Chapter III

Modern Techniques in Forensic Science and their Utility in the Criminal Justice System: An Overview
MODERN TECHNIQUES IN FORENSIC SCIENCE AND THEIR UTILITY IN THE CRIMINAL JUSTICE SYSTEM: AN OVERVIEW

3.1 Introduction

“Today we see enormous changes being brought about by science. The whole context of life is changing. As a matter of fact, looking back at least half century with which I have been more or less concerned and some of you also see that enormous changes have been brought about chiefly by science and technology. This pace of change is growing and I have no doubt that another fifty years hence you will see even greater changes not merely in spaces researches but something affecting human life in order to participate in this movement, you should build yourself up in the science and technology.”

Pt. Jawahar Lal Nehru

The nature of law is dynamic and not static, so the law also changes when society change. The law is the cement of the society and the judiciary has the responsibility of interpreting the law for the greater good.¹ The application of science and technology to the detection and investigation of crime and investigation of crime and administration of justice is not new to India.² Inspite of this many people are not aware from the fact that science plays an important role in the identification of crime and criminals. The area of its operation is quite wide and comprehensive. In its application to the administration of law, it is known as “Forensic Science”. Earlier it was forensic medicine, which first came to the field of the science in as such as medical man’s opinion has been sought throughout the ages to find out the cause of death of a person both in case of natural or of unnatural death.

The area of forensic science is changing very fast by the new technologies and methods. Nowadays use of DNA tests, high-performance liquid chromatography, mass spectrometry, 3-D computer imaging, and other sophisticated technologies are used by scientists to reconstruct the offence and the mishap. The modern forensic

¹ Philosophy propounded by Jeremy Bentham and John Stuart Mills.
science can differentiate trace element and organic materials down to the level of merely a few hundred molecules.\textsuperscript{3}

Given the sensitivity of the instruments, forensic scientists require adhering to rigorous procedures and standards to make certain that their outcome are valid and dependable and can withstand inspection in the courts of law and the community. The recent forensics can facilitate to expose concealed offense, convict the guilty and vindicate the innocent if it exercises with care. At present, multifaceted science plays an important role in recognizing sufferers of offence, mishap, tragedy, and combat which provides assurance, conclusion, and poignant support for bereaved’s survivors.\textsuperscript{4}

The characteristic of our criminal justice system is the attentive look for reality. Our technique of inquiry, rules of criminal procedure and appellate procedure are fundamentally designed to make certain that the responsible are punished whereas the innocent are protected. However, while ours is a system to be appreciated, it is not an ideal system, and those charged with the administration of justice have a responsibility to seek its continued improvement.\textsuperscript{5}

Science and law, two distinctive professions have more and more become co-mingled, for making sure a fair procedure and to observe that justice is done. Nowadays the legal system has to pact with new scientific proof on many instances, which has posed profound challenges for the law. At basic level, many of these challenges occur from fundamental differences between the scientific and legal procedure. The quandaries are self-evident. On one hand, scientific proof holds out the alluring chance of tremendously precise fact-finding and a decrease in the ambiguity that frequently accompanies legal decision-making. Simultaneously, scientific methodologies often contain risks of ambiguity which the legal system is unwilling to bear.\textsuperscript{6}

Additionally, at every instance, scientific proof examination of the capability of judges and lawyers, all of whom may lack the scientific proficiency to understand the proof and evaluate it in an informal manner. Lawyers must make efforts to

\textsuperscript{3} “Innovative techniques of forensic science”, \textit{available at} : www.therapyceu.com (visited on date 16-07-2012).

\textsuperscript{4} \textit{Ibid.}

\textsuperscript{5} \textit{Ibid.}

\textsuperscript{6} \textit{Id.}
understand the difficulty of scientific investigation and expressions if they are to fully comprehend testing procedures and consequences, and their impact in the legal field. One modern development in the scientific community that has had a substantial and almost mesmerizing impact on the legal profession is the development of lie detection and Narco-Analysis in criminal cases. 7

Usually, forensic science is the application of science to find out the answer which required by the legal system. These answers may relate to civil or criminal actions. At present it is also very much related with scientific field. Forensic science which is used to answer criminal question provides answer though the comparison with, controlled substance, biological proof a firearms that may be found at the site of the offence. In Addition to this, with the help of trace proof and impression proof like fingerprints, tire tracks and footwear impressions and all other proof that may be found in a scene of offence, the required answers for criminal examination can be found with the help forensic science. 8

The proof found on the site of the offence is generally produced in the crime laboratory and it is this branch of forensic science that is used in the media and shown in fiction stories and programs. Besides this, forensic science has other disciplines. It is used for solving disputes as in forensic accounting which is the study and understanding of accounting evidence. When one speaks of forensic economics, it relates to the branch of forensic science which studies economic damage that leads to the loss of a business, household services or business profits. 9

In forensic engineering, one would be able to find out the cause for the failure of a device or structure. On the other hand, forensic anthropology is a branch of forensic science which helps in the recognition and recovery of any skeletonized human remains. When the legal system needs linguistic expertise, forensic linguistic is generally resorted to. Odontology is the branch of forensic science which deals with the study of teeth.

