

# Scientific Methods and Tools Used In Forensic Examination and Investigation: A Review

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**Abstract:** Forensic examination and investigation is a field of science that is employed to help the investigators in bringing the criminals to the justice. The crimes in the present day context have acquired a new dimension and hence there is a need of advances technology towards investigation. Today various technological advancements, scientific methods and scientific tools or instruments are being used in Forensic Science Laboratories for the investigation of crime. A number of special tools and techniques have been developed to help in criminal investigation. In this review paper Scientific Methods and Tools Used In Forensic Examination and Investigation is discussed.

**Keywords:** Forensic examination, technological advancements, scientific methods and tools, investigation, crime

## I- INTRODUCTION

The crimes in the present day context have acquired a new dimension and hence there is a need of advances technology towards investigation. Forensic science is increasingly relied upon by law enforcement to assist in solving crime and gaining convictions, and by the judicial system in the adjudication of specific criminal cases. However, the value of forensic science relative to the work involved and the outcome of cases has yet to be established. Previous research in this area has mainly focused on the science and technology, rather than examining how people can use forensic services/science to the best possible advantage to produce appropriate justice outcomes. This five-year project entails an investigation into the effectiveness of forensic science in police investigations and court trials. It aims to identify when, where and how forensic science can add value to

criminal investigations, court trials and justice outcomes while ensuring the efficient use of available.

While complying the procedure established by the law these forensic measures are now a day used in regular practice whenever required to establish the evidence and crime against the accused. In the forensic laboratories whether the statutory or non-statutory the samples of blood, urine, hair, skin and the others are collected and investigated for getting assistance in solving the legal matters. Conducting of DNA test, Norco analysis for various purposes and getting the information has been proven to be very useful tool in the situation wherein all the other available evidences collected from the crime spot either have loosen its value because of tempered or destroyed by the others or by the accused.

Forensic science is very vast field in its scope and application. The forensic science engages pathologists, biologists, physicists, chemists and medical officers to solve queries of crime. Forensic science can effectively help to found missing persons, establishing their true identities, relate and prosecute through testimony who victimized whom through production of scientific evidence. Forensic examination and investigation is a field of science that is employed to help the investigators in bringing the criminals to the justice. Today various technological advancements, scientific methods and scientific tools or instruments are being used in Forensic Science Laboratories for the investigation of crime. A number of special tools and techniques have been developed to help in criminal investigation. Some of them, which are currently in use in the Forensic Science Laboratories, are as follows

### **Spectrograph:**

Ultra-violet emission spectrograph is an indispensable instrument in criminalities studies. A Forensic Scientist

confidently lays his hands on it to determine the trace and gross chemical constituents of inorganic origin for the purpose of identification and comparison of physical clues like glass, paint, soil, dirt, dust, debris, metallic fragments, etc., collected in the course of crime investigation. A few milligrams of the sample are quite enough to carry out the examination and that too in a very short time. A permanent record of the examination in the form of Spectrogram is obtained for demonstration, if desired, in the court

#### **Spectrophotometer:**

In the examination of physical clues, mostly of organic nature, the Forensic Scientist conveniently makes use of Spectrophotometer. Depending on the type of material under examination, this instrument can be used to scan through a wide range of Electro Magnetic Spectrum, namely Ultraviolet, Infrared and Visible regions. It is used in the examination of dyes, drugs, insecticides, oils, solvents and various other organic substances present separately or in combination

#### **Gas Chromatograph:**

This instrument is a recent addition to the armory of criminalistics, which is extensively used in Police Crime Laboratory. It finds its use in detecting substances, which are volatile, like organic solvent. Complex mixture of volatile organic can be isolated with ease. Denaturants used in rectified alcohols, alcohol in blood, volatile organic poisons, inflammable substances used in arson or homicides, gas chromatography. Micrometer quantity of the substance will suffice to carry out the examination.

#### **Electrophoresis:**

It is a comparatively simple instrument, yet very useful to a criminalistician. It finds wide applicability in forensic analysis and is mainly used in the examination of physiological fluids, separation of alkaloids, inks, dyes and such other materials that from charged ions or particles in solution. Electrophoresis pattern of sera from different animal species differs considerably and this is found very useful in characterizing animals of different species.<sup>25</sup>

#### **X-Ray Diffraction:**

The various instruments referred above are disadvantageous from one point of view. The sample material analyzed is destroyed and is thus irrecoverable. In X-Ray diffraction analysis, however, the sample material remains intact. IN crime investigation work, minute quantities of clue materials are available for

analysis. These, at times, may have to be preserved for evaluation of evidence by courts. It is here the X-Ray diffraction instrument is of a particular advantage.

#### **Mass Spectrometer:**

This is yet another instrument, which provides further sensitivity in the determination of various organic and inorganic substances. Unlike spectrometers mentioned earlier, this instrument works on different principle. The substance to be analyzed is transformed into ions by ionic sources like thermal ionization, electron bombardment, etc. The transformed ions, which consist of electrically charged particles of different masses, are made to pass through a magnetic field, which separates different ions according to their masses. Thus a spectrum of lines corresponding to different masses of various elements is obtained. This spectrum helps to determine the substance both qualitatively and quantitatively.

