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ROLE OF FORENSIC SCIENCE IN CRIMINAL INVESTIGATION IN INDIA

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Abstract

The paper deals with the role of Forensic Science in criminal investigation in India. Forensic science plays a pivotal role in modern crime investigation since it links the potential offender to a crime scene. The investigating officers and the court rely heavily on forensic evidence as it guides criminal investigators and provides accurate information to judges about the crime so that they can take decisions about crime with full confidence. Starting from a brief introduction about forensic science and discussing the historical background of forensic science in India, the paper descends to the recent techniques and their impact. It is important because as a scientific method, it can help as evidence before court to prove facts. It helps to serve justice more accurately. Forensic evidence contains the most scientific techniques such as DNA profiling, fingerprint analysis, toxicology, ballistics etc. The paper would then proceed to discuss the law relating to experts and Scientific Evidence. The paper also examines the constitutional validity of forensic techniques. Another interest concerning the study involves cases solved with the help of forensics in India.

Keywords: Forensic Science, Fundamental Principles, Expert Evidence, DNA profiling, Constitution of India.

Introduction

From the commencement of human civilization, crime plays as one of the ingredients in our society. From the beginning of the traditional Era, society has had a dynamic nature which means, when the needs of people change, Society changes. Likewise, technologies will get advanced, which gives space for the way crime commits to get advanced.Criminals start to commit offences using advanced technologies which will become hard to prove. Traditional

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methods which were used for crime investigations were Confessions, Examinations, Deposition, and various other methods. Early days onwards, it showed insufficiency in showcasing criminals and crime, so to cope up with this insufficiency, forensic science developed, and it became one of the most important scientific tools.

Forensic science literally means applying scientific principles and techniques to Law. More importantly, when it comes to crime investigation, the term Forensic developed from the Latin word "forensis", which means before the court of law. Forensic Science has evolved from various branches such as biology, physics, chemistry, technology and medicine. These branches are very essential in crime investigations under forensic science; it helps to examine and scrutinise evidence and it helps courts in identifying truth. It's one of the most energetic, charismatic and contemporary and exhilarating branches of science used in identifying crimes and criminals.[2]

In the modern era, Scientific development plays a vital role in society. It helps society by providing accurate scientific evidence. It helps police and other investigators in identifying the offender or suspect and victim and mainly it concludes on what basis the death has happened. In simple words it intervenes in between suspect victim and crime. As it creates a link, it acts as a connecting link between Forensic science and law.

Nature and Scope of Forensic Science in Criminal Investigation

Forensic science is not independent in nature. It is developed from several branches such as Biology, science, physics, technology, and chemistry and lastly it is applied to matters of law. In simple words, forensic science works as inter-professional and inter-disciplinary in nature.

Earlier we adopted many forensic techniques from other fields of science, but as time passes, forensic science has evolved and developed and some of these specialized branches are ballistics, DNA profiling, fingerprint analysis, toxicology, forensic anthropology etc. As society changes, technologies will get advanced, where forensic science develops and other modern techniques like pattern recognition, voice analysis, digital imaging also develops. All these are major improvements in specialised branches of forensic science which highlight the dynamic nature of society where it also affects forensic science.Now it is an essential ingredient in satisfying the criminal justice system as it helps in administration of justice. It

[2]Nayan Joshi, Medical Jurisprudence and Toxicology (Kamal Publishers, New Delhi, 2008) 23

acts as a helping hand to police officers, prosecution, and judges. For actual investigation, scientific ways of investigation are very necessary.[3]

Role of Forensic Science in Criminal Investigation

A comprehensive criminal investigation can include probing, consultations, cross-examinations, evidence collection, preservation and various methods of investigation.[4] The important and primary role of forensic science in the legal system is to identify the findings and the physical evidence, collected from the crime scenes where this evidence acts as important information or fact which helps the investigators to understand how the crime happened and who the suspect is. With the advent of science and technology every aspect of human life has changed and the court and its judicature is no exception to his general rule.[5]

When criminal investigation is taking place by accessing forensic science, it can be done through different ways: -

1. *Helps in identifying parties involved:*

When working under criminal investigation, it helps to find out who the suspect and who the victim is. It is done through some specialised branches of Forensic science which have

developed lately. Fingerprints, DNA, profiling, and other evidences can help investigators to easily find the suspect. It can act as a bridge between the crime scene and the suspect.

