following requirements:

- a) the witness must be classified as an expert;
- b) the expert statements or reports must meet the minimum standards of reliability;
- c) the expert statements are relevant and of probative value;

⁷³ S P Sarkar, Commentary on The Law of Evidence, second edition, Dwivedi Law Agency

- d) the content of the expert statements falls within the accepted expertise of the expert witness.⁷⁴

However, scientific evidence has to some extent proved to be problematic for judges and lawyers as both these authorities have little or no training in science and technology. Courts while entertaining scientific evidence face the difficulty in choosing the veracity of scientific explanation which is tendered by the expert witness. In order to solve this difficulty and to reduce the delay and expenses involved in getting expert opinion, examination of certain experts have been dispensed under the law. As per Section 293(2) of Criminal Procedure Code, 1973 –

The Court may, if it thinks fit, summon and examine any expert as to the subject-matter of his report, namely –

- a) Any Chemical Examiner / Asst. Chemical examiner to the Government,
- b) The Chief Controller of explosives,
- c) The Director of Fingerprint Bureau,
- d) The Director of Haffkein Institute, Bombay,
- e) The Director, Dy. Director or Asst. Director of Central and State Forensic Science Laboratory,
- f) The Serologist to the Government,
- g) Any other Govt. Scientific Experts specified by notification of the Central Govt.
- h) Any other Govt. Scientific Experts specified by notification of the Central Govt.

The abovementioned reports which are executed by any of the abovementioned government scientific experts is admissible as evidence in any inquiry, trial or proceeding. However, he may be exempted by the court from personal appearance as an expert witness unless the court deems fit and proper to call him for testifying the material facts. He may instead depute any other officer in his place to attend the court but that officer must be well versed with the facts of the case and must be capable of deposing as an expert in the court.⁷⁵

⁷⁴ Artur Appazov, Expert Evidence and International Criminal Justice, Springer International Publishing, Switzerland, 2016

⁷⁵ The Code of Criminal Procedure, 1973, Bare Act, 2015, Professional Book publishers

James Alphonso Frye claimed innocence to a charge of murder by requesting the court to engage an expert and carry on polygraph test, the ‘systolic blood pressure deception test’ on him. In this case, the issue was whether an expert’s evidence must be accepted outright or a rule for its acceptance must be made. This court laid down the rule of general acceptance. It said that the expert’s opinion will be admitted if it has gained general acceptance from the scientific community. As per the court, the law shall be protected by deferring to science which was already proven and accepted by the scientific world. As a result of this judgement, a standard for admissibility of expert was set. According to this standard, an expert’s testimony which is based on any scientific theory shall be admissible in the court of law if the scientific principle on which it is based is accepted generally in the field to which it belongs. However, Frye’s decision failed to explain the meaning of general acceptance and hence different courts interpreted it as per their understanding. The Frye’s decision was widely applicable in the court in spite of a lot of criticism from various community.⁷⁶

In 1975, the Federal Rule of evidence was enacted by the Congress. Rule no 702 spoke of admissibility of expert testimony. As per this rule, if any party to the litigation wishes to bring an expert to testify in his case then such an expert witness shall be qualified to act as an expert because of his knowledge, training, education in the respective science. This rule explained the scope of admissibility of scientific evidence in the courts. This rule existed for the next two decades till Daubert’s judgement was passed.

➤ ***Daubert v. Merrell Dow Pharmaceuticals***⁷⁷

It is an important one as it laid down the standard for admissibility of expert’s evidence in legal proceeding in the United States Federal Court. In this, the plaintiff had filed a case against the defendant pharmaceutical company for manufacturing a drug named Bendectine. Because of ingestion of this drug by plaintiff’s wife during pregnancy, it caused defect in the two child born out of his wife. The defendant wins this case on the basis of an expert testimony who gave an opinion that there was no risk involved in taking this medicine on human beings. However, the plaintiff presented affidavits to prove that this medicine caused birth defects in the animals. The court’s decision was based on following opinion which says Whenever an expert testifies in the court, the judge must preliminarily assess whether the method underlying the expert’s

⁷⁶ Bobak Razavi, J D, Admissible Expert Testimony and Summary Judgement, The Journal of Legal Medicine, 29:307-343, 2008 Taylor & Francis Group

⁷⁷ Inc 509 US 579 (1993)

testimony is scientifically valid or not. Also whether the reason or methodology used by the expert is applicable to the fact-in-issue.

In this judgement, the court laid down some general rules of acceptance of expert testimony given as follows:

- a) Whether the scientific method used can be effectively tested;
- b) Whether the scientific theory involved is subjected to peer review of the scientific community and whether it has been published thereafter;
- c) Is every scientific technique accepted by the community, the court should know the rate of error involved.⁷⁸

As per the judgement passed in Daubert's case, the trial judges were referred as the 'gatekeeper' who ensured that the expert's opinion involved in any case was reliable and relevant. As per the new standard, the scientific evidence was to be based on sound principles and accepted by the scientific community, only then the judges will consider them as reliable evidence.

From 1923 to 1993, Frye's judgement set the standard of admitting the scientific evidence in the courts based on general acceptance rule. Then came the Federal Rules in 1975 which expanded the ambit of admissibility of scientific evidence. In 1993, with the passing of Daubert's judgement, new standards and norms were set up to accept the scientific evidence.

3.4 FORENSIC EVIDENCE AND ITS CONSTITUTIONAL IMPLICATIONS

The accused cannot be made to give any statement or respond to any inquiry using threat or any force that might later be used as evidence against him.

The purview of Article 20(3) of the Indian Constitution also includes the right to remain silent. This right also immunises the accused to be a witness against himself. The accused gets the protection that threat or any kind of force cannot be used on the accused for the purpose of obtaining any statement from him. In *V.S Kuttan Pillai v. Ramakrishnan and Another*⁷⁹ it

⁷⁸ The Florida Senate, Analysis of Law relating to Admissibility of Expert Testimony and Scientific Evidence, October 2008, 2009-331

⁷⁹ 1980 AIR 185, 1980 SCR (1) 673

was held by the Court that in order to search for any document or to obtain something from the possession of the accused, a warrant can be issued.

3.5 APPLICATION OF FORENSIC EVIDENCE IN CRIMINAL INVESTIGATION

In India, the cases take a lot of time, and thus, this results in the delay to provide justice to a person. With the advancement of science, certain improvements are made in the criminal justice system with the introduction of forensic science. Thus, forensic science includes methods from the different fields of science, for example, biology, chemistry, medication to expedite the process of a criminal investigation.

At the crime location, an examining officer collects all the evidence available on the spot which later on goes to the forensic labs for testing and investigation purposes. The reports obtained from these forensic science tests can serve as evidence in a court of law. **In *Rojo George v. Deputy Superintendent of Police (2006)***⁸⁰, it was pointed out by the Court that the conventional methods of investigation are not very useful in the present era where crimes are committed using very sophisticated ways and thus, there is a need to allow tests like narco-analysis.

3.6 STATUTORY REQUIREMENTS PERTAINING TO USE OF FORENSIC EVIDENCE

The right to self-incrimination provided under Article 20(3) of the Indian Constitution is available only to a person against whom an FIR has been lodged. There are certain components that need to be fulfilled for the right under Article 20(3) to be effective. It is crucial that the person who is accused of an offense is forced to respond to any inquiry or give any statement against himself or in other words be forced to be a witness against himself. If the statement obtained under compulsion from an accused ends up being evidence against him, the right under Article 20(3) can be invoked.

If any statement that is obtained under force or threat from the accused is presented before the court of law as evidence, it can be rejected by the court. In the ***Kalawati v. State of H.P*** (1953),⁸¹ it was held by the Supreme Court of India held that if an accused makes any statement

⁸⁰ 2006 (2) KLT 197

⁸¹ 1953 AIR 131, 1953 SCR 546

voluntarily and without the use of threat or force, then Article 20(3) cannot be applied in that case. The protection under Article 20(3) can only be granted in criminal proceedings and not in civil proceedings and the same was also held in the case of *Vidya Verma v. Shri Narain (1956)*.⁸²

Section 53 of the Criminal Procedure Code, 1973 provides that if an accused is arrested and there are reasonable grounds to believe that the medical examination of that person may serve as evidence in the court of law, then it is lawful for a registered medical practitioner to make an examination of the arrested person at the request of a police officer who shall not be below the rank of sub-inspector.

3.6.1 INTERPLAY BETWEEN CrPC AND FORENSIC EVIDENCE

The Code of Criminal Procedure provides the machinery for the investigation of crime, apprehension of suspected criminals, collection of evidence, determination of guilt or innocence of the accused person and the determination of punishment of the guilty. It also has provisions for containing public nuisance, prevention of offences and maintenance of wife, child and parents.

Forensic science plays a vital role in the criminal justice system by gathering and analyzing evidence found at crime scenes, conducting laboratory tests, and presenting the results in court. Its significance lies in providing accurate information through the examination of physical evidence and identifying the perpetrator through personal identifiers like fingerprints, footprints, blood droplets, or hair. By linking the perpetrator to the crime through artifacts left at the scene or connecting them to the victim, forensic science establishes a crucial connection. Conversely, if the evidence does not link the accused to the victim or the crime scene, it can help establish the innocence of the accused.

➤ The extent and applicability of the Code of Criminal Procedure, 1973

The law relating to criminal procedure applicable to all criminal proceedings in India (except those in the State of Nagaland and the Tribal Areas in Assam) is contained in the Code of Criminal Procedure, 1898.

⁸² 1956 AIR 108, 1955 SCR (2) 983

The Code has been amended from time to time by various Acts of the Central and State Legislatures. The more important of these were the amendments brought about by Central legislation in 1923 and 1955. The amendments of 1955 were extensive and were intended to simplify procedures and speed up trials as far as possible in addition; local amendments were made by State Legislatures of which the most important were those made to bring about separation of the Judiciary from the Executive. Apart from these amendments, the provisions of the Code of 1898 have remained practically unchanged through these decades and no attempt was made to have a comprehensive revision of this old Code till the Central Law Commission was set up in 1955.

Explanation-In this section, "tribal areas" means the territories which immediately before the 21st day of January, 1972, were included in the tribal areas of Assam, as referred in paragraph 20 of the Sixth Schedule to the Constitution, other than those within the local limits of the municipality of Shillong.

➤ **Investigation Process**

The process of investigation initiates the beginning of the police action in to a criminal case. It is one of the important processes in the criminal justice practices. To start with criminal case police arrest few alleged/ accused to get close to the culprit.

➤ **Arrest (section 41 to 60)**

This term "Arrest" is very common term that we pick up a lot in our day today life. Normally, we see a person, who do or have done something against the law, get arrested. Generally, the term "arrest" in its ordinary sense, means the apprehension or restraint or the deprivation of one's personal liberty. Let's understand this term in Indian law, Criminal procedure Code, 1973 in its chapter V (section 41 to 60) deals with Arrest of a person. Ironically, Code has not defined the term "Arrest". Every deprivation of liberty or physical restraint is not arrest. Only the deprivation of liberty by legal authority or at least by apparent legal authority, in a professionally competent and adept manner amounts to arrest. Thus, we can say arrest means 'apprehension of a person by legal authority resulting in deprivation of his liberty'.

In *Joginder Kumar v. State of UP*⁸³, the Supreme Court established guidelines for police during arrests. It ruled that the arrestee must be informed of the reasons for their arrest and given the opportunity to consult with their lawyer during interrogation.

In *D.K. Basu v. State of West Bengal*⁸⁴, the Supreme Court provided guidelines for police regarding the arrest and detention of individuals. The court emphasized that the arrested person must be informed of their right to inform someone about their arrest and must be presented before a magistrate within 24 hours.

➤ **Provisions Supporting Forensic Investigation under CrPC**

- a) **Section 53 of the Criminal Procedure Code (CrPC)** states that at the request of a police officer using reasonable force, an accused person (female solely by female registered practitioner) can be examined by a medical practitioner. This provision allows for the medical examination of the accused to gather evidence or assess their physical condition.
- b) **Section 53 A CrPC** states examination of person accused of rape by medical practitioner.
- c) **Section 54 CrPC**, states that a medical practitioner can also examine an arrested individual at their request to detect any evidence that may support their case. This provision enables the accused to obtain medical evidence that may be relevant to their defense.
- d) **Section 164 A CrPC**, states medical examination of the victim of rape, which was inserted by 2005 amendment
- e) **Section 174 CrPC**, states that an inquest report mandates the police to investigate and report cases of suicide or an unnatural death. This provision requires the police to conduct a thorough investigation into the circumstances surrounding a suicide, including the collection of evidence, statements from witnesses, and other relevant information.
- f) **Section 176 CrPC** pertains to a magistrate's inquiry into the cause of death. It empowers a magistrate to conduct an inquiry into any suspicious or unnatural death, including deaths that occur during police custody which establish legal frameworks for medical examinations of accused individuals, investigations into suicides, and inquiries into the cause of death.
- g) **Section 293 of the CrPC**, reports of certain Government scientific experts.

⁸³ 994 AIR 1349, 1994 SCC (4) 260

⁸⁴ SC 1996

Any document purporting to be a report under the hand of a Government scientific expert upon any matter or thing duly submitted to him for examination or analysis and report in the course of any proceeding under this Code, may be used as evidence in any inquiry, trial or other proceeding under this Code.

The Court may, if it thinks fit, summon and examine any such expert as to the subject-matter of his report.

- h) **Chapter XXIII of CrPC** also supports evidence in inquiries and trials from section 272-299 of the code which further elaborates,
- i. Mode of taking and recording evidence. (272-283)
 - ii. Commissions for examination of the accused (284-299)

3.6.2 INDIAN EVIDENCE ACT, 1872 AND FORENSIC EVIDENCE.

The opinions or beliefs of third persons are, as a general rule, irrelevant, and therefore, inadmissible. Witnesses are to state the facts only, i.e., what they themselves saw or heard or perceived by any other sense. It is the function of the Judge and the Jury to form their own conclusion or opinion on the facts stated. Thus, the opinion or the impression of a witness that it appeared to him from the conduct of a mob that they had collected for an unlawful purpose is not admissible to prove the object of the assembly.

There are, however, cases in which the Court is not in a position to form a correct judgment, without the help of the persons who have acquired special skill or experience in a particular subject. In such cases, the help of experts is required. In these cases, the rule is relaxed, and expert evidence is admitted to enable the Court to come to a proper decision and under this head come matters of science, art, trade, handwriting, finger impressions and foreign law. The rule admitting expert evidence is founded on necessity.

• Who is an Expert?

The expression “expert” covers ‘person especially skilled’. An expert may be defined as a person who, by practice and observation, has become experienced in any science or trade. He is one who has devoted time and study to a special branch of learning, and is thus especially skilled in that field wherein he is called to give his opinion.

The term implies both superior knowledge and practical experience in the art or profession, but generally, nothing more is required to entitle one to give testimony as an expert than that he had been educated in a particular art or profession.

Before such evidence can be considered, it must be proved that the person giving the evidence is an expert. If on considering the evidence, the Court comes to the conclusion that the person who has given evidence is not an expert; his opinion has to be discarded.

➤ **Medico Legal Opinion**

Section provide relevancy of opinion of third persons, which is commonly called in our day to day practice as expert's opinion. These provisions are exceptional in nature to the general rule that evidence is to be given of the facts only which are within the knowledge of a witness. The exception is based on the principle that the court can't form opinion on the matters, which are technically complicated and professionally sophisticated, without assistance of the persons who have acquired special knowledge and skill on those matters. Conditions for admitting an expert opinion are following⁸⁵:

- a) That the dispute can't be resolved without expert opinion and
- b) That the witness expressing the opinion is really an expert.

➤ **Duty of the Expert:**

- a) An expert is not a witness of fact.
- b) His evidence is of advisory character.
- c) An expert deposes and does not decide.
- d) An expert witness is to furnish the judge necessary scientific criteria for testing the accuracy of the conclusion so as to enable the judge to form his independent judgment by application of the criteria to the facts proved by the evidence.

➤ **Forensic Science Expert Opinion**

Sec. 45 to Sec.51 under Chapter-II of the Indian Evidence Act provide relevancy of opinion of third persons, which is commonly called in our day to day practice as expert's opinion. These

⁸⁵ State of H.P. v. Jai Lal and Ors., [(1999) 7 SCC 280]

provisions are exceptional in nature to the general rule that evidence is to be given of the facts only which are within the knowledge of a witness. The exception is based on the principle that the court can't form opinion on the matters, which are technically complicated and professionally sophisticated, without assistance of the persons who have acquired special knowledge and skill on those matters. Conditions for admitting an expert opinion are following:

- a) That the dispute can't be resolved without expert opinion and
- b) That the witness expressing the opinion is really an expert.

➤ **Section 47A. Relevancy of Opinion as to Electronic Signature**

When the court has to form an opinion as to the electronic signature of any person, the opinion of the Certifying authority which has issued the Electronic Signature Certificate, is relevant. The question arises whether an electronic signature is of A. The certifying authority which has issued the electronic signature opines that A is not the person who has applied or approached for getting an electronic signature. Thus A is not the owner of the electronic signature in question. It belongs to someone else.

