Chapter II

Conceptual Analysis of Forensic Science and its Relevancy in Crime Investigation: A Panoramic View
CONCEPTUAL ANALYSIS OF FORENSIC SCIENCE AND ITS RELEVANCY IN CRIME INVESTIGATION: A PANORAMIC VIEW

2.1 Introduction

Crime is as old as civilization itself. The day “homo Sapience” became sophisticated crime was defined. Societal norms were set for identifying the do’s and don’ts for the people, if they were to live together. The clear aim was to recognize the people who do not go behind the lay down norms, penalize them and isolate them from the mainstream and therefore keep the society clean. This gave birth to the processes of discovery and investigation of crime and administration of criminal justice, which in order, led to the establishment of institution for investigation, trial and for imparting impartiality. Originally, the criminal justice delivery system profoundly depended on the testimony of eyewitness to the crime. The dependence on “eyewitness” did not prove to be effective, as they were found to turn hostile, many a time due to threat to life or lure of money, hence it lacked reliability. The crime investigators then resorted to “third degree methods” for examination of the suspect to reveal the truth, which, due to the cultural change and values accepted generally, were considered cruel, as many innocent people also suffered and sometimes inadvertently. In the meantime, lot of scientific research and development took place, and it was then visualized that the modern scientific techniques could provide quick solution to a majority of problem of human being, and therefore, crime investigation of “forensic science” got evolved.1

2.2 Definitional Aspect:

Forensic science is science used for the purpose of the law and thus any branch of science used in the resolution of legal disputes is forensic science. In the broadest sense, forensic science is any science used in the resolution of legal conflicts. The word “forensic” is rooted in Latin word ‘forensis’. The dictionary meaning of word the “forensic” is “relating to court or law” or “relating to court of law”. But in legal terminology it may mean “the science which deals with the principles and practice of different branches of science which elucidates doubtful questions in court

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of justice”. It is a science composing of those matters which may be considered as common ground to both the scientists and the legal practitioners.\footnote{Deepak Ratan and Mohd. H. Zaidi, \textit{Application of Forensic Science in India and World} 28 (Alia Law Agency, Allahabad, edn. 2008).} The ancient Roman forum was the site of debate concerning governmental issues, but it also was the courthouse, where trials were held. Therefore, forensic science has come to mean the study and practice of applying natural and physical sciences to the just resolution of social and legal issues. Its use by the legal system distinguishes it from other science; the expectation of routine appearances in a court of law distinguishes a forensic scientist from other scientists. Forensic science subsists coming together with law and science. Even though forensic science has been identified intimately with the criminal justice system in the past, now the forensic scientist plays a gradually more active role in civil proceedings and in regulatory issues. Virtually no limitation exists to the scope of physical evidence that is gist for all forensic scientists. Physical evidence may range in size from the microscopic (for example, a pollen grain) to the macroscopic (for example, a diesel truck). It may be as appalling as the lifeless body of a battered child, as intangible as the brief vapors of gasoline following a suspected arson fire, or as obscure as the composition of dyes in the ink of a contested will.\footnote{John I. Thornton, “Uses and Abuses of Forensic Science”69 American Bar Association Journal 289(1983).} This wide meaning covers criminal prosecutions in the widest sense, together with patrons and ecological safeguard and physical condition and protection at work, as well as civil proceeding such as violate of agreement and negligence. On the other hand, in universal practice the term is applied more narrowly to use of science in the in the investigation of crime by the police and by the courts as evidence in resolving the issue in any subsequent trial.\footnote{Peter White (ed.), \textit{Crime Scene to Court The Essential of Forensic Science}1 (RSC Publication, Cambridge, 1998).} Forensic Science is basically the application of science to law. Forensic science is used to investigate criminal cases involving a victim, such as assault, robbery, kidnapping; rape, murder and civil cases such as forgeries, fraud, or negligence. Forensic science also determines as to whether laws or policies have been dishonored in the marketing of items relating to food and drink, manufacturing of medicine, agricultural particular use, automobile discharge observance, consumption water cleanliness, and monitoring international secret nuclear weapons etc. The first aspect of applied Forensic Science commence with the recognition or individualization might merely be probable after conducting chemical
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or scientific Test. Kinds of evidence that requires testing to ensure correct recognition comprise bloodstains, body fluid, drugs, arson accelerants and other chemicals. The recognition of unidentified material or object may be attained through comparing their characteristics with those of the known standard and established criteria or data base information. In the Forensic examination of fiber and hairs, determination of fiber type, form, due composition, elucidation of colour, species or anatomical origins utilizes class characteristics for such identification. The eventual goal of the recognition process in forensic science is individualization, specifically to say that a meticulous piece of evidence originates from a precise locus, scene or person. In reality few type of evidence can be unambiguously individualized like fingerprint and DNA evidence. All other type of evidence can be said to be reliable with originating from a meticulous resource, site or individual, if appropriately identified. Many of the classical database, technique and test now routinely used in the forensic recognition have been created, for some discipline; have taken centuries and for more recent technologies, a few decades. To describe the past growth and development of forensic science, the ongoing discussion would largely deal with the recognized occurrence of the organizational and developmental aspect of numerous discipline as well as specialities within the profession, outlining the profession from basic conception to the application of some methodologies and techniques used today. The progress of the field originates with the universal improvement of a number of different areas of expertise or subspecialty scientific discipline with the rate of exam progress or development of each discipline being tremendously changeable, because of complication, geographical site or availability of financial resource and technology.

2.3 Forensic Sciences and Its Historical Perspectives

Crime in some form or the other has always existed since the beginning of human race. With the advancement in science and technology, the concepts of crime as well as the methods adopted by criminals in its commission has undergone a phenomenal change. On one hand, the intelligent criminal has been quick to exploit science for his criminal acts and on the other hand, the investigator is no longer able

