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The Role of Forensic Science in Criminal Investigation

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ABSTRACT

Forensic science is a crucial element of the criminal justice system. Forensic scientists examine and analyse evidence from crime scenes and elsewhere to develop objective findings that can assist in the investigation and prosecution of perpetrators of crime or absolve an innocent person from suspicion. This study comprises a crime scene investigation, which is a scene where the case investigator and crime scene personnel work together to define and secure areas that may contain evidence; examine and document the scene; collect physical evidence; preserve, pack, and submit the evidence to the laboratory for analysis. Further, this study discusses forensic psychology and crime investigation, which elucidates the use of clinical specialties to walk through criminal acts and behaviours by applying psychological research, data, and theory to differentiate between the suspects and the main culprits. Additionally, the investigative techniques in forensic science have been thoroughly lined up, such as DNA analysis, finger printing, voice recognition, handwriting analysis, ballistics, autopsy, etc. Furthermore, the role of DNA profiling technology is conceptualised as a procedure that can be used to identify individuals on the basis of their unique genetic makeup. Moreover, the role of forensics in the identification of the accused and victim is mentioned in this study. The identification of the victim is executed by examining the teeth, mouth, or body alignment. To obtain an identification of the suspect, police use several modes like visual, audio, scientific, and test identification parades. Next, the role of toxicology, serology, and narcotics analysis in investigation is related to this study. These three deal with the study of chemistry, biology, and psychotherapy for the individual. This study makes use of brain mapping, polygraph, and narcotics analysis, the tests that are useful to know the concealed information that is related to crime. Eventually, the forensic evidence and the opinion of the experts are the last steps to assist the criminal investigation and to subjectively correlate all the aspects of the forensic methodology and crime scene.

KEYWORDS: Crime Scene Investigation, Forensic Science, Forensic Evidence, Forensic Psychology, DNA Profiling Technology, Crime Investigation, Scientific Technology, Role, Analysis

INTRODUCTION

Justice cannot be served with a single click or a blink to anybody. It takes incredible several moves. Forensic science is where science meets the law. It has a great significance in the criminal as well as civil matters. Forensic evidence is the physical evidence found at the crime scene, which is to be collected, preserved, analysed, calculated, measured and is sent through several parameters and processes to carry

out nearly accurate inferences and finding out the relationship between the accused, the victim and the crime committed.

1. MEANING OF FORENSIC SCIENCE:

The term "forensic science" implies forensics (or forensis, in Latin), which means a forum or a discussion or a public debate. However, in a more modern context, the coroner (medical examiner address the courts or the judicial system). Combining this with forensic science and science means applying scientific methods and processes to solve crime mysteries. Forensic science is the use of scientific methods or expertise to investigate crimes or examine evidence that might be presented in a court of law. Forensic science comprises a diverse array of disciplines, from fingerprints and DNA analysis to anthropology and wildlife forensics.[1]

2. HISTORY AND DEVELOPMENT OF FORENSIC SCIENCE:

The history of forensic science awaits exploration as forensic science as a discipline was not much spoken about until recently. On increasing the cognizance of the subtle importance of forensic science in the past, one cannot but amp up the reverence for this field of science. The word forensic has its origin from the Latin word "forensis" which stands for a forum. Forensic Science is basically used in tandem with any discipline that has associations with the legal system. In a nutshell, forensic science is the application of scientific methods and principles to questions of law.

2.1 The Origin:

Forensic science as a part of the modern-day criminal justice system is still in its formative years. Interestingly, the importance of forensic science dates back to some of the ancient civilizations. The earliest application of forensic science dates back to the ancient Greek and Roman societies. Those civilizations made significant contributions to the field of medicine, especially pharmacology. Their research on the production, use, and symptoms of toxins made the study of their use in past murders possible.

2.2 Forensic Science in the Early Roman Dynasty:

Early in the 1st century AD, Roman orator and jurist Quintilian used basic forensics to acquit an innocent. The Roman model forms the foundation of the modern-day court and legal system. Thus, the application of scientific principles in the examination of evidence in ancient Rome is not surprising. However, with the fall of the Roman Empire in the West, the applications of forensic science in criminal justice stagnated over the next millennium.

2.3 The Early Methods of Forensic Examination used by a Forensic Investigator:

One of Song Ci's account in his book talks about the basic methods used to crack a murder case. First, the investigator tested various blades on an animal carcass and compared the wound to the actual one. This helped him deduce that the weapon used to commit the murder was a sickle. Next, he asked every resident of the crime area to bring their sickles to one location. Eventually, the murderer confessed when the smell

[1] What is Forensic Science, *available at:* https://www.nist.gov//forensic-science (Last Modified October 13, 2023)

of blood caused flies to gather on his sickle. The book also provided methods and logic to estimate if a death resulted from suicide, accident or murder.[2]

2.4 The Glorious 16th & 17th Centuries in the History of Forensic Science:

In 16th century Europe, the gathering of information on the cause and manner of death was first initiated by medical practitioners. A French army surgeon, Ambroise Paré, methodically studied the effect that violent death has on internal organs**.** Italian surgeons, Fortunato Fidelis and Paolo Zacchia laid the foundation of modern pathology. They achieved this through a study of the changes occurring in the structure of the body due to a disease. With the dawn of the 17th century, the importance of forensic science received a boost resulting due to the other advancements in science.