2. *Helps in reconstructing Events:*

Forensic experts reconstruct events that happened to identify physical evidence, such as blood patterns, glass fragments, then identify and understand modus operandi, happened at the event of time, which means it provides an overall information of events taking place.

3. *Identify cause of death:*

In simple words, it helps to understand how the person died, whether the said person died due to accident, murder, suicide, culpable homicide, or through any other natural causes. For this

[3] Satyendra K. Kaul and M.H. Zaidi, Narco Analysis, lie detector, Narco Analysis, Brain Mapping, Hypnosis Tests in Interrogation of Suspects (Alia Law Agency, Allahabad,2008) 1

[4]Charles E. O'Hara and Gregory L. O'Hara, Fundamentals of criminal investigation (6 th edn., Charles C. Thomas Publisher 1994) 103

[5] Supra note 1, p180

forensic pathology and toxicology is used. Forensic pathology is used to identify corpses and to determine cause of death and Forensic toxicology helps to detect alcohol, drugs and other elements such as poison at the cause of death.

4. Verifying testimony of witness:

Forensic evidence plays as scientific evidence which helps witness testimony in proving and by giving weightage to evidence. Either scientific evidence can confirm or contradict testimony made by the witness.

5. Finding out mode of operation or modus operandi:

One of the main important roles of forensic science under criminal investigation is to find out mode of operation and identifying mode of operation put forth, why, and how the event or crime happened.

The important aim of law is to provide justice by ensuring fairness, equality and reasonableness. Forensic science helps law in a way, scientific evidence does not just give a mere suspicion, it directs suspicion to certainty, and it helps in reducing the wrongful suspicion and conviction.

Types of Evidences

Forensic evidence is classified into Logical evidence, Physical evidence, and Digital evidence, and each evidence has several sub-disciplines. All this evidence helps investigators and courts to prove mere suspicion.

1.Biological evidence:

These are the evidence which creates a direct link between victim and suspect, some of the biological evidences are blood stains, semen, hair, skin cells, bones, tissues, and saliva, these are collected through forensic biology and analysed by DNA profiling, these evidence can be collected from the crime scene. This helps to understand who committed the crime.

2. Physical evidence:

This evidence includes fingerprints, white marks, medications, drugs, poisons, documents evidence, shoe prints and foot prints, soil, clothes, then ballistics such as bullets, cartridges, weapons, object marks or tool marks or impressions either seen in the crime scene or in the

body. Physical evidence helps in crime investigation by reconstructing how the crime happened, then helping to find out the suspect by looking towards the evidence. All the above said evidence can be found by using fingerprint analysis and in physical evidence It shows how actually the crime occurred.

3.Digital evidence:

Electronic evidence includes mobile phones, SIM, pen drive, social media, mails, files, CCTV footage, location finder, or GPS data. This helps to find out the communication between the suspect and the victim. what relation they had, how far they have been communicated. Does this have a direct link towards committing the crime? Was the victim seen with the suspect at the time of death?, whether they travelled together? etc. Digital evidence is one of the main types of evidence which provides a link between actual suspect and victim. This makes it easier for investigators to find suspects easily. Digital evidence shows how and when the crime occurred.

When all this evidence is collected and analysed accurately, this will help in solving crimes precisely. All evidence creates a bridge between the suspect and the crime scene which helps investigators or law enforcement to reach the end.

Fundamental principles of forensic science

There are mainly six fundamental principles of forensic science: -

1. Edmond Locard's principle

This principle is also known as the principle of exchange. This says that when a crime occurs, there is a contact between victim and the suspect which means the materials come to contact and when this material comes to contact this makes a path to exchange traces. These traces are lately considered to be evidence and helps to find out suspects.

