

Science in pursuit of truth and justice

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Most crimes leave behind traces of 'silent evidence'. Yes, traces of materials known as physical evidence, found at the scene of crime act as potent clues that become the most eloquent witnesses. Thanks to the tremendous strides made in