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6 Dr. B.R. Sharma, Forensic Science in Criminal Investigation and Trial 2 (Universal Law Publishing Co., New Delhi).
7 Supra 2.
to rely on age old art of interrogation and methods to detect crime. Criminalistic is synonym which is used in U.S.A. If one remembers the term ‘Eureka’, then one would also know where the history of Forensic Science originated. History considers Archimedes (287-212 BC), the man behind the exclamation ‘Eureka,’ as the father of forensic science. He was exulted when he had found out that a crown was not made of gold, (as it was falsely claimed) by its density and buoyancy. After Archimedes, another early forensic science application was made by Mr. Soleiman, an Arabic merchant of the 7th century. He used fingerprints as a proof of validity between debtors and lenders. In the 700s, the Chinese also used the fingerprint concept. In the 1000s, Quintillion, a prosecutor in the Roman courts, used a similar method to solve murders. The first document that mentions the use of Forensics in the legal matters is the book Xi Yuan Ji Lu (translated as “Collected Cases of Injustice Rectified”) written in 1248 by the Chinese author Song Ci. Forensic science became quite widespread in the 16th century Europe. Medics began to use their knowledge to investigate the cause of death. Ambrose Paré, a French army surgeon, two Italian surgeons, Fortunato Fidelis and Paolo Zacchia were some of the well known pioneers in this field. Then we have a series of written record like “A Treatise on Forensic Medicine and Public Health” by the French physician Fodéré and “The Complete System of Police Medicine” by the German medic Johann Peter Franck and the first dissertation on systematic document examination published by François Demelle of France. In 1686, Marcello Malpighi, a professor of anatomy at the University of Bologna, identified the fingerprint method. In the 18th century, many scholars did some groundbreaking work in Forensics. Swedish chemist Carl Wilhelm Scheele and German chemist Valentine Ross led the way. England also solved a number of murder cases using forensic science. For instance, in the year 1784 in Lancaster, John Toms was convicted of murder, when a torn bit of a newspaper in a gun was found matching a leftover paper in his pocket. In the 19th century, scholars like Thomas Bewick, an English naturalist, Spanish professor of medicinal/forensic chemistry Mathiew Orfila, John Evangelist Purkinji, professor of anatomy at the University of Breslau, to name a few, made history in forensic science. Eugene François Vidocq is another name in record since he established the first detective force, the Surety of Paris. Arthur Conan Doyle of course cannot be forgotten, who wrote the first Sherlock Holmes case in Bee ton’s Christmas Annual of London. By the 20th century, it was the time when we got the Federal Bureau of Investigation (FBI) which launched its Automated Fingerprint
Identification System (AFIS) with the first computerized scans. With the arrival of the computers, there was no looking back. Today there is no crime solving without the help of forensic science. The history of Forensic Science is there to prove its worth. 8

2.4 Forensic Science Timeline

BCE  Fingerprints were found in early paintings and in rock carvings of prehistoric humans. The Chinese used fingerprints to establish identity of documents and clay sculpture, but without any formal classification system. (700s) while Quintilian, an attorney in the Roman courts, showed that bloody palm prints were meant to frame a blind man of his mother’s murder. (ca. 1000)

A Chinese book, Hsi Duan Yu (the washing away of wrongs), contains a description of how to distinguish drowning from strangulation. This was the first recorded application of medical knowledge to the solution of crime. (1248)

In Lancaster, England, John Toms was convicted of murder on the basis of the torn edge of wad of newspaper in a pistol matching a remaining piece in his pocket. This was one of the first documented uses of physical matching. (1784)

Thomas Bewick, an English naturalist, used engravings of his own fingerprints to identify books he published. (1800s)

In 1813 Mathiew Orfila, a Spaniard who became professor of medicinal/forensic chemistry at University of Paris, published Traite des Poisons Tires des Regnes Mineral, Vegetal et Animal, ou Toxicologie General l. Orfila is considered the father of modern toxicology. He also made significant contributions to the development of tests for the presence of blood in a forensic context and is credited as the first to attempt the use of a microscope in the assessment of blood and semen stains.

In 1823 John Evangelist Purkinji, a professor of anatomy at the University of Breslau, Czecheslovakia, published the first paper on the nature of fingerprints and suggested a classification system based on nine major types. However, he failed to recognize their individualizing potential.

In the year 1828 William Nichol invented the polarizing light microscope.

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In 1830 Adolphe Quetelet, a Belgian statistician, provided the foundation for Brillion’s work by stating his belief that no two human bodies were exactly alike.

In 1835, Henry Goddard, one of Scotland Yard’s original Bow Street Runners, first used bullet comparison to catch a murderer. His comparison was based on a visible flaw in the bullet which was traced back to a mold.

In 1836 James Marsh, a Scottish chemist, was the first to use toxicology (arsenic detection) in a jury trial.

In 1839 H. Bayard published the first reliable procedures for the microscopic detection of sperm. He also noted the different microscopic characteristics of various different substrate fabrics.

In 1851 Jean Servais Stas, a chemistry professor from Brussels, Belgium, was the first who successfully identified vegetable poisons in body tissue.

Ludwig Teichmann, in Kracow, Poland, developed the first microscopic crystal test for hemoglobin using hemin crystals in 1853.

In 1854, An English physician, Maddox, developed dry plate photography, eclipsing M. Daguerre’s wet plate on tin method. This made practical the photographing of inmates for prison records.

In 1863 the German scientist Schönbein first discovered the ability of hemoglobin to oxidize hydrogen peroxide making it foam. This resulted in first presumptive test for blood.

Odelbrecht first advocated the use of photography for the identification of criminals and the documentation of evidence and crime scenes in the year 1864 while Thomas Taylor, microscopist to U.S. Department of Agriculture, in the year 1877 suggested that markings of the palms of the hands and the tips of the fingers could be used for the identification in the criminal cases.

Likewise Rudolph Virchow, a German pathologist, was one of the first to both study hair and recognizes its limitations in 1879.

Henry Faulds, a Scottish physician working in Tokyo, published a paper in the journal Nature suggesting that fingerprints at the scene of a crime could identify the offender. In one of the first recorded uses of fingerprints to solve a crime, Faulds used
fingerprints to eliminate an innocent suspect and indicate a perpetrator in a Tokyo burglary in 1880.

In 1891 Hans Gross, examining magistrate and professor of criminal law at the University of Graz, Austria, published Criminal Investigation, the first comprehensive description of uses of physical evidence in solving crime. Gross is also sometimes credited with coining the word criminalistics. In 1892 Francis Galton published Fingerprints, the first comprehensive book on the nature of fingerprints and their use in solving crime. Alfred Dreyfus of France was convicted of treason based on mistaken handwriting identification by Bertillon in 1894.

Sir Edward Richard Henry developed the print classification system that would come to be used in Europe and North America. He published Classification and Uses of Finger Prints in 1896. In 1898 Paul Jesrich, a forensic chemist working in Berlin, Germany, took photomicrographs of two bullets to compare, and subsequently individualize, the minutiae.

In 1900, Karl Landsteiner first discovered human blood groups and was awarded the Nobel Prize for his work in 1930. Max Richter adapted the technique to type stains. This is one of the first instances of performing validation experiments specifically to adapt a method for forensic science. Landsteiner's continued work on the detection of blood, its species, and its type formed the basis of practically all subsequent work.

Sir Edward Richard Henry was appointed head of Scotland Yard and forced the adoption of fingerprint identification to replace anthropometry in 1901. In 1903, the New York State Prison system began the first systematic use of fingerprints in United States for criminal identification. While Oskar and Rudolf Adler developed a presumptive test for blood based on benzidine, a new chemical developed by Merk in 1904.

In 1905 American President Theodore Roosevelt established Federal Bureau of Investigation (FBI). Victor Balthazard, professor of forensic medicine at the Sorbonne, with Marcelle Lambert, published the first comprehensive hair study, Le poil de l’homme et des animaux. In one of the first cases involving hairs, Rosella Rousseau was convinced to confess to murder of Germaine Bichon. Balthazard also
used photographic enlargements of bullets and cartridge cases to determining weapon type and was among the first to attempt to individualize a bullet to a weapon in 1910.