➤ **The Opinion of Certifying Authority may be Accepted by the Court.**

Section 48. Relevancy of opinion as to existence of right or custom When the court has to form an opinion as to the existence of any general custom or right, the opinion of the persons who are in a position to know about its existence, are relevant.

• **The Value of Expert Evidence before Court of Law**

Perhaps the testimony which least deserves credit with a jury is that of skilled witnesses. These witnesses are usually required to speak not facts, but to give opinions; and when this is the case, it is often quite surprising to see with what facility, and to what extent, their views can be made to correspond with the wishes or the interests of the parties who call them. They do not indeed will fully misrepresent what they think, but their judgment becomes so warped by regarding the subject from one point of view, that even when conscientiously disposed, they are incapable of forming an independent opinion. Testimony of experts is usually considered to be of slight value, since they are proverbially, though perhaps unwittingly, biased in favour

of the side which calls them. As the Privy Council once observed: “There cannot be any more unsatisfactory evidence than that of an interested party called as an expert.”

In *Kishore Chandra Singh Deo v. Babu Ganesh Prasad Bhagat*,⁸⁶ the Supreme Court observed that the conclusions based on mere comparison of handwriting must, at best, be indecisive, and therefore, should yield to the positive evidence in the case.

Similarly, in *Emperor, v. Ramrao Mangesh*⁸⁷, it was held that expert evidence, as a mode of proof, though permissible, is hazardous and inconclusive, and as a method of proving disputed handwriting, it is accepted by the Courts with great caution. It is indeed unsafe to base a conviction on the uncorroborated opinion of a handwriting expert.

As observed in an American case⁸⁸,—“Expert witnesses are affected by that pride of opinion and that kind of mental fascination with which men are affected when engaged in the pursuit of what they call scientific enquiries.”

An expert’s evidence is admissible as evidence in the court of law. However, expert’s opinion in written form or report is considered as weak and not reliable evidence. It is observed that it is unsafe to base a conviction only on the basis of written expert opinion, unless this opinion is corroborated by an independent evidence.⁸⁹

According to Bentham, witnesses are considered as eyes and ears of a justice system. Whenever an eye witness accounts for the facts perceived by him in relation to a crime, the Court place huge reliance on such a testimony. But such testimony has to carefully and independently be assessed and evaluated for credibility. In case an ocular evidence given by a witness is at variance with the medical evidence (expert’s opinion) , it will be erroneous on the part of Court to believe in medical evidence and exclude eye witnesses statement.⁹⁰

⁸⁶ (A.I.R. 1954 S.C. 316)

⁸⁷ (1932) 34 BOMLR 598

⁸⁸ (Peoples v. Patrick, 182 N.Y. 131)

⁸⁹ *M Durga Prasad, Spl Assistant, Syndicate Bank and etc v. The State of AP and etc.* [2004 CrLJ 242]

⁹⁰ *State of UP v. Hari Chand* 2009 CrLJ 3039

In case an opinion is given on a fact by two different experts and both their opinions vary from each other, the court may not qualify their opinion as conclusive expert opinion and shall not rely on them.⁹¹

In *Baso Prasad & ors v. State of Bihar*⁹², the Hon'ble Supreme Court observed that opinions of the experts are relevant facts. The courts may consider the expert's opinion as relevant, admissible and reliable. It is for the court to decide whether to take experts opinion as reliable or in case of contradiction between expert opinion and ocular evidence, upon whom to believe! An expert may be a medical or a ballistic expert. However, a medical officer cannot be categorised as a ballistic expert and thus he is not expected to answer whether an inquiry is caused by a bullet or not. If he makes an opinion regarding the injury to be caused by a bullet, no reliance can be placed on his opinion because he is not a ballistic expert.⁹³

In *Ramesh Chandra Agrawal v. Regency Hospital Ltd & ors.*⁹⁴ was stated that an expert in law is not a witness of fact. He gives his opinion relating to a fact-in-issue, which is advisory in nature. Such an opinion is considered credible by the court if it depends on reasons in support of his reason.

From the above analysis it may be submitted that evidence of an expert is not a substantive piece of evidence. The courts do not consider it conclusive. Without independent and reliable corroboration, it may have no value in the eye of law. Once the court accepts an opinion of an expert, it ceases to be the opinion of the expert and becomes the opinion of the court.

The Daubert decision did not change the standards for judging the relevance of expert evidence, the qualification of experts or other considerations that enter into the assessment of expert evidence but it did affirm that the judges should act as a gatekeeper while accepting a forensic evidence. After Daubert case, the judges began acting as more watchful gatekeepers. They carefully started scrutinizing not just the reliability of an evidence but all dimensions of expert evidence. The judges nowadays may feel compelled to act as a gatekeeper to evaluate the reliability of a forensic evidence but is not yet knowledgeable enough in the relevant field to

⁹¹ *Sidharth Vashist@ Manu Sharma v. State (NCT of Delhi)*

⁹² AIR 2007 Supreme Court 1019

⁹³ *Mahmood and anr v. State of UP* AIR 2008 SC 515

⁹⁴ AIR 2010 SC 806

make accurate determinations. An evidence could be admitted because the judge does not understand the flaw in the argument also because the evidence is reliable,

The judges usually admit a forensic evidence. However, they totally do not rely on it as a gospel truth, before passing the judgement. Expert evidence is opinion evidence and it can't take the place of substantive evidence. In *S. Gopal Reddy v. State of A.P.*⁹⁵ the court stated that it is a rule of procedure that expert evidence must be corroborated either by clear direct evidence or by circumstantial evidence. Courts do not consider it as conclusive and, therefore, not safe to rely upon it without seeking independent and reliable corroboration. It is not safe to rely upon this type of evidence without seeking independent and reliable corroboration.

➤ **Relevant Sections under Evidence Act**

45. Opinions of experts.

45A. Opinion of Examiner of Electronic Evidence.

46. Facts bearing upon opinions of experts.

47. Opinion as to handwriting, when relevant.

47A. Opinion as to digital signature, when relevant.

48. Opinion as to existence of right or custom, when relevant.

49. Opinion as to usages, tenets, etc., when relevant.

50. Opinion on relationship, when relevant.

51. Grounds of opinion, when relevant.

65A. Special provisions as to evidence relating to electronic record.

65B. Admissibility of electronic records.

67. Proof of signature and handwriting of person alleged to have signed or written document produced.

67A. Proof as to electronic signature.

⁹⁵ AIR 1996 SC 2184

73. Comparison of signature, writing or seal with others admitted or proved.

73A. Proof as to verification of digital signature

112. Birth during marriage, conclusive proof of legitimacy

3.6.3 ADMISSIBILITY UNDER OTHER ACTS,

The acts mentioned earlier, along with the additional information about Section 5 and 6 of the Identification of Prisoners Act, serve specific purposes in the legal and regulatory landscape of India. Here is a reframed description:

i. Identification of Prisoners Act (Section 5 and 6):

Section 5 and 6 of the Identification of Prisoners Act pertain to the acquisition of thumb impressions and handwriting samples for identification purposes. These sections specify that such evidence shall not be used against the person as personal testimony. The act helps in the identification of prisoners while protecting their rights during legal proceedings.

ii. Information and Technology (IT) Act (2000)

It was enacted to provide legislation in the booming cyber space. The second schedule of this act specifically deals with computer crime in India.

- Sec 2(t) of IT act defines electronic data.
- An amendment in IT act in 2008, gives importance to communication devices under Sec 2(ha).

Surge of technological advancement has made collecting and generating of evidence complicated. The traditional definition of evidence under section 3 of Indian Evidence Act now recognises “electronic evidence”⁹⁶

The Indian Evidence Act, 1872, and the Information Technology Act, 2000 provide legal recognition to electronic records and evidence presented in the form of electronic records.

⁹⁶ Amendment of 2000

According to section 2(t) of the Information Technology Act, 2000, an "electronic record" refers to data, records, or information generated, stored, received, or transmitted in electronic form, microfilm, or computer-generated microfiche.

The Information Technology Amendment Act, 2008 has further extended the recognition to various forms of communication devices. Section 2(ha) of the Act defines a "communication device" as cell phones, personal digital assistants (PDAs), or a combination of both, or any other device used for communication, transmission, or sending of text, video, audio, or images.

These legislative provisions establish the legal validity and admissibility of electronic records and evidence in India, recognizing the importance of technology and digital communication in today's society.

Section 3 of the Evidence Act in India establishes that terms like "electronic form," "electronic records," "information," and others will be given the same meaning as defined in the Information Technology Act, 2000 (IT Act).

Sections 65A and 65B of the Indian Evidence Act outline the methodology and procedure for proving electronic evidence in court proceedings. These provisions validate secondary evidence in the form of electronic output or paper printouts generated by a computer. Section 65A enables the proof of electronic records in accordance with Section 65B.

• **Judicial Approach**

Section 65B of the Indian Evidence Act has been a source of judicial controversy due to its poor drafting and subsequent varying interpretations in different cases. Over the past two decades, there have been conflicting judgments on the admissibility of electronic evidence without complying with the requirements of Section 65B(4).

In the case of *Navjot Sandhu v NCT Delhi*⁹⁷, a two-judge Bench of the Supreme Court held that the absence of a certificate under Section 65B(4) does not render computer output of electronic evidence per se inadmissible. It could still be proved as secondary evidence under Section 63 with Section 65 of the Indian Evidence Act.

⁹⁷ (2005) 11 SCC 600

However, in the case of *Anvar P V v P K Basheer*,⁹⁸ a three-judge Bench of the Supreme Court overturned the decision in Navjot Sandhu's case and held that Section 65B is a special provision that overrides the general provision of Section 65. Accordingly, any computer output related to an electronic record must be accompanied by a certificate under Section 65B(4) to be admissible. The judgment stated that "an electronic record by way of secondary evidence shall not be admitted unless the requirements under Section 65B are satisfied." It also clarified that if an electronic record is used as primary evidence under Section 62, the conditions of Section 65B need not be fulfilled.

In the *Shafhi Mohammed v.State of H.P*⁹⁹ case, a two-judge Bench expressed a contrary view to Anvar's case, stating that the requirement of a certificate under Section 65B(4) is procedural and can be relaxed by the court in the interest of justice. This judgment relied on the Tomaso Bruno case, where another three-judge Bench emphasized the increasing use of technological advancements in investigations and the need to focus more on substantive issues of evidence rather than procedural formalities.

In the *Arjun Panditrao Khotkar v. Kailash Kushanrao Gorantyal*¹⁰⁰ case, a three-judge Bench explicitly overruled both the Tomaso Bruno case and the Shafhi Mohammed case, declaring the judgment in Anvar P V as the correct law. However, it removed the reference to Section 62 of the Indian Evidence Act concerning primary evidence. Notably, a three-judge Bench cannot overturn the judgment of another three-judge Bench. The judgment aimed to eliminate the distinct classification of primary and secondary evidence for documents, as referred to in Sections 62 and 63 of the Indian Evidence Act, as those sections do not apply to electronic evidence but only to physical documents. Nevertheless, the judgment affirmed that Section 65B differentiates between the original information in electronic form (considered primary evidence) contained within the computer and the copies made from it in the form of computer output (such as printouts and digital copies) which are considered secondary evidence. This interpretation expands the meaning of secondary evidence as reflected in Sections 63 and 65 of the Act. The judgment reiterated that the certificate under Section 65B(4) of the Indian Evidence Act is mandatory when considering computer output as evidence.

⁹⁸ (2014) 10 SCC 473

⁹⁹ (2018) 2 SCC 801

¹⁰⁰ 2020 SCC Online SC 571

The IT (Amendment) Act, 2008, specifically in Section 79A, establishes a clear definition for electronic evidence, which encompasses diverse forms of information that exist in electronic format. This definition encompasses computer evidence, digital audio and video recordings, and various electronic devices including cell phones and digital fax machines.

Reading Section 3 and Section 65-B, The Evidence Act, 1872 cumulatively, it can be inferred that certain computer outputs of the original electronic record, are now made admissible as evidence.

iii. The Poison Act (1990):

The Poison Act of 1990 focuses on the regulation, control, and prevention of the misuse and unauthorized sale of poisonous substances. It provides guidelines for the safe handling, storage, transportation, and disposal of such substances, ensuring public safety.

iv. Drugs and Cosmetics Act (1940):

The Drugs and Cosmetics Act, established in 1940, regulates the manufacture, sale, and distribution of drugs and cosmetics in India. It ensures the quality, safety, and efficacy of drugs and cosmetics available in the market. The act covers aspects such as licensing, labeling, packaging requirements, and approval of new drugs.

v. Narcotic Drugs and Psychotropic Substances (NDPS) Act (1985):

The NDPS Act is a crucial legislation that deals with the control and regulation of narcotic drugs and psychotropic substances. Enacted in 1985, it aims to prevent abuse, illicit trafficking, and addiction to these substances. The act classifies drugs, prescribes penalties for offenses, and includes provisions for rehabilitation and treatment.

• NARCO use in India

The term NARCO analysis was first introduced in India in 1935 in the process of investigation. It was used to put a person in a trance-like state and subject him to queries. In the later period it was unheard of as an investigating tool in many years. It again surfaced in the Godhra carnage probe (Inter-communal violence in Gujarat following the burning of a train in Godhra on 27 February 2002, which caused the deaths of 58 Hindu pilgrims and religious workers returning from Ayodhya in 2002). Thereafter it is consistently being used as an investigating tool in many cases. Narco-analysis has been conducted in some major cases like, Godhra Carnage Probe in

Gujarat, Multi Crore Rupee fake stamp murder¹⁰¹, Shashi murder case, Noida serial murder i.e the infamous Nithari case, Abu Salem, The Arushi Murder Case in May 2008¹⁰², Malegaon Bomb Blast Case, Mumbai train blast, Mohammed Ajmal Amir Kasab, a Lashkar-e-Taiba militant case etc.

The Narco analysis test has no evidentiary value in courts. Till recently it was used as an investigation tool. But the Supreme Court decision in *Selvi & others vs. State of Karnataka & Anr*¹⁰³ has held that no Narco analysis tests should be administered except on the basis of consent of the accused as it contradicts Art. 20(3), Art. 21 and some sections of Cr.P.C. This researcher has identified the following constitutional issues that surround the test.

- a. Whether the involuntary administration of the impugned techniques violates the 'right against self incrimination' enumerated in Article 20(3) of the Constitution? Whether the investigative use of the impugned techniques creates a likelihood of incrimination for the subject?
- b. Whether the results derived from the impugned techniques amount to 'testimonial compulsion' thereby attracting the bar of Article 20(3)?
- c. Whether the involuntary administration of the impugned techniques is a reasonable restriction on 'personal liberty' as understood in the context of Article 21 of the Constitution?

vi. The Pharmacy Act (1948):

The Pharmacy Act governs the pharmacy profession in India. Established in 1948, it outlines regulations for the registration, education, and practice of pharmacists. The act sets standards for qualifications, conduct, and ethics, ensuring the quality and safety of pharmaceutical services.

vii. The Drug Control Act (1950):

The Drug Control Act, enacted in 1950, regulates drugs in India to ensure their quality, safety, and efficacy. It covers licensing, inspections, quality control measures, and penalties for violations. The act establishes Drug Control Authorities at the state and central levels.

¹⁰¹ 2004 Bombay High Court

¹⁰² *Dr. Mrs. Nupur Talwar v. State of UP & Anr* (2017)

¹⁰³ (Criminal Appeal No. 1267 of 2004 SC)

These acts collectively contribute to the regulation, control, and safety measures concerning poisons, corrosive substances, adulterants, chemicals, and various aspects of the healthcare system, drug regulation, pharmacy profession, and criminal proceedings in India.

CHAPTER-4

CHALLENGES IN THE USE OF FORENSIC EVIDENCE IN INDIA

Forensic science, the sibling of science has transformed the criminal adjudication especially the criminal trial process. Nowadays, it has become a greater helping hand of the crime investigation agencies and the criminal justice system in properly identifying the guilty and safeguarding the innocent. In a recent case, *Dharam Deo Yadav v. State of U.P.*¹⁰⁴, the Supreme Court of India has explained the importance of forensic scientific evidence, particularly in more brutal and well organized crimes. The potentiality of scientific evidence in criminal investigation and trial is undisputed but the role of the legal stakeholders and their capability in screening the evidence is always a controversial topic not only in India but also throughout the globe.

In India, it is also doubtful whether the criminal investigation team is fully equipped to grab the culprit without using third degree methods. Moreover, the most alarming thing is the reporting of some erroneous convictions as a result of faulty forensic evidence. To date around 318 convicts who were convicted with faulty forensic evidences were released from jail on the basis of DNA test. The purpose of the paper is to highlight some of the major shortcomings in our system concerning forensic scientific evidence and to bring out some suggestions for improvement.