2.5 Fingerprint Analysis – A major milestone in the History of Forensic Science:

The technique of fingerprint analysis to link incidents to suspects was a major breakthrough in the forensic landscape in 1880. Fingerprint analysis resulted from the groundbreaking theory established by Henry Faulds and William James Herschel from the uniqueness of fingerprints. This study received a huge support from experts all over the world and was later accepted as crucial evidence in the legal system. The ancient Chinese used fingerprint analysis for the identification of business documents. It was Francis Galton and Edward Henry who actually implemented Herschel's fingerprinting practices in criminal investigations. Sir Francis Galton started the first system for classifying fingerprints. Sir Edward Henry, the commissioner of the Metropolitan Police of London, used the direction, flow, pattern and other characteristics in fingerprints to develop his own system of fingerprint analysis. Now, the Henry Classification System is the standard for criminal fingerprint analysis techniques worldwide.[3]

3. OBJECTIVE OF FORENSIC SCIENCE IN CRIME INVESTIGATION:

Forensic science applies scientific principles, techniques, and methods to the investigation of crime. A forensic laboratory has two objectives –

1. It is accountable for analysis of evidence and involved in all aspects of evidence recognition, collection, and preservation.
2. It must ensure the assistance to law enforcement officers, investigators, attorneys, judges and juries in understanding the parameters which surround collection and testing of evidence.

The emphasis is on research and development for refining new techniques and instrumentation, assessing the operating and functioning needs of laboratories, and examining the operations of forensic laboratories and their interface with other criminal justice agencies. Although the exact manner in which the physical and chemical properties are analysed for each substance differs, the analyses are all based on the principles of the scientific method.

ROLE OF FORENSIC SCIENCE IN CRIMINAL INVESTIGATION

Forensic science is a crucial element of the criminal justice system. Forensic scientists examine and analyse evidence from crime scenes and elsewhere to develop objective findings that can assist in the

[2] Exploring the History of Forensic Science through ages, *available at:* https://ifflab.org/history-of-forensic-science/ (Last Modified October 15, 2023)
[3] Exploring the History of Forensic Science through ages, *available at:* https://ifflab.org/history-of-forensic-science/ (Last Modified October 15, 2023)

investigation and prosecution of perpetrators of crime or absolve an innocent person from suspicion. Forensic Science deals with the application of the methodology and the knowledge of various disciplines of science to legal matters. It involves the use of multiple disciplines such as physics, chemistry, biology, computer science and engineering for evidence analysis. For instance, physics is used to understand the pattern of a blood spatter, biology to establish the source of an unidentified suspect and chemistry to determine the composition of drugs. Thus, the role of forensic science in criminal justice and the legal system is particular and highly dependent but is often underrated. In criminal cases, forensic scientists are often involved in the search for and examination of physical traces that might be useful for establishing or excluding an association between someone suspected of committing a crime and the scene of the crime or victim.[4]

STEPS FOLLOWED AT CRIME SCENE INVESTIGATION

1. MEANING OF A CRIME SCENE:

At a scene, the case investigator and crime scene personnel who reached there, work together to:

1. define and secure areas that may contain evidence; examine and document the scene; collect physical evidence; and
2. preserve, package and submit the evidence to the laboratory for analysis.

With these key pieces of evidence, the investigator can attempt to reconstruct the elements of the crime.

2. THE STEPS:

The steps and the procedure followed at a crime scene investigation in assistance with forensic science are as follows:

STEP 1 is to reach the crime scene and to secure the crime scene. In order to protect and prevent unwanted access to crime scene by the people with curiosity or malicious intentions, a perimeter must be established by police line tape. Also, to prevent contamination of the scene or any other evidence, the officer must prevent anyone from entering into the crime scene. The investigating officer needs to wear gloves and protective clothing to reduce the possibility of contaminating the evidence themselves. This is also to control the flow of personnel and animals entering and leaving the scene to maintain integrity of the scene. Also, for the maintenance of the privacy and confidentiality of scene of crime, media and press personnel are also not allowed.

STEP 2 is preliminary survey. An overall survey of the crime scene is done. The evaluation and establishment of a path of entry / exit to the scene is to be utilized by authorized personnel only. The scene "walk through" and initial documentation is conducted. Identification and protection of fragile and / or perishable evidences is done. Preliminary documentation of the scene as observed is prepared. Ensure that all evidences that may be compromised are immediately documented, photographed and collected. Identify the origin of the incidence and reconstruct the sequence of events. The sequence of events should not contradict with the statement of witnesses.

[4] Role of Forensic Science in a Criminal Investigation, *available at:* https://indainlawportal.co.in/role-of-forensic-science-in-a-criminal-investigation (Last Modified October 15, 2023)

STEP 3 is documentation. The investigating officer shall maintain documentation as a permanent record. Review preliminary survey of scene of crime to determine what kind of documentation is needed (e.g., photography, video, sketch, measurements, notes). The notes and reports should be done in a chronological order and should include no opinions, no analysis or no conclusions but just facts. A general description of the scene of crime should be given just as the investigating officer sees it when he / she does the preliminary survey.