Masaeo Takayama developed another microscopic crystal test for hemoglobin using hemochromogen crystals in 1912. While in 1913, Victor Balthazard, professor of forensic medicine at the Sorbonne, published the first article on individualizing bullet markings.

In 1915, Leone Lattes, professor at the Institute of Forensic Medicine in Turin Italy, developed the first antibody test for ABO blood groups. He first used the test in casework to resolve a marital dispute. He published L’Individualità del sangue nella biologia, nella clinica, nella medicina, legale, the first book dealing not only with clinical issues, but heritability, paternity, and typing of dried stains.

In 1915, International Association for Criminal Identification, (to become The International Association of Identification (IAI), was also organized in Oakland, California.

In 1918, Edmond Locard first suggested 12 matching points as positive fingerprint identification. Georg Popp pioneered the use of botanical identification in forensic work in 1920. John Larson and Leonard Keeler designed the portable polygraph in 1921.

In 1923, Vittorio Siracusa, working at the Institute of Legal Medicine of the R. University of Messina, Italy, developed the absorption-elution test for ABO blood typing of stains. Along with his mentor, Lattes also performed significant work on the absorption-inhibition technique.

August Vollmer, as chief of police in Los Angeles, California, implemented the first U.S. police crime laboratory in 1924.

Saburo Sirai, a Japanese scientist, is credited with the first recognition of secretion of group-specific antigens into body fluids other than blood in 1925.

Landsteiner and Levine first detected the M, N, and P blood factors leading to development of the MNSs and P typing systems in 1927.

Yosida, K. I. a Japanese scientist, conducted the first comprehensive investigation establishing the existence of serological isoantibodies in body fluids other than blood in 1929. Calvin Goddard’s work on the St. Valentine’s Day massacre
led to the founding of the Scientific Crime Detection Laboratory on the campus of Northwestern University, Evanston, Illinois in 1929.

In 1930, American Journal of Police Science was founded and published by staff of Goddard’s Scientific Crime Detection Laboratory in Chicago. In 1932, it was absorbed by Journal of Criminal Law and Criminology, becoming the Journal of Criminal Law, Criminology and police science.

In 1931, Franz Josef Holzer, an Austrian scientist, working at the Institute for Forensic Medicine of the University of Innsbruck, developed the absorption-inhibition ABO typing technique that became the basis of that commonly used in forensic laboratories. It was based on the prior work of Siracusa and Lattes.

The Federal Bureau of Investigation (FBI) crime laboratory was created in 1932. While M. Polonovski and M. Jayle first identified haptoglobin in 1938.

Landsteiner and A.S. Wiener first described the concept of Rh blood groups in 1940.

While in 1941 Murray Hill of Bell Labs initiated the study voiceprint identification. The technique was refined by L.G. Kersta.

In 1945, Frank Lundquist, working at the Legal Medicine Unit at the University of Copenhagen, developed the acid phosphates test for semen. While Mourant first described the Lewis blood group system in 1946.

M. Cutbush, and colleagues first described the Duffy blood group system in 1950.

F. H. Allen and colleagues first described the Kidd blood grouping system in 1951.

Kirk published Crime Investigation, one of the first comprehensive criminalistics and crime investigation texts that encompassed theory in addition to practice in 1953.

A. S. Weiner and colleagues introduced the use of H-lectin to determine positively O blood type in 1958.

Hirshfeld first identified the polymorphic nature of group specific component (GC) in 1959.

Lucas, in Canada, described the application of gas chromatography (GC) to the identification of petroleum products in the forensic laboratory and discussed potential limitations in the brand identity of gasoline in 1960.
D.A. Hopkinson and colleagues first identified the polymorphic nature of erythrocyte acid phosphates (EAP) in 1963.

Culliford, of the British Metropolitan Police Laboratory, initiated the development of gel-based methods to test for isoenzymes in dried bloodstains. He was also instrumental in the development and dissemination of methods for testing proteins and isoenzymes in both blood and other body fluids and secretions in 1967.

Spencer and colleagues first identified the polymorphic nature of red cell adenosine deaminase (ADA) in 1968.

Culliford published The Examination and Typing of Bloodstains in the Crime Laboratory, generally accepted as responsible for disseminating reliable protocols for the typing of polymorphic protein and enzyme markers to the United States and worldwide in 1971.

In 1974, the detection of Gun Shot Residue (GSR) using scanning electron microscopy with electron dispersive X-rays (SEM-EDX) technology was developed by J. E. Wessel, P. F. Jones, Q. Y. Kwan, R. S. Nesbitt and E. J. Rattin at Aerospace Corporation.

In 1976, Zoro and Hadley in the United Kingdom first evaluated GC-MS for forensic purposes. While in 1977, Fuseo Matsumur, a trace evidence examiner at the Saga Prefectural Crime Laboratory of the National Police Agency of Japan, notices his own fingerprints developing on microscope slides while mounting hairs from a taxi driver murder case. He relates the information to co-worker Masato Soba, a latent print examiner. Soba would later that year be the first to develop latent prints intentionally by “Superglue(r)” fuming.

The Fourier transform infrared spectrophotometer (FTIR) is adapted for use in the forensic laboratory in 1977.


In 1986, in the first use of DNA to solve a crime, Jeffreys used DNA profiling to identify Colin Pitchfork as the murderer of two young girls in the English Midlands. Significantly, in the course of the investigation, DNA was first used to exonerate an innocent suspect.
DNA profiling was introduced for the first time in a U.S. criminal court. Based on RFLP analysis performed by Lifecodes, Tommy Lee Andrews was convicted of a series of sexual assaults in Orlando, Florida in 1987.

K. Kasai and colleagues published the first paper suggesting the D1S80 locus (pMCT118) for forensic DNA analysis. D1S80 was subsequently developed by Cetus (subsequently Roche Molecular Systems) corporation as a commercially available forensic DNA typing system in 1990.

Walsh Automation Inc., in Montreal, launched development of an automated imaging system called the Integrated Ballistics Identification System, or IBIS, for comparison of the marks left on fired bullets, cartridge cases, and shell casings. This system was subsequently developed for the U.S. market in collaboration with the Bureau of Alcohol, Tobacco, and Firearms (ATF) in 1991.

In response to concerns about the practice of forensic DNA analysis and interpretation of the results, the National Research Council Committee on Forensic DNA (NRC I) published DNA Technology in Forensic Science in 1992.

In Daubert et al. v. Merrell Dow, a U.S. federal court relaxed the Frye standard for admission of scientific evidence and conferred on the judge a “gatekeeping” role. The ruling cited Karl Popper’s views that scientific theories are falsifiable as a criterion for whether something is “scientific knowledge” and should be admissible in 1993.

Roche Molecular Systems (formerly Cetus) released a set of five additional DNA markers (“polymarker”) to add to the HLA-DQA1 forensic DNA typing system in 1994.

In response to continued concerns about the statistical interpretation of forensic DNA evidence, a second National Research Council Committee on Forensic DNA (NRC II) was convened and published The Evaluation of Forensic DNA Evidence in 1996.

An FBI DNA database, NIDIS, enabling interstate cooperation in linking crimes, was put into practice in 1998.