4.1 Problems Associated with Crime Scene Investigation and Chain of Custody

Crime Scene Investigation (hereinafter CSI) is the significant and opening procedure in all criminal cases. The importance of CSI was observed by the Supreme Court in *Yadav's* case:

Forensic science plays a pivotal role, which may assist in establishing the element of crime, identifying the suspect, ascertaining the guilt or innocence of the accused. One of the major activities of the Investigating officer at the crime scene is to make thorough search for potential evidence that have probative value in the crime. Investigating Officer may be guarded against potential contamination of physical evidence which can grow at the crime scene during

¹⁰⁴ (2014) SCc_509 hypothetical protein [*Serratia symbiotica* str. 'Cinara cedri'], Gene ID: 11576315: [http://www.ncbi.nlm.nih.gov/gene?term=scc%20509\[gene\]%20AND%20alive\[prop\]%20NOT%20newentry\[gene\]%20&sort=weight](http://www.ncbi.nlm.nih.gov/gene?term=scc%20509[gene]%20AND%20alive[prop]%20NOT%20newentry[gene]%20&sort=weight), Visited on. 11/05/2023.

collection, packing and forwarding. Proper precaution has to be taken to preserve evidence and also against any attempt to tamper with the material or causing any contamination or damage.

It is a widely accepted fact that the quality of the evidence based on forensic procedures depends mainly on the quantity and quality of the forensic samples collected from the crime scene. Therefore, utmost care should be given by the investigators while handling the crime scenes¹⁰⁵.

- **Handling the Crime Scene**

In a criminal trial, the weight of the evidence is determined on the basis of strength of the chain of custody of the forensic evidence starting from the stage of first reporting by the police personnel who had visited the crime scene. Regrettably, due to the mistakes from the side of the police authorities in India, the probative value of the evidence will be affected when it comes for trial. There are various factors that directly affect the value of the real evidence. The most important one is the ignorance of the investigating officers in handling the crime scene and the way in which they collect the evidence from the scene. Due to the lack of education and training, the police personnel's usually disturb the crime scene and destroy the valuable evidence which could be collected intact by a trained Crime Scene Investigator with his due diligence and skill.

- **Communication of Relevant Information**

For establishing an accurate chain of custody, there should be a proper communication of information from the first person who visits the crime scene to the police investigators and crime scene investigators. Everything considered as having link with the crime should be photographed, video recorded and properly documented. Systematic documentation is essential to establish the credibility of the scientific evidence. In India, unfortunately neither the investigating officers nor the judiciary give much of importance to the chain of custody.

¹⁰⁵ Fisher, B. A., & Fisher, D. R. (2012). Techniques of crime scene investigation. CRC Press.

- **Contamination of the Crime Scene**

Similar to the U.S. or U.K. in India there is no criminalistics. The police will directly enter into the scene and disturb and taint the valuable evidences. The feasible solution is that if the police personnel's feel unmanageable the crime scene, they should request to the concerned FSL to have a detailed investigation. The more serious concern is the possibility of purposeful contamination of the crime scene materials to save the culprit from the liability. This usually happens either due to the bribery or because of high political influence.

4.2 Autonomy of Crime Labs

In India the most serious concern is about the independence of crime labs and its self regulation. The state and central forensic science laboratories are under the direct administrative control of the law enforcement authorities. The State and Union Territory Forensic Science Laboratories is either directly functioning under the respective Home Department or through police establishments. The Central Bureau of Investigation has a separate forensic science laboratory at Delhi with a branch at Chennai.¹⁰⁶ In the U.S., the National Academy of Sciences in its report, "Strengthening Forensic Science in the United States: A Path Forward" (hereinafter NAS Report) has observed: "The best science is conducted in a scientific setting as opposed to a law enforcement setting. Because forensic scientists often are driven in their work by a need to answer a particular question related to the issues of a particular case, they sometimes face pressure to sacrifice appropriate methodology for the sake of expediency". The forensic personnel's are always pressurized by the law enforcement wing which results in faulty forensic analysis and results. In the NAS report it is stated that bias is there in all crime laboratories. The main reason for the bias is because of the organizational structure of the crime labs. Currently, the crime laboratory personnel's feel that they are working under the police department for convicting the accused, hence bias. This could be solved to a great extent if the forensic experts change their mindset and think that they are 'good scientists than good prosecution witnesses'. The prosecutor also influences the scientific experts and changes their mind for winning his case. The usual procedure is that before the examination, he will tutor the scientific witness for creating a proper link of evidence. Nowadays, scientists identified cognitive bias as a problem in the subjective decision making

¹⁰⁶ Dr. Gopal Ji Misra, Dr. C.Damodaran (2010) he in all report on perspective plan for Indian forensics. available at http://www.mha.nic.in/hindi/sites/upload_iles/mhahindi/iles/pdf/IFS%282010%29-FinalRpt.pdf.

of forensic scientists. This is more serious in forensic identifications like fingerprint, footprint, hair etc, in which conclusions are reached through subjective judgment.

4.3 Partisanship of Forensic Experts

The term 'partisanship' in this context means favouring the party who is paying for the expertise. In criminal cases, forensic personnel's are salaried government servants whose duty is to help the state in establishing the truth. Apart from their salary they are not expected to accept any remuneration from any other person for the case in which they are duty bound to serve the state. In most of the cases the partisanship happens because of two reasons:

(1) if an expert is hired by a person for stating opinion only favourable to the party and for that he will form his own theory and come as witness to convince the judge about the application of his theory through which the party could succeed;

(2) an expert who is a government servant after accepting bribe from the opposite side will create twist or submit wrong statement with manipulated forensic reports. Some experts are named as "hired guns", who will prepare for the party who hired him. This is like selling their opinion for the party who are ready to purchase them. In fact, partisanship and bias are two sides of the same coin because if partisanship is present then there is possibility of bias. The reason is that if an expert is remunerated by a party, obviously that expert shall always be biased towards the other side.

Forensic scientific experts are educated, trained, experienced and skilled persons. Their duty is to testify the truth they discovered through the application of their special knowledge which cannot be detected by the judges using their common sense.

At this juncture, I think it is not productive to suggest for a better expertise through the system in which the experts will function in a well denied ethical code; instead, I would like to advice for a complete separation of expert opinion epistemology from the present organizational structure to the province of the judiciary. This can be effectively done either through 'court appointed experts' or 'panel of experts'. The court appointed or panel experts can check the partisanship if any on the side of any of the experts representing the parties and restrict the faulty evidence entering into the courtroom.

4.4 PROBLEMS RELATING TO INDIVIDUALISATION

Individualization is a process through which forensic science discerns a person or thing from the rest of others in the world. It is, in fact, the power of forensic science and without this utility it has lesser significance in the legal system¹⁰⁷. Only through this individualization process forensic experts can declare a perfect match of the crime scene material with the crime, accused or victim. However, all these determinations are based on probabilistic calculations since in proof no one can expect any mathematical certainty. The major query at this juncture is how much of individuality could be gained from forensic application. In fact, the recent research studies has pointed out that even the concept 'individualization' itself is a fallacy. Michael J. Saks & Jonathan J. Koehler has rightly mentioned in their paper that unique individuality cannot be proven with limited samples. That means if we want to know that a particular characteristic of a person or thing is really unique, it is logically impossible without checking the rest of the things or persons. For example, the well accepted hypothesis that no two fingers in the world have same ridge characteristics will be refuted by the discovery of similar ridge characteristics of two fingers. If that happens what would be the future of the fingerprint evidence.

The way in which the reports of the forensic analysis are communicated to the judiciary is very important. The strength and weight of forensic evidence depends on the probabilistic calculations. In India the forensic scientific evidence is flowing into the courtroom in an incomplete nature. It is an accepted fact in both forensic and legal community that if the evidence is not communicating to the courtroom in the form of probabilistic calculations, it is worthless since it is the only way in which the scientists can properly convey it to others. Unfortunately, in India the scientific experts are submitting their reports stating only whether the samples are matching or not. This, in fact, is not sufficient to check the probative value of the evidence because with this form of evidence it is difficult to determine the individuality excluding others having the possibility of similar characteristics. The probative value of a particular piece of evidence always depends on its strength to exclude the possible suspects other than the accused. In the legal setting, the probative value of particular forensic evidence is useful not only to prove a particular fact in issue of a case but also to disprove it. For e.g., if a DNA sample collected from the crime scene match the sample from the suspect, it has

¹⁰⁷ . David L. Faigman (2008-2009) Modern scientific evidence: the law and science of expert testimony, 34:1.

probative value to connect the suspect with the crime. On the other hand, if it mismatches, it will exclude the suspect from the crime.

A forensic scientific expert cannot simply come before a court of law and testify in an untestable manner that two objects or persons that involved in a crime are same. They are responsible to adduce statistics in a quantifiable manner, so as to distinguish the similarities and differences of the two. This doesn't mean that the expert should search the entire objects in that class before reaching the conclusion that the object in issue is unique. The advantage of quantitative data is that it would be easier for the expert to communicate his subjective as well as objective findings before the fact finder. The other merit is that the fact finder can easily make a link with other form of evidence.

4.5 FACTORS AFFECTING RELIABILITY OF FORENSIC EVIDENCE IN INDIA

In India, though forensic science is considered as a reliable discipline, there are various pertinent factors, apart from those discussed earlier, which affects the reliability of case specific application of the technique. The list includes

1. lack of scientific certainty
2. lack of research
3. forensic science as neglected discipline
4. absence of well defined code of ethics
5. lack of certification to the technical personnel's
6. lack of national database for identification evidence
7. lack of error rate statistics for all techniques, and so on.

The lack of scientific certainty in forensic science is not only the problem in India but also it is a common problem throughout the world. Different from other scientific disciplines, in forensic science there is no absolute scientific proof or certainty. The major reason is because of its close association with law since in legal truth finding different from scientific , law is not expecting any certainty but the proof based on probabilities. As Craig rightly stated, "public crime laboratories are not sanctuaries of science...."¹⁰⁸. The public cannot give that much of reliance on those labs similar to other research laboratories because in crime labs the scientists

¹⁰⁸ Craig M. Cooley (2011) Nurturing forensic science: how appropriate funding and government oversight can further strengthen the forensic science community. Tex. Wesleyan L. Rev. 17: 441.

are researching with old, degraded, partial, distorted, blurred and contaminated samples. Similarly, all forensic identification tests based on matching of samples are based on the subjective evaluation of the examiner which is subject to the final interpretation by an independent person. Because of the human intervention, there is possibility of error in fixing the match of different characteristics in two samples.

The other major problem affecting the reliability is the lack of research and the shortage of peer-reviewed papers and validation studies. Moreover, the applications of the majority of forensic techniques are based on long standing application in the court of law and not as a result of proper scientific research. The best example is fingerprint technique which has no valid scientific basis, though considered as reliable by the judiciary due to its long standing track record.

The National Research Council of the National Academies, United States, in its publication “Strengthening Forensic Science in the United States: A Path Forward” has made certain valuable recommendations for improving the accuracy, reliability and validity in the forensic science disciplines. The recommendations are:

“The National Institute of Forensic Science should competitively fund peer-reviewed research in the following areas:

- a. Studies establishing the scientific bases demonstrating the validity of forensic methods.
- b. The development and establishment of quantifiable measures of the reliability and accuracy of forensic techniques should reflect actual practice on realistic case scenarios, averaged across a representative sample of forensic sciences and laboratories. Studies also should establish the limits of reliability and accuracy that analytic methods can be expected to achieve as the conditions of forensic evidence vary. The research by which measures of reliability and accuracy are determined should be peer reviewed and published in respected scientific journal.
- c. The development of quantifiable measures of uncertainty in the conclusions of forensic analyses.
- d. Automated techniques capable of enhancing forensic technologies”.

Apart from the aforesaid problems, in comparison with other scientific disciplines, forensic science is always treated as a neglected discipline. From very early days most of the nations

have side lined it as a part of law enforcement and justice delivery system. This was the reason for the shortage of funding from the government for research.

The bias, bribe and partisanship of experts are escalating due to the absence of well defined code of ethics and its proper implementation. Restrictions should be imposed by the state against experts in offering the services to the defence. For all forensic techniques stringent protocol should be implemented to overcome bias. In India also we have to formulate a code of ethics and proper mechanism for enforcing it. In the U.S., The National Institute of Forensic Science (NIFS) has recommended that there should be a national code of ethics for all forensic science disciplines and encourages individual societies to incorporate this national code as part of their professional code of ethics¹⁰⁹. It also emphasizes that a proper mechanism should be established to enforce the code for those who commit serious ethical violations.

The other well-known challenge is the quality assurance in forensic service. The quality of the evidence depends on several factors like validation of a technique, instrumental quality check, capacity of the persons employed, standard protocol, and accreditation of the crime labs and certification of the scientists. If there is compromise in any of these factors, it will directly affect the quality and there by the reliability of test results. Apart from this, the overall quality can be tested using proficiency tests. The proficiency tests are useful for testing both scientific personnel and crime lab. The test can be conducted by a national body like NIFS in U.S. or National Accreditation Board for Testing and Calibration Laboratories (NABL) in India.

4.6 LEGALITY OF SCIENTIFIC TEST ON ACCUSED :SELF INCRIMINATION

The right to self-incrimination, originating from medieval Roman church law, is enshrined in the Indian Constitution under Article 20(3). This right applies specifically to criminal proceedings and allows individuals to avoid being compelled to provide evidence against themselves. However, this protection does not extend to cases where objects or documents are searched or seized from the accused. It also does not prevent the accused from undergoing medical examinations or providing their thumbprint or specimen signature. The application of this protection depends on the specific facts and circumstances of each case, and the judiciary plays a crucial role in determining its scope and applicability.

¹⁰⁹ P.C. Giannelli (2001) Scientific evidence in civil and criminal cases. Ariz. St. L. J.103: 112.

- **Meaning of Compelled Testimony**

The term "compelled testimony" encompasses more than just physical threats or violence used to extract evidence. It extends to a range of methods that can be considered forms of psychological torture or coercion. These may include creating an oppressive or intimidating atmosphere, subjecting individuals to environmental pressures, employing exhaustive and lengthy interrogations, and utilizing overbearing tactics.

In *Nandini Satpathy v. P.L. Dani*¹¹⁰ it was noted that compelled testimony does not refer to legal penalties imposed for violating the law. Instead, it focuses on methods employed to extract information from individuals, often through psychological means that go beyond physical force. These coercive methods aim to break down the will or resistance of the person being interrogated, compromising their ability to provide testimony freely and truthfully.

4.6.1 NARCO ANALYSIS AND SELF INCRIMINATION

The admissibility of science in a court of law demands that three major requirements be met: namely validity, reliability and legality.¹¹¹ The same must be used to analyse the science of narco analysis and its prospective admissibility in our courts. Validity demands that the evidence procured be the result of a scientifically validated method and that it measures all that it claims to measure with a reasonable amount of accuracy. Reliability on the other hand is an indication of consistency in the accuracy of the results procured, the success rate of the tests conducted and other consequences of the same.

*M.P. Sharma v. Satish Chandra*¹¹² gave this right a broad interpretation and held that it is not possible to limit this provision to oral evidence; the Supreme Court here brought in various other forms of evidence such as 'production of a thing' and evidence by other modes within the ambit of this Article. Scientific evidence has not been accorded its due place in our country owing to the pace of developments in the field. Thus even though M.P. Sharma case attempted to answer all major questions posed to the Self Incrimination Doctrine in its current times, advancements in forensic science quickly put forth new challenges to it. **Kalu Kathi Oghad**¹¹³

¹¹⁰ AIR 1978 SC 1025)

¹¹¹ Dr. Ramanadham Memorial Meeting on "Narco Analysis, Torture and Democratic Rights" conducted by the Peoples' Union for Democratic Rights, p.12.

¹¹² AIR 1954 SC 300.

¹¹³ AIR 1961 SC 1808.

answered the question of compelling the accused to give specimen handwriting, thumb impressions and signatures stated that the right of the accused against self incrimination is not violated in such cases since “self incrimination must mean conveying information based upon the personal knowledge of the person giving the information” and covers only “personal testimony which must depend upon his volition”. Here the court restricted the meaning of the phrase “to be witness” to furnishing evidence in the form of oral or written statement and not large enough to include impressions and specimen signatures. The leading case that has guided precedent in our country with respect to narco-tests has been *U.S. v. Solomon*¹¹⁴ where the United States Supreme Court held used expert witnesses to establish that adequate safeguarding against the unreliability of narco-tests was possible; on the whole however, while narco-tests were held as unreliable, their acceptance as an investigative technique was upheld. The question of compulsion was answered by the Indian Supreme Court in *Dinesh Dalmia v. State of Maharashtra*¹¹⁵ wherein it said that consent played no role in court-ordered narco-tests. This decision was however based on a technical irregularity. If this decision is to be upheld as valid, then it can be considered a valuable landmark in the course of the self incrimination doctrine in India; this case however said that while subjecting a person to narco-tests was compulsive, the revelations made are entirely voluntary; as such it has been held to widespread criticism by the proponents of this right. The most recent development as far as consent of the accused for conducting narco-analysis has been in the form of a stay order by the Supreme Court in November 2006 on narcoanalysis being carried on K. Venkateshwar Rao in a case involving Krushi Cooperative Urban Bank.¹¹⁶ This is considered a welcome move; however consent implies ‘informed consent’. The person giving this consent must not only be made aware of his right against incriminatory evidence, but he must also in cases of such consent be made aware of the procedure to be carried on him and the consequences of such procedures. These two conflicting judgments however, leave us in hazy ground with respect to the role of consent in conducting such tests. Such a vital component of the privilege against Self Incrimination demands better scrutiny by the courts. A previous judgment of the court in the case of *Nandini Satpathy v. P.L.Dani*¹¹⁷ places any form of duress, physical or mental under the definition of ‘compelled testimony’ and holds it as violative of the privilege. The aspect of narco analysis,

¹¹⁴ 753 F.2d.1522 (9th Cir. 1985).