An additional branch of forensic science is forensic photography, in which the accurate reproduction of a crime scene to be presented to a court of law is involved. Forensic psychology and psychiatry are taken into consideration by the court of law

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9 Ibid.
for providing human behaviour in legal matter. Forensic science in which the effect of drugs and poison on a person is dealt is known as toxicology.\(^{10}\)

In the field of entomology, one finds out the outcome of insects found in, on and around human remains with the help of this, it is feasible to find out the location of death and time of death and if the body was moved after death, the location of place. So it can be seen that forensic science plays an effective role in solving the complicated and unsolved cases.\(^{11}\)

From the time immemorial crime has been a part of human society. The requirement of law and various kinds of legislations was felt when crime started the very existence of the human society. There are various kinds of laws and regulation which fight against the crimes in the society. Crime is both social and economic phenomenon, by which whole human society gets distressed.\(^{12}\) The nature of the crime has been also changing and diversifying with the growth and development of the society. Presently, the guardian of law took the help from many techniques and advancement of science for fighting against crime. Many advancement have taken place in the field of forensic science which has been welcomed in the criminal investigation. Some of such advancements are discussed below in brief. However, any discrepancies that may have crept in are regretted.\(^{13}\)

It can be said that crime was present from time immemorial. Likewise, the investigation and detection of crime is also quite old. With the advancement of science and technology, the criminals have adopted new methods and techniques for committing offence, but science also helped the investigating authorities in their efforts to find out the criminals or real culprits. The Forensic Science is one of advanced techniques used in recognizing crimes and criminals. It is very challenging, charming, dynamic, and exiting science.\(^{14}\) The application of advance science which embraces all institution like Chemistry, Ballistic, photography, Physics, Brain Fingerprinting, Toxicology, Narcotics, DNA Profiling, Narco-Analysis, Biology, etc in criminal law is commonly understood as the forensic science in the field of law.

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10 Supra 7.
11 “Forensic Science”, available at: physicspost.com (visited on 12-12-2010).
The main functions of forensic science are the detection, collection, packing, transportation and analysis of physical evidence and biological material etc.

3.2 Narco-Analysis Test

Narcosis is a state of stupor induced by drugs. The use of narcotics as a therapeutic aid in psychiatric is believed to have a history dating back to the use of opium for mental disorder by the early Egyptians.\textsuperscript{15} Earlier in the 20\textsuperscript{th} Century the medical doctors started to use scopolamine together with morphine and chloroform to induce a state called ‘twilight sleep’ during childbirth as these have the effect of sedative. However, scopolamine was also known to create a state of disorientation, confusion and amnesia during the period of intoxication.

Narco-Analysis is a process whereby a subject is put to sleep or put into semi-somnolent state by means of chemical injection and was then interrogated while in this dream like state, or the process of injecting a ‘truth serum ‘drug into a patient /suspect to induce semi consciousness, and then interrogating the patient /suspect .This process has been utilized to enhance the memory of a witness.\textsuperscript{16}

In 1922, Robert House, a Texas based Obstetrician thinking that an alike method may be used to cross-examine the suspects in criminal examinations. For that reason he arranged for two suspected prisoners for investigation who were under trial and whose guilt seemed to be confirmed. Upon such investigation, both the person denied such charges and both on trial were found not to be guilty. This led Robert House to conclude that a person under the effect of scopolamine cannot lie, because there is no reason or power to think. His idea and experiment gained a lot of limelight and attention and therefore led the beginning of Narco-Analysis in criminal investigation.

During the process of Narco-Analysis test a person has no power to think due to the effect of drugs which was injected torn him. His idea and experiment gained a lot of limelight and attention and therefore led the introduction of Narco-Analysis in criminal investigation.

Narco-analysis has witnessed a mixed response from the judiciary, ranging from outright disapproval to reluctant and latent encouragement. For instance, in \textit{M.C}

\begin{itemize}
\item \textsuperscript{15} \textit{Id.}, 357.
\item \textsuperscript{16} P.Ramanatha Aiyer’s Law lexicon 3121, Edn. 2005.
\end{itemize}
Sekharan v. State of Kerala, the Kerala High Court took an acerbic approach towards the process, declaring unequivocally that it is against the fundamental right of an accused. However, during 2004-2009, various High Courts have been relaxed in commenting on the civil liberties aspect of Narco-Analysis while some have decreed it a permissible practice, in conformity with Part III of the Constitution.17 Thus the judicial tryst with Narco-Analysis in the previous decade had been one of the ambivalence or approval. The judiciary possibly viewed this practice to be a solution to compare the threat to internal security faced by India during the aforementioned period. 18