The FBI upgraded its computerized fingerprint database and implemented the Integrated Automated Fingerprint Identification System (IAFIS), allowing paperless
submission, storage, and search capabilities directly to the national database maintained at the FBI in 1999.  

2.5 Relevance of Forensic Science: An Appraisal

In the criminal investigation there is a pressing and awful requirement for the application of forensic science. The current picture of crime investigation of criminals is a depressing story. A big percentage of the murder trials, lastly, end in acquittals. It is expected that the prosecution agency spends on an average over Rs. 10,000.00 per trial. Therefore, not only a hazardous criminal goes scot free but vast amount of public currency is also wasted. These recurrent acquittals also make confident the criminals. In India investigation of crime and prosecution of persons having committed the crime are not up to the mark. Even in dreadful crimes large number of criminals could not be prosecuted and a few percentages of trials end in acquittal accordingly of which numbers of criminals as well as crimes are rising gradually. These recurrent acquittals are mainly because of outdated techniques of investigation which depart various loopholes. Thus for effective investigation scientific ways of investigation is very necessary. The need for the application of science in criminal investigation has arisen from the following factors:

2.5.1 Social change

The society is enormously changing with the changing of the time with great speed. India has developed from colonial rules to the democratic republic. Sizeable industrial complex has multiplied. With the passage of the time the transport facilities have also revolutionized. There is huge exodus of people from the rural to the urban cities due to vast industrialization search for suitable employment and better livelihood. Due to these drastic changes the old methods of crime investigation have become totally redundant in the presence of the new modern techniques of forensic science. During the British regime the role of police was quite fearful. Often it was apprehended that the police would resort to the degree torturous methods on the suspect ones making them confess under huge

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11 Supra 7, 26.
pressure or creating undue fear in the mind of the suspect. Thus, their basic purpose was to extract confession either by hook or by crook methods.¹²

2.5.2 Hiding facilities

At present, the quick means of transport and overcrowding of population in cities the commission of the offence has becomes quite easy. The offender can hide himself in a corner of a city or move away to thousands of miles in a few hours. Therefore, he escapes from one place to another from apprehension and prosecution.¹³

2.5.3 Technical knowledge

The technological knowledge and awareness of an average man has increased tremendously in modern era. The methods of committing crimes are getting modernize day by day. So there is dire need for the development of new scientific techniques for investigating officer in order to combat the modern day criminals.¹⁴

2.5.4 Wide field

The area of criminal’s activities is increasing day by day at terrific rate. In the earlier time mostly the criminals wee local in the country, but with the huge multiplication of modern society, both national and international criminal have entered in to the arena of the crime. Some of the expanding areas are financial frauds, Smuggling, Drug trafficking and fake proposal.¹⁵

2.5.5 Better evidence

Normally the physical evidence judged by an expert is quite objective in nature, where if a fingerprint is found at the scene of crime, it is viewed to be only one person. If that person happens to be the suspect, he must account for his presence at the scene. Similarly that if a bullet is recovered from a dead body, it can be attributed to only one firearm. If this firearm happens to be that of the accused, he must be accountable for its involvement in the crime. Such evidence is always verifiable.¹⁶

2.6 Scope of Forensic Science

At the present time, because of scientific and technical growth the value of forensic science is increasing with time. Forensic Science has its wide scope. It is

¹² Supra 10, 8.
¹³ Ibid.
¹⁴ Ibid.
¹⁵ Id.
¹⁶ Ibid.
used to examine the criminal cases connecting the victim, for instance assault, robbery, kidnapping rape, murder and civil cases for example forgeries, fraud or negligence. Forensic Science decides as well whether laws or regulation were violated in marketing food and drink, manufacturing of medicine, agricultural pesticide use, automobile emission compliance, drinking water purity and monitoring international secret nuclear weapon program. It also deals with forensic medicine and toxicology, DNA profiling, personal identification, fingerprint, ballistic and firearm identification, soil examination, identification and association of human hair, blood, serum, hair, saliva etc.\(^\text{17}\)

There are various fields relating with forensic science like as Criminalistics, Engineering Sciences, General, Jurisprudence, Odontology, Pathology/Biology, Physical Anthropology, Psychiatry & Behavioural Science, Questioned Documents, and Toxicology.

### 2.6.1 Criminalistics

Criminalistic is the science dealing with the recognition, correction, identification, individualization, and interpretation of physical evidence and the application of natural sciences to law science matter. The term was commence from the book ‘Handbuch für Untersuchungsrichter ales System der Kriminalistik’ (3rd Ed.) by Hans Gross, who was an investigating magistrate and professor of Criminology at the University of Prague. The citation of Mr. Paul L. Kirk\(^\text{18}\) is important in pointing out, which is as follows: "Wherever he steps, whatever he touches, whatever he leaves, even without thinking, will serve as silent evidence against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen that he deposits or collects - all these bear mute testimony against him. This is evidence that does not recall. It is not confused by the stimulation of the moment. It is not absent because human witnesses are rather is a factual evidence. Physical evidence cannot be wrong it cannot perjure itself; it cannot be wholly absent. Only its explanation can make a mistake. Only human failure to find it, study and understand it can diminish its value." \(^\text{19}\)

\(^{17}\) "Forensic Science Timeline", available at: www.forensicscience.com (visited on date 21-11-2010).

\(^{18}\) Popularly known as the Father of Criminalistics.

\(^{19}\) "Forensic Science", available at: http://www.criminalistic.com (visited on date 14-10-2010).
The regulation of Criminalistic include all areas of trace evidences, for instance soil, glass, hairs, fibers, blood, and other body fluid, including, saliva, swear, semen and vitreous humor. Criminalistic moreover contain arson, explosive, drug recognition and examination, understanding of outline and imprint evidence, and is definitely the largest of the discipline of forensic science. Criminalists examine, evaluate, recognize, and understand physical evidences. There are two main functions of forensic labs: 1) recognizing evidence, and 2) connecting the suspect, injured party, and crime scene throughout physical evidences. The major function of the criminalist is to independently relate the techniques of the physical and usual sciences to observe physical evidence. Physical evidence may be something: evidence so little that a microscope is considered necessary to observe it, or as big as a truck. It might be as subtle as a smell of a inflammable gas at an arson scene or as apparent as a pool of blood at a slaughter sight. The vast collection of material challenges the inventiveness of the criminalist who examines and identifies hair, fibers, blood, seminal and body fluid stains, alcohol, drugs, smear, glass, botanicals, soil, flammables, and safe insulating material, restores smeared or smudged markings, and identifies firearms and compares bullets, tool markings, and foot prints. In most cases, the amount of the evidence to be tested is very small, such as a drop of blood, a hair, or a piece of glass.

