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## A Critical Review on Forensic Science Laboratory

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### ABSTRACT

A forensic science laboratory is scientific laboratory specializing in forensic science. Such laboratories maybe run by private companies or the government but are often associated with the law enforcement infrastructure of a country. Its functions are to examine, compare and evaluate physical evidence so as to link a suspect to the victim or to the scene of a crime. In most cases, the laboratory supplements the work of police investigator in order to convert suspicion into a reasonable certainty of either guilt or innocence. Protection of the innocent example of person arrested for selling narcotics is set free if the chemical analysis of the material shows it to be harmless. It determines facts, which are not subject to the bias and Prejudice & other human failings of the eye witness. Training of the police investigators as to what constitutes physical evidence, how it is to be found, collected, reserved and delivered to the laboratory.

It is not a solution for all the difficulties that confront the police in searching out crime; it is merely an aid in crime detection. Its results are more often rather negative than positive. The items which are most commonly handled by the laboratory and which frequently serve as evidence knives, blunt instruments, blood & seminal stains, chemical substances, poisons, fingerprints & footprints, hair, fibers, bullets, cartridge cases and wad, tools & tool marks, broken glass, paint chips, oil, grease, petroleum products, soils, clothing, pieces of paper, cigars, cigarette stumps, matches, documents & fragments of various materials. Sometimes laboratory technicians are called to the scene of crime to collect specimens with which investigating officers are not qualified to deal.

**KEYWORDS** Fingerprint, Narcotics, Cartridge, Cases, Firearms, Footprint



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## INTRODUCTION

Forensic science laboratory is the study and application of scientific examination & evaluation of evidence for legal purposes. It provides three major categories of services clinical, pathological and laboratory. In addition, it should have stores, exhibit rooms, workshop and library. Forensic science laboratory include examination of victims of assault, sexual crime, drunkenness, chemical analysis, toxicology, serology, biology, photography, fingerprints, ballistics etc. Every laboratory should establish a museum containing fingerprints, bullets and cartridge cases, tyre tread patterns, animal hair, soils, typewritten specimens, inks, rope and cordage, cloth, photographs of various crystal poisons etc.

Staffing:

1. Director, medical or scientific.
2. Clinical services -  
Physician and obstetrician.
3. Pathology services -  
Pathologist
4. Laboratory services -  
Biologist, physicist, serologist,  
micro-analyst, photographer, fingerprint  
expert, ballistic expert etc.
5. Others -  
Librarian

**Functions:**<sup>1</sup>

The laboratory functions in three main categories-

1. **Reconstruction:** The police investigator can reconstruct the events leading up to, during and sometimes preceding a crime in most cases. The laboratory helps to make these events more clear. Usually, an investigation cannot be effective without such reconstruction of events from physical evidence. The arrest and conviction of a criminal would be difficult, if the investigator fails to know what happened at the scene of crime.
2. **Corpus Delicti:** When a substance is confiscated and the holder is charged with possession of narcotics, the detection of the substance by laboratory analysis will establish the body of crime.
3. **Connective - Disconnective mode:** If certain material found on the suspect are also found at the scene of the crime & vice versa, and of common or similar origin, it will connect to the suspect to the crime. If there is no similarity in physical evidence collected from the suspect and scene of crime it will aid in disconnecting the suspect from the crime.

## MATERIALS

Criminal Investigation: All criminal investigation is concerned either with people or with material objects. The main



objective of Crime Investigation is to recognize, collect, preserve, analyze, interpret and reconstruct all the physical evidence collected from the scene of crime. The term physical evidence includes any and all objects living or dead solid, liquid or gas and the relationship between all objects as they relate to the problem in question e.g. a crime. A knife, burglar, tool, woodsplinters, toolmarks, firearms, bullets, blood & seminal stains, saliva, pus, milk, poisons, sputum, vomit, fingerprints, hair, fibres, glass, paint, oil, grease, chemicals, signature, teeth marks, handkerchief, footwear and even an odour are all physical evidence. Physical evidence is useful in two ways-

- i. It is often the decisive factor in determining guilt/innocence. It can do this by supplying the demonstrable facts, thus resolving discrepancies in ordinary testimony.
- ii. It can be a material aid to link a suspect, a weapon or a scene to a crime. Evidence should be marked or labeled so that it can be positively identified. Date, time, place, from whom and by whom it was taken or found, should be recorded. The chain of evidence must be intact and complete. Evidence should be preserved in the same condition in which it was found. The forensic scientist must routinely work with forensic scientists of various

other disciplines in the investigation of a criminal matter or civil dispute.