3.3 Polygraph or Lie Detector Test

The term ‘Polygraph literally means ‘many writings’ therefore the name refers to a process in which selected psychological activities are recorded.19 The first attempt in this direction was made to expand a scientific instrument to identify reality or fraud as early as 1895 by Lombroso. It was basically designed to record blood pressure and changes in pulse rate. Later Larsen and Keeler designed an instrument which was further developed by John Reid in 1947. The very fundamental principle underlying Polygraph is that when a person lie he becomes nervous, which in turn causes mental excitation. To conceal the excitement which the person attempts, adrenal glands are stimulated to secrete Adrenalin, which on entering the blood stream, sets up the blood pressure and rate of pulse and respiration. All these psychological changes when recorded are collectively called Polygram, which is analysed and evaluate to find out whether during the lie detection test, the subject experienced emotional stress with any of the questions asked.20

Such examination is performed on the basis of supposition that there is an intimate contact between mind and body and is performed by different components or the sensors of the Polygraph machine, which are attached to the body of the suspected person’s body that is being cross-examined. The principle behind the test is that the suspect fears detection of his/her lie and creates in him/her an emotion of fear which

20 Id.,65.
consequently results in psychological changes which are captured by different instrument.\textsuperscript{21} The blood pressure, pulse rate, respiration and muscle movements details etc recorded by the machine. This test is conducted at three stages namely pretest interview, chart recording and diagnosis. The examiners arrange a set of questions which depend upon the relevant information about the case which is provided by the investigation machinists such as the charges against the person and statements made by the suspects. The reaction which occurs during the examination of the suspect is recorded and measured. A baseline is created by the examiner by asking few question answer of which is already known to him. Whether a person is lying or not is recognized by behavioural and psychological changes, which the graph exposes. The sign of lie is derived from the base line. All such evidence is then corroborated with the other evidence collected. Keeler further developed the Polygraph machine by adding psycho-galvanometer, which would record electrical resistance of the skin.\textsuperscript{22}

3.4 Modern Advances in the Recognition of Dishonesty

Lombroso was the first to experiment with a machine measuring blood pressure and pulse to record in 1895. He is known as the founding father of criminology. It was called by him a hydroshygmograph. An identical device was employed by Harvard psychologist William Marston during World War I in espionage cases, who brought the technique into American court systems. In 1921, John Larson added the thing of respiration rate, and, Leonard Keeler, who was one of the founding fathers of forensic science, added skin conductance and an amplifier by 1939, therefore indication the birth of the Polygraph as it is known by us today. Polygraph (Lie-Detector) is based on the principle of psychosomatic interactions of an individual i.e. psychologically a change in a person's deliberately held feeling produces a defense reaction in the form of physiological changes in his blood pressure, pulse rate, respiration and electro-dermal response(GSR).\textsuperscript{23}

The main modernization in the Polygraph has been the introduction of computer to record and analyse the physiological reaction and data, although a few innovations in the input devices to increase the number of recording, to reduce the

\textsuperscript{21} Supra 5, 457.
discomfort and decrease the time for testing have also come up. Computerized Polygraphs have the following advantages:

- Operational training need less time
- make available better interpretable data
- No frequent calibrations as in traditional Polygraphs due to pen distortion.\(^{24}\)

Furthermore the successful process of Polygraph depends on the experience, personality, integrity of the examiner, proper operational environment and interrogation room.\(^{25}\)

### 3.5 Brain Mapping or P300 Test

Dr. Lawrence A. Farwell, Director and Chief scientist of ‘Brain Wave Science’ IWOA developed this test and patented in the year 1995. He was a well known neurologist. This technique is also known as ‘Brain wave finger printing’. In this technique, the suspect is first interviewed and interrogated to find out whether he is concealing any important information. Then sensors are attached to the head and the person is made to sit in front of a computer monitor. He is then shown and made to hear certain images and voice. The sensor attached to head monitors and records electrical activity and P300 waves in the brain, which is produced only if the subject has link with stimulus. The subject is not asked any question. To put it simply, it simply means that brain finger printing matches the information stored in the brain with that of the related crime and crime scene. In case of an innocent person no such P300 waves would get registered during the test\(^{26}\).

In India, the first Forensic laboratory which used this technique is Forensic laboratory of Bangalore. Proof produced by Expert in a criminal trial would be just a fraction of the totality of the evidence on the appreciation of which the judge or jury takes judgment. The Court takes into account all the other proofs at hand along with the view of the scientific expert, which is just one piece of evidence needed to be taken into consideration and appreciated for its evidentiary value. Even after the validity of the technique of brain fingerprinting satisfies Daubert's criteria, its application as a forensic tool in individual cases will depend upon the genuineness of

\(^{24}\) “Admissibility of Scientific Evidence and the Bias against Lie Detection available”, available at: www.legalservice.com (visited on 05-12-2013).

\(^{25}\) Ibid.