¹¹⁵ Cri LJ (2006) 2401.

¹¹⁶ Supra note 51 at 4.

¹¹⁷ 1978 SC

keeping in mind the compelling interest of the state in security and order, cannot be put away without further explanation.

The drafting committee on “National Criminal Justice System Policy” headed by Prof. N. R. Madhavanan has recommended various measures to be taken by the government to amend various parts of the Criminal Procedural Code for effective management of the overall science and technology needs of the criminal justice system.¹¹⁸ Section 53 of the Code of Criminal Procedure, 1973⁶¹ was amended to allow medical examination of an accused in the interests of justice, “as maybe reasonably necessary”. Narco-tests may be considered reasonable under such circumstances as terrorist attacks and other grave cases. A question relates to how the graveness of such an issue is to be decided; it is, under the said Section, the discretion of the prescribed police officers to make such a move and as evident is open to abuse. Section 45 of the Indian Evidence Act, 1872⁶² affords, in the interests of justice the opinions of experts as admissible in the court; it is however silent on the complicated question of narco-tests. This complication arises from the fact that the result of a narco-test is submitted to the court in the form of a report by the expert doctor under whose supervision such a test is conducted.

The problem therefore, is threefold. First relates to the compulsive subjugation of a person to narco-tests; second is relating to the right extending to all stages of investigation and not merely to the trial stage. The third is relating to the form in which the results of such tests are submitted to the court. An answer could be sought by considering, that narco-tests, like other forms of scientific evidence are alternatives to confessions and likewise are meant to by pass the privilege guaranteed against self incrimination. Going strictly by precedent, no conclusive answer can be reached to either of the question posed above; however as Cardozo. J has said “the right against Self Incrimination is a right that might be lost and justice still be done.”

It is argued that Narco-Tests satisfy all the requirements of the UN definition of torture⁶⁵. If this argument is accepted, there can be no question as to the admissibility of Narco-tests in a court of law; the situation however is different owing to the counter-argument that it is in fact a substitute of third degree methods of extracting information from an accused. *Kishore Singh v. State of Rajasthan*¹¹⁹ prescribed humane treatment of an accused as far as possible unless absolutely necessary as long as he was in police custody. The case *of Gobind Singh v. State of*

¹¹⁸ Para 7.2.4 and para 7.2.5 propose amendments to the Indian Evidence Act to make scientific evidence admissible as “substantive evidence rather than opinion evidence”.

¹¹⁹ AIR 1981 SC 265.

*Madhya Pradesh*¹²⁰ ruled on the ‘Right to Privacy’ of an individual as extending to the physical and mental state of the individual. Further developments in this area⁶⁸ have clearly pointed out as ultra vires the authority of the State to forcibly expose the parts of an individual’s life that he wishes to keep to himself within his private sphere. An approach to the issue of Narco analysis guided by the sole motives of individual liberties would therefore hold the same to be in contravention of the rights guaranteed under Articles 20(3) and 21⁶⁹ of the Constitution of India.

In *Selvi v. State of Karnataka*¹²¹, the Supreme Court rejected the High Court’s reliance on the supposed utility, reliability and validity of narco analysis test and other tests as methods of criminal investigation. First, the Court found that forcing a subject to undergo narco-analysis, brain-mapping, or polygraph tests itself amounted to the requisite compulsion, regardless of the lack of physical harm done to administer the test or the nature of the answers given during the tests. Secondly, the Court found that since the answers given during the administration of the test are not consciously and voluntarily given, and since an individual does not have the ability to decide whether or not to answer a given question, the results from all three tests amount to the requisite compelled testimony to violate Article 20(3). The Supreme Court found that narco-analysis violated individual right to privacy and amounted to cruel, inhuman or degrading treatment.

4.6.2 BRAIN MAPPING (P-300 Test) AND SELF INCRIMINATION

The Brain Mapping Test, also known as the P-300 test, involves interviewing and interrogating a suspect to determine if they are hiding any information. By presenting different types of words, including neutral, probe, and target words, the test aims to activate the brain's associated memory. Neutral words have no direct connection to the case, probe words are related to the case and intended to elicit concealed information known to the suspects, and target words are based on confidential findings unknown to the suspect.

¹²⁰ AIR 1975 SC 1378. “...they sought to protect individuals in their belief, thought, their emotions and their sensation. Therefore they must be deemed to have conferred upon the individual as against the government, a sphere where he should be left alone.”

¹²¹ AIR 2010 SC 1974

- **Recording of Brain Mapping Test**

The Brain Mapping Test involves recording brain responses using a 32-channel EEG-ERP Neuro Scan cording system. The suspect is asked to sit down, close their eyes, and listen to words presented in three parts randomly. The test does not require oral responses. Experts analyze the results to determine if the person has knowledge relevant to the investigation. The test reveals whether the person possesses information about the crime but does not indicate lies or specific stored information in the brain. It extracts information from the witness.

The Brain Mapping Test can be conducted on the accused without requiring their consent, as it is considered part of the investigation process. The test is used when the accused has not provided truthful information during the investigation.

In *Santokben Sharmanbhai Jadeja v. State of Gujarat*¹²² was stated that consent is not expected in such cases, and there is no provision in the Criminal Procedure Code that necessitates consent for the test. Precautions are taken to ensure the accused's safety during the test, and medical experts are present. However, the test does not affect the accused's right to seek bail, and the court should not delay the bail hearing until after the test is conducted. Bail applications should be heard and decided promptly.

4.6.3 THE LEGITIMACY OF FINGERPRINTS

Many people argued over a debate that fingerprints and DNA analysis for verification defeat the provision of Art. 20(3). They felt that forcing the accused to give fingerprints is like the accused giving evidence against themselves. But the Supreme Court in the case of the *State of Bombay v. Kathi Kalu Oghad and Anr*¹²³ held that compelling any person to give any sort of forensic evidence like fingerprints, blood, hair semen, does not violate the provision of Art. 20(3). The same is even mentioned in Sec. 73 of the Indian Evidence Act, which directs any person including the accused can be asked to give a fingerprint or DNA examination.

4.6.4 THE LEGITIMACY OF DNA TEST

The application of DNA tests has been observed in around 5% of homicide cases and around 3% of assault cases. While DNA tests can serve as strong evidence in the court of law, yet the

¹²² 2009 Cri LJ 68 (Guj.)

¹²³ 1961 AIR 1808, 1962 SCR (3) 10

courts are resistant in accepting evidence based on DNA tests. The DNA test challenges the right to privacy which is inherent under the right to life and personal liberty enshrined under Article 21 of the Constitution of India.

Many have claimed that forcing to undergo a DNA test violates the right under Article 20(3) of the Indian Constitution as it constitutes an accused giving evidence against himself. However, in some cases, the Court also held that the right under Article 21 of the Indian Constitution is not absolute and includes certain restrictions.

In the case of *Kanchan Bedi v. Gurpreet Singh Bedi*¹²⁴ (2003), it was held that if a person is directed to give a sample for a DNA test, then it does not amount to a violation of the fundamental right to privacy. In *Geeta Saha v. NCT of Delhi*¹²⁵ (1999), a DNA test was directed by the division bench in an assault case.

¹²⁴ Delhi HC 2003

¹²⁵ HIGH COURT OF DELHI Decided on January 13,1999

CHAPTER-5

ROLE OF JUDICIARY REGARDING FORENSIC EVIDENCE IN INDIA

Forensic evidence plays a crucial role in the criminal justice system in India. It provides an objective and scientific basis for establishing the guilt or innocence of a suspect, which is essential for ensuring justice and fairness in criminal trials. Forensic evidence is also important in identifying perpetrators of crime and establishing the facts of a case. This article will discuss the role of forensic evidence in the criminal justice system in India, its importance, and the challenges it faces.

Forensic evidence includes any physical or digital evidence that can be used to solve a crime. This evidence can be gathered from crime scenes, victims, suspects, or witnesses. Forensic science covers a range of disciplines, including DNA analysis, ballistics, toxicology, digital forensics, and fingerprint analysis. The collection, analysis, and interpretation of forensic evidence require specialized training and expertise, which is provided by forensic experts and forensic laboratories.

The use of forensic evidence in the criminal justice system in India has increased significantly in recent years. This is due to the increasing awareness of the importance of scientific evidence in criminal investigations and the establishment of specialized forensic laboratories across the country. The Central Forensic Science Laboratory (CFSL) is the premier forensic laboratory in India, and it has regional branches in different parts of the country.

Forensic evidence plays a crucial role in criminal investigations in India. It helps to identify suspects, establish the facts of a case, and link suspects to the crime scene. Forensic evidence can also be used to support or refute witness testimony and to establish the cause of death in cases of homicide. The use of forensic evidence in criminal trials has been crucial in ensuring that the guilty are convicted and the innocent are acquitted.

The importance of forensic evidence in the criminal justice system in India cannot be overstated. Forensic evidence is objective, unbiased, and based on scientific principles. It provides a level of certainty and accuracy that other forms of evidence cannot match. The use of forensic evidence in criminal trials also promotes transparency and accountability in the

criminal justice system. It helps to ensure that justice is served and that the rights of the accused and the victims are protected.

Despite the importance of forensic evidence in the criminal justice system in India, there are several challenges that it faces. One of the main challenges is the lack of resources and infrastructure. Many forensic laboratories in India are under-resourced and understaffed, which can lead to delays in the processing of evidence and mistakes in analysis. Another challenge is the lack of standardization in forensic procedures and protocols. This can lead to inconsistencies in the analysis and interpretation of evidence

Another challenge faced by forensic evidence in the criminal justice system in India is the lack of awareness among the public and law enforcement agencies. Many people are unaware of the importance of forensic evidence in criminal investigations, and law enforcement agencies may not have the necessary training and expertise to collect and process evidence effectively.

Forensic evidence plays a crucial role in the criminal justice system in India. It provides an objective and scientific basis for establishing the guilt or innocence of a suspect, identifying perpetrators of crime, and establishing the facts of a case. The use of forensic evidence in criminal trials promotes transparency and accountability in the criminal justice system and helps to ensure that justice is served.

However, there are several challenges that forensic evidence faces in India, including the lack of resources and infrastructure, the lack of standardization in forensic procedures and protocols, and the lack of awareness among the public and law enforcement agencies. Addressing these challenges will be crucial in ensuring that forensic evidence continues to play a central role in the criminal justice system in India.

5.1 Case 1 : THE ARUSHI HEMRAJ MURDER CASE

➤ Aarushi Talwar Case Facts

The case of *Dr. Nupur Talwar v. State of UP & Anr*¹²⁶ is often referred to as the “Noida Double Murder case”. In this case, 14 year old Aarushi Talwar was brutally murdered and 45-

¹²⁶ (1984) 2 SCC 627

year old Hemraj Banjade, a domestic help was murdered in the same fashion. Both were killed on the intervening night of 15-16 May, 2008 at Aarushi's home. The case has received media coverage through and through. It has raised various allegations on the character of the deceased as well as the accused. Moreover the critics have also quoted it as a media trial. The Ghaziabad sessions court has held the parents of Aarushi, who were the prime suspects guilty after the investigation of two CBI teams. The case has been appealed in the Allahabad High Court.

FACTS:

The dead body of a young 14 year old Aarushi Talwar at 6:00 a.m. in L-32 , Jalayu Vihar Flats in sector 25 of Noida, Uttar Pradesh on May, 16. At that point and time in the F.I.R the father, Rajesh Talwar named their missing domestic help, Hemraj as the main suspect. The next day on May, 17 the decomposed body of Hemraj was found on the terrace.

Aarushi Talwar (24 May 1994 – 16 May 2008) was a student a Delhi Public School Noida. She was a daughter of a dentist Couple, Dr. Rajesh Talwar and Dr. Nupur Talwar born out of the IVF (In- Vitro-Fertilization) treatment. She was the only daughter of the dentist couple and they lived in the very flat in which she was found brutally murdered. Hemraj was a live in domestic help and a cook in the Talwar family and he lived in the servant quarters of the flat.

After the discovery of the decomposed dead body of Hemraj the possibility of him being the suspect in the murder of Aarushi Talwar was ruled out and the prime suspects were now Aarushi's parents. The police has developed two theories for the motive of Dr. Rajesh Talwar to murder Ssrushi and Hemraj:

- 1) Rajesh Talwar murdered the two in a fit of rage seeing the deceased in a compromising position on the fateful night.

OR

- 2) Hemraj blackmailing Rajesh about his alleged extra marital affair with Anita Daurani with whom they shared the Noida Dental clinic and Hemraj confronting the same to Aarushi.

The case was transferred to CBI. The CBI team suspected the Talwar's assistants Krishna Along with the two other domestic servants- Rajkumar and Vijay. The CBI conducted a narco analysis on the three suspects. The three suspects have in the narco analysis confessed about

their involvement in the narco analysis and it is presumed that they killed Aarushi after attempting to sexually assault her and since Hemraj had witnessed the same they killed Hemraj too. But all the three man were released as no evidence was found against them. Moreover at the same time the Talwar couple came clear in the narco analysis and nothing was found against them and they were not involved in the crime scene. As per the Section 45 the results of the narco analysis test is not binding on the court.

In 2009, September the case was transferred to a new CBI team which was leaded by SP Neelabh Kishore and the investigating officer was Additional SP AGL Kaul. The Second CBI team suspected the Talwar couple but due to insufficient evidence it has suggested the closure of the case and has submitted a closure report stating that the servants Krishna, Rajkumar and Vijay have a clean chit and they are not involved in crime as during the narco tests they said is not reliable and moreover they have a valid alibi. Moreover there is no evidence that they were at the Talwar residence at the time of the incident. They have also stated that the possibility of any outsider committing the murders is ruled out as there are no signs of forceful entry and there is no other evidence suggesting the presence of any outsider. Thus with all the possibilities ruled out all the evidence is pointing towards the Talwar couple. The CBI suspects the Talwar couple on the basis of circumstantial evidence but due to lack of evidence they submitted a closure report on December 29, 2010. In January 2011 the Talwars filed a petition against the CBI in Ghaziabad Court in an attempt to close the case. In February 2011, the Hon'ble Ghaziabad sessions court converted the Closure report of the CBI into a charge-sheet and the Talwar couple was summoned in the court and thus a case was filed in the court against the parents of the deceased on the basis of the closure report of the CBI.

➤ **Timeline of Events before Murder**

○ **MAY 15, 2008 BEFORE 9:00 P.M:**

In the time span of 9:00 a. m to 1:00 p. m Nupur Talwar was working at the Hauz Khas clinic and then after picking Aarushi from her school at 1:30 they returned to their residence for lunch. They were joined by Rajesh's brother, Dinesh's wife for the same. Both the ladies left the house after the lunch and Aarushi was left alone in the house. In the time span of 4:30 p. m to 7:00 p. m Nupur saw patients at Fortis Hospital and she was back home around 7:30 p. m in the evening. Dr. Rajesh Talwar as a part of the routine from 8:45 a. m to 3:30 p. m in the noon

took classes at the ITS Dental college and then saw the patients at the Hauz Khas clinic till 8:30 P.M

○ **MAY 15, 2008 9:00 P.M to 10:00 P.M:**

Rajesh returned home from the Hauz khas clinic around 9:30 p. m. At around 9:30 Umesh, driver or Rajesh Talwar had come to the house to hand over the car keys. He handed over Rajesh's car keys and his bag to Hemraj. It is evident from the circumstances and evidence that Umesh was the last outsider to see both the deceased alive. Thus the theory of last seen together has been applied. Umesh saw that Hemraj had cooked the food for the family and Nupur and Aarushi were sitting at the dining table waiting for Rajesh Talwar to join whereas he saw Rajesh Talwar at the door of the bedroom.

○ **MAY 16, 2008 AFTER 12:00 P.M (MIDNIGHT):**

At the stroke of 12:00 it has been observed from the telephone records that one of Aarushi's friends tried calling on her Cell phone but the same was unanswered hence he called on the landline number, the same was unanswered hence he sent a SMS on Aarushi's phone but the same was not received on her phone. It is detected from the the data that the internet was last used at 12:08 a. m and from this the CBI has drawn a conclusion that the Talwars were awake till 12:08 a. m

As per the post mortem reports both have been murdered between 12:00 a. m to 1:00 a. m but the exact sequence of the events are not available with the CBI in the time span of 12:00 a. m to 6:00 p.m.