### **Locards Exchange Principle:**

When any two subjects come into contact, there is a transfer of material from each object on the other. Traces from the scene may be carried away on the person or tools of the criminal, and at the same time, traces from all or any of these may be left at the scene. Wherever a criminal goes, whatever he touches & whatever he leaves will serve as silent evidence against him e.g. fingerprints, footprints, hair, fibres from clothes, broken glass, tool marks, paints, scratches, blood/seminal stains etc. It is actual evidence and its presence is absolute proof of the crime. The evidence of eyewitness's maybe wrong, as a result of their prejudice and faulty memory or defective observation. Physical evidence cannot be wrong and completely absent. Only its interpretation can be wrong. Only human failure to find it, study and understand it, can diminish its value. The laboratory must be devoted to this study and understanding. Large number of criminals escapes because the physical evidence is not fully understood and utilized. More laboratory failures are due to inadequate collection of existing evidence than are caused by the failure of laboratory to examine it properly. All laboratory findings are related to probability and a single piece



of evidence is rarely sufficient in itself to establish proof of guilt or innocence.

### **Control sample:**

It means specimens of material e.g. vegetation or soil from the scene, sample of blood, hair, fingerprint etc. from the victim for comparison with any questioned material from the crime scene. Blood stains found on garment soil etc. will require unstained samples to rule out the false positive test due to substrate interference.

### **Illustrations:**

#### **a. Personal identity:**

The main problem of the criminal investigator is the establishment of personal identity of the criminal fingerprints, footprints; hair, blood, semen etc are unique to the individual.

The criminal may be identified indirectly through the tool he used, the gun he fired, the clothes he wore, writing he made, the soil, glass, paint etc. he removed from the scene of crime. No two objects are even completely identical. In physical evidence, the term identity must be understood to signify practical and determinable identity only.

#### **b. Blood**

In murder, assault, rape etc blood from the victim may be present at the scene of crime and on the person, clothing of accused & weapons. The distribution and appearance

of blood stained areas on the victim and his clothing may be used to interpret and reconstruct details of the crime.

#### **c. Semen<sup>3</sup>**

Stains may be found on the clothes of the accused and victim, pubic hair and person, on the bedding mattress, floor or ground on which the offence was committed or on the piece of cloth, used by the culprit or the victim for wiping after the offence. Ultraviolet light is useful in fluorescence test such as examining stains on garments.

#### **d. Firearms**

A bullet recovered from a dead body can be examined to determine the type of gun which fired it and the type of ammunition fired. By careful study of the markings on the bullets the gun which fired it can be determined.

#### **e. Fingerprints<sup>4</sup>**

A criminal can be identified especially by means of latent prints left at the scene of the crime, on a weapon or in another incriminating location. Fingerprints are also useful in identification of dead bodies, persons suspected of operating under aliases, amnesia victims etc.

#### **f. Hair**

Traces of certain elements are deposited in our hair because of diet, drug intake and atmospheric conditions. The proportions of these differ considerably in different



persons and these can be measured through neutron activation analysis. Hair from a criminal may be pulled out by objects at the scene. Similarly, hair from the victim may adhere to the criminal's person, along with the clothing or weapon. In a sexual offence, hair from the victim may be found on the genitals of the accused and vice versa.

g. Fibers

The fibers may be of animal, vegetable, mineral and synthetic origin. A crime against person often involves contact between the criminal's clothes on the other. Even in burglary, or theft the criminal often hands or touches several objects in the premises, due to which clothing fibers are transferred from the criminal to the scene of crime & vice versa, because the clothes constantly carry loose fibers. If it is found that a fiber from one source exactly matches one from another source, there is definite probability that the 2 sources have come into contact with each other.

h. Poisons:

In a suspected case of poisoning, the identification of the poison is necessary. It must be remembered that the presence of injuries or a disease sufficient to account for death does not rule out the possibility of poisoning.

i. Weapons & Tools:

A wide variety of tools are used in the commission of crimes e.g. knives, screw

drivers, bars, saws, pliers, cutters, hammers, drill etc. Some of these leaves marks which are very characteristic and by which the tool may be quite accurately identified.

j. Cloths:

Fibers, paint, grease or dust may be found on the suspects cloths in a burglary and stains of semen and blood on the cloths of both the victim and the assailant in sexual offenses

k. Glass:

In hit and run traffic accident cyclist rear lamp may be broken, the glass fragments of which may be found on bumper or other parts of the vehicle. Also traces of glass from the headlamp of the vehicle may be found at the same. The burglar is trying to enter the house may break window glass, the fragments of which may be carried in his cloths etc. The refractive index, specific gravity, exposure to ultraviolet light, glass fragment help to identify their probable source. The composition of glass can be checked chemically and by spectroscopic examination.

l. Wood

If a piece of wood from the handle of the tool used by the criminal is found at a scene, can be identified by matching it with the handle of the tool seized from the suspect. Particles or splinters of the wood found on the suspect's clothes or tool should be



compared with the wood of door or window broken for the forced entry. Faults, marks, bruises & other individual pointers assist in matching a piece of wood with another piece, from which it has been separated. Paint & external factors also indicate a relation between broken pieces microscopical examination of the cell structures is useful in identification of sawdust.

m. Metals

Most evidence which is metallic in nature is in the form of tools and weapons, like wood, metal piece from the tool used by the criminal may be found at the scene of crime and metal fragments from the door & window fittings and from the boxes & safes may be recovered from the criminals clothing or tool. Metallic fragments can be examined chemically or with a spectroscope and can be identified with the specimen sample of the metal.

n. Tool marks

The two main types of tool marks are compression and scrap marks with the combination of both and also cutting marks. Every tool has its own peculiarities and the wear causes an individuality which is transmitted to the object on which the tool has been used. The density, pigment distribution, spectrographic analysis to determine the chemical composition of the mineral constituent of paint samples and

microscopic examination give positive proof.

o. Paint

In a road accident, flakes of paint from the vehicle may be found on the ground or on the person, animal or object hit by it and traces of paint from the object may be seen on the vehicle. A burglar may carry on his body; tool for clothing, paint from the wall or doors of the house which he has burgled or from the safe if he has broken open.

p. Dust and dirt:

A criminal invariably carries soil in varying quantities on his feet or footwear from the earth on which he has walked and on his body or clothing from the ground on which he has lied down during the commission of the crime or fallen in the course of a struggle. Soil usually consists of mineral constituent, decomposed organic matter, broken leaves, pollen grains etc. capable of direct identification.

q. Vegetable material

Anyone committing a crime out of doors is likely to get plant material on his clothing, the identification of which will connect him with the scene. Algae and fungi are usually found on damp walls, in buildings the soils on vegetation and on domestic articles. The burglar climbing the damp wall or fall pipe may get smears of green algae. Seeds, portion of leaf, bark and other vegetable fragments are useful and can be identified



to belong to particular areas of country. Grass fragments, particularly uncommon types, pollen, weeds and seeds are identifiable with their particular source of origin.

r. Strings and ropes

The criminal may have brought his tools to the scene tied up in a bundle with string or cord, & may have left it behind. If it is identical in structure, size, shape, appearance with another found in the suspect's possession, it is of great value.

s. Tyre marks

It may be possible to trace a case by means of its tyre mark. A tyre mark should be compared with a test mark and not directly with the tyre.

t. Documents

They are physical evidence like blood, hair, glass etc. Questioned documents may necessitate 1. Physical and chemical examination including a study and identification of; a. Writing materials e.g. paper, pen, ink, pencil, typewriter. b. Erasers, obliterations & alterations c. Order and age of writing, typing or other markings. (2) Identification of the authorship of the writing. The individual should be asked to write something for the purpose of comparison with a questioned document. Infrared light will assist in the examination of closed letters, questioned documents etc.

u. Photography

Photography provides life like reproductions, which serve to refresh memory and are usual evidence. In the forensic sciences, photographs are used 1) as means to record a phenomenon observed and 2) to reveal that cannot be normally be seen. The first category includes the recording of simple matching techniques, photomicrography and photo macrography. The second category includes the effect of infrared and ultraviolet radiations, which helps in seeing things which are not seen in ordinary light, such as faint letter marks and for the production of radiographs using X Ray.

v. Lie detection

a. Polygraph: It is an instrument used to detect lies. Keelers polygraphy and Stoelling deceptograph are common in use. Polygraph makes a continuous record of blood pressure, pulse, respiration, muscular moments and electrodermal reactions changes in response to stimuli in the form of questions. It is based on the theory that, when the person tells a lie answer to a question and there is fear that lie will be detected, the emotion of fear results in stimulation of sympathetic nervous system which results in certain physiological changes (psychosomatic reactions) some of which may be easily recorded. There is relative rise in blood pressure and recovery,



pulse rate increases, slowing down of the breathing, erratic breathing and many times suppression of the involuntary muscle movements and lowering of the Galvanic skin resistance of the individual due to activity of sweat glands.