2. *Principle of individuality*

This principle puts forward the idea that every individual is different from others, which means everyone has unique nature as they are different in character, thinking capability and in physical nature. This principle helps to find out the specific individual involved in this crime and this can be found through DNA profiling, fingerprints as DNA and fingerprints of each individual are different.

3. Principle of comparison

This principle helps to compare the evidence which is found in a crime scene with the known sample. Samples need to be compared correctly to identify forensic evidence.

For example, if a fingerprint is identified from the crime scene, it should be compared with the suspect's fingerprint, then only we can move to the next step. This principle makes sure that the samples are collected and compared precisely and accurately.

4.*Principle of Analysis*

When the evidence is collected, the latest step is very important. It is to analyse and scientifically test. The evidence by applying proper lab methods, some of the laboratory methods are chemical analysis of drugs, DNA analysis. When this evidence is properly collected and analysed then only the accurate result will be found else it will mislead.

5. *Principle of probability*

This means forensic experts cannot determine things that are certain that are 100% right, for example this evidence belongs to a particular person. So, this principle says that evaluating evidence is comparing how much probability is there to match that person.

6. *Principle of progressive change*

Environmental changes are a direct link towards crimes, scenes, and evidence change. When a crime occurs, the evidence must be collected quickly. Otherwise, environmental conditions may deteriorate the crime scene. For example, blood stains may get dry very quickly, which makes it difficult for the experts to find evidence.

Historical Development of Forensic Science

During the 19th century forensic science began to develop rapidly, when scientists started to apply natural sciences to criminal investigations. Several pioneers made their specific contribution in building the foundation of Forensic Science.

Mathieu Orfila (1787 – 1853)

He is considered as the creator of Forensic Toxicology. His research focused on toxins, their effects, and animal indications and symptoms.

Alphonse Bertillon (1853 – 1914)

He created the first ever systematic and scientific criminal identification system, which used body measurements to identify criminals.

Sir Francis Galton (1822 – 1911)

He tried to systematically categorise fingerprints for recording and filing. He conducted *research* on fingerprints and established fingerprints as a full proof method of determining who someone is.

Hans Gross (1847 – 1915)

He focused on the application of scientific methods in criminal investigations. He made contributions through his book "Handbuch Fur Untersuchungsrichter", which was later translated into English as "Criminal Investigation".

Edmund Locard (1877 – 1966)

He used Grosses concept as a foundation and developed a working crime laboratory in Lyons in 1910. He formulated the famous Lockard's Exchange Principle. He also developed a variety of Crime Laboratories around Europe.

Karl Landsteiner (1901)

He discovered the blood grouping system, which is important in forensic serology.

Alec Jeffreys

He discovered the use of DNA as a personal identification tool. This led to the method of detecting persons using their DNA profile derived from his body fluids, tissues etc.

Development of Forensic Science in India

In India, personal identification purely based on fingerprints began with the establishment of the first Fingerprint Bureau of the World in 1897 at Calcutta. Several institutions like Chemical Examiner Laboratories, Serology Departments, Ballistics Laboratories and Questioned document Examination Units etc were established during the early 20th Century to assist criminal investigations. After India got Independence, a need to modernise crime investigation methods and criminal justice in our country was felt. Therefore, the first State Forensic Science Laboratory was established in Calcutta in 1952. Some of the later developments in the field of Forensic Science includes the establishment and creation of :

Central Forensic Science Laboratories

Central Fingerprint Bureau

Bureau of Police Research and Development DNA Typing Laboratories.

Today, at both central and state levels Forensic Science Laboratories operate in India. These Laboratories provide scientific assistance to law enforcement agencies.

DNA Forensics and Modern Techniques

DNA Profiling is the most major advancement in Forensic Science. This process begins by taking a minute sample of genetic material – deoxyribonucleic acid from human tissue and ends when the sample is given a computerized numeric value in the form of a bar code. By taking and analysing DNA samples from biological materials investigators can easily identify the suspects with high accuracy. DNA Profiling is mainly used for :

- Identifying criminals
- Establishing paternity and maternity
- Identifying victims of disasters
- Resolving missing person cases
- Linking suspects to crime scenes

Several other modern techniques are also used by the investigators to identify the criminals.