➤ **Suspects and Evidences**

○ **Hemraj as Suspect:**

In the morning on 16th May when Aarushi's dead body was found at the Talwar residence in her room. Firstly the parents saw her dead and then when the maid came in the house she also saw the dead body of Aarushi was lying on the bed and it was covered with a flannel blanket.

Here the parents as well as the police suspected the live in servant, Hemraj as the prime suspect in the murder as he was not present at the crime scene. Rajesh Talwar suspected Hemraj for Aarushi's murder. Moreover he was telling the police several times to catch hold of Hemraj

and to waste their time at the Talwar residence as Hemraj flee away from the crime scene after committing a murder. He asked them to go to the native village of Hemraj in Nepal and he offered them Rs. 25000 for the same.

The Police also initially suspected Hemraj for the murder and made a presumption that Hemraj might have drank the scotch whiskey from the bottle which was lying on the table. Then in that drunk state of mind he might have gone to Aarushi's room and tried to sexually assault her. She might have resisted it and hence he killed her and slit her throat. The police at the early stage suspected a nepali knife, Khukhri as the murder weapon.

On finding the dead body of Hemraj on the terrace on 17th May when the terrace door was broken open the suspicion of the police on Hemraj was negated and moreover it was also a shameful part on the side of the police as they had failed to investigate the crime scene.

○ **Earlier Servants as Suspects:**

On finding Hemraj's body lying on the terrace the police suspected the Talwar's previous live in domestic help, Vishnu.

Vishnu had been with the Talwar family since the last 10 years and each time he would go for a vacation to his village he would put any of his distant relative in his place to work for the Talwar's. The last time he had been to village was 8 months prior to the murder and at that time he had replaced himself with Hemraj. But when he returned, to his despair he was removed from his job and the Talwars had preferred Hemraj over him. Thus the police came up with a new theory that losing his job to Hemraj might have enraged Vishnu thus he killed Hemraj and Aarushi might have witnessed the same hence he killed her too. But this theory also flawed since he had a strong alibi.

○ **Parents as Suspect:**

There is no direct evidence and on the basis of circumstantial evidence the CBI suspected the parents:

- How is possible that the parents were sleeping all the night and could not hear anything going on in the house? Or how is it even possible that they did not hear Aarushi scream.

- The door of Aarushi's room was such that it could be opened from inside and to open the same from outside one had to use the keys. The keys of the room remained with Nupur then who else could have opened the door apart from the parents.
- The another probability is seeing Aarushi and Hemraj in a compromising position Rajesh killed the two in a fit of rage. Thus, there is possibility of honour killing.
- They cremated Aarushi's body in haste. Thus, there was undue haste in cremation.

➤ **Judgment:**

The Court has quoted the Judgment of *Khem Karan v. State of U.P*¹²⁷ If all the circumstances and the evidence on those basis point towards the guilt of the accused and there is no possibility of any other alternative hypothesis then in such a situation only the accused can be convicted solely on the basis of circumstantial evidence. In the current case the current case the court has relied on the following circumstances as they unerringly point towards the guilt of the accused:

- a) As per the last seen theory both the deceased were last seen by the driver, Umesh at the Talwar residence at 9:30. As per the last seen theory the time gap between the murder and the last seen should be such as to rule out the possibility of somebody else committing the crime. Moreover the burden of proof shifts on the accused to prove the facts after the last seen.
- b) In the morning on 16-05-2008 at 6:00 a.m. Aarushi was found murdered in her bed room. Her room and her parent's room were adjacent to each other and they were separated by a wooden wall.
- c) The suspect, Domestic help Hemraj's dead body was found on the terrace of the flat in the pool of blood on 17-05-2008 which was locked from inside.
- d) It has been admitted by both the accused that the door of Aarushi's room was such that it can be shut from inside then it can be either opened from inside or with the help of the keys from outside. In such a situation the accused have failed to offer explanations as to how be the door opened or who opened the door.

¹²⁷ AIR 1974 SC 1567 (3JJ)

➤ **Critical analysis:**

The researcher is firmly of the view that somewhere the court has failed to appreciate the evidences in a proper fashion and moreover the circumstantial evidences also have not been established firmly. In case if the conviction is to based solely on the basis of circumstantial evidence then each of the evidence which is relied upon must be firmly established and all these circumstances when taken cumulatively must forms a complete chain of events which suggests that the only possibility is that the accused are the ones who have committed the crime. In the case of *Ramdas v. The state of Maharashtra*¹²⁸ it has been held that in a case when there are two possible inferences the court must accept that inference which is in favour of the accused. Moreover it is also interpreted that in case if the conditions laid down in the case of *Sathya Narayan v. State* for the conviction on the basis of circumstantial evidence are not fulfilled then in a criminal case the accused is entitled to get benefit of doubt. Moreover the court is of the opinion that the parents, the accused had the exclusive opportunity to commit the crime, and hence they have committed the murders but in the **case of Taantje**¹²⁹ the maid was held guilty of theft as she had the exclusive opportunity to commit theft in the house she underwent the punishment and later it was proved that the butcher had hidden in the house and he had committed the theft. Hence there is an absolute possibility that though on the face of it, it appears that the accused had the exclusive opportunity but there are all probabilities there can be an outsider. The researcher differs from the point of view of the court and has an explanation to every point or every circumstantial evidence on which the court has relied.

The court is inferring that the Parents of the single child would ideally cry seeing her dead but there is a possibility that they might be in deep shock. Earlier in the case of *Palvinder Kaur v. State of Punjab*¹³⁰ the Supreme Court has held that a wife disposing the dead body of her husband who died after consuming potassium cyanide cannot be considered as destroying of evidence. The court laid down that different person would react differently to the situation. So here also there is a situation which is very unnatural for parents to see their only daughter murdered and hence they can be too shocked to weep. Moreover the maid has said in her statement maid as well as the other visitors has testified to the court that the parents were weeping.

¹²⁸ AIR 1977 SC 1164

¹²⁹ Cited in Batuklal's Law of Evidence

¹³⁰ AIR 1952 SC 354

5.2 Case 2 :*Vasu v. Santha* 1975 (Kerala)¹³¹:

The court has established some standards regarding DNA tests and their admissibility to show parentage in the circumstances mentioned above:

- a) Courts in India cannot order blood tests as a matter of course.
- b) Wherever applications for such petitions are filed to conduct a roving inquiry, the Forensic Evidences in Criminal Trial: Need of the Hour blood test request cannot be accepted.
- c) The husband must show non-access to dispel the presumption arising under Section 112 of the Evidence Act¹³², which requires a strong prima facie case.
- d) The court must carefully consider the consequences of conducting the blood test, including whether it will brand a child as a scumbag and the mother as an unchaste woman.

No one can be forced to furnish a blood sample for testing. Furthermore, the court stated that a blood-grouping test is a useful tool for determining paternity disputes. It can be used by courts as circumstantial evidence, allowing them to rule out a particular person as the child's father. However, it is important to stress that no one can be forced to donate a blood sample for analysis against their will, and no negative consequences can be drawn as a result of their refusal.

5.3 Case 3 :TANDOOR MURDER CASE (1995) Delhi¹³³:

This was the first criminal case in India to be solved using forensics. In this case, Sushil Sharma murdered his wife Naina Sahni at home by firing three gunshots into her body. He murdered his wife, believing she was having an affair with Matloob Karim, a classmate, and fellow congressman. Sharma drove his wife's body to the Bagia restaurant after murdering her, where he and restaurant manager Keshav Kumar attempted to burn her in a tandoor. Sharma's revolver and blood-stained clothes were confiscated by police and sent to the Lodhi Road forensic laboratory. They also extracted a blood sample from Harbhajan Singh and Jaswant Kaur, Sahni's parents, and sent it to Hyderabad for a DNA test.

¹³¹ (1975) K.L.T. 533

¹³² See s. 112 of Indian Evidence Act, 1872 available at: <https://indiankanoon.org/doc/817818/>, (Visited on 18/05/2023.)

¹³³ *State v. Sushil Sharma* (2007) CriLJ 4008

5.4 Case 4 : NEERAJ GROVER MURDER CASE (2008)¹³⁴:

The body of Mumbai-based television executive Neeraj Grover was chopped into pieces, stuffed into three bags, and set on fire in a forest.

From the charred bones forensic experts collected three teeth, femur bones, and some other residue to extract the DNA sample from it. The collected DNA sample was then matched with that of his parents and it was established that the charred bones and teeth were indeed that of Grover. The forensic evidence also proved the involvement of Ms. Maria Susairaj, a struggling Kannada actress, and her fiancé Emile Jerome in the murder.

5.5 Case 5: THE 2008 MUMBAI TERROR ATTACKS

The attacks were carried out by 10 gunmen who were believed to be connected to Lashkar-e-Taiba, a Pakistan-based terrorist organization. Armed with automatic weapons and hand grenades, the terrorists targeted civilians at numerous sites in the southern part of Mumbai, including the Chhatrapati Shivaji railway station, the popular Leopold Café, two hospitals, and a theatre. While most of the attacks ended within a few hours after they began at around 9:30 PM on November 26, the terror continued to unfold at three locations where hostages were taken—the Nariman House, where a Jewish outreach centre was located, and the luxury hotels Oberoi Trident and Taj Mahal Palace & Tower.

➤ Reaction in India

The terrorist attacks in Mumbai exposed loopholes in the security system that India had in place to deal with this “new brand” of terrorism—urban warfare characterized by symbolic attacks, multiple targets, and high casualties. Subsequent reports indicated that several intelligence warnings by Indian as well as U.S. sources had preceded the attacks but that authorities, citing the lack of “actionable intelligence,” had ignored them. Moreover, there was an inordinate delay in the deployment of India’s elite National Security Guards, whose commandos reached the besieged hotels some 10 hours after the first shootings took place on November 26. The lack of coordination between authorities in the Indian capital of New Delhi and officials in Maharashtra state also weakened the immediate crisis response. India’s interior minister,

¹³⁴ *Neeraj Alias Kamal Grover vs State And Anr. (2015)*

Shivraj Patil, who was widely criticized in the aftermath of the attacks, tendered his resignation on November 30, 2008, declaring that he took “moral responsibility” for the assault.

The November attacks prompted the Indian government to introduce important new institutions as well as legal mechanisms to fight terrorism. On December 17, 2008, the Indian parliament consented to the creation of the National Investigation Agency, a federal counterterrorism group whose functions would be similar to many of those of the U.S. Federal Bureau of Investigation. Parliament also approved amendments to the Unlawful Activities (Prevention) Act that incorporated stringent mechanisms to contain and investigate terrorism. Although myriad comparisons were made between the September 11, 2001, attacks in the United States and those that occurred in Mumbai, the latter outbreak of terrorism was of a much more-limited scale, in terms of both casualties and financial implications. The Mumbai attacks did, however, evoke a similarly strong national and international outcry against such violence and renewed calls to increase efforts to deal with the menace of terrorism.

5.6 Case 6 : THE NIRBHAYA GANGRAPE AND MURDER CASE

➤ Legal Changes through Nirbhaya Rape Case

○ *Mukesh & Anr v. State For NCT of Delhi & Ors.*¹³⁵

After the Nirbhaya Rape case, many significant changes were made in the law. Justice Verma Commission was set up to analyse the existing laws. It recommended the enhancement of punishment for committing rape and for causing death in rape. It was extended to 20 years maximum imprisonment in the former case and Life Imprisonment in the latter. On the basis of the recommendation of the commission, the Criminal Law Amendment Act, 2013 or Nirbhaya Rape, was brought to force.(A)Nirbhaya Act or Criminal Law Amendment Act, 2013¹³⁶

This Act brought various changes in the Indian Penal Code (IPC), Code of Criminal Procedure(CrPC), Indian Evidence Act(IEA) and Protection of Children from Sexual Offences Act(POCSO). The following are the important changes in the respective law.

¹³⁵ (2017) 6 SCC 1

¹³⁶ The Criminal Law(Amendment) Act, 2013, No. 13, Act of Parliament (2013).

- i. Redefined Rape:** The Amendment widened the definition of rape. Now, acts additional to penile-vaginal penetration or sexual intercourse also come under the ambit of rape.
- ii. Punishment of Rape:** The punishment of rape was increased to a minimum imprisonment of 20 years. Aggravated forms of rape with more stringent punishment were added, such as Gang Rape, Rape of Minor, etc. Even a death sentence could be imposed in case of rape of a girl below 16 or 12 years.
- iii. Age of Consent increased from 16 to 18 years:** Thus, statutory fiction, consent of any girl below 18 is not considered as consent at all.
- iv. Insertion of New Offences:** Certain acts were not as serious as rape but were important factors behind the increase in rape. These acts include stalking, voyeurism, acid attack, trafficking, etc. The Nirbhaya Act not only worked on rape but also on these ancillary factors which contribute towards rape. The Amendment made all these separate acts offences so that the basic factors behind the sexual offences are subverted.
- v. Medical Help and Justice were made easier:** New Sections 166A and 166B cast a duty on the hospital and the police to assist the victim. The hospitals have a duty to treat the victim, and the police have a duty to register FIR. Failure or neglect would attract penal consequences.
- vi. Medical Examination:** In this, the two-finger test made the victim uncomfortable filing the case. This test was removed.
- vii. Evidence:** The provisions of the evidence act were amended. Now, it is mandatory for the court to presume that victim did not consent in rape cases falling under S. 376(2)(a) to (n).²⁴ Now it is for the defence to prove that the victim consented. The victim need not prove the absence of consent in such cases. Further, to prove consent, the defence cannot produce evidence or cross-examine the rape victim in respect of her immoral character or previous sexual experiences. It was felt that such questions made the victim uncomfortable, and this was one of the reasons why the victim was reluctant to file a complaint.

5.7 Case 7: THE SHENA BORA MURDER CASE

➤ *Pratim Alias Peter Mukherjea vs. Union Of India And Anr on 19 January, 2018*¹³⁷

Indrani Bora was born in Guwahati. She later shifted to Kolkata and was in live-in relationship with Siddhartha Das. They did not marry each other because she was a minor. She gave birth to Sheena and Mikhail. She moved back to Guwahati with her children. She later in 1990 left her children to their grandparents. She again moved to Kolkata. In Kolkata she met Sanjeev Khanna and got married. She later married Peter Mukherjea and separated with her former husband. Her children came to the wedding but she introduced them as their siblings.

Indrani and Sanjeev Khanna are arrested for the murder charges. Peter Mukherjea had a son named Rahul Mukherjea, he and Sheena got close this worried Indrani. Both of them were not in good terms. On April 24 2012, Indrani calls Sheena to meet near Bandra's RD National College. Rahul (Sheena's boyfriend) drops her at the place and subsequently Indrani and Sanjeev Khanna picks her up. Shyam Rai was driving the car. Indrani and Sanjeev are said to have strangled her while she was drugged. Firstly they planned on going to Pen but they cancel it after noticing police check posts. They return to Peter's Worli house and park the car in the garage along with Sheena's corpse. Later at the night, they load the body in a red suitcase. The next morning on April 25, along with the driver, they move to Pen near Gagode Budruk village. They drag the body 50 metres off the highway and set it on fire. All three of them then return to Peter's house and Khanna goes back to Kolkata in the evening.

Queries made by Rahul to Indrani about Sheena, she says that Sheena moved to US because she did not wanted to be with him anymore. Obvious doubts led him to call her brother, Mikhail. Mikhail finds her passport. After this they go police to report for missing case. Police says that Sheena is not a kid and asks them to have patience. Her brother goes back when Indrani assures her well being.

Rahul boyfriend keeps calling on her phone but no answers from the either side. Later a text has been send to him that she do not wish to be with him and had moved to US. Again, he goes to police and asks to report for missing person. Police says it can be recorded only after an

¹³⁷ Case No. RC. 12(s)/2015.

inquiry has been done. Police goes to Worli, they are told that Rahul was stalking her. Due to this no report was filed.