The criminalist separates significant evidence from that having little or no value by means of investigative ability and realistic practice. Subsequently, the

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criminalists arranges, evaluate, and recognizing the proof by using chemicals and instruments expand useful information for trial or an examination. It may be finding by the Criminalistic that a bullet has been fired from a particular gun, the blood in the suspect's car is from the injured party, or that a piece of plastic from the scene of a hit-and-run accident has broken off a particular car. These types of examination are complicated; they need an eye for detail, large realistic scientific surroundings, and the capability to relate these skills in the laboratory.21

Wildlife forensics is one of the most recent areas of criminalists. Poaching infringements, the expansion of state and federal pursuing regulations, the Endangered Species Act of 1973 and the United National Convention on International Trade in Endangered Species (CITIES) are some of the aspect which helped generates this innovative field. The major difference between criminal forensic science and wildlife forensic science is that in the wildlife forensic the sufferer (and rarely the suspect) is an animal. The recognition of wildlife evidence, on the other hand, can be more difficult in comparison of human science in that wildlife enforcement officers hardly ever confiscate total animals, which can be eagerly recognized by a museum or zoo expert. They will further characteristically seize parts and products of these animals as proof. The difficulty at that time is that the uniqueness which identifies an animal species is hardly ever present in those parts.22

Pelts and Skins from Dying Out Animals

21 Supra 10.
22 Id.
Government of India has enacted laws to protect wild life from poaching. Violation of these laws is not uncommon. Forensic science laboratories are required to create facilities for investigation of wild life crime. Infrastructure facilities for raising the “anti-ceras” may be upgraded\textsuperscript{23} by major FSLs in the country. With the new legislation on patents and creation of gene banks, forensic science laboratories have to face new challenges involving scientific examination of species of plants etc. It is imperative for the forensic science laboratories to create infrastructure facilities for this type of crime investigation.\textsuperscript{24} Wildlife forensic scientists are frequently required to expand recent ways to recognize class throughout study with carefully documented known specimens before they can examine evidence in a case and testify in court. An extra difficulty is that, at the same time as human forensics deals with only a single species (Homo sapiens), wildlife forensic scientists must be ready to recognize evidence from any species in the world that is unlawfully killed, smuggled, poached or sold on an illicit market. There are various examples of wildlife evidence items. It might be blood on an unlawful hunter's clothing, fresh, freezing or smoked meats, loose hair, fur coats, reptile leather products, for example purses, shoes and belts, loose feathers and down, carved ivory objects, sea turtle oil (suntan lotion), shell jewelry, and powdered rhinoceros horn.\textsuperscript{25}

\textbf{Banned Objects Prepared from Ivory}

\textsuperscript{23} Supra1, 215.
\textsuperscript{24} Id., 216.
\textsuperscript{25} Supra 12.
2.6.2 Engineering Sciences

Forensic engineering is a comparatively novel discipline; forensic engineers commonly are called on to assist with the modernization of automobile accidents, to assess evidence in product liability cases, and to conduct failure analyses on a wide variety of manufactured items. Innovations and problem-solving are explaining behavior of an engineer. The principles of mathematics and science are applied by an engineer for various purposes. The art and science of engineering is applied by the forensic engineer to the purpose of the law. A good number desire for services involve civil suits. On the other hand, the forensic engineer might also support in the prosecution or defense of unlawful or regulatory matters.

Questions produce to forensic engineers are in subjects as diverse as the specialties of the engineers themselves. Distinctive subjects consist of: plan analysis, excellence assessment of creation or manufacturing, safeguarding measures, failure examination, accident renovation, reasons and beginning of fires or explosions, and environment definition. The extents might vary from whole communique networks or shipping systems to the molecular composition or granule structure of a specific component. Structures examined may vary from skyscrapers, aircraft, or bridges to surgical implants or bones. Conclusions are applied in personal injury litigation, construction claims, contract or warranty disputes, patent or copyright infringements, criminal, and regulatory matters.

A few pertinent questions may be asked by the engineer to answer are as follows:

- Why did the vehicle roll over?
- How could the mishap have happened?
- Why did the airoplane collide?
- Why did the building collapse?
- Did defects exist? 27

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26 Supra 2, 290.
In most of the lawful disputes involving engineering issues, every party will appoint its own engineer for discussion and to verify on its behalf. In further words, the forensic engineers work is matter to the inspection of other extremely qualified professional.

2.6.3 General Section

"There is literally no end to the number of disciplines that become ‘forensic’ by definition. Nor is there an end in sight to the number of present or future specialities that may become forensic”.\(^{28}\)

The General Section is the domicile of recently escalating forensic scientific area of expertise and for those established areas of forensic science not appropriate the more narrow definitions or membership requirements of the other sections, or those forensic specialists whose numbers are not adequate to uphold a divide section .\(^{29}\) Members of the General Section contain scientists who have forensic specialties in the scientific areas of laboratory examination, field examination, scientific work, communiqué, processor examination, learning, explore, and other up-and-coming forensic science disciplines. These scientists are employed or practicing in the following areas of forensic activity: bureaucrat, accountant, archaeologist, artiste/sculptor (including facial renewal), aviation mishap researcher, ballistics psychoanalyst (bullets recital and injury understanding), processor connected crime

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\(^{28}\) Supra 9.

researcher, processor expert, forensic advisor, coroner (non-pathologist), crime scene examiner, medico-legal researcher, teacher (potentially every forensic regions), picture improvement expert, maritime ecologist, nurse inspector, photographer, polygraph inspector, radiologist, investigator, rehabilitation specialist, social worker - forensic applications, and speech scientist (voice recognition, improvement of recordings, legalization as well as verification of transcriptions and/or recordings).

Innovative regions of forensic cram consequence from a mixture of distinctive trouble faced by examiners and advancement in natural and social sciences. A lot of the entrenched disciplines in the forensic sciences were nurture in and came out from the General Section of the American Academy of Forensic Sciences. The beginning of digital photography with its possibility to aid in the certification of crime scenes and damages, as well as to speed up all aspects of photography from mug shots to autopsy, creates an important area of research and development. Such photographs present many dares and the weight of simple modification ought to be balanced with the benefits of pace and economy. These issues extend to the computer imaging of crime scenes, suspect composites, and victim characteristics for possible

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identification. The trustworthiness and scientific correctness of processor recreations of felony panorama proceedings as well remain an area for much-needed research.

Tape recordings and digital voice recognition etiquette, audio as well as verbal communication examinations persist to be a growing region of study and appliance. By capabilities to disguise voices by off-the-shelf machinery, the examination of fundamental aural pattern has turn into one of a lot of significant areas of both technological and linguistic research.

Environmental consciousness fetches the inquiry of felony connecting to the diverse facet of dangerous squander, unlawful discarding, as well as further such offense in opposition to the surroundings to those with skill in region for instance the forensic marine sciences, and numerous other sciences applied to environmental issues. Environmental felonies engage a few concept of gain, rather frequently economic in nature. The growth of sophisticated accounting software for the universal community escorts to enlarge in both accounting mistakes and absolute deception. In the direction of assist uncover the details of financial schemes, money laundering, and digital deception on the Internet, an important area of inquiry connecting forensic accounting has been developed.