They are -

- Polygraph test – In this, the examiner measures and records the physiological indicators like blood pressure, pulse, respiration, breathing patterns, body temperature and skin conductivity of the subject. It is based on the theory that wrong answers produce involuntary physical stress reactions. This is also known as “lie detector test”.
- Narco-Analysis – This test is also known as “truth serum” test. In this a psychoactive drug (sodium pentathol) is injected to the subject’s body by the examiner for the purpose of reducing their ability to lie and to bring him to a semi-conscious state. It is

expected that in such a state the person will reveal repressed memories or hidden information connected to the crime.

- Brain Mapping – This test is often known as "Quantitative Electroencephalography." In this the electrical activity in the brain is measured and visualised to analyse functional, structural and cognitive patterns. It helps the doctors to diagnose, treat and understand neurological and psychological conditions.

The above mentioned three primary scientific interrogating tools helps in eradicating the usage of "third degree torture" by police authorities. They are also used to investigate illegal or questionable behaviour and to support the results of the investigating officer.

Law Relating to Experts and Scientific Evidence

An expert is a person who has knowledge and expertise that no one else has. An example of an expert is a person who has gained knowledge regarding the value of land through experience and not through profession. Section 39 of the Bharatiya Sakshya Adhiniyam, 2023 deals with the expert opinion. Section 328 of the Bharatiya Nagarik Suraksha Sanhita (BNSS), 2023 deals with certain Government Scientific Experts.

Mobarak Ali Ahmed vs The State of Bombay[6] - In this case, the court observed that the expert opinion has to be corroborated by other evidence.

In **Kapil Singh v State of Bihar**[7] - The Court held that Footprint evidence is weak evidence and not safe to rely.

State of H. P v V. JaiLal[8] - In this case, the Court observed that an expert's report will not go in as evidence automatically; rather he is to be examined as a witness in Court and has to face cross-examination.

Raj Mohamaddan v State of H.P[9] - In this case, the Court held that if there is a conflict between Government experts' opinion and the opinion of the expert produced by the accused, then the opinion of Government experts will be more reliable.

[6]AIR 1957 SC 318
[7]AIR 1969 SC 53
[8](1999) 7 SC 280
[9]Cri. L.J. 810 (HP)

In **Shashi Kumar Banerjee v Subodh Kumar Banerjee**[10] - The Court held that Expert opinion on handwriting need corroboration.

Constitutional Validity of Forensic Techniques

Right against Self – Incrimination

This right is both a Legislative and Fundamental Right in India, as per Article 20(3) of the Constitution of India. The Article says that no person accused of any offence shall be compelled to be a witness against themselves. The rule of nemo debet prodereipsum, or the privilege against self-incrimination, underlies the right to silence[11]. This right protects personal privacy. The accused's confession will be dismissed if it is obtained by physical or moral pressure. "No individual shall be forced to be a witness against himself in any criminal action," according to the 5th Amendment of the US Constitution."[12]

In **Nandini Satpathy v P.L. Dani**,[13] Court held that an accused person should not be forced or coerced to submit or speak a false statement.

In **M.P. Sharma v Satish Chandra**[14], Court dealt with the scope of Article 20(3). The court opined that the protection under Article 20(3) is wide enough to encompass compelled production of documents and statements, thereby emphasizing that any compelled act that has the potential to furnish evidence against the accused that falls within the mischief of the constitutional prohibition.[15]

The legal concerns made in **Selvi v State of Karnataka**[16] are:

1. Whether application of polygraph, Narco Analysis and Brain Mapping without the consent of the subject amounts to violation of “Right against self-incrimination” as mentioned under Article 20(3)?