In pre test interview the test questions are framed with mutual consent of the subjects and to the satisfaction of examiner, that they are adequate to serve the purpose of the particular examination. Basic explanation of the attachments in the polygraph is given to the subject and attempt is made to answer the subjects questions regarding the procedure. The questions are framed in such a way that they are clearly understood by the subject and they call for only yes or no as answer. The questions usually number 10. Relevant and irrelevant questions are mixed up. The control questions are put to reduce the notional nervousness, the natural stigma of the issue at stake and the natural slight recentment of the accusatory nature of the matter involved in the investigation. The question is asked every 20-25 seconds and polygraph chart recorded in 3-4 minutes. Usually the same test is repeated twice/thrice as a check on any possible error. An experienced and competent polygraph examiner can correctly detect truth or lie in about 80% to 90% cases. The few errors that do occur favour the innocent since the known

mistakes in diagnosis almost always involved a failure to detect lies of deceptive subjects. Offenders, suspects, complainant, witnesses and informants are examined by this method, to test truth of the statements. It is also useful in civil cases, e.g. paternity cases, insurance claims, pre employment screening- by banks and other institutions.

b. Narco analysis (Truth Serum Drugs)

This is based on the principle that, at a point very close to unconsciousness the subject will mentally be incapable of resistance to questioning and incapable of inventing the falsehoods that he has used to conceal his guilt. The methods used are half mg of scopolamine hydrobromides. c. followed by one fourth mg every 20 minutes, for an average 3 to 6 injections till the subject reaches the proper stage of questioning.

c. Hypnosis

Many people cannot be hypnotized and many cannot be hypnotized to a deep level. It does not often enhance memory. Hypnotized witnesses 1) produce more fabricated recollections 2) are more influenced by interviewers misleading comments and questions and 3) more confident in the accuracy of their recollections that are non hypnotized witnesses even when their recollections are false.

d. Word Association



Changes in reaction time of the subjects reply to word stimuli either visual or auditory or by stereotype of answers or by exhibition of uncoordinated physical moments, have been employed in attempts to detect deception.

**Brain mapping (brain fingerprinting):**

It is a technique that measures recognition of familiar stimuli by measuring electrical brainwave responses P300 to words, phrases or pictures that are presented on a computer screen. It is based on the theory that, the suspect's reaction to the details of an event or activity will reflect in, if the suspect had prior knowledge of the event or activity. It uses a multidisciplinary approach involving brain imaging, neuropsychology, clinical neuroscience, computer science and bio instrumentation to integrate information on a scale ranging from whole brain structure to the microscopic level. Modern brain scanning techniques consist of Electroencephalography (EEG), magnetoencephalography (MEG), Positron emission tomography (PET), Magnetic resonance imaging (MRI) and Computer tomography (CT). The equipment called "electro-cap" is fixed on the suspect's head for recording EEG. The suspected person is questioned about the crime and also shown the visuals of the Crime Scene (victim, weapon, time, place and how he committed the crime etc. along

with irrelevant words, photographs etc.) on a video monitor under computer control to stimulate his brain and encourage reaction on a computer monitor. Apart from his verbal replies another computer keeps track of the neuro-impulses emitted whenever the visual is seen. A specific wave response called MERMER (Memory encoding related multifocused electroencephalographic response) is elicited when the brain processes the relevant information it recognizes. This pattern occurs within about a second after the stimulus presentation and can be detected using EEG amplifier and a programmed computer when the details of the crime, would know are presented, a MERMER is emitted by the brain of a separated traitor but not by the brain of an innocent suspect. It depends on the cognitive brain responses to detect the MERMER. Each stimulus appears for a fraction of a second. Three types of stimuli are presented, targets, elements and probes. The target illicit a MERMER. Most of the non-target stimuli are irrelevant and do not elicit MERMER. Some of the non-target stimuli are irrelevant to the situation and are called probes and does not depend on the emotions and is not affected emotional responses. Similarly, when the information tested is information known only to members of a particular



organization group e.g. terrorist group, the information present indicates affiliation with the group in question. It is said to be 100% accurate.

## CONCLUSION

Forensic science laboratory helpful for analysis of biological samples to check for the presence of toxins & drugs and also has its prime importance in road accidents, poisoning, sexual violence etc.<sup>5</sup> The lab reports furnish key information about the nature of substance present in an individual pertaining to an incidence. It also determines whether the quantity of substances are normal as per a therapeutic dosage or exceed the permissible level. Since newer variants of drugs are developed each day, this branch of science is ever evolving and demands up to date approach.



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