The computer crime and cellular telephony investigation are the emerging field of forensic science today. Computer forensics has turned into significant since a new intrusion to gain or fraudulent information in other computer systems by criminals using computer technology to support their behavior has become a main offense bustle. Computer can be received as evidence in financial crimes, computer frauds, espionage, and sabotage, data communication network terrorism, murder, drugs, cellular frauds, child pornography and almost every other investigative classification. The computer forensic investigation involves dealing with technically complex issues such as cracking computer security schemes, repair or modification of damaged hardware or storage media, retrieving hidden or corrupted data, incompatibilities of proprietary or non-standard data or storage media formats, analysis of extremely large volumes of data, review and assessment of complex operating or

31 Supra 14, 210.
application software, low level analysis of storage media format and files structure and destructive traps used by criminals.\textsuperscript{33}

2.6.4 Jurisprudence

Black's Law Dictionary defined Forensic as "belonging to courts of justice." Forensic science is the application of science to assist courts in resolving questions of facts in Criminal and Civil trials. At the crack of dawn of the recent millennium, on the other hand, the jurisprudence of forensics applies a definition broader than that of "forensic science."\textsuperscript{34}

The law of evidence defined many areas of forensic science as “technical or other specialized knowledge” which are being analyzed or and evaluated by courts under different standards of reliability. In this historical perspective, the common meaning of forensic science is the application of "scientific, technical, or other specialized knowledge" to help courts in deciding questions of fact in civil and criminal trials.

Judges and lawyers play a pivotal role in administering the proceedings of the court. The lawyer by whom the expert testimony apply in civil and criminal trial before court must have knowledge of forensic law that govern the admissibility of forensic evidence, and must be qualified enough to apply this law to present and challenge forensic proof in deposition and court proceedings. The judges must appreciate all the matter and make sure of the legality of the whole process.

Even though every declaration and court manifestation is an exclusive practice, forensic witnesses may rationally wait for that express and cross-examination will cover at least a small number of key areas. The lawyer might create a threshold investigation into the area of specialty in which the witness claims to be an expert, reliability of that field of knowledge for judicial purposes, and the witness' credentials in that field. This investigation may deal with some and the entire formal learning the witness has or has not finished. Learning in the field of particular awareness in which the witness asserts to be specialist will be most pertinent. Any publications or other instructive resources authored or abridge by the witness and others in the field may be evaluate and tackle to either support or challenge the

\textsuperscript{33} Supra 21,210.  
witness' opinions and conclusions. Proficient or technological training in the area of interest, the witness' recital in that training, and certifications or other qualifications linked to the field of specialty, might also be addressed.

The knowledge of the witness in the area of particular awareness may too cover, in common with any matters connected to the witness who is capable in presentation in the area. The witness' presentation at work contains written and verbal performance assessment, penalizing procedures, and any other proof pertinent to the witness' experience may be inspecting. Statement of the witness in other court proceedings may also be addressed if it may be used to challenge the dependability or soundness of the witness' opinion in the case at hand.35

Express test by the legal representative who keep hold of the witness will development in a way that permits the witness to favorably state the witness' learning, instruction, and experience in the witness' area of specific awareness; the facts of the case on which the witness relied in making any description, précising, or preparing any view for the case; any assumptions, process, or procedures applied by the witness in understanding and interpreting the facts; and any conclusions or opinions the witness may have reached as a result of this process. Direct examination is characteristically a smooth, relaxed elucidation of the witness' experience, way of thinking, and view.

Cross-examination by the opposite counsel is characteristically more complicated. The chief objective of cross-examination is to recognize any weak point that may demoralize the significance, dependability, and/or legality of the witness' evidence. Weak point will be sought in the witness' experience, awareness of the scope, restrictions, soundness, and dependability of the witness' field of specialty, application of the field of particular awareness to the facts of the case, and/or relevance of the evidence to the issues in the case.36

2.6.5 Odontology

Forensic dentistry (odontology) is an essential branch of forensic science that includes the application of dental science to the identification of unknown human remains and bite marks, using both physical and biological dental evidence. Odontology is the study of teeth and their morphology, anatomical and pathological changes due to age. In case of mass killing, such as bomb explosion, air crash etc., forensic odontology is highly useful techniques for identification of the deceased from their skeletal remains.\(^37\)

A wide range of medico-legal problems are deal with by forensic dentist. Recognition of the human remains of natural disaster, unknown and missing person, terrorist activities etc is a central activity. Participation in autopsy examination may be include at the requirement of law enforcement coroners, or medical examiners at the local or state level. The post-mortem dental examination of human remains generally includes charting dental and cranial features, radiographic (x-ray) documentation of these features and forensic report writing regarding these finding. The application of these finding to investigation by law enforcement to recognize the missing or unknown person is second step.\(^38\)

\(^{37}\) *Supra* 16,215.  
\(^{38}\) *Ibid.*
The recognition of unidentified persons may initiate at a misfortune or felony panorama or throughout the postmortem examination at the demand of the law enforcement authorities, coroners or medical examiners at the local or State level. By means of both physical, biological and dental proof (a whole or fragmented jowl or some teeth), the postmortem test consists of a visual test and X-rays. A written report is prepared of the information collected during this examination along with cranial features. This information is either used by the law enforcement agencies to help in the examination and/or coded into a processor recognition plan that include both antemortem (before death) and postmortem (after death) dental record. The processor compares these records in an attempt to match the unknown with known samples, records, or photographs. One more significant field of forensic dentistry is bite mark analysis in the cases of assault, rape, and/or homicide. This is demanding work with rigorous standards requiring special training and experience. Inexperienced odontologists usually consult senior odontologists to serve as mentors when embarking on actual casework.

Odontologists also give expert testimony in civil litigation involving dental issues for instance personal injury law, workers compensation, professional malpractice, and disputes concerning aspect of the dentist/patient connection.

Two Dental Radiographs. Left is Taken after Death; Right is Before Death. The Metal Crown and Dental Structures have Similar Outlines

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40 “Role of forensic odontologist in criminal cases”, available at: www.asfo.org.(visited on date 15-12-2011).
2.6.6 Pathology/Biology

Pathology is a medical area of expertise the study of disease. Pathologists examine disease by applying a kind of operation which is called an autopsy and observing the tissues detached, and by examining surgically detached specimens under the microscope. By examining the fluids taken from the body such as blood or urine, the pathologist get vital information about the disease. Forensic biology is the application of biology to law enforcement.41

Forensic pathology is the application of the principles of pathology, and of medicine in general, to the legal needs of society. Autopsies performed by Forensic pathologists to find out that under what conditions a person's death caused. The conditions surrounding the death are also involved in the inquiry. Through these conditions the method of death is lastly determine whether the death is natural or caused by mishap, suicide, and homicide or undermine.