\(^{26}\) Supra 2.
the investigation and other factors. The test would not be applicable in a case in which two suspects in an investigation were both present at a crime, but one was a witness and the other a perpetrator. The method can only detect information from their memory that would place both at the scene of the crime and it cannot decide what their roles were, thereby creating a distinct possibility of an innocent eye-witness becoming a suspect of the crime and giving a dubious opportunity to the real culprit to create a situation of doubt. Moreover, the method would not be definitive in a case in which investigators do not have sufficient information about a crime to be able to test a suspect for crime-relevant information stored in the brain. The brain-fingerprinting analysis identifies the existence or nonexistence of information and not the guilt or innocence per se. In few cases, a person may possess virtually all the available information about a crime, although he is not a perpetrator. In such cases, possessing relevant information with respect to crime will not recognize that individual as the perpetrator and the test cannot be applied to solve the case. The heuristics proposed consists of five basic parts and emphasizes the underlying principles common to all fields of science. It is suggested by the author that the judges and the lawyers who assist them about their cases, must be able to do five things: (i) Identify and examine the proffered theory and hypothesis for their power to explain the data; (ii) Examine the data that supports (and undermines) the expert's theory; (iii) Use supportable assumptions to fill the inevitable gaps between data and theory; (iv) Examine the methodology; and (v) Engage in probabilistic assessment of the link between the data and the hypothesis.

3.6 DNA Profiling

One of the latest growing and most reliable modes of investigation in forensic science is DNA profiling. DNA is the abbreviation of the term, “Deoxyribose Nucleic Acid”. It is an organic substance which is found in every living cell and which gives an individual genetic blue print. DNA can be obtained from a wide variety of sources like, blood, semen, bone, saliva etc.

28 Ibid.
29 Id.
DNA was first discovered by Fredrick Micscher in the year 1869. Sir Alec J. Jeffery discovered the use of DNA in forensic analysis in 1984 in England and it was first used in the famous Endbury case wherein two girls were raped and murdered. Since then scientists have developed various techniques like RFLP and later another technique was developed which is known as PCR. PCR had advantages over RFLP as it takes lesser number of samples and replicates them in manifolds. It is quicker and cost effective. It also enabled to analyze highly degraded samples and therefore it is the most widely followed method of DNA profiling.

DNA tests are highly effective because each individual’s DNA is unique except the twins. The probability of DNA being same is one in three billion. And it is credible because it cannot be tampered with. DNA test can be used in various cases in order to such as to establish the parentage of a child, identify mutilated dead bodies etc.

### 3.6.1 Paternity

The raison d’être under the Indian Evidence Act, 1872, is against the legitimization of a child and the public policy is that no child should suffer due to lapses on the part of their parents. It is well established that when certain fact is considered as conclusive proof of another fact, the judiciary generally disables the party in disrupting such proof. The only exception occurs when the party is able to show that there was no access to the other party when the conception could have taken place. Whenever paternity is contested, the burden of proof is on the party pleading negative.

In the famous case of *Gautam Kundu v West Bengal* the apex court has laid down certain note-worthy guidelines regarding DNA test and their admissibility in the parentage case.

1. The courts in India cannot order blood test as a matter of course.

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32 Restriction Fragment Length Polymerase.
33 Polymerase Chain Reaction Technique.
34 Sec. 6 of Indian Evidence Act, 1872.
35 Sec. 112 of Indian Evidence Act, 1872.
2. Whenever application is made for such prayer in order to have roving enquiry, the prayer of blood test cannot be entertained.

3. There must be strong prima facie case in which the husband must have established non-access in order to dispel the presumption arising under section 112 of Indian Evidence Act, 1872,

4. The court should carefully examine as to what would be the consequence of ordering the blood test.

5. No one can be compelled to give blood sample for analysis.

   In case of *Kanti Devi v Poshi Ram* \(^{37}\) the Supreme Court held that even a DNA test that indicated that the person is not the father of the child would not be enough to rebut the conclusiveness of marriage as proof of legitimacy of child.

   Section 125 of the Code of Criminal Procedure code, 1973 lamented that the natural and fundamental duty of a man is to maintain his legally wedded wife, children and parents so long as they are unable to maintain themselves.

   The famous *9/11 in U.S.A* attack left none in any doubt about the great capacity and capability of the criminals of that era found their modus operandi used in the commission of such crime. Hence there is an urgent need for modification of the crime investigation process and tools were felt. The development of DNA is a welcome step and it has become more and more reliable instrument. Unlike civil paternity case, Indian courts have accepted the role of DNA in criminal paternity case. Likewise in *Rajiv Gandhi Murder Case* \(^{38}\), the DNA samples of alleged assassin Dhanu were compared with her relatives, which gave conclusive proof about her being involved in the gruesome attack. Similarly in the famous *Tandoor murder case*, the DNA samples of the victim Naina Sahni were compared with that of her parents to establish her identity.

### 3.7 Fingerprints

Though fingerprints have been used by the crime investigators for more than a century, they persist one of the most requisite after pieces of evidence. All human beings are born with a characteristic set of ridges on the fingertips. The ridges, which are rich in sweat pores, form a pattern that remains fixed for life. Even if the skin is

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\(^{37}\) AIR 2001 S.C 2026.