- i. DNA Testing under S 26 of the Indian Evidence Act: The recent results of the DNA test proved that Indrani Mukherjee was in fact the mother of Sheena. If the DNA from the skeletal remains does not match that of any of Sheena's immediate family members, it will not be a fatal blow to the murder charge. There are plenty of Supreme Court rulings clarifying that a murder charge is sustainable even in cases where the police were unable to recover the body of the murdered person. In the event of a mismatch of DNA evidence, the Indrani's defence can surely cite that factor in their favour as Sheena's physical remains were reportedly recovered at Rai's instance. But then, the court may also take into account the probability of deterioration of the DNA evidence due to the burning and burial of the body parts. On the other hand, if the DNA test confirms that those remains are of Sheena, there is little that the defence will be able to do to counter such a formidable scientific evidence. DNA extracted from the bone recovered after Shyam Rai told to the Police the site where they disposed off the body under section 26 of EA states "How much of information received from accused may be proved.—Provided that, when any fact is deposed to as discovered in consequence of information received from a person accused of any offence, in the custody of a police officer, so much of such information, whether it amounts to a confession or not, as relates distinctly to the fact thereby discovered, may be proved." DNA matches 100% with Indrani in this murder case. So it is beyond clear that the body was of Sheena Bora, the daughter of Indrani.
- ii. 'Special Knowledge' under S 106, Indian Evidence Act: The recovery of Sheena's passport stance against Indrani. Because it is known that Indrani had 'special knowledge' of Sheena having left the country. Section 106 of EA applies which says if the person alone has knowledge of something then the burden of proof falls on him. Since Indrani claims that Sheena left the country three years ago on a forged passport rather than her genuine one, Indrani will at the least have to explain why her daughter would have done such a curious thing.
- iii. 'Last seen together theory': Indrani has to explain why she didn't file a missing person report and also that how she fooled Mikhail and Rahul when they inquired about Sheena. Indrani also bears the onus of explaining her failure to report Sheena's

disappearance to the police and her reported attempts to fob off any inquiries about Sheena's whereabouts over the last three years from Rahul Mukerjea or Mikhail Bora. Also because the 'last seen' principle is weighs on her because Rahul saw her last with Sheena.

- iv. No eye-witness scenario: Call data records (CDR) can prove and compensate the 'no eye witness' scenario by tracking down the locations they travelled on the day when Sheena was murdered through cell towers.
- v. Diary of Sheena Bora under S 32 of Indian Evidence Act: Diary of Sheena Bora which has her handwriting showing the turbulent relationship between Indrani and Sheena Bora. Sheena Bora hated her mother. Section 32 of EA applies here. It states as "Statements, written or verbal, of relevant facts made by a person who is dead, or who cannot be found, or who has become incapable of giving evidence, or whose attendance cannot be procured without an amount of delay or expense which, under the circumstances of the case, appears to the Court unreasonable, are themselves relevant facts".
- vi. Admissibility of electronic records as evidence under S 65 B of the Indian Evidence Act: Phone calls and emails exchanged between Indrani and Sanjeev Bora. Section 65 B of EA applies. Admissibility of electronic records as evidence in the Court.
- vii. Circumstantial Evidence: Since there are no eye witnesses to this case, it relies on circumstantial evidence.

CHAPTER-6

CRITIQUE OF THE ROLE OF FORENSIC EVIDENCE IN CRIMINAL JUSTICE SYSTEM

6.1 ADVANTAGES AND LIMITATIONS OF FORENSIC SCIENCE

The criminal justice system has historically accepted forensic science testimony with great deference and trust.¹³⁸ After all, scientists are intellectually curious experts with specialized training who make dispassionate observations about the laws of nature. However, over the past 25 years, post-conviction deoxyribonucleic acid ("DNA") testing has revealed the limitations of scientific evidence by conclusively proving innocence in cases in which forensic analysts had previously presented evidence of guilt.¹³⁸ In this way, DNA exoneration cases have prompted a more critical evaluation of forensic science in general. This evaluation has revealed a range of problems including the misapplication of otherwise solid science, overstated conclusions, and some disciplines that lack fundamental scientific foundations. We have also learned that scientists are not impervious to the influences of an adversarial criminal justice system; they are not uniquely immune to the cognitive biases that all humans possess. These DNA exoneration cases provide a common starting point, representing what we have learned about the limitations of forensic science thus far, as we continue to explore how science can contribute to wrongful convictions and how it can be strengthened to avoid additional miscarriages of justice.

The Innocence Project, a non-profit organization dedicated to exonerating the wrongfully convicted through DNA testing and to reforming the criminal justice system to prevent future injustice, maintains a database of case facts from every DNA exoneration across the United States.¹³⁹ These case facts come from several sources: directly from post-conviction attorneys, from others in the innocence movement (e.g., the team at the National Registry of Exonerations, law professor Brandon Garrett), from reputable media outlets, and from the Innocence Record. The Innocence Record, a collaboration between the law firm Winston &

¹³⁸ See generally JOHN ROMAN ET AL., POST-CONVICTION DNA TESTING AND WRONGFUL CONVICTION (Urban Institute, 2012); Robert J. Norris, Framing DNA: Social Movement Theory and the Foundations of the Innocence Movement, J. CONTEM. CRIM. JUSTICE (forthcoming 2016), <http://ccj.sagepub.com/content/early/2016/10/20/1043986216673014.abstract>, Visited on 11-05-2023

¹³⁹ See generally Cases, INNOCENCE PROJECT, <http://www.innocenceproject.org/cases> (last visited Nov. 3, 2016).

Strawn and the Innocence Project, is an online repository of DNA exoneration case summaries and underlying source documents including police and laboratory reports, trial transcripts, and trial and post-conviction motions and pleadings.⁷ Using these documents, and guided by findings from the experts at the National Academy of Sciences ("NAS"),⁸ the Innocence Project has been able to identify DNA exoneration cases that involved the misapplication of forensic science.

For the purposes of Innocence Project research, the misapplication of forensic science is defined as an instance in which forensic evidence (i.e., analysis and/or testimony) was used to associate, identify, or implicate someone who was later conclusively proven innocent with post-conviction DNA testing, thereby demonstrating that the original forensic evidence was incorrect. To date, 158 DNA exonerees' cases-nearly half (46%) of all 343 DNA exonerees nationwide-meet this definition, making flawed forensics the second most common contributing factor among those we systematically track. In 13 cases, misapplied forensic science was the only evidence that linked an innocent suspect to a crime, but more often (in 145 cases) it appeared in conjunction with other factors, lending an air of credibility to problematic evidence like eyewitness misidentification, false confession, and/or incentivized informant testimony.¹⁴⁰

Breaking these numbers down further, serology (the study of blood and other bodily fluids) was the discipline that was misapplied most often, with 86 cases featuring flawed serological analysis and/or testimony. Although, according to the NAS, serology-and also DNA testing-are based on solid theory and research, these disciplines can be misapplied through scientific error, misleading testimony, or misconduct. A common example of misapplied serology involves testimony about a phenomenon known as masking. Humans have different blood types, which are inherited from our parents and determined by the presence or absence of different antigens. Type A, Type B, Type AB, and Type O are the four major groups in the ABO blood group system and occur with different frequencies in different ethnic populations.⁶ ABO blood group markers can be detected in blood, of course, but approximately 80% of the population also secretes blood group substances in their other bodily fluids (e.g., saliva, semen, vaginal fluid).¹⁴¹ If a sample of bodily fluid contains a mixture of a relatively large amount of the victim's biological material and a relatively small amount of the perpetrator's biological

¹⁴⁰ Statistics available from the Innocence Project's internal database (on file with the author).

¹⁴¹ See Garrett & Neufeld, *supra* note 14, at 35.

material (as is often the case in instances of rape), the victim's contribution can overwhelm the perpetrator's, rendering the perpetrator's blood type unidentifiable or masked. Therefore, while ABO blood grouping is a scientifically valid and reliable way to narrow down the pool of possible donors of a biological sample, suggesting that someone is a possible contributor without clarifying that, in instances of potential masking, literally anyone could be the donor is misleading and is a misapplication of forensic science. This is exactly what happened in the most recent (343d) DNA exoneration. Similarly, flawed DNA evidence was involved in nine cases in this sample.

6.2 COMPARISON WITH INTERNATIONAL STANDARDS

The introduction of forensic science technology has resulted in dramatic technological advances in the decision-making process in criminal trials, but further research is needed to determine the precise role of forensic evidence in deciding the rate of prosecution and acquittal. It was also necessary to determine which types of forensic evidence could be used in which types of cases. What kind of proof is forensic evidence, i.e. is it considered substantive evidence or corroborative evidence? In what conditions did the court consider the forensic evidence? Is it usually the case that accepting forensic evidence results in a verdict, or has an acquittal been confirmed despite the acceptance of forensic evidence? In this sense, the perspectives of various superior courts on forensic science have been reviewed as that evidence is referred to in the decision-making phase in criminal proceedings. The conventional approach of the eyewitness-based criminal justice system has proven to be almost impossible for effective criminal prosecution. This form of criminal prosecution degrades the criminal justice system.

It becomes impossible for judges to determine a criminal case or corroborate a fact-in-issue solely on the testimony of witnesses who might lie or be untrustworthy (because witnesses fail to appear on the dates fixed by the courts or might not be subject to the process of the court, which delays justice). Furthermore, after scrutinizing the in-chief and cross-examinations, the judges are unable to draw a definitive decision about the incident. Nowadays, witnesses fail to come to testify in court, even though they believe or have seen the evidence, for fear of being victim to suspects or assaults, which can be fatal. Many times, crimes are committed in such a way that simply obtaining a single witness is difficult. In other cases, the decision-making process in forensic cases is entirely based on circumstantial facts such as DNA evidence, ballistic analyst reports, fingerprints, or chemical analysis reports. Many heinous suspects are convicted or go free on the grounds of even the slightest suspicion due to a lack of conviction

or sufficient proof. Furthermore, the prosecution pays a significant amount of money on court criminal proceedings. As a result, most public funds are lost in traditional prosecutions, and suspects are acquitted on the grounds of the benefit of the doubt. Crimes are now committed technically, and scientific crimes have arisen that can only be solved through forensic technology. To solve a cyber case, for example, cyber forensics must be used. The classification of crimes has also shifted from conventional to technical. Conventional crimes are often conducted in a scientific manner using computers, in which case cyber forensics is the only alternative. Intelligent criminals began to use science in their illegal activities, although investigators are no longer able to rely on the age-old art of investigation, source creation, and surveillance to identify crime. As a result, the criminal justice system cannot function without the assistance of forensic science or advanced technologies. The advancement in Forensic Science has presented law enforcement authorities and the courts with a valuable instrument.¹⁴² A scientific investigation into the crime and the justice system, with the assistance of forensic evidence, effectively and accurately determines the criminal evidence of an accused. Scientific case solving with the assistance of forensic science has been embraced all over the world, and good police investigation can be accomplished with the aid of forensic science. The foundation of a criminal prosecution is largely dependent on criminal investigation. Scientific investigating with the assistance of forensic science is much more effective, accurate, and fruitful than the criminal justice system based on eyewitness testimony. An offender cannot be left at the hands of a bystander. But, except the Indian Evidence Act, which deals with expert evidence, there is no specific law on the admissibility of forensic evidence in court, so we normally rely on the rulings and judgments of the higher courts or the Apex Court.

Section 45 of the Indian Evidence Act of 1872 deals with 'expert opinion, where applicable.' However, the expert's opinion is admissible as proof only after it has been scrutinized under Articles 21 and 20(3) of the Indian Constitution, as well as Section 161(2) of the Code of Criminal Procedure, 1973. Section 293 of the 1973 Code of Criminal Procedure outlines the conditions in which such findings of Government science consultants can be used as evidence. Sections 53 and 53A of the 1973 Code of Criminal Procedure are both very useful for DNA profiling of the convicted. The legislation about 'fingerprints' is expressly protected by several provisions of the Identification of Prisoners Act, 1920, Section 73 of the Indian Evidence Act,

¹⁴² B.S. Nabar, *Forensic Science In Crime Investigation* (Asia Law House Hyderabad, 3rd edn., 2002)

1872, and Section 293 of the Code of Criminal Procedure, 1973, in addition to the general laws related to other forensic techniques. Toxicology rules are expressly addressed in some clauses alongside general laws. Section 284 of the Indian Penal Code imposes a penalty for "negligent acts concerning a toxic drug." The Sale of Poisons Act of 1919 prohibits the importation of any prescription poison unless accompanied by a license and, by statute, limits the issuing of licenses. Psychotropic and narcotic medications.

6.3 ADMISSIBILITY OF SCIENTIFIC EVIDENCE BY US COURTS

This chapter aims to examine how criminal trials involving forensic evidence are addressed by courts around the world. In the past decade, there has been a shift in the admissibility of factual facts in federal courts.¹⁴³ *Frye v. the United States*¹⁴⁴ was the first significant decision in the United States about the enforceability of scientific evidence. The Frye test consisted of two segments. Then, there is the theory or scientific technique, and then there is acceptance. The facets of the test were questioned for two reasons.

- That there would continue to be a significant time gap before the scientific approach is embraced by the community.
- That the scientific community is more trusted than the Court of Law. As a result, the Federal Rules of Evidence were adopted in 1975.

As a result, the Federal Rules of Evidence were adopted in 1975. "If science, technological, or other professional expertise will assist the trier of fact in understanding the facts or determining a fact in question, a witness qualified as an expert by knowledge, ability, experience, training, or education can testify thereto in the form of an opinion or otherwise," according to Rule 702.¹⁴⁵ However, the legislation did not resolve the controversy because it did not contain the Frye standard or make any mention of the general acceptance standard. So, in the landmark case of *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, the United States Supreme Court established the rules. The court continued by stating that the Frye Rule was overridden by the Federal Rules of Evidence and that the strict general approval rule could not stand in the way of a fair minority scientific opinion in the case of recent and existing findings focused on

¹⁴³ Paul W. Grimm, Chief Magistrate Judge, United States District Court, District of Maryland.

¹⁴⁴ *Frye v. the United States* 293 F.1013 (D.C. Cir. 1923).

¹⁴⁵ Federal Rules of Evidence. 1975.

credible studies. It also established factors for the basis of scientific evidence, known as The Daubert Guidelines. The below are the guidelines:

1. The scientific process should be used to assess the content of previously tested scientific testimony;
2. The procedure has been subjected to peer review, preferably in the form of publishing in peer review literature.
3. There are technical guidelines that are routinely and accurately followed, as well as proven or possible error rates for the technique.
4. Takes into account universal recognition in the related scientific community.

Eventually, in the Kumho Tire Case,⁶ the Daubert Analysis was extended to scientific and advanced topics that do not fall into the heading of "science." The Federal Rules of Evidence were amended in the year 2000, after the creation of the Daubert Guidelines. Scientific, technological, or advanced evidence (also known as "expert testimony") is now admissible if: (a) the expert is qualified; (b) the expert's testimony may help the jury decide issues in the case or understand the evidence, and (c) the expert's testimony is centred on appropriate facts or data; is the product of valid rules and techniques; and if the expert demonstrates the facts of the case in trial.¹⁴⁶ As a part of this revolution, federal trial judges are now expected to act as so called "gatekeepers" in civil and criminal courts and determine if expert testimony will be able to be considered by the jury before it lets the jury resolve questions in the case or understand the facts, according to Rule 702 of the Federal Rules of Evidence. In Daubert, Justice Blackmun, majority opinion, expressed the Court's belief in the quality of federal trial judges to serve as gatekeepers of the permissibility of scientific and technical evidence, ensuring that only eligible experts are permitted to testify on these issues, relying on sufficient facts or data, and appropriate methodology that has been properly applied to the facts of the case. He said, "When confronted with the proffer of expert scientific evidence, the trial judge must decide at the outset, according to Rule 104(a), whether the expert is proposing to testify to 1) scientific information that (2) would assist the trier of truth in understanding or determining a fact in dispute." This involves deciding whether the argument or procedure

¹⁴⁶ Dr. M.P. Kantak, Dr. M.S. Ghodkirekar & Dr. S. G. Perni "Utility Of Daubert Guidelines In India" 26(3) JIAFM 110 (2004).

behind the testimony is scientifically valid, as well as whether the rationale or techniques can be applied accurately to the facts at hand.

Associate Justice Stephen Breyer made the following statement on the role of science in court cases in the Joiner Case, ¹⁴⁷ which addressed the constitutionality of experimental evidence: "In this age of science, science should hope to find a warm reception, maybe a permanent home, in our courtrooms."¹⁴⁸ The reasoning is clear. The ideas and tools of science are constantly being used in court cases. The proper settlement of such cases is important not only to the litigants but also to the general population – those who live in our technologically diverse culture and whom the law is supposed to represent.

In two case laws, *General Electric Co. v. Joiner*¹⁴⁹ and *Kumho Tire Co. v. Carmichael*,¹⁵⁰ the Court expanded trial judges' reach under Daubert by shielding their rulings from scrutiny, enabling them to accept findings rather than the only methodology, and expanding the gatekeeping position to non-scientific evidence. In joiner, the Court ruled that the appellate court could review trial judges' Daubert admissibility judgments under the violation of discretion standard and that the trial court could reject evidence based on dissatisfaction with the experts' assessments of studies instead of their procedures alone, because "conclusion and methodology are not entirely opposed."

The Court in Kumho Tire case extended the Daubert analysis beyond scientific evidence to include "technical" and "other professional expertise" as specified by Rule 702. The Court backed this finding by pointing out the legislative language's lack of differentiation, the fair award of discretion in testimony to non-scientific specialists, and the difficulties of identifying between "science" and "technical" or "other professional" expertise. The extension to Rule 702 in 2000 was the most recent advancement of federal admissibility review.