Forensic Histotechnologist Preparing Tissue for Microscopic Slide Examination

Even though there is much importance on vicious deaths (deaths due to homicide, mishap, or suicide), forensic pathologists also examine sudden deaths of apparently fit persons (those not presently being treated for a disease so that the sudden death occur), the death of someone who has never seen a doctor (unattended), deaths taking place in police custody, doubtful or extraordinary deaths, deaths that may be the result of surgical or diagnostic procedure which could be a curative misfortune, or some deaths which happen in community institutions. The law of the

specific jurisdiction where the death occurs determines which deaths must be reported to the medical examiner (frequently a forensic pathologist) or, in some states, the coroner. Then it is the liability of the medical adviser or coroner to find out if an autopsy is necessary to decide the reason and method of death.42

Attending and Resident Pathologists at Weekly Neuropathology Conference

The contribution and study of forensic pathologist may involve visiting the scene of death. Forensic pathologist and their investigators collect information relating with the happening at the time of death, medical history of the person and what the person was doing at the time.43

The forensic test of a body involve testing the clothing on the body, body itself and an internal testing of the organ which is called autopsy. After taking the photograph of the body, a detailed report is prepared by the forensic pathologist describing any injury or disease process. The autopsy generally involves microscopic testing of the tissue of the body etc. X-rays may also be taken to look for bullets, broken bones, or other deformity.

The forensic pathologist work with other branches of forensic science. The forensic pathologist may gather proof from the body such as blood, hair, swab and fibre from the body and cloths of the dead person. These are sent to the forensic laboratory for testing by a criminalist. Samples for instance urine, blood, stomach content, bile, body tissue are also gathered by the forensic pathologist for toxicology analysis. These samples are checked by the pathologist for the presence of drugs,

42 “Forensic Pathology”, available at :forensicscience.com (visited on date 23-10-2010).
43 Ibid.
alcohol and chemical or poison in the body. If bullets, shotgun pellets, or wadding are recovered at autopsy, they are also sent to the forensic laboratory for test. A firearms adviser examines these samples and is frequently capable to match them to a specific gun.44

Forensic pathologists play a significant role in the field of public health and disease and prevention of injury. Control and identification of epidemic disease as well as observance of faulty consumer product design, which may cause injury or disease are significant for both the forensic pathologist and society as a whole. In addition, genetic disorder common to a particular family may be recognised and reported to those affected.

Forensic pathologists also play a significant role in the field of clinical forensic pathology. Types of injury are not only seen at the time when the persons are deceased, it can also be identified in living patients in emergency rooms and clinics. This is especially critical in cases of elder and child abuse. The interpretation of these injury is not valuable to police or other law enforcement agencies in a criminal investigation.45

44 *Id.*
2.6.7 Physical Anthropology

Forensic anthropologists are often named to recognize persons died in calamity such as plane crashes, blast, fires, and other misfortunes consequential in the loss of life and disfigurement of bodies.

In this society, recognition of the dead is significant for various causes. The first step in homicide inquiry is generally finding out the uniqueness of the victim. This not only connected relations of the deceased, but it is also linked with the judicial authorities who required to make out whether someone is alive or dead so that will can be read, estate can be settled, second marriage can be arranged and so forth. Law enforcement agencies required knowing if recovered bones are human or non-human. If they are human and of recent origin, the individual must be recognized, and the reason of death and time elapsed since death need to be determined. If they are old, human bones, perhaps a burial ground has been uncovered.

**Anthropologists Using a Metal Detector for Recovery of Materials During Crime Scene Analysis**

The scientist performing this task generally a physical anthropologists who are expert in the field of human skeletal biology. Physical anthropologists have a lengthy custom of the study of human skeletal remainder from primitive civilization. The technology has been developed by them for determining health status, sex, race, mark of occupational stress and trauma and occupational tension, and height in life also have inveterate very valuable in forensic sciences.
In the recognition of skeletal material forensic anthropologists are thus expert. Additionally to their efforts to document, age, sex, stature, race, and other characteristics of the samples under examination, they are familiar with many kinds of injuries and can work with forensic pathologist to ascertain reason of death. A lot of forensic anthropologists have training in archaeological techniques and help law enforcement agencies in the first inquiry of felony sight. Anthropologists can generally concert (recover) human remain from different kind of forests, rivers system, desert, etc, with the help of analysis of soil and vegetation pattern and testing of animal remains.

A few forensic anthropologists are expert in the art of facial duplicate which includes the modeling of how a face may have appeared in the living subject for which the only surviving proof is a skull. Other forensic anthropologists have developed expertise in the determination of time elapsed since death by testing insect remains (entomology) and states of body decompositions.46

2.6.8 Psychiatry & Behavioral Science

Forensic pathologist and psychiatrist addressed a wide range of legal issue because they work with civil and criminal cases and other field such as law relating to domestic and family. In criminal law the main focus is on the matter relating with competence and the assessment of the mental illness etc. Civil law needs evaluation of such issues as involuntary psychiatric hospitalization, right to refuse treatment, competency to participate in do-not resuscitate decisions, and disability compensation

among others. Issues in family and domestic relations may include juvenile delinquency, child custody, parental fitness, domestic abuse, adoption, and foster care.

Forensic pathologist and psychiatrist spend a significant amount of time in interfacing with judges and lawyers, so that they trained in giving expert testimony.

In organizing the components of a forensic psychiatry assessment, a four-step series of the following questions is often used:

- What is the specific psychiatric-legal issue?
- What are the legal criteria that decide this issue?
- What are the relevant psychiatric-legal data?
- What is the reasoning process used to reach the concluding opinion?

A single person may represent several different issues, each of which may be addressed separately. For instance, in criminal law the question may be asked from defendant about his criminal responsibility for the offence, the likelihood of his being dangerous if he were discharged to the community, the validity of the confession made to police officers, his capacity to abide by the terms of probation if applied etc. Some of these issues show the past (for instance at the time of the alleged crime the mental functioning and behaviour of the accused person or at the time of confession), some issues show the present (competence to cooperates with legal counsel), and some show the future (abiding by the terms of probation). The difference between data which has been gathered by the psychiatrist depend upon the fact whether the psychiatrist is showing past, present or future mental functioning and behaviour.47

2.6.9 Toxicology

The earliest documented forensic specialty could probably be considered to be forensic medicine, also known as legal medicine or medical jurisprudence, and is the application of medicine and medical science to answer legal problem. The development of modern -day chemistry is considered to have begun at the end of the eighteen century, paving the way for the development of modern toxicology.48 Toxicology is the study of harmful effects of chemicals or drugs on living systems. Forensic toxicology is that branch of forensic science which deals with the medico-

48 Supra 11, 1071.
legal aspects of toxicology. Forensic toxicologists answer the question, "Did prescription or illegal drugs and/or alcohol lead or contribute to the person's death or intoxication?" Answering this question often needs forensic pathologists, law enforcement officers, forensic toxicologists, other forensic scientists, and crime scene investigators to work together.49

The Information Triangle - A Collaboration of Input and Information from Three Areas: Toxicology, Pathology and Scene Investigations. This can lead to the Interpretation of a Cause and Manner of Death

There are several areas of specialization within the field, which offer a variety of career paths. One, postmortem toxicology, includes the determination of the contribution of drugs or other chemicals to the circumstances of the death. The forensic toxicology laboratory contributes a critical perspective to a death investigation, working with a forensic pathologist, and scene investigators, to determine which drug analyses or poisons are involved. This is accomplished by performing tests on body fluid and tissue samples received from the forensic pathologist, and then assisting with the interpretation of the findings. This effort requires knowledge of analytical chemistry techniques, including instrument methods utilizing gas and liquid chromatographic techniques, mass spectrophotometry, UV-Visible spectrophotometry, flame emission and absorption spectrophotometric techniques, antigen-antibody immunoassay methods, as well as, traditional qualitative and quantitative methods of analysis. An inquiring mind is required, along with the ability to apply knowledge of chemistry and pharmacology to solving real world puzzles.