\(^{38}\) AIR 1993 SC.
removed, the same pattern will be evident when the skin regenerates. Some of the typical patterns found in fingerprints are arches, loops, and whorls. Oils from sweat glands collect on these ridges. When we touch something, a small amount of the oils and other materials on the fingers are left on the surface of the object we touched. The pattern left by these substances, which collect along the ridges on our fingers, make up the fingerprints that police look for at the scene of a crime. It is the unique pattern made by these ridges that motivate the police to record people's fingerprints. To take someone's fingerprints, the ends of the person's fingers are first covered with ink. The fingers are then rolled; one at a time, on a smooth surface to make an imprint that can be preserved. Fingerprints collected as evidence can be compared with fingerprints on file or taken from a suspect.  

Everyone entering the military services, like the merchant marine, or any other organizations are fingerprinted. The FBI maintains a fingerprint library with patterns taken from more than 10% of the entire United States population. Each year the FBI responds to thousands of requests to compare samples collected as evidence with those in file at their library. The process of comparison has been improved in terms of speed and effectiveness in recent years by the development of automated fingerprint identification systems (AFIS) that allows the police departments with computer access to search the collection. In many other countries investigating authorities have also fingerprint data to have their records as well as if someone of them got indulged in a crime so that they can easily be found out.

Many fingerprints found at crime scenes are not visible. These latent (conceded) fingerprints, which are often incomplete, are obtained in various ways. The oldest and most frequently used method is to use a powder such as ninhydrin to dust the surface. The powder sticks to the oily substances on the print making the pattern visible. The print can then be photographed and lifted off the surface by using a tape to which the powder adheres. To search for fingerprints on porous materials such as paper, forensic technicians use fumes of iodine or cyanoacrylate. These fumes readily collect on the oils in the print pattern and can be photographed. Since 1978, argon lasers have also been used to view latent fingerprints. When illuminated by light from an argon laser, a latent print is often quite visible. Visibility under laser

light can be enhanced by first dusting the print with a fluorescent fingerprint powder.\footnote{Ibid.}

Fingerprints are not the only incriminating patterns that a criminal may leave behind. Lip prints are frequently found on glasses. Footprints and the soil left on the print may match those found in a search of an accused person's premises. Tire tracks, bite marks, toe prints, and prints left by bare feet may also provide useful evidence. In cases where the identity of a victim is difficult because of tissue decomposition or death caused by explosions or extremely forceful collisions, a victim's teeth may be used for comparison with the dental records of missing people.\footnote{“Forensic science fingerprint”, available at : http://science/ jrank. Org. / Forensic -Science - Fingerprints. Htm(visited on date 24-10-2012).} Every coin has two sides. Every technology or knowledge created can be used or misused by the user. But that cannot be used as a ground to reject development of the knowledge.

Thus scientific evidence is an inescapable facet of modern litigation. The faulty analysis of scientific evidence would deprive the litigants of intellectual due process from judges and undercut the proper functioning and credibility of the judicial system. In USA, more than 140 people convicted of murder were exonerated using DNA test. Isn’t it sufficient to prove the development very useful? The criminal justice system is supposed to be based on just and equitable principles. The task of the Court is to industriously understand the scientific evidence and assess its value, without being affected by commercial publicity given to the scientific inventions patented for use of science as commerce.

Our criminal justice system has to be upgraded so as to leave no stone unturned to save an innocent person and to affirm that a criminal does not get away at the cost of innocent life. Our criminal justice system says let hundred guilty one get away but let not one innocent suffer. It’s high time for us to develop our system to the level that none of the criminals get away without being punished for their crime because when they are able to do so, their victims are being denied justice and that frustrates the whole system. Let’s hope all these developments of forensic science would be a sufficient tool in the hands of the people fighting crime so as to arm them against it and make the system work to establish more and more just and safe place for people live in peace and prosperity\footnote{supra 16.}.
3.8 Brain fingerprinting

Brain Fingerprinting is yet another latest innovative computer technology to recognize the criminal accurately and scientifically by measuring brain-wave responses to crime-relevant words or pictures presented on a computer screen. Brain Fingerprinting has proven 100% accurate in over 120 tests, including tests on FBI agents, tests for a US intelligence agency and for the US Navy, and tests on real-life situations including misdemeanor crimes. The same system is also adopted in most European as well as developed countries.

Brain fingerprinting is based on the finding that the brain generates a unique brain wave pattern when a person encounters a well-known use of functional magnetic resonance imaging in lie detection derives from the studies suggesting that persons asked to lie show different patterns of brain activity than they do when being truthful. Issues related to the use of such evidence in the courts would be discussed later.

In the field of criminology, a new lie detector has been developed in the United States of America. This is called “brain finger printing.” This discovery is supposed to be the best lie detector available as on that date and is said to perceive even smooth criminals who pass the Polygraph test (the predictable lie detector test) with ease. The latest method employs brain waves, which are useful in detecting whether the person subjected to the test, remembers finer details of the crime. Even if the person willingly suppresses the necessary information, the brain wave is sure to trap him, according to the experts.