If the specialist claims to extend rules and procedures to the facts of the situation, this application must be carried out consistently. However, in some circumstances, it may be necessary for an expert to advise the fact finder on general principles without ever having to apply these theories to the particular facts of the case. For example, experts can advise the fact finder on thermodynamic principles or blood clotting principles without even knowing about

¹⁴⁷ *General Electric v. Joiner*, 522 U.S. 136 (1997).

¹⁴⁸ Stephen Breyer, Introduction to Reference manual on scientific evidence (2nd edn., 2000).

¹⁴⁹ 522 U.S. 136 (1997)

¹⁵⁰ 526 U.S. 137

or attempting to tie their evidence into the facts of the case. The amendment makes no changes to the long-standing practice of using expert testimony to educate the fact finder on broad principles. Rule 702 specifies the following for this kind of generalized testimony: 1) the expert is qualified; 2) the testimony presents a subject matter on which the fact finder may be supported by an expert; 3) the evidence must be authentic, and 4) the evidence must "fit" the facts of the case.¹⁵¹

6.4 ADMISSIBILITY OF SCIENTIFIC EVIDENCE BY UNITED KINGDOM

The statute in England governing the admissibility of empirical facts differs significantly from that of the United States. According to the English precedential review, judges in the United States are hesitant to enforce certain strict criteria, such as the "reliability" test. The English courts continue to apply Lawton, L.J.'s standard common law measure of "helpfulness" in the well-known case of **R vs. Turner**¹⁵². In England and Wales (common law) nations, the four conditions for expert opinion admissibility are;

(a) Assistance

The leading case of Turner clarified the definition of "Assistance" by stating that an expert opinion "is admissible to provide the court with... evidence that is likely to be beyond the expertise and understanding of a judge or jury. If a judge or jury can draw their conclusions depending on the evidence, an expert's opinion is irrelevant. Or other words, if the expert's viewpoint is superfluous, it is inadmissible."¹⁵³

(b) Relevant Expertise

The person who claims competence must be an expert in the relevant field. This point has been explained in the South Australian case *Bonython*.¹⁵⁴ According to the explanation, competence is a prerequisite that a person "has gained adequate knowledge of the subject by research or experience to make his [her] opinion of importance." It has been proposed in *R (Doughty) v Ely Magistrates Court*¹⁵⁵ that the entry for portraying skills is not very high. The criteria can be interpreted as follows: first, the entry point may not be smaller than what is needed to support

¹⁵¹ Rule 702 https://www.law.cornell.edu/rules/fre/rule_702

¹⁵² (No 2) [1971] 1 WLR 901

¹⁵³ *R v. Mohan* [1994] 2 SCR 9, 10f (Canadian Supreme Court).

¹⁵⁴ *The Queen v. Bonython* (1984) 38 SASR 45

¹⁵⁵ *R (Doughty) v Ely Magistrates Court* [2008] EWHC 522.

a fact on the balance of probabilities; second, laypeople are not able to have those forms of expert proof. Third, criteria for evaluating competence must be adopted that have been established for research fields.

(c) Impartiality

The proof provided by the specialist should be objective and purposeful. Lord Woolf, the Master of the Rolls, said in *Field v. Leeds City Council*,¹⁵⁶ that for an expert to be "qualified to provide evidence as an expert," he or she must be able to have an independent, impartial view on the matters to which his or her evidence relates. The Court of Appeal (Civil Division) recognized expert testimony in *Tooth vs. Jarman*,¹⁵⁷ holding that expert evidence can offer impartial assistance to the court in the form of objective unbiased judgment and that if an expert witness has a material or serious conflict of interest, the court is likely to fail to rule on his/her evidence.

(d) Evidentiary Reliability

Besides, the expert opinion proof must meet a criterion (entry) of satisfactory reliability. Aside from these, the Court of Appeal (Criminal Division) has cited several common law admissibility provisions in various cases. They can be summarized as follows: Dallagher established that the area of specialization must be reasonably well established to pass the standard validity and reliability checks. The admissibility of expert opinion testimony was quoted in Bonython, although it had not been thoroughly analyzed in England and Wales. Gilfoyle proposed a different form of durability measure.

This admissibility criterion was defined as follows in Bonython: "unless the subject matter of the [expert's] opinion forms part of a body of knowledge or experience that is sufficiently assembled or recognized to be acknowledged as a valid body of knowledge or experience." The common law reliability test for "expert proof of a factual nature" was affirmed by the court of appeals in Reed, although the court did not depart from the existing stance that there is no improved reliability test for such evidence. The Court of Appeal accepted the common law credibility test for empirical proof in Weller.

¹⁵⁶ *Field v Leeds City Council* [2000] 1 EGLR 54.

¹⁵⁷ *Tooth v. Jarman* [2006] EWCA Civ 1028, [2006] 4 All ER 1276.

The Court of Appeal stated that it is the trial judge's responsibility to decide if scientific expert testimony has a reasonably credible scientific background.

- **The Relationship between the Four Admissibility Test**

The first aspect of the common law admissibility test known as "*The Turner Test*," namely "Assistance," guarantees that expert testimony can only be accepted where it has ample probative merit, which means that the evidence must assist the court in resolving a contested question. The second limb, "Relevant Expertise," and the third limb, "Impartiality," are intended to affirm that such expert testimony is admissible in criminal trials where a minimum threshold of general reliability, known as "reliability in the round," is met. The fourth leg, known as "Evidentiary Reliability," is intended to address issues beneath the expert's view, such as his/her soundness in the area of expertise and methodology of any assumptions relied on.

- **Opinion Evidence and Evidence of Fact**

In the United Kingdom, expert evidence is classified into two types: i) Opinion Evidence, and the other as ii) Factual Evidence. Since much expert testimony is focused on opinion, special guidelines are needed to ensure that it informs instead of misleads, specifically in criminal trials dominated by expert evidence. However, an expert witness can be called to provide factual testimony. When a specialist is summoned to explain how an extraordinary piece of equipment works, or to provide evidence of a reading given by an instrument or a symptom detected during a patient examination. These are referred to as proof of fact because fact often implies facts. If the court orders some credible evidence, the first three limbs of the common law test must be extended in the same manner as the branches are applied to opinion evidence. The witness providing expert proof of truth can do so only if the court needs the expert's support or support, the witness is an expert in the subject area, and the testimony presented by the witness is impartial. Although the expert Proof Of Fact is not protected by the common law rules summarized above in the case of Meads, it is claimed in "Phipson on Evidence" to choose the "Evidence Of Fact" as expert evidence where the level of competence available was of the most basic order.

6.5 ADMISSION OF SCIENTIFIC EVIDENCE BY GERMAN COURTS

In Germany, the court must, in general, choose an expert who has been approved by a public law agency at the state level. The body is known as 'Kammern' keeps a registry of those experts who are selected to prevent potential difficulties in the selection of an appropriate specialist in a particular field. However, depending on the situation and situations, the court can select experts other than those registered with the 'Kammern',¹⁵⁸ which occurs regularly in practice. The public prosecutor frequently retains experts in the preliminary criminal investigation. During the trial hearing, the complainant will insist that the expert witness be able to testify. Such a motion by the defendant cannot be denied if the expert witness called by the defendant is demonstrably more competent than the expert held by the court.¹⁵⁹ The complainant can also call an expert into question on a variety of legal grounds.¹⁶⁰ Before being approved by a 'Kammern,' the specialist must go through a screening process that assesses his personal and technical abilities to draft reports as well as his level of competence. The accreditation is applicable for a period of five years.. The Kammern, for which accredited experts are registered, screens them daily. Their accreditation can be retained as long as they follow the standards. The most often used qualifications are above-average experience in a particular area, the ability to write an expert article, and the standards of impartiality and freedom. Both experiences, however, can be found in qualified experts. The German Federal Criminal Service and the numerous State Criminal Offices have extensive experience in areas such as DNA research. Expert registrations in Germany are not related to criminal proceedings.

- **DNA EVIDENCE IN GERMANY**

Blood sampling for genetic fingerprinting or DNA analysis was not legal in Germany until March 1997. The Code of Criminal Procedure (StPO) permitted the collection of blood samples from a victim for a criminal investigation. Originally, section 81a of the StPO was primarily used to determine the accused's blood alcohol content in cases of traffic offenses, to determine criminal guilt at the time of the crime, and, in some cases, to determine the suspect's ability to stand trial. The review of Section 81a of the StPO shows that the reason for which blood may be drawn is not defined, so collecting blood samples to collect genetic fingerprints was commonly accepted as legal within the police population. Even though the Federal Supreme

¹⁵⁸ Section 73 StPO

¹⁵⁹ Section 244 StPO

¹⁶⁰ Section 74 StPO

Court and Federal Constitutional Court recognized section 81a as the adequate legal basis for the collection of blood samples for DNA review in criminal cases, constitutional and criminal law questions were posed by different industries. The draft amendment to the Code of Criminal Procedure, dated 2 March 1995, alleviated concern by expressly addressing the issue. The German Social Democratic Parliamentary Group (SPD) has proposed its draft code. St VAG 1997 was passed on December 6, 1996, based on previous drafts by the Federal Ministry of Justice and the SPD, but it was eventually vetoed because it did not specifically preclude the creation of gene databanks. Following that, in March 1997, the Parliamentary Act, which amended the halt, and the Administrative Offenses Act went into effect.¹⁶¹

6.6 ADMISSION OF SCIENTIFIC EVIDENCE BY INDIAN COURTS

The relevance theory governs proof admissibility in India. Section 45 of the Indian Evidence Act of 1872 deals with expert evidence. In Indian courts, the rules of admissibility state that proof can only be submitted of specific facts and facts in question. A fact can be true but not admissible, as in the case of historical testimony, where secondary evidence of a record may be provided only under such conditions. If it does not accommodate the legislative provision, a document may be relevant but not admissible. It is also possible if a text or an expert opinion is admissible whether it is original or otherwise, but because it is irrelevant, such documentation is not recognized by courts. As a result, the criterion for recognizing forensic evidence in India is relevancy and admissibility. Under the general principles of relevance, 'come durability, usefulness, and fitness, which are viewed as separate grounds in the United States. Assistance, applicable knowledge, impartiality, and evidentiary credibility, which are the principles for admitting expert testimony in the UK, both fall into the category of 'relevancy.'

Sections 45 to 51 of the Indian Evidence Act, 1872 govern expert evidence law in India. In the case of *Mahmood v. State of U.P.*,¹⁶² the Supreme Court described the term expert and stated that convicting anyone solely on the testimony of an expert would be extremely dangerous. While prosecution based on expert testimony is risky, Sections 53 and 53A of the Code of Criminal Procedure, 1973, require that expert evidence be used in such cases. In the case of

¹⁶¹ 2 Jyotirmoy Adhikary, DNA Technology in Administration of Justice (LexisNexis Butterworths, New Delhi, 2007).

¹⁶² V.R. Dinkar, Scientific Expert Evidence (Eastern Law House, Calcutta, 1st edn., 2013).

Selvi vs. the State of Karnataka,¹⁶³ the Supreme Court ruled that compulsory administration of forensic techniques such as polygraphy, was unconstitutional if conducted without the accused's permission, it violates Articles 20(3) and 21 of the Indian Constitution.

6.7 CRITICAL ANALYSIS ON LAWS OF FORENSIC EVIDENCE IN INDIA AND ABROAD

Frye, Daubert, and Kumho had played a major role in deciding the standard for the admissibility of expert testimony in US jurisdiction. Frye's general approval test was the prevailing criterion for deciding the admissibility of new science facts from 1923 to 1933, and it insisted on two things:

- i) determining the appropriate scientific area to which the specific scientific technique belongs, and
- ii) whether the society approved the technique in question. In reality, this standard aided trial judges in deciding the authenticity of the proof.

Before the Frye decision, the determinants of admissibility of scientific proof were in a pathetic condition. The Daubert case, decided by the United States Supreme Court, marked a watershed moment. In Daubert, the court overruled Frye's general approval requirement as an exclusive standard in consideration of Federal Rules of Evidence requirements. The Court stated unequivocally that Frye's general approval criterion was superseded by Rule 702 of the Federal Rules of Proof. Furthermore, the Daubert court ruled that Rule 702 applies equally to both scientific and novel scientific facts. In a corresponding ruling by Joiner, the court explained the application of the Daubert conditions. The Joiner court ruled that an appeals court would investigate a trial judge's ruling for wrongdoing. The Court has stated that when assessing the credibility of science data, trial judges should consider the findings based on a scientific technique's methods. In another Kumho ruling, the court applied the Daubert factors to non-scientific expert testimony. As a result, in the year 2000, Congress changed the Federal Rules of Evidence to make the admissibility prong consistent with Daubert and Kumho.¹⁶⁴

¹⁶³ 2010 (7) SCC 263.

¹⁶⁴ V.R. Dinkar, *Scientific Expert Evidence* (Eastern Law House, Calcutta, 1st edn., 2013).

Between 1980 and 2000, the acceptance of factual evidence in the United Kingdom was at an all-time low. A large number of trials were settled without adequate evaluation, resulting in false prosecutions. The main issue in the United Kingdom seemed to be the failure to apply evidentiary standards such as continuity. The judges have acknowledged that the court has struggled to develop a consistent evidentiary principle for the admissibility of scientific proof. The court in **R v. Gilfoyle**¹⁶⁵ demonstrated interest in extending the durability test by invoking Frye's general acceptance factor. Explaining that "evidence based on an emerging new brand of research or medication is not admissible unless recognized by the scientific community as being capable of providing credible and authoritative opinion" is not admissible in the United States. Nevertheless, in a later ruling, **R v. Dallagher**,¹⁶⁶ the court overturned its position by criticizing the observation in Gilfoyle. As a result, in the majority of cases, the court avoided using the reliability test as a standard; instead, the court used other standards dependent on the expert's qualification.

Three significant cases have had their sentences overturned by the appellate court due to insufficient interpretation of factual evidence. They are Dallagher,¹⁶⁷ Clarke, and Harris . Considering the criminal law miscarriages of justice that existed in several recently settled cases, the United Kingdom Government appointed the Law Commission in 2009 to examine and deliver a report, which was submitted to Parliament in 2011, as discussed above.

This paper shows the standards upon which criminal prosecutions involving forensic evidence are handled by the judiciary. In the United States, when determining if expert testimony is admissible, the Judge must consider whether the evidence is valid, credible, effective, and appropriate. The criteria for admissibility of expert testimony in the United Kingdom (UK) are support, appropriate competence, impartiality, and evidentiary reliability. The suitability of expertise in the subject field is one of the standards of admissibility of expert testimony in Germany. The principles of free assessment of proof regulate German evidentiary prosecutions. With a few statutory exceptions, the court has complete jurisdiction over the admission and weighing of proof. German courts, in compliance with the standards of free assessment of proof, do not observe such evidentiary laws adhered to by US courts. In German courts, for example, hearsay testimony is admissible, and it is up to the judge to decide whether or not the

¹⁶⁵[2012]1 Cr App R 5.

¹⁶⁶ Crown Court 15 December 1998

¹⁶⁷ *R. v. Dallagher* [2002] EWCA Crim 1903.

evidence is compelling. The 'opinion law,' which prohibits lay witnesses from making truthful statements, and the 'best proof rule,' which requires original documents to prove the contents of the text, are not available in German courts. In Germany, judges actively participate in the compilation of testimony, and the court's decision on admissibility is final. The relevance theory governs proof admissibility in India. The Indian Evidence Act of 1872 states that evidence should only be provided of specific facts and facts in question. A fact can be true but not admissible, as in the case of historical testimony, where secondary evidence of a record may be provided only under such conditions. If it does not fulfill the statutory clause, a text may be valid but not admissible. It is also possible if a text or an expert opinion is admissible whether it is original or otherwise, but because it is irrelevant, such documentation is not recognized by courts. As a result, the criterion for recognizing forensic evidence in India is significance and admissibility. In other words, if the forensic evidence satisfies the requirement of relevancy, it is assumed that it will satisfy the requirement of superior proof or have more probative merit, as stated in the hypothesis.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

This part provides a summary of various forensic evidences examined in previous chapters and relates them to the hypothesis. It analyzes the principles of admissibility of forensic evidence and its impact on the decision-making process and also discusses the relevance of forensic evidence in satisfying the hypothesis and meeting the requirements of relevancy.

➤ Does DNA Evidence Corroborate the Hypothesis in Criminal Cases?

In many cases like *Chandradevi v. State of Tamil Nadu*¹⁶⁸ by Inspector of Police, *Kamalanath & Others v. State of Tamil Nadu*¹⁶⁹, *State of U.P. v. Amarmani Tripathi*,¹⁷⁰ the DNA test revealed that the accused had fathered the terminated foetus, on the basis of which he was convicted. Thus it satisfies and proves the hypothesis that scientific investigation of crime with the aid of forensic science has more probative value, specially where there is no means to resort to direct evidence like witnesses. In this case, it is impossible to determine the father of the foetus without the means of scientific evidence like DNA.