49 "Scope of forensic science", available at: forensicsciencedna.com (visited on date 17-02-2012).
Instrumental Automation as Exemplified by the Automated Sampler which can Extend the Work Day and Lead to Increased Case Analysis and Decreased Turnaround Time

The Ion Source in a Mass Spectrophotometer. Gas Chromatography/Mass Spectrophotometry (GC/MS) is a Technology that Represents a Definitive Means of Identifying the Presence of a Substance

Other forensic toxicologists function with law enforcement authorities in the examination of offense in which alcohol or drug used by individuals is an ingredient of the offense or may be a protection. This includes the analogous application of technology as in setting of the death inquiry, but characteristically deals with lower concentrations of drugs, which needs greater sensitivity of testing. The interpretation of the examination outcome in this field is the utmost challenge, applying knowledge from clinical and medical studies, and experience in the field, to give a view about the affects of a drug or mixture of drug on an individual at the time of the offense or accident.
Workplace drug testing and forensic urine drug testing has become a significant feature of employment and industries with hazardous work conditions or jobs affecting the safety of others. This aspect of forensic toxicology is generally limited to the recognition of particular drugs of abuse in a large number of urine samples with some laboratories performing tests on over 10,000 urine samples every day. As with all of the forensic environments, there is a strong emphasis of record keeping, chain-of custody documentation, stringent quality control, and data management. The challenge is to get the testing of such great numbers done as reliably and efficiently as possible. Developments in this area include the evaluation of specimens other than blood or urine for drug testing, such as sweat, hair, and saliva.50

Forensic toxicology testing also contributes in other areas, as varied as wildlife crimes involving the poisoning of animals, the use of drugs to facilitate sexual assault, and drug use and doping in human and animal sports. In all of the aspects of forensic toxicology, the interpretation of the results is a consistent challenge. The results obtained are determined by tests that are complex and difficult for most juries and lawyers to fully understand and appreciate. Therefore, the toxicologist must have or develop the ability to describe the process involved, the findings determined, and the relevant interpretation derived in a straightforward and easily understood manner.51

2.6.10 DNA profiling

Evolving from classical Serology, DNA profiling could be considered as the modern-day technique revolutionizing personal identification in forensic science. In the mid-1980 Sir Alex Jeffreys developed the technique allowing the profile analysis of DNA after publishing his achievements in Nature in 1985. Jeffreys was subsequently called upon to apply his techniques to solve the first crime in 1986. In combination with the British Home Office Forensic Science Service, his DNA profiling techniques were used to identify Colin Pitchfork as the murderer of Dawn Ashworth and Lynda Mann in Leicestershire, England. Cetus Corporation furthered the developments of DNA profiling and molecular biology techniques in the personal identification during the rest of the 1980 with the development of the Polymerase

50 B.B. Nanda and R.K. Tiwari, Forensic Science in India, A Vision for the Twenty- First Century214 (Select Publisher, New Delhi, 2001).
Chain Reaction. In 1987, not only was DNA profiling introduced for the first time to some criminal courts, but the admissibility of DNA evidence was also challenged, resulting in the development and implementation of appropriate accreditation, standardization and quality controls for DNA and forensic laboratories. During 1996, the FBI DNA Analysis Unit began using mitochondrial DNA analysis. This type of analysis can be applied to small or degraded quantities of DNA from hair, bones, teeth and body fluids, allowing the examination of evidence that may not have been suitable for comparison prior to the development of this technique.52

2.6.11 Forensic Polygraphy

The society owes a commitment to the people that the potential and might of the state is not abused in dispensation of justice and that the concept of human rights is upheld and nurtured all the time. The preserve his common rights, the basic tool human being have devised is the police set-up. Death, rape and torture in police custody are common, factual reports have embarrassed several State Government and their police outfits which employed third degree methods in the interrogation of the suspected people detained to reveal the truth or their plans. The third degree methods will never put an end to the crime as the criminals get establishment. Interrogation of the suspected criminals using third degree methods results into los of fear and respect for the authority of the state. The law enforcement machinery in the country will have to react effectively by scientific interrogation of the victim and the accused and try to get as much of evidence as possible to establish the charge. This is to be done by resorting to forensic polygraphy technique, available in most forensic science laboratory in the country.53

2.6.12 Forensic Chemistry

The chemistry department is usually the largest single unit in a forensic laboratory (followed by the biologist). The kind of materials handled are paint and glass- often resulting from vehicle crashes or hit- and- run accidents The chemist is also responsible for the examination and matching of impression, such as tyre and shoe-print and tool marks left at the scene of a crime normally during the process of illegal entry.54 Illegal drugs are a growing international problem, and this is reflected

52 “DNA Profiling in India”, available at: www.forensicedna.com (visited on date 21-10-2010).
53 Supra41, 213.
54 Brian Lane, the Encyclopedia of Forensic Science 5(BCA Publication, London.).
in the case-load of the Worlds forensic science laboratory. The situation is complicated by the ever increasing number of new drugs that are finding their way from the pharmacist’s shelf to the street, and the huge increase in what are called ‘designer’ drugs, a cocktail of existing substances in new combinations to satisfy a cultural or fashion need. In this respect, the forensic chemist will have not only substance to analyze, but the equipment from illegal drug factories and the paraphernalia of drug use; on top of which are the blood and urine samples from alleged users passed on the police surgeon.55

When a pathologist has completed his post-mortem examination of a suspected poisoning case, it is usual for the whole of the stomach contents-probably accompanied by the stomach itself- the small intestine, and most of the internal organs to be dispatched to the forensic science laboratory for qualitative and quantitative analysis of possible toxins.

2.7 Conclusion

The analysis of the aforesaid presentation amply reveal that forensic science can contribute a lot for getting speedy justice to the contemporary society if the above said measure are taken care for due and effective implementation. The quality and undelayed reports from the forensic scientists shall certainly fulfill the aspiration of the society from the forensic professionals.56 At present time because of the fact that criminals are adopting new modern sophisticated techniques in committing the crimes, so, it is not possible to solve the crime without applying the new scientific technique. Therefore the importance of forensic science is fast increasing in the present time because with the help of forensic science and its new techniques the mystery crime can be easily solved. The scope of forensic science is ever-increasing with passing of the time. There are various branches of forensic science which are really very helpful in detection and in solving the crime and in finding out the criminal.

55 Ibid.
56 Dr. J.R. Gaur, A Compendium of Forensic Science 22(Shiv Shakti Book Traders, New Delhi, 2006).