STEP 4 is sketching of scene of crime. The crime scene sketch should generally be rough sketch, however in cases of heinous crime sketches must be to scale also, distances should be measured accurately and nothing of important should be left out of the sketch map. The exact position of one or two permanent fixture should be provided which will be helpful in ascertaining its distance to the major articles, exhibits, marks such as blood stains, track marks of vehicles etc. The compass point must be indicated and the north point should be obtained by means of a compass. The title, case reference, date, time, name and signature of investigation officer should be mentioned in the corner of the sketch. [5]

STEP 5 is photography of crime scene. Photography should be used as part of the documentation for all physical crime scenes. The photographs should include dead body (if present) to show locations, injuries and condition. Each piece of evidence should be photographed to illustrate where it was found to establish relationship of evidences to the victim. Photographs of evidences should be taken from straight above eliminating potential distance distortions. Blood pattern should be photographed along with the scale from different angles. Identify the type of weapon of offence from blood stain pattern on scene of crime.

STEP 6 is the methods used for searching crime scenes. The investigating officer must adopt an orderly process to access the crime scene so that any material evidence is not left out. Any one of the following crime scene search patterns may be adopted as per need.

1. Line or Strip Method: Walk a path from one end of the crime scene to the other side of the room/area and then return in the direction from where you first started. Useful for large and outdoor scenes.
2. Grid method: Best for large crime scenes such as fields. It is basically a double line search where searcher moves from one end of the area to the other.
3. Wheel or Ray method: Best for small and circular crime scenes. The searchers gather at the centre and proceed outward along radii.
4. Spiral method: It is best used where there are no physical barriers (outdoor scenes). The searcher examines the area for evidences in an ever-widening circle, from the position of centre or core of crime scene and then moves in an outward direction.
5. Zone method: Most effective in houses of buildings. The area is divided into four quadrants / squares and then examined using previously described methods. [6]

[5] Crime Scene Procedures, *available at:* https://www.crime-scene-investigator.net/crime-scene-procedures.html/ (Last Modified October 16, 2023)
[6] Crime Scene Procedures, *available at:* https://www.crime-scene-investigator.net/crime-scene-procedures.html/ (Last Modified October 16, 2023)

STEP 7 is packing of Physical Evidence / Exhibits:

7.1 Protection of Evidence (against):

- Loss
- Contamination
- Cross-transfer:

➢ Suspect to victim
➢ Victim to suspect
➢ Scene to scene o Item to item

- Deterioration.

7.2 Packing Material:

- Plastic Container/Polythene pouch: In some cases, plastic containers/polythene pouches are optimal and can be used for drugs, documents and digital evidences.
- Airtight polythene pouches
- Paper bags/envelopes are optimal and may prevent the deterioration of a biological sample if it is not completely dry when packaged.

After the completion of all these steps, the evidences so procured are sent to the forensic department which constitutes of a forensic laboratory along with experts who are skilled in various fields, which in end facilitates the crime investigating personnel with their reports and inferences after their testing and research for a particular fact or evidence. [7]

THE INVESTIGATIVE TECHNIQUES AVAILABLE IN THE FORENSIC SCIENCE AND THEIR ROLES:

The investigative techniques in forensic science use the evidence to put together information on a crime and find the criminal responsible. Police departments use several methods to investigate crime scenes.

The main goal of the investigative techniques in forensic science is to handle a large amount of data, gather as much evidence as possible, and uncover all the hidden and untraced data.

Some of the investigative techniques which are traditionally and are followed from a very long time are:

1. DNA Profiling Technology,
2. Toxicology,
3. Serology,
4. Narco-Analysis Test,
5. Brain Mapping,
6. Polygraph Test, etc.

1) DNA PROFILING TECHNOLOGY:

1.1) Meaning of DNA:

Deoxyribonucleic acid abbreviated as DNA, is the molecule that carries genetic information for the development and functioning of an

organism. It is the hereditary material in humans and almost all other organisms.

[7] Crime Scene Procedures, *available at:* https://www.crime-scene-investigator.net/crime-scene-procedures.html/ (Last Modified October 16, 2023)

1.2) Meaning of DNA Profiling:

DNA profile, unique to an individual, can be obtained via DNA profiling or DNA typing, which is a scientific process whereby the person's genetic material is isolated and transformed into discernible images.

1.3) Role of DNA Profiling:

It provides for the swift identification of criminals through forensic analysis of crime scene samples. This article seeks to introduce the different modern technologies used in DNA forensic analysis and illustrate the application of DNA evidence in criminal justice with a range of cases.

The origin of DNA technology improved the status of forensic science from passive to active key player in the administration of justice.

The uniqueness in the DNA is the sole determining factor to identify one separately from another except the genetically identical twins. The innovation of the said science can be used to identify criminals with an incredible accuracy when biological evidence is recovered at the crime scene. At the same time, it can also be used to exonerate persons mistakenly accused or convicted of crimes. For that reason, DNA technology is considered to be the best one to find out the truth. Engineering developed at that time largely independent of science and was guided by experience and tradition. It is only in the modern age that science and technology have become closely interlinked, and the gap between them has narrowed down. The result of scientific discoveries and technical inventions accelerate the rapid progress of both0 science and technology and the radical transformation\ of society.