[10]AIR 1969 SC 53
[11]J.N. Pandey, Constitutional Law of India (48th edn., 2011) 234
[12]ibid
[13]AIR 1978 SC 1025
[14] AIR 1954 SC 300
[15]Ms. Sherin N.B., Ms. Akshara B., “Article 20(3) And Beyond: The Scope of Protection Against Self-Incrimination in India” 13 International Journal of creative research Thoughts (IJCRT) 67-68 (2025)
[16] (2010) 7 SCC 263

The Court referring Manekha Gandhi v Union of India[17] case, held that Article 20(3) must be examined along with Article 21, which guarantees personal liberty and the right to a fair trial.

The rule against self-incrimination is based on 2 principles as follows:

- Reliability of the statement
- Voluntariness of the statement

Statements given by a person under pressure, threat or coercion by police are unreliable or false. Such statements will affect the fairness of a trial. Therefore, the Supreme Court heldthat application of such tests without the subject's consent amounts to violation of Article 20(3).

2. Whether the use of some investigative techniques makes a person say something that could be used against him in a criminal case?

In Nandini Satpathy v P.L. Dani, court held that protection of Article 20(3) extends also to the investigation stage. If a person is forced while questioning to give an answer that couldlead

to them being charged with a crime, it will amount to violation of Article 20(3). So, using those investigative techniques creates a risk of self-incrimination, which is protected under Article 20(3).

3. Whether application of these tests without the consent violates Article 21 of the Constitution?

Involuntary administration of any of these tests will amount to restriction of personal liberty. Forced interference with a person's mental processes violates the 'right against self-incrimination.

Cases cracked by forensics

1. Ted Bundy Case

[17]AIR 1978 SC 597

In 1978, Ted Bundy, a serial killer was caught by police since they had strong physical evidence against him. The bite mark on the victim matched the unusual crooked and chipped teeth of Bundy.

2. The Atlanta Child Murder Case

Wayne Williams, a serial killer was arrested by police mainly based on forensic evidence. He killed nearly 29 people and threw their bodies into a river. The police gathered forensic evidence. The fibers found on victims matched the fibers found in things in William's house.

3. Night Stalker Case

Richard Ramirez, a serial killer from California broke into people's homes at night and killed 13 people and attacked many others. A teenager wrote down the licence plate and reported to police about a suspicious car. Police discovered the car and found a fingerprint which matched Richard's fingerprints. He was captured and sentenced to death.

4. Tandoor Murder Case

Sunil Sharma killed his wife, Naina Sahni by shooting her and burnt her body. His revolver and blood stained clothes were found by police and sent for testing. Through testing it was found that blood from the body and from the bullet matched. Police also conducted DNA tests by collecting samples from the wife's parents. The results prove beyond any reasonable doubt that the body was of Naina Sahni. Thus, with help of forensic evidence Sunil Sharma was found guilty of murder.

5. Sister Abhaya Murder Case

The body of Sister Abhaya, a nun from Kerala was found in a well in the convent compound. CBI used the recent techniques of forensic evidence namely, Brain Mapping, Narco Analysis and Polygraph and eventually arrested 2 Catholic Priests.

Conclusion

Forensic Science plays a critical role in Criminal Investigation in India. With the introduction of scientific methods for analysing evidence, it helped in linking potential offenders to a crime scene. Recent advancements in Forensic science such as DNA profiling, Polygraph,

Brain Mapping, Narco Analysis etc strengthened the criminal justice system. However, we must take utmost care while applying these tests to ensure they protect Fundamental Rights.

Even though forensic science helps in administering justice, there are some flaws in applying these tests. If our system overcomes these flaws forensic science becomes a powerful instrument for delivering justice and it helps society to combat crime along with safeguarding the rights of individuals. The following are some of the suggestions:

- The law makers should try to adopt a single, comprehensive and uniform national law that regulates DNA testing and its admissibility in courts.
- The procedures followed in Forensic Laboratories should be regulated properly. This will enhance the credibility of Forensic Lab Reports
- The police department should be equipped with sufficient Forensic Science facilities.
- More Forensic Labs should be opened so as to reduce backlog in evidence processing.
- Integrate AI based tools and forensic evidence for faster and more accurate data collection.