When a crime is committed, a record is stored in the brain of the doer .Brain Fingerprinting provides a means to objectively and scientifically connect evidence from the crime scene with evidence stored in the brain of the perpetrator. (This is similar to the process of connecting DNA samples from the perpetrator with biological evidence found at the scene of the crime; only the evidence evaluated by Brain Fingerprinting is the evidence stored in the brain.) Brain Fingerprinting measures electrical brain activity in response to crime-relevant words or pictures presented on a computer screen, and reveals a brain MERMER (memory and encoding related multifaceted electroencephalographic response) when, and only when, the evidence stored in the brain matches the evidence from the crime scene.
Thus, the guilty can be identified and the innocent can be cleared in an accurate, scientific, objective, non-invasive, non-stressful, and non-testimonial manner.43

3.9 Ballistic Fingerprinting

Ballistic fingerprinting is one of the important branch of Forensic Science. It is another type of evidence. In ballistic Fingerprinting the distinctive marking left on ammunition as a result of its use in a specific weapon. During the late 15th Century gun maker found that the addition of groove to the inner surface of a gun barrel improved the accuracy of bullet fired from the gun. Bullets fired from rifled the gun barrel. The pattern of scratches on the bullet matches those in the gun barrel. A gun barrel with seven helical grooves, for example results in a pattern of seven scratches on a bullet, fired from the gun. Since rifling pattern tends to differ from weapon to weapon, the pattern they produce on bullets fired from them tend to be distinctive, perhaps unique.44

3.10 Other techniques of forensic Science

There are other new Forensic Science techniques which are helpful in the field of forensic science.

3.10.1 Binocular for identifying Dangerous gases

It is a device, which is known as polychromatic, is developed to spot and identify gases from two miles away when attached to binoculars. The system works by identifying the holographic signature of gases using infrared light to build up a 3-dimentional pattern of the composition of the gas. Within the binocular, a small hologram is programmed to mimic the chemical signature of any gas and by comparing it with the light from the gas, the two can be matched to identify the gas. The process takes less than a millisecond and can be used to simultaneously identify number of gases. To identify the chemical weapon, the soldier can use it mainly for military and defence purposes. Fireman can also use it for the assessment of burning factories, houses and building. It may also be used for checking cars exhaust fumes in future. This device can suitably be adapted for preventive forensic application.45

44 David E. Newton, DNA evidence and Forensic Science 21(Viva Book Publication, New Delhi, 2006).
45 Supra 2, 219.
3.10.2 Remote personal assessment

It is a covert technique of forensic Science. It uses microwaves or lasers to assess the stress on the person remotely, covertly.

3.10.3 Psycholinguistic profile

It is a profile of a criminal based upon his written and spoken words and texts used by the criminal. Competent Forensic Psychologist can draw a fairly accurate description of the possible criminal from the written or spoken (or both) words.

3.10.4 Criminal Profiling

It is criminal’s profiling based on his action and behaviour. His acts, behaviour, mannerism and expressions are used to construct his profile.

3.10.5 Psychological Stress evaluator

It uses a voice spectrograph to study changes in vibration in the subsonic sound. Waves under interrogative stress when the subject tells lie in answer to the question, to find the truth.46

3.10.6 Forensic Acoustics- Speaker identification

Like variation in the face, fingerprint, and other biological parameters are discernible from one person to another, the voice also differs from one person to another. Voice analysis is essentially a sound spectrograph based technique, which is used to compare the recorded voice of an unknown individual to a known recorded voice sample of a suspected kidnapper, extortionist, terrorist, and others who communicate their intent to commit violent acts. The Central Forensic Science Laboratory (CFSL) and Central Bureau of Investigation (CBI) is using the spectrographic technique coupled with linguistic analysis for forensic investigation. CFSL and CBI is also collecting acoustic and phonetic data of English and Hindi utterances from speakers of different dialects of North India for fixing their regional identify. CFSL, Chandigarh is working on the development of speaker identification system and conducting research regarding the reliability of the examination under varying conditions of recording, fidelity, interfering background sounds, sample size, voice disguise, restrictive frequency range, non-voice sounds and other factors commonly encountered in investigative matters with the help of computer and

artificial intelligence. With this development, the employment of voice analysis for crime investigation and court testimony purposes will become practicable in the country.47

3.11 Relation of Forensic Science with Crime Investigation: An Analysis

Crime is as old as the human civilization. Likewise also the conviction of the wrongdoer and punishment in one form or the other also existed in society. After the enactment of various laws, the criminals are put on trial, in the courts of law for establishment guilt or innocence of a person. The guilty persons are non convicted by the courts and punished for their acts. The traditional methods have not proved very fruitful in attaining the required conviction rate. In recent years, due to the application of knowledge and techniques of forensic science, there has been relatively higher increase in the conviction of various crimes but still the conviction rate is not in balance with the crimes committed. Forensic Science in the investigation of crime and in the administration justice is surely a versatile tool.48 Forensic Science can be defined as Criminalistic science. In other words, the scientific studies or investigation of crime can be termed as Forensic Science. Along with the development of science and technology the pattern of our society has also changed to cope with the day to day development. Accordingly the criminal also often uses different techniques for the commission of various crimes within our society. So it has become a problem for the law enforcing agencies to check the potentiality of crimes. For such checking, the need of forensic science becomes an essential prerequisite on the part of the investigative agencies.