In cases like *Anil @ Raju Namdev Patil v. Administration of Daman and Diu*¹⁷¹, *Shakti Singh And Another v. State of Rajasthan*¹⁷², *Sachin v. State (NCT of Delhi)*,¹⁷³ the DNA test revealed that the remnants were that of deceased, which also satisfies and proves the hypothesis that scientific investigation of crime with the aid of forensic science has more probative value and not only that, it also proves that it has more probative value than direct evidence as in this case no direct evidence was available. Thus, on the basis of indirect and circumstantial evidence, the conviction of the appellant accused was upheld.

DNA evidence is accepted based on the principles of relevancy and adherence to professional standards, as outlined in the Daubert Guidelines. These guidelines require that the scientific testimony can be tested using scientific methods, has undergone peer review, follows

¹⁶⁸ (12.12.2002 – MADHC) MANU/TN2335/2002

¹⁶⁹ (2005) 5 SCC 195

¹⁷⁰ (2005) 8 SCC 21

¹⁷¹ (24.11.2006 – SC) MANU/SC/8725/2006

¹⁷² MANU/RH/0276/2006

¹⁷³ (13.07.2007 – DELHC) MANU/DE/8182/2007

established professional standards with known error rates, and enjoys general acceptance within the scientific community.

- **Whether DNA evidence satisfies hypothesis in paternity cases?**

The hypothesis that ‘Scientific investigation of crime with the aid of forensic science has more probative value than direct evidences in deciding criminal cases’ is also proved where DNA evidence was used in determining paternity or maternity. In cases for determining paternity or maternity, DNA evidence is treated like corroborative evidence as there are no other means to determine the paternity of a child except on scientific evidence. Even direct evidence may not be sufficient to determine paternity or maternity of a child.

From the opinion of the court in *Sukhwant Singh v. State of Punjab*¹⁷⁴, the importance of forensic science has become very evident. The court held that in cases where injuries are caused by firearms, the opinion of the ballistic expert is of a considerable importance where both the firearm and the crime cartridge were recovered during investigation to connect an accused with the crime. Failure to produce the expert opinion before the trial court in such cases affects the creditworthiness of the prosecution case to a great extent. A reading of mind of the court satisfies and proves the hypothesis that ‘Scientific investigation of crime with the aid of forensic science has more probative value than direct evidences in deciding criminal cases’.

Fingerprint evidence is accepted by the courts on the assumption that no two individuals have identical fingerprints. Scientific research and analysis leads to the conclusion that the probability for the existence of two identical fingerprint patterns in the world’s population is extremely small. The fundamental principles of fingerprints are:

- i) A fingerprint is an individual characteristic, no two fingers have yet been found to possess identical ridge characteristics
- ii) A fingerprint will remain unchanged during an individual’s life time
- iii) Fingerprints have general ridge patterns that permit them to be systematically classified.

¹⁷⁴ 18 May 2009 SC

Fingerprint evidence is a very valuable piece of evidence in any criminal investigation and its importance can never be underestimated. Therefore, from this study forwarded by the court, it is proved that 'Scientific investigation of crime with the aid of forensic science has more probative value than direct evidences in deciding criminal cases'. Like the other forensic evidences, the fingerprint evidence should be properly preserved and properly packed before it is sent to the scientific officers, only then it would be accepted and considered to have probative value. In a certain case, fingerprints of A-1 were taken neither in the presence of the Magistrate nor under the orders of the court and the same were sent to the scientific officers by prosecution witness who did not claim to have properly packed the same. The scientific officer even did not speak of receiving the material from the IO in a properly sealed manner. There is a gap of nearly a month between collecting the material and forwarding the same to the Scientific Officer. What proper care the Investigating Officer has taken to keep the incriminating material intact is not evident from the record. In these circumstances, the court found it difficult to give any authenticity to the report submitted by the Scientific Officers⁴³. Thus in this kind of situation the hypothesis would not be satisfied.

The scientific evidence of crime can lead to conviction as well as acquittal. In a certain case of rape and murder under Article 376 and 302, the seized articles were sent for chemical analysis and the chemical analyzer's report regarding blood group of the accused/appellant and other accused persons were obtained and were brought on record. The semen, blood and pubic hair of the accused appellant were collected by the prosecution witness and were sent for chemical analysis. As regards the semen and blood of the accused/appellant, the Chemical Analyzer showed that the blood group of the accused/appellant was 'A' group. Chemical analyzer's report further showed that neither semen nor spermatozoa was detected on the pubic hair of the accused/appellant. Clothes of the accused/appellant were seized and the analysis of all the items revealed that no blood was detected on any of these articles nor any semen was found. On the other hand, the clothes of the deceased which were seized revealed that they were stained with blood of group 'O' as well as blood group 'B'. Undisputedly, the blood group of accused/appellant was 'A' but the victim's clothes had blood stains of group 'O' and semen of blood group 'O' and 'B'. These facts created doubt about the involvement of the accused/appellant in the crime. Vital links of chain to bring home guilt of appellant under section 376(g) beyond reasonable doubt was missing.

- **Relevancy of Fingerprint Established through Cases**

- It is settled principle of law that, if the fingerprints of the accused are taken procedurally when the material objects recovered from the place of occurrence were sent for the purpose of comparison with the fingerprints taken from the accused, then such evidence become relevant¹⁷⁵.
- If the specimen fingerprints is taken before or under the order of a Magistrate, it becomes relevant.¹⁷⁶
- If a link exists between the evidence of the fingerprint expert and the IO, then it becomes relevant.¹⁷⁷
- When fingerprints were not exhibited, no question was put to accused in statement under section 313 CrPC and SDM before whom the specimen fingerprints were allegedly taken were not produced in evidence, the fingerprint evidence was not reliable.¹⁷⁸
- If the lifted chance fingerprints matches with the admitted fingerprints when compared with each other, the fingerprint evidence becomes relevant.¹⁷⁹

➤ **NARCO-Analysis Tests vis a vis Self Incrimination**

The use of narco-analysis tests has sparked considerable debate due to the involuntary nature of the responses given during these tests. The individual undergoing the test is not given the option to decide whether or not to respond to the questions. Narco-analysis is employed to analyze the behaviour of an accused or suspect by inducing a hypnotic state through the administration of drugs, which may lead to the disclosure of information.

In *Ramachandra Ram Reddy v. State of Maharashtra*,¹⁸⁰ the Court held that narco-analysis does not violate the fundamental right under Article 20(3) of the Indian Constitution.

¹⁷⁵ Palanichamy and v. The State represented by The Inspector of Police (26.07.2010 – MADHC) MANU/TN/2116/2010

¹⁷⁶ Mohd. Aman And Another v. State of Rajasthan (1997) 10 SCC 44

¹⁷⁷ Abdul Razak @ Razak v. State represented by Inspector of Police, Cheranpadi Police Station (07.08.2000 – MADHC) MANU/TN/0944/2000

¹⁷⁸ State of Rajasthan v. Rakesh (03.05.2000 – RAJHC) MANU/RH/0629/2000

¹⁷⁹ Praveen Kumar v. State of Mangalore Rural Circle Police (28.10.2002 – KARHC) MANU/KA/0686/2002

¹⁸⁰ 2004 Latest Caselaw 274 Bom

In the case of *State of Andhra Pradesh v. Smt. Inapuri Padma*,¹⁸¹ the Court ruled that narco-analysis violates Article 20(3) of the Indian Constitution only when performed on the accused, allowing it to be conducted on suspects.

In *Santokben Sarman Bhai Jadeja v. The State of Gujarat*,¹⁸² the Court determined that the use of narco-analysis tests during investigations is justified as a last resort when all other avenues for obtaining evidence have been exhausted. It was stated that conducting a narco-analysis test on the accused does not violate Article 20(3). However, if the self-incriminating information obtained from the accused during such a test is used against them, it violates their rights under Article 20(3) of the Indian Constitution.

Consequently, the Court authorized the narco-analysis of certain suspects. However, in the case of *Selvi v. State of Karnataka*¹⁸³ (2010), the Supreme Court of India dismissed the reliance on narco-examinations and related tests by the High Court for criminal incrimination. The Court extended the scope of Article 20(3) to encompass not only the accused but also suspects, ensuring this right for every individual and prohibiting the administration of narco-analysis tests without their consent. Such evidence was deemed inadmissible in the Court of law.

The narco-analysis test is often associated with potential infringement on an individual's fundamental rights, raising questions about its evidentiary value. According to the constitution, a person cannot be compelled to be a witness against themselves, rendering statements provided under the influence of drugs inadmissible as evidence in India. The test's results may be doubtful as individuals may deliberately withhold information or provide false accounts of incidents. Nevertheless, the test is gradually being integrated into investigations, court proceedings, and laboratories in India.

Notably, the *Aarushi Talwar murder case*¹⁸⁴ exemplifies the use of narco-analysis. Dr. Rajesh and Nupur Talwar, parents of the victim, were subjected to narco-analysis tests due to suspicions surrounding their involvement. However, no evidence could be gathered, and it was later ruled unconstitutional by the Supreme Court.

¹⁸¹ Andhra Pradesh HC 2008

¹⁸² Gujarat HC 2007

¹⁸³ (2010) 7 SCC 263

¹⁸⁴ 2008 Noida Double Murder Case

Another instance is the Nithari Serial Killings Case, where the main accused underwent a narco-analysis test. Pandher and Koli were accused of serial killings in Nithari village. The test revealed Koli's admissions of raping and murdering children to satisfy his ego, as well as dismembering their bodies and disposing of them in drains. Although the test results were not admissible in court, they aided the police in their investigation.

In conclusion, the use of narco-analysis tests remains controversial, with concerns raised about infringing upon individuals' rights and the reliability of the obtained information.

➤ **RECOMMENDATIONS & SUGGESTIONS**

This study puts forward a crucial recommendation for the implementation of effective coordination among investigators, forensic experts, and prosecutors, with a strong emphasis on leveraging advanced technology, to enhance the overall efficiency of the Criminal Justice System. Recognizing the importance of collaboration, it emphasizes the need for a close partnership and a spirit of teamwork between investigating officers (IOs) and forensic scientists. Furthermore, the study provides detailed recommendations for three major stakeholders in the criminal justice system: the investigating agency, forensic experts, and the judiciary, with a particular focus on utilizing advanced technology.

In today's ever-changing landscape of criminal activities, it is crucial to establish trust and utilize advanced technology to effectively navigate the criminal justice system. The evolving tactics employed by offenders necessitate adaptation and collaboration among law enforcement agencies, forensic experts, and the judiciary to ensure transparency, dependability, and credibility throughout the investigative process. The following key aspects are emphasized:

1. Enhanced Collaboration:

Recognizing the evolving nature of criminal activities, fostering collaboration among investigating agencies becomes essential. This involves promoting information sharing, joint operations, and coordinated efforts between different agencies, such as police departments, intelligence units, and specialized task forces. By working together, agencies can pool their resources, expertise, and intelligence to effectively respond to sophisticated offenses.

2. Trust-building Measures:

Building trust between investigating agencies and the community they serve is crucial for successful investigations. This requires open and transparent communication, community outreach initiatives, and establishing positive relationships. Engaging with the public, addressing their concerns, and demonstrating professionalism and respect in interactions can help foster trust and cooperation, leading to valuable information and support for investigations.

3. Transparency in Procedures:

Ensuring transparency in the investigation process is vital to maintain public trust and confidence. This involves establishing clear guidelines, protocols, and standard operating procedures for investigators to follow. Documenting each step of the investigation, maintaining accurate records, and adhering to legal and ethical standards help establish transparency, allowing for scrutiny and accountability.

4. Reliability through Advanced Technology:

The integration of advanced technology plays a significant role in enhancing the reliability of investigations. Leveraging tools such as digital forensics, data analytics, and surveillance systems can help collect, preserve, and analyze evidence more efficiently. Advanced forensic techniques like DNA analysis, fingerprint identification, and facial recognition can provide objective and scientifically sound evidence, strengthening the reliability of the investigation process.

5. Training and Skill Development:

Equipping investigators with the necessary knowledge and skills is crucial to adapt to the changing landscape of criminal activities. Training programs should focus on familiarizing investigators with advanced technology, digital evidence handling, and emerging investigative techniques. By enhancing their proficiency, investigators can effectively utilize technological resources and adopt best practices to ensure reliable and thorough investigations.

6. Continuous Evaluation and Improvement:

Regular evaluation of investigation procedures is essential to identify areas for improvement. Establishing mechanisms for internal audits, feedback loops, and quality assurance processes enables investigating agencies to assess their performance, identify shortcomings, and implement necessary changes. Continuously adapting and improving investigation practices based on feedback and lessons learned helps maintain transparency, reliability, and effectiveness.

7. Association with International Bodies

Forensic science can not flourish in isolation. Crimes and criminals are no more confined to limited areas. Commission of crimes is becoming fast and widespread and can now be controlled and committed by satellites.

8. Providing Enough Means

In order to establish the truth before the court it is necessary to provide enough expenses and facilities to the medical practitioner so that provocation to contaminate the evidences by means of money or bribing to change the facts should not work.

By prioritizing trust, transparency, and the integration of advanced technology, the criminal justice system can uphold its fundamental values of fairness, accountability, and justice. This collaborative approach ensures that investigations are conducted in a transparent, dependable, and trustworthy manner, thereby fostering public confidence and safeguarding the principles of justice.

BIBLIOGRAPHY

➤ **LIST OF BOOKS**

- B.R. Sharma, Forensic Science In Criminal Investigation & Trials (Universal Publication, New Delhi, 4th edn. 2008)
- Basu S.C., Handbook of Forensic Medicine and Toxicology
- B.S. Nabar, Forensic Science In Crime Investigation (Asia Law House Hyderabad, 3 rd edn., 2002)
- Bernadette H. Schell and Clemens Martin, Cybercrime (ABC CLIO, California, U.S.A., 2004)
- Brian J. Heard, Forensic Ballistics in Court: Interpretation and Presentation of Firearms Evidence (John, Wiley & Sons., U.S., 2013)
- Budhpurnima, Iyer's Comprehensive Classic On Narcotic Drugs And Psychotropic Substances Act, 1985: A Legal Compendium Of Anti-drug In India (Delhi Law House, Delhi, 2nd edn. 2014)
- Committee on DNA Technology in Forensic Science, Evaluation of Forensic DNA Evidence (National Academies Press, 1996)
- Committee on Identifying the Needs of the Forensic Sciences Community National Research Council, Strengthening Forensic Science in the United States: A Path Forward (National Academies Press, U.S., 2009)

➤ **LIST OF STATUTES**

1. The Indian Evidence Act (1872),
2. Code of Criminal Procedure (1973),
3. Indian Penal Code, 1860,
4. Drugs and Cosmetics Act (1940),
5. Information Technology Act 2000,
6. Probation of Offender Act (1958),
7. Constitution of India
8. Narcotic Drugs and Psychotropic Substances Act, (1985),
9. The Poison Act (1990)
10. Indian Medical Council Act (1956)
11. Code of Medical Ethics Regulations, 2002

➤ **LIST OF ARTICLES**

1. Abhyadaya Agarwal & Prithurjet Gangopadhayay, "Use of Modern Scientific tests in investigation and Evidence."
2. Anand Srivastava, "Medical Evidence v. Eye Witness Testimony", 2008 Cr. L.J Jour/16X (Sep 2008).
3. Dr. Nirpat Patel, "The Role of DNA in Criminal investigation – Admissibility in Indian legal system and future perspectives" IJHSSI Vol.2/Issue 7/July 2013/p. 15-21
4. Malak Bhatti, "Loss of Justice for sake of convenience? Narco Analysis and Brain mapping : A Examination in Light of Article 20(3) 2009 Cr.L.J Jour/203 (July 2009).

➤ **LIST OF JOURNALS**

1. "Admitting Doubt : A New Standard For Scientific Evidence" 123 Harv. L. Rev. 2021 (2010)
2. Dr. M.P. Kantak, Dr. M.S. Ghodkirekar & Dr. S. G. Perni "Utility Of Daubert Guidelines In India" 26(3) JIAFM 110 (2004)
3. R.K Tewari and K.V Ravikumar, History and development of forensic science in India.,46 J Postgrad Med 303, 305-8 (2000)
4. Nivedita Grover and Isha Tyagi, Development of Forensic Science and Criminal Prosecution-India., 4 Int. J Scientific and Research Pub. 1, 5-7 (2014)

➤ **WEBLIOGRAPHY**

1. <https://blog.ipleaders.in/right-against-self-incrimination/> (visited on 22 April 2023)
2. <https://legaldesire.com/laws-relating-to-forensic-science-admissibility-in-indian-laws/>(visited on 2 May 2023)
3. <https://www.legalservicesindia.com/article/1583/Experts-Opinion-and-its-admissibility-and-relevancy---Law-of-Evidence.html> 9visited on 5 May 2023)
4. https://www.indiacode.nic.in/handle/123456789/15623?sam_handle=123456789/1362 (visited on 14 May 2023)
5. https://shodhganga.inflibnet.ac.in/simple-search?location=%2F&query=ROLE+OF+FORENSIC+EVIDENCE+IN+CRIMINAL+TRIAL&rpp=10&sort_by=score&order=desc(visited on 18 May 2023)