#### **Neutron Activation Analysis:**

Criminologists have never lagged behind in adopting latest scientific techniques in crime investigation work. Neutron activation analysis is the latest development in the scientific field. Its utilization to the fullest extent by the Forensic Science Laboratories has not yet been achieved. It is yet in its preliminary stage. It is a method wherein minute quantity of inorganic material is irradiated with nuclear particles, mostly neutrons obtained from Reactor source. The irradiated sample then gets disintegrated with the emission of high energy electromagnetic radiation's called gamma-rays.

#### **Documents Examination:**

Starting from birth certificate and thereafter every human activity is connected with some type of documents or to her. These very documents are today most prevalent causes of crime through which the society suffers crores of rupees worth of economic losses. The nation's economy pays dearly due to frauds, forgeries, counterfeiting, forged cheques, embezzlements etc. Surprisingly this large white-collar crime is comparatively much less dramatic than the violent crime involving guns, bombs and explosives. In the drive against economic crime, the suspect documents are basic crime-exhibits whose examination is now receiving priority in the application of most reliable scientific.

#### **OPTICAL Comparators:**

Both examination and comparison of documents for forgery, erasures, alterations etc. have involved non-destructive examination using visible, ultra-violet and infrared spectral regions of light. For such lengthy

examinations, a variety of individual equipment including microscopes, ultra-violet viewers, infrared image converters and photographic equipment have been utilized in the past.

**Photography:**

Photography is an important aid in criminal investigation. For a long time photography was mainly used in the identification of criminals. In the recent years, photography has made such advances that it has become indispensable in criminal investigation. The science of photography includes the photomicrography which is the science of combining the microscope and the camera and with the help of it, minute clues, which are not visible to ordinary eyes, can be seen. The hair, fibers, dust particles, perforation on paper can be examined with this technology. The fluoroscope camera enables the instruments to piece solid matter and photographic objects that are not visible. It is used in investigation to probe the interior or suspicious packages suspected containing explosive devices etc. 'Radiography' can be used to read the contents of a sealed letter. It is also used to find out position of fracture, dislocation, presence of foreign body like bullet and coins in human body. Photography provides faithful, accurate exhaustive, unbiased, incontrovertible records of various events which may not be possible by other ways. Video camera helps in obtaining irrefutable proof of occurrences and role played by the offenders and police in unlawful assemblies, Gambling bribery etc. The device provides clear picture of crimes to the Courts. The ultraviolet and infra-red light are also used in photography which used for detecting the forgery, blood stains, semen stains, differences in seals, faded and secret writings, burnt documents etc. Photography can also be used in preparing the sketches of scene of crimes and wanted criminals.

**Footprints:**

Footprint is a general term used for bare footprint or impression and shoeprints or impression. The examination of footprints as an aid to identification is an art as old as civilization. The footprints and shoeprints may establish the presence of the culprit at the scene of crime. The foot prints and shoe prints are not the reliable evidences but they can be used as supportive evidences. Track identification parade should be conducted ordinarily in the jail in the presence of a magistrate for this suspects shoes should be taken into possession of police and duly sealed and signed by the witnesses. These shoes should be produced before the magistrate holding parade to be worn by the suspect. The videos of the sole of foot have all the attributes, physical

characteristics and identification requisites as those on fingers. The investigation officer should search foot prints on the scene of occurrence, along the route taken by the criminals both at the time of coming in or going out and of the places and where the culprits had assembled before or after the commission of the crime. Usually a footprint is presented by taking photograph or casts and by drawing the impressions upon a sheet of glass or celluloid.

**Portrait Parle:**

In criminal investigations it has always been a problem to identify a wanted suspect, or missing persons or those required for the purposes of alienation from inquiries. A French scientist named Bertillon, initiated a process called 'anthropometrics', from which was adopted the term 'Portrait Parle' literally meaning 'word picture'. Portrait Parle necessitated measurements of various body parts and well descriptions of the criminals. Portrait Parle is of great assistance in locating criminals in the initial stage.

**Handwriting:**

The identity of a person can be established by comparison of handwriting also. Handwriting of any person provides important clue in scientific criminal investigation mainly in respect of commission of act of forgery or where a handwritten document is under suspicion. First of all the admitted or standard of writing of the accused for a comparison with the disputed writing is obtained. Such standard writing can be taken from personal correspondence, cancelled cheques, diaries, account books, application for employment or other papers written approximately at the same time when the disputed writing was written. The investigation of handwriting is done by the hand writing experts, known as calligraphic experts, on scientific principles. A person's identity can be established by his handwriting. There is certain distinct prevailing feature or character in every person's identity and it can be discovered by observation. Two people cannot write alike. Handwritings vary as speeches vary at different period of life. There are certain factors which affects the handwriting. These are age, sickness, fear, anger, insanity, hurry, lack of care, status, education, flow of ink from pen etc.

Forensic Science today is an integral part of the criminal justice administration. Started with the humble beginning it is today a well-recognized multi-disciplined science serving the cause of justice. The revolutionary development in science and technology that has taken place over the years, has progressively improved the methods and tools of forensic science. During the last

few decades there have been significant developments in the field of Forensic Science throughout the world.

### CONCLUSION

Law changes according to the changes in society and also in the science and technology. Development in the science and technology shall be accepted by the legal system as long as they do not violate fundamental legal principals and are for the betterment of the society as a whole. 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. The technological advancement that are used in investigation of crime especially the Forensic examination as a tool of interrogation. Forensic science play pivotal role in criminal investigation to find out the crime and criminals. Forensic science is a versatile and enormously powerful tool in the investigation of a crime. At today the investigating authority are using scientific methods and tools used In Forensic Examination and Investigation

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