Considering the huge necessity and importance of forensic science, the Govt. of India has established a few forensic science laboratories in the different parts of our country. Similarly the Govt. of various states have also established some forensic science laboratories. For example, the Govt. of Assam has established a forensic science laboratory at Guwahati.

Forensic Science Laboratory, Assam is a scientific institution under the Police Department established in the year 1967. This laboratory has been established in the

47 Supra 30, 214.
48 Prof. Vimla Veeraghavan (ed.), Handbook of Forensic Science 1(Selective and Scientific Book Publisher, 2004).
pattern of an ideal forensic science laboratory, comprising eight important branches of science like Chemistry, Physics, Biology, Serology, Ballistics, Toxicology, Question Documents and Photography.49

The operation of forensic science is nothing but the application of techniques and methods of basic science techniques and methods of basic science for different analyses of different crimes. Since its beginning, the scientists of the Forensic Science Laboratory, Assam have been rendering invaluable service to the investigating agencies in various ways for the cause of justice.

The scientific examinations of a forensic scientist adjoins a missing link or strengthens the investigation by furnishing an impartial evidence, thus helping the courts to come to a conclusion regarding the criminals and their punishments. The field of study or examination of forensic scientist is very wide, diversible and unpredictable. Generally the duties and responsibilities of forensic scientists are very hazardous, onerous and risk bearing too. Because they are to deal with the material exhibits pertaining to various nature of crimes such as murder, rape, blood, saliva, firearms, ammunitions, explosives, and explosives substances, liquor, hashish, opium, adulterated petrol, kerosene, diesel, etc. and other chemical vehicles involved in accidents, various types of paints. Weapons used in burglary, arson, etc. different types of poisons and poisons and poisonous substances, hair, skeletal remains and other plant or animal remnants. Apart from these, forensic scientists also examine the forged signatures and documents along with the photographic analysis of all materials exhibits. Any material exhibit encountered in the way of investigation needs to be thoroughly examined to prove or disprove its association with a particular crime or criminal. Practically the forensic scientists are to examine the material exhibits connected with various nature of crimes covering the sections of Indian Penal Code and other relevant Acts and the laws of the land. Unlike other research and analytical materials, forensic scientists are required to work with limited quantity and amount of materials generally left behind or carried away by criminals.50

For better collection of exhibits for various range of studies, forensic scientists are often summoned to the scene of crime so as to assist the investigation agencies in

50 Supra 18.
determining the clue by means of scientific analysis. So far, the duties and role of forensic scientists in general have been discussed. The role and nature of forensic scientist of different branches in connection with their respective and specialized field of work shall also have to be discussed.

Let us discuss about the forensic physicists. Generally the material exhibits which are obtained at the scene of crime are examined by the scientists of this division. Besides, comparative studies of various impressions and marks of tools etc. used in commission of crime are also made in this division. Determination of forced engine or chassis marks or restoration of an erased number upon metallic dates are also determined by the scientist of this division. Analysis of paints and glass articles, stamp impressions of forest authorities can be examined by these scientists to establish the relevant facts for the determination of clues of commission of crimes and criminals.  

Secondly the scientists of forensic chemistry are equally busy determining clues of crime and detection of criminals by their various methods of analysis. For instance it is the forensic chemist who has to determine purity of petrol, diesel and kerosene from samples. They are also to determine the quality of liquor, opium, ganja and other chemicals, analysis of explosive and the like. From their various methods of analysis, they have to establish facts which are based upon which the investigating officers can detect the clues of a particular crime.

Forensic biologists have also been playing an important and commendable role in examining biological exhibits oriented with crime. It is the biologist who has to analyze the material exhibit starting from a micro organism to a higher plant or an animal and also their parts and products. From the skeletal remains, a biologist has to determine the sex, origin, stature, and age of the deceased. He is to identify from the skull by using superimposition method and thereby help the investigating authority in coming to a conclusion with the regard to a particular crime. In case of a suspected death case, the biologist has to ascertain the cause of death. He has also to analyze various poisonous plant materials in cases where plant poison is administered in the commission of crimes.

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51 Ibid.
A Serologist plays equally important role in establishing facts in respect of various crimes. In case of a murder where knife and other weapons are involved, it is the serologist who ascertains whether the particular weapon is stained with human blood or not. From the findings of a serologist, the investigating officer can get a definite clue in a particular case, depending on which the investigating officer can identify the culprit of the crime. It is the serologist who has to establish the facts of disputed paternity cases by testing the blood group in question.