Moreover, in the modern scientific era, subjective knowledge based on experience is largely replaced by objective experimental deterministic knowledge that minimizes chance and probability factors and ensures certainty in our lives. Like that, the application of DNA technology ensures fairness in the criminal justice system. In fact, the usefulness of DNA technology has played an important role in the investigation of crime. Some of the uses are:

1.3.1) Identification of convicts in sexual assault cases,
1.3.2) Identification of convicts in murder cases,
1.3.3) Identification of paternity and maternity of the child,
1.3.4) Identification of mutilated remains,
1.3.5) General identification of criminals,
1.3.6) Immigration purposes [8]

2) TOXICOLOGY:

2.1) Meaning of Toxicology:

Toxicology is the study of poisons and their effects, particularly on living systems. Because many substances are known to be poisonous to life (whether plant, animal, or microbial), toxicology is a broad field, overlapping with biochemistry, histology, pharmacology, pathology, and many other disciplines.[9]

2.2) Role of Toxicology:

Toxicology provides critical information and knowledge that can be used by regulatory agencies, decision makers, and others to put programs and policies in place to limit our exposures to these substances, thereby

[8] Jyotirmoyee Adikari, *DNA Technology in the administration of Justice*, (Page no. 4) (Lexis Nexis Butterworths, 2007)
[9] *Available at:* https://www.britannica.com/science/toxicology (Last Modified October 16, 2023)

preventing or reducing the likelihood that a disease or other negative health outcome would occur. For example, the state of California used NTP findings to establish the first in the nation drinking water standard for Hexavalent Chromium.[10] This standard will help reduce people's exposure to this metallic element. Other benefits of toxicology include:

- Government agencies have a sound scientific basis for establishing regulations and policies aimed at protecting and preserving human health and the environment.
- Companies, such as pharmaceutical and chemical, are able to develop safer products, drugs, and workplaces.
- Consumers have access to information that helps them make decisions about their own health and prevent diseases.

3) SEROLOGY:

3.1) Meaning of Serology:

Serology is a medical science dealing with blood serum especially in regard to its immunological reactions and properties. It is process of the testing of blood serum to detect the presence of antibodies against a specific antigen. [11]

3.2) Categorisation of Serology:

Serology is split into two categories of investigation:

3.2.1) Presumptive Testing: These tests provide two separate means of producing a result. One is to use compounds that can have an effect on blood when introduced to it. These results are a simple and quick way of proving that samples are actually blood especially if time is of the essence

3.2.2) Confirmatory Tests: This is a more involved set of tests that are carried out using samples of what is believed to be blood and mixing them with a chemical compound that reacts adversely with haemoglobin, the resultant factor being the production of crystals under the microscope that can be identified as blood.

It is important that these tests – either one of them – are carried out to prove that these stains are in actual fact blood; and, more importantly, human blood. This is particularly important if the deceased's body has been found outside where it may be possible that animal blood has been spilled on the ground at some point. [12]

3.3) Role of Serology:

Serology allows the forensic scientists to segregate these bodily fluids when found at the scene of the crime and then perform a variety of tests on them in order to identify where these fluids originated from – or most importantly – who they came from. One important aspect of Serology is determining whether or not stains resembling blood found at a crime scene are actually blood or some other stain that bears a similar resemblance. Serology, in addition to examining and identifying blood, is used to identify and

[10] *Available at:* https://www.niehs.nih.gov/health/topics/agents/hex-chromium/index.cfm (Last Modified October 20, 2023)
[11] Immunology and Serology, *available at:* https://www.hopkinsmedicine.org/health/treatment-tests-therapies/immunology-and-serology (Last Modified October 20, 2023)
[12] *Available at:* https://www.sciencedirect.com/forensic-serology (Last Modified 20, 2023)

categorise semen, saliva, sweat and even human faeces. This can be achieved in the instance of faeces as it is covered in a mucus membrane to enable expulsion from the body.
Serology also has a use in proving if unlawful sexual intercourse has taken place; this has become a necessary element of forensic science given the rise in sexual assaults and cases of rape. The processes used by a Serologist can help time intercourse and also help prove that unlawful intercourse actually took place. [13]

4) NACRO-ANALYSIS TEST:

There are several methods for Criminal Investigation, to detect lying and deception by the suspect and accused. Modern techniques like polygraph, narco-analysis, and brain mapping tests are non-invasive methods that will detect deception without causing physical or mental injury to the subject. Scientific techniques are necessary for proving the guilt as well as the innocence of the accused. Narco – Analysis is one such scientific progress that has become increasingly, common in India.
The term Narco-Analysis is derived from the Greek word narko (meaning anaesthesia or Torpor) and is used to describe a diagnostic and psychotherapeutic technique that uses psychotropic drugs, particularly barbiturates.
This technique is used for investigation purpose It is a process of abreaction or catharsis. Also known as Truth Serum or Drug Hypnosis or Narco interview technique. Hypnosis is induced by using barbiturates or another psychotropic drug as a means of releasing repressed feelings. Technique effective in two ways –

1. Therapeutic
2. Rehabilitative

4.1) History of Narco-Analysis:

The term Narco–analysis was coined by Horsley. In 1922 first time used in the criminal investigation in the US, when Robert House, a Texas obstetrician used the drug Scopolamine on two prisoners. Truth serum is a psychoactive medication used to obtain information from subjects who are unable to provide it.

4.2) Principle of Narco-Analysis:

- By using imagination, a person is able to lie.
- In this test, the subject's imagination is neutralized by making him/her in semi-conscious.
- In this state, it becomes difficult to lie and answer would be restricted to facts that he/she is already aware of.
- Expert inject the subject with Sodium Amytal.
- The dose is dependent on the person's sex, age, health and physical condition.
- A wrong dose can result a person going into a coma or even death. [14]
- The subject is not in a position to speak up on his own but can answer specific, simple questions.

[13] Puri C, Avinash, "Comparative Role of Serology and DNA Profiling in Forensics", Volume 12:8, *JOFR,* (2021)
[14] *Available at:* https://www.sifs.in/blog-details/narco-analysis-:-unearthing-the-truth/54 (Last Modified 21, 2023)

- The answers are believed to be spontaneous as a semi-conscious person is unable to manipulate the answers.

4.3) Team of Experts:

- Clinical forensic psychologist
- Psychiatrist
- Physician
- Audio – videographer
- Writer
- Supporting nursing staff

4.4) Process of conducting Narco-Analysis Test:

Narco-analysis test is conducted by mixing 3 grams of Sodium Pentothal or Sodium Amytal dissolved in 3000ml of distilled water. The dose is calculated as per Kg. of the body weight of the subject and the drug is pushed by an Anaesthetist (a medical doctor) at the rate of 4ml/min (100 mg/ min) of a 2.5% solution of Sodium Pentothal. Narco test refers to the practice of administering barbiturates or certain other chemical substances, most often Sodium Pentothal, to lower a subject's inhibitions in the hope that the subject will more freely share information and feelings. In the narco-analysis test, the subject's inhibitions are lowered by interfering with his nervous system at the molecular level. In such a sleep-like state, efforts are made to obtain probative truth about the crime. Experts inject a subject with hypnotic-like Sodium Pentothal or Sodium Amytal under the circumstances of the laboratory. The dose is dependent on the person's sex, age, health, and physical condition.

The wrong dose can send the subject into a coma or even result in death. The rate of administration is controlled to drive the accused slowly into a hypnotic trance. The effect of the biomolecules on the bioactivity of an individual is evident as the drug depresses the CNS (Central Nervous System), lowers blood pressure, and slows the heart rate, putting the subject into hypnotic trance resulting in the lack of inhibition. The subject is then interrogated by the investigating agencies in the presence of the doctors. The revelations made during this stage are recorded both in video and audio cassettes. The report prepared by the expert is used in the process of collecting evidence. This procedure is conducted in government hospitals after a court order is passed instructing the doctors or hospital authorities to conduct the test. Personal consent of the subject is also required.

Sedative and hypnotics that alter higher cognitive function by depressing the CNS include Ethanol, Scopolamine, Quinuclidine benzilate, Temazepam and various barbiturates, such as Sodium thiopental (Commonly known as Sodium Pentothal), Sodium Amytal (Amobarbital), Seconal are particularly worth mentioning. Scopolamine (an alkaloid of the atropine group) was the first chemical substance is used, but nowadays, barbiturates, particularly the Sodium Pentothal are the drug of choice for the Narco-analysis.

4.5) Procedure of Narco-Analysis Test

It includes –

- Pre-Test Interview: Individual is explained regarding the whole procedure and informed consent is taken.
- Pre-Narcotic State: Aesthetic induces narco and maintains the pre narcotic state throughout the interview. The drug is injected till the person appears relaxed and in a state of good contact.

- Semi Narcotic State: After establishing the semi narcotic state and the individual appears to be: a. Flushed, b. Slowing and Slurred speech Forensic psychologists and psychiatrists facilitate the interview. The individual is allowed to sleep of and allowed to wake up. Once he/she wakes up, the anaesthetist checks him/her and allows to drink coffee or tea. Complete narco interview is audio-video recorded and also written.
- Post Test Interview: It includes: Memory is checked. The individual is allowed to know what he/she has spoken during the interview. Individuals experience a more relaxed and anxiety-free state.

4.6) Narco-Analysis in India:

A few democratic countries, India most notably, still continue to use Narco-analysis. Narco-analysis for the purpose of the interview is conducted in a forensic laboratory. In India, at Bangalore and Gujarat, this test is conducted. Consent of Court is required.

4.7) Few Cases where it has been an aid

- Veerappan Case
- Godhra Carnage probe
- Abdul Karim Telgi Case
- Bhanvri Devi Case
- Mumbai Train Blast
- Malegaon Blast
- Nithari Murder Case
- Aarushi Murder Case
- Shasi Murder Case
- Abu Salem
- Mohammad Ajmal Amir Kasab, a Lashkar-e-Taiba militant

4.8) Importance of Narco-Analysis:

- Narco-analysis involves the use of certain barbiturates, using Sodium Pentothal.
- It is used in conjunction with other tests – Polygraph or the Lie detector test, psychological profiling or Brain mapping.
- The most laborious part of a criminal investigation is extracting information from an uncooperative source and therefore, narco-analysis provides a simple, non – violent method of finding out the truth.

It is a proven technique in the medical setup as well as in forensic setup for investigation purposes. This test requires procedure, precautions, and expertise to use in the investigation. Narco analysis is admissible in Court as a co – evidence. Regarding the legal status of Narco-analysis, one needs to interpret carefully Article 20(3) of the Indian Constitution and Section 161(2) of the Criminal Procedure Code, 1973.On 5th may 2010 Supreme Court of India concluded the following point on this test – Article 20 (3) of the Indian Constitution, "No person accused of any offense shall be compelled to be a witness against himself". The test result cannot be admitted as evidence if they have been obtained through the use of compulsion. [15]

[15] *Available at:* https://www.sifs.in/blog-details/narco-analysis-:-unearthing-the-truth/54 (Last Modified 21, 2023)

5) BRAIN MAPPING:

5.1) Meaning of Brain Mapping:

Brain mapping is a non-invasive procedure that painlessly and safely measures brain activity. While other tests measure brain structure, brain mapping measures its function. Brain mapping can:

- Identify irregular brain wave patterns and the regions in which they occur
- Point to areas where brain activity may be too high or too low · Reveal areas of the brain that are not optimally communicating with other regions
- Aid in diagnosing psychiatric and cognitive conditions
- Identify brain injuries
- Indicate your level of stress
- Help predict your response to medication

Most importantly, brain mapping yields critical information needed to design a customized neurofeedback program tailored to an individual's needs.[16]

5.2) Working of Brain Mapping:

Electrical impulses, or brain waves, are generated when any of the 100 billion neurons in your brain communicate. These brain waves can be picked up by the QEEG (quantitative Electroencephalogram) diagnostic tool. This shows how your brain functions and allows the test administrator to pick up on any atypical results. It is a relatively quick process. First, a sensor cap is placed on your scalp. You sit comfortably while the electrical activity in your brain is captured by a device connected to the sensor cap. The data is analysed and compared to normal controls, then a report, including color-coded maps of your brain's activity, is generated. Again, the procedure is safe and non-invasive. Brain mapping only records your brain's signals and does not affect them.

5.3) Process after Brain Mapping:

Highly qualified professionals use information from your brain mapping session (along clinical and medical evaluations) to formulate a comprehensive addiction treatment plan. Your initial brain mapping report also provides a baseline from which your progress can be tracked over time.

Part of your plan can include neurofeedback. A form of biofeedback, neurofeedback uses a reward system, such as music or game playing to help retrain your brain to function in a healthy manner. For example, when your brainwaves are optimal, you may hear music or have access to a fun game. Likewise, when your brainwaves are not optimal, you will receive "negative" feedback such as the music or the game stopping. This painless training teaches your brain to operate optimally. [17]

6) POLYGRAH TEST:

6.1) Meaning of Polygraph Test:

Polygraphy test, also generally knowns as lie-detector test. Polygraphy is an instrument used by police to determine if an individual is speaking truth or lies. This technology may be included in interrogation process in recent decades in India. But this technic used by this instrument has a long history. The technic of one saying truth or not goes way-back to ancient China. In ancient China, people use to make the

[16] *Available at:* https://www.foundbationwellness.net (Last Modified 0ctober 22, 2023)
[17] *Available at:* https://www.foundbationwellness.net (Last Modified 0ctober 22, 2023)

suspects eat dry rice powder and chew, this is because the people believed that when person is in fear or tensed that person doesn't produce saliva. So, if the powder remained dry, then he/she is considered guilty. This technical belief of people may be not that reliable in nature. But it is truth that when a person lies there will be some changes physically like increase in blood pressure, and few visible movements in body. The scientist has developed an instrument which follows this technic and principles of observing changes in a human body. And that instrument is known as polygraphy or lie detector.

The first attempt to make an instrument which can detect lies, was very simple. The first machine was only made in such a way that it only detects the changes in the blood pressure of the person who is being questioned. Later on, there were upgrades or advancements in the machine. A scientist named John Reid, improved the instrument and also gave the technique to do the test in an effective way. After further advancement and upgrades to the polygraphy machine became more versatile and rekindle in nature. Right now, polygraphy test is more practical and accurate in detection of lies when compared to other scientific methods. [18]

6.2) The Mechanism:

The test works on a psychological principle known as the psychosomatic interaction. The principal deals with the minor physical changes occur in a human body. The changes are like change in the respiration like heavy breathing, Galvanic skin resistance, change in Blood pressure or pulse rate, Muscular pressure, Finger pulse, change in body temperature. Whenever a person lies or fake a statement, that person will have fear of getting caught and he holds his emotions, which leads a mental disturbance within that person. All these reactions lead to psychological changes in that person's body.

The instrument (polygraphy/lie detector) records the changes taking place in the body of the suspect/the person who is being questioned. It records the changes like abdominal respiration, Galvanic skin resistance, the changes in blood pressure and pulse rate and few other aspects.

The new model of polygraphy instrument also records the muscular movement in the body of the subject.

The lie detector instrument is attached to the suspect who is being questioned in the following:

- To record the changes in respiration patterns of the subject (the suspect who is being questioned), one pneumography tube is strapped around his chest and other one around his abdomen. A regular blood pressure cuff is attached to his upper arm.
- Electrodes are attached to his fingers (index or ring finger), through which a weak electric current is passed through to measure the galvanic skin reflex.
- The body movements and pressure are measured through the chair he she is sitting on. The chair is designed in such way.

The questioning is done by the polygraphy expert, also addressed as an examiner. During the test the physical changes in the subject are recorded on a chart. The examiner should be given all the information required for questioning the subject. For the better results from the test, there are few aspects which need to be considered. The room where the test is conducted, it should be a quite space. The room should not contain a lot of people. Only the polygraphy expert, the subject and the in-charge of that case should be present in that room. The question asked during the test are simple and brief, which should be responded by saying yes or no by the subject. The polygraphy expert have few questioning technics for better results from the test. Questioning session in a polygraphy is easier than the analysing the polygraphy

[18] *Available at:* https://www.nap.nationalacademies.org (Last Modified October 23, 2023)

chart. Analysing a polygraphy chart is the difficult part of this job. The examiner analysis the chart and gives the final results. Is the subject saying the truth or not.[19]

LAWS RELATING TO FORENSIC SCIENCE ADMISSIBILITY IN INDIA

Admissible evidence is the kind of evidence which cannot be objected or dismissed or rebutted on the basis of any non-substantial or irrelevant arguments and statements. It could be holding a potential or a probative value in the court of law. Evidences have to be authentic, complete, reliable and believable in order to be admissible in the court of law.[20]

In the Indian Legal Framework, laws related to Forensic Science are more numbered in the Indian Evidence Act (IEA), compared to Code of Criminal Procedure (CrPC) and Indian Penal Code (IPC).

The Indian Evidence Act contains provisions regarding admissibility of scientific evidence in the court of law. This act is classified into 3 parts with a total of 11 chapters, which are:

- The first part deals with relevancy of facts. It has 2 chapters.
- The second part has chapters 3 to 6 and each has its own peculiarity. Chapter 3 describes about facts that need to be proved before the court of law. Chapter 4 deals with oral evidence. Chapter 5 gives in details of documentary evidence and Chapter 6 provides you with circumstances where documentary evidence has or should be given preference over oral evidence.
- The third part has chapters 7 to 11. Chapter 7 gives importance to burden of proof and how important it is to prove evidence and facts. Chapter 8, 9, 10 talks about estoppels, witnesses and examination of witness respectively. The final Chapter 11 defines improper admission and rejection of evidence.

Forensic Science is applied in Indian law considering the IEA, within 4 aspects: witness, admission, facts and circumstantial evidence. Here are superficial details of some widely known laws that make forensic evidence admissible in the court of law. Most important and widely known aspect of Forensic Science is DNA and it's testing. There is no official legislation passed with respect to DNA testing in the Indian constitution, but Sec 53 and 54 of CrPC deals with examination of alleged person by a certified medical practitioner on reasonable grounds of inquest.[21]

Sec 293 of CrPC lists some Government Scientific Experts for the admissibility of expert opinion in the court of law. The expert is examined as a witness for his/her opinion to be valid after cross contamination. Also, Sec 45 of IPC provides relevancy to expert opinion in any field of expertise in forensic science, to help the court in framing judgements considering technically complicated and sophisticated matters.

Forensic Toxicology has been the most active branch of Forensic Science where separate acts were introduced amending the existing laws and legislations. Sec 272 to 278, Sec 284, Sec 328 of IPC deals with poisoning. Along with general description of poisons, corrosive substances, adulterants, chemicals and medico-legal aspects, there are acts like:

- The Poison Act (1990)

[19] *Available at:* https://www.nap.nationalacademies.org (Last Modified October 23, 2023)
[20] *Available at:* https://www.legaldesire.com/laws-relating-to-forensic-science-admissibility-in-indian-laws/ (Visited on October 24, 2023)
[21] *Available at:* https://www.legaldesire.com/laws-relating-to-forensic-science-admissibility-in-indian-laws/ (Visited on October 24, 2023)

- The Drugs and Cosmetics Act (1940)
- The Narcotic Drugs and Psychotropic Substance (NDPS) Act (1985)
- The Pharmacy Act (1948)
- The Drug control Act (1950)

Another commonly heard term with respect to Forensic Science is fingerprints. According to Sec 73 of IEA any person is compelled to give his/her fingerprints on orders from the court. The Supreme Court has given special mention that this section isn't a violation of their fundamental rights. Sec 5 and 6 of Identification of Prisoners Act, 1920 has the same context and allows acquiring thumb impressions and handwriting samples. It also declares that these shall not be used against the person as personal testimony. Forgery, fraudulence and cheating are quite common in current scenario and are gaining momentum to be the commonly occurring white-collar crimes. Indian laws have defined every term related to crimes related to documents:

- Sec 29 of IPC defines document.
- Sec 29A of IPC defines electronic records.
- Sec 463 of IPC and Sec 44 of IEA defines forgery.
- Sec 420 of IPC defines cheating and Sec 417 defines punishment for the same.
- Sec 47 of IEA is for handwriting opinion and elaborates the circumstances under which the handwriting expert shall consider it to be a disputed handwriting.
- Sec 67 of IEA gives details of methods of how a signature in a document should be proved.[22]

Though it's been neglected from a quite long time, psychology plays an essential role in legal proceedings and Forensic Psychology is very crucial in the processing of a case. There are 3 specific laws related to admissibility of forensic psychology in court of law:

- Sec 84 of IPC is related to an act of a person of unsound mind.
- Indian Lunacy Act, 1912 was introduced to amend laws related to lunacy and define certain terms.
- The Mental Health Act, 1987 (MHA) was enacted for improving hospitality and treatment towards mentally ill people keeping in mind to protect the human rights of individuals.

Indulgence of Forensic Psychology in court proceedings help in assessment of mental condition, prediction of violence and risk-management, assessment of child custody in divorce and competency to stand trial.

Wildlife crimes are yet another commonly occurring crime, but are least noticed. It is because they take place at remote locations devoid of any witness and surveillance. The Wildlife Protection Act (1972) places stringent restrictions on trade for protection and conservation of wildlife and the schedules of this act are dedicated to wildlife forensics in specific and protocols to be followed.

Entering into the new millennium of 2000s, there was global advancement in fields of science and technology and criminal activities took a new dimension. It was necessary for the law to be updated with necessary amendments. It was the beginning of the era of cybercrime. Information and Technology (IT) Act, 2000 was enacted to provide legislation in the booming cyber space. The second schedule of this act

[22] *Available at:* https://www.legaldesire.com/laws-relating-to-forensic-science-admissibility-in-indian-laws/ (Visited on October 24, 2023)

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).

Few terms were foreign to the Indian law and they needed proper definitions. Expressions like 'digital signature', 'certifying authority', 'electronic record, 'secure network' and 'subscription' had their meanings assigned clearly while preparing the IT act in 2000. [23]

In the current time, with the increase in awareness and vigilance, most criminal investigation investigations and trials are relied upon forensic science for standard protocols and proper proceeding of the cases. Forensic science is still not known to everybody and people lack awareness about it. The existing laws and amendments allow forensic evidence to be admissible in the court of law. Evidence shall be cross examined and accepted by the court based on the admissibility standard as mentioned in the law books. In the future, there shall be amendments made and laws introduced considering the contemporary crime scenario and technological advancements.[24]

JUDICIAL TRENDS RELATING TO FORENSIC SCIENCE AND ITS RELEVANCY IN CRIMINAL INVESTIGATION

1. Tandoor Murder Case (1995) Delhi[25]

This was the first criminal case in India solved by the help of forensics. In this case Sushil Sharma murdered his wife by firing bullets in to her body because of the misunderstanding that she had illicit relationship with her classmate and fellow congress worker Maktoob Karim. After committing the sinful act, he took her body in his car to the Bagiya restaurant, where he along with the manager of restaurant Keshav Kumar attempted to burn her in a tandoor there. Police recovered Sharma's revolver and blood-stained clothes and sent them to Lodhi Road forensic laboratory. They also took blood sample of Sahni's parents, Harbhajan Singh and Jaswant Kaur and sent them to Hyderabad for a DNA test. Lab reports Confirmed that the body was that of wife of Sushil Sharma, the DNA report said, "The tests prove beyond any reasonable doubt that the charred body is that of Naina Sahni who is the biological offspring of Mr. Harbhajan Singh and Jaswant Kaur." And finally, Mr. Sushil Sharma was found guilty with the help of forensic evidences.

2. Sister Abhaya murder case (1995) Kerala[26]

The Sister Abhaya Case is a case regarding the death of a Kamaya Roman Catholic nun, who was found dead in a water well in St Pius X convent in Kottayam, India, on 27 March 1992. During the investigation of this case various scientific techniques like Narco-analysis, Brain Mapping, Polygraphy tests were used to solve this case and finally two priests were held liable for the rape and murder of sister Abhaya

3. Aarushi Talwar murder case (2013) Noida[27]

Aarushi Talwar, the 14-year-old daughter of a successful dentist couple. She was found dead with her throat slit in her parents' home at Jal Vayu Vihar in Noida, a posh suburb of Delhi. Suspicion immediately

[23] *Available at:* https://www.legaldesire.com/laws-relating-to-forensic-science-admissibility-in-indian-laws/ (Visited on October 24, 2023)
[24] *Available at:* https://www.legaldesire.com/laws-relating-to-forensic-science-admissibility-in-indian-laws/ (Visited on October 24, 2023)
[25] Sushil Sharma V. State of Delhi (2014) 4, SCC, 317
[26]
[27] Dr Rajesh Talwar & anr. v. CBI: 2013(82) ACC 303

fell on the family's live-in man-servant, Yam Prasad Banjade alias Hemraj, a 45-year-old Nepalese national, who was found missing from the home. But later on, after the investigations were complete, it was seen that the murder was committed by her own parents and declared as a case of honour killing.

4. In **Harpal Singh vs State Of H.P**,[28] the fact in issue was about the age of the girl, the age of the girl was ascertained by scientific techniques the same result obtained by that of the medical tests was then corroborated with those of the records of the school which was certified by that of the headmaster and also by the entry in the birth register.

5. The case which brought DNA controversy to the forefront in the Indian Legal System was rape and murder of Priyadarshani Matoo.[29] At trail stage, this case relied upon the DNA tests of vaginal swabs of the deceased, which later came to be positive and made ends of justice meet.

6. The same technology of DNA testing has also helped to prove that the former minister Rajendra Mushahary belonging to Asom Gana Parishad had raped a woman twice and due to which such lady became pregnant thus he was held to be the father of the woman's child.[30]

7. This technology of DNA Testing proved beneficial in bringing the murderer of Rajiv Ghandhi,[31] Dhannu,[32] to meet her fate by testing her mutilated body.

8. Similarly, the terrorist attack that happened on WTO building 9/11 in New York bodies of victims were identified by scientific technology of DNA testing.

CONCLUSION

Forensics technology is witnessing a paradigm shift in its approach to solving homicide and other crimes. It seems the science fiction stories of a few decades back will come true in real life in the not-too-distant future.

Forensic science is that piece without which the puzzle of a criminal investigation is incomplete. Without the application of forensic science, criminals can never be convicted unless an eyewitness is present. While detectives and law enforcement agencies are involved in the collection of evidence, be it physical or digital, it is forensic science that deals with the analysis of those evidence in order to establish facts admissible in the court of law.

Thus, in a world devoid of forensic science, murderers, thieves, drug traffickers and rapists would be roaming scot-free.

The duties and responsibilities of a forensic scientist in a criminal investigation is crucial as it involves the careful examination of an evidence while ensuring that it is not tampered with. A diverse pool of forensic scientists and forensic tools go into the investigation of a criminal act.

[28] (1999) 8, SLC 679
[29] CBI v. Santosh Singh FIR no.50/96 Courts of Additional Session Judge, New Delhi
[30] Pranam Kumar Rout, "DNA Test A Forensic Boon", *CLJ*, (2003) page 349
[31] State of Tamil Nadu v. Nalini & ors., 1996(6), SCC
[32] Real name is Thenmozhi Rajaratnam