Now, with regard to the ballistic branch of forensic science it may be stated that a ballistic expert is the only person who ascertains whether a particular fire arm was used or not while committing a crime. He is also to examine the types of fire arms and ammunitions used in commission of a crime. He has also to establish the facts with regard to firing ranges, distance, direction, and angle of firing. After obtaining the opinion of a ballistic expert the investigating officers can come to a reasonable conclusion in respect of a particular crime. Apart from the different fire arms and ammunitions, a ballistic expert is also expected to examine the explosive substances which are nowadays very often used for committing heinous crimes.

A toxicologist determines the clues of the crime in which the poison is used. In any such case, be it accidental, suicidal or intentional, a toxicologist analyses the viscera and other relevant materials from which he establishes the quality and quantity of the poison used. From the report of a toxicologist, the investigating officer can usually obtain vital clues for detecting the criminals involved. Similarly, the Court also gets positive evidence for coming to a conclusion in any particular case.

A document expert examines the various types of documents directly or indirectly involved in a forgery case. The forgery cases may be of different types, but all these are examined by the handwriting expert. From the report of a document examiner, the investigating agency can definitely detect the real culprit of a particular case. Apart from the forged signatures or documents, a handwriting expert often gives opinion on typed papers, time of writing and the age of the ink used for writing a questionable document. So the opinion of a handwriting expert also helps the court to reach the conclusion in meeting the ends of justice.

From the above discussion it can be concluded that the forensic scientists by the very nature of their work is duty bound for the establishment of justice to the
society. As a matter of fact forensic scientists are playing a vital role in reducing the potentiality of crime and also in determining the root causes of crime in our society.

3.12 Forensic Science Unit

The introduction of molecular techniques into environmental and forensic sciences has opened up an entirely new window of observation into our world's biology and its history. However, the very sensitive nature of such methods leaves them particularly prone to error and artifact. This is especially true in the analysis of problematic samples with suboptimal nucleic acid quantity or quality, as is often the case in microbial ecological studies and ancient DNA investigations. Numerous studies have highlighted the potential sources and extent of artifact in such molecular approaches, but such cautionary messages have generally gone unheeded. Some unavoidable sources of error and artifact are inherent to molecular studies and must simply be kept in mind when interpreting the robustness of results. Other causes of error can at least be partially addressed via good laboratory practice measures, proper controls and thorough data scrutiny. Some laboratories and disciplines have been keen to adopt appropriate measures to circumvent some of the validity issues involved in molecular studies, whereas others lag behind. Here, we identify sources of error, contamination and artifact in nucleic acid-based studies, especially as they apply to the problematic material, suboptimal in sample size, source, quality or purity. In evaluating these concerns, we further offer some considerations and suggestions to help minimize sources of error and artifacts in laboratories studying molecular ecology and evolution with frequently problematic, and usually rare, sample materials.52

Thus it can be asserted that Forensic science is gaining solid ground in the area of effective crime prevention, especially in the areas where more sophisticated use of available technology is prevalent.53 All it takes is high-level cooperation among nations that can help them deal with criminality. It is apparent that cooperation will not be enough on its own and this development will require a network of qualified forensic laboratories spread over Europe. Forensic science laboratories need to be better involved in the fight against crime. For this to be achieved, a good level of

53 Supra 21.
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cooperation should be established and maintained. It is also to be noted that harmonization is required for such cooperation and seeking accreditation according to an internationally acceptable standard, such as ISO/VIEC 17025, will eventually bring harmonization as an end result. Because, ISO/VIEC 17025 as an international standard, has been a tool that helps forensic science laboratories in the current trend towards accreditation that can be observed not only in Europe, but also in the rest of the world of forensic science. In the introduction part, ISO/IEC 17025 states that “the acceptance of testing and calibration results between countries should be facilitated if laboratories comply with this international standard and if they obtain accreditation from bodies which have entered into mutual recognition agreements with equivalent bodies in other countries using this international standard.” Furthermore, it is emphasized that the use of this international standard will assist in the harmonization of standards and procedures. The background of forensic science cooperation in Europe will be explained by using an existing European forensic science network, i.e. ENFSI, in order to understand the current status of forensic science in Europe better.

The function of the Forensic Science laboratory may be determined by the three factors (1) what is technically capable of being done; (2) the awareness of police forces served by it of what it can do and (3) the pattern of crime in the area which it serves. Forensic Science service laboratories scattered around the country, some of which are stranger on certain scientific discipline and some on other – firearms etc.

3.13 Conclusion

The Present World is the World of advance science and technology and of new researches in every field. The rate at which the globe has progressed is commendable. Advance technology has given the World an effective and precise tool for the purpose of criminal investigation. Presently forensic science plays vital role in crime and criminal detection. There are various techniques relating with the important role in detection of crime. DNA Profiling, Brain fingerprinting, Brain Mapping, Narco-Analysis, Polygraph test, Forensic photography etc. are the important techniques in the field of forensic science which play pivotal role in criminal investigation to find out the crime and criminals. At today the investigating authority are employing these effective modern techniques in solving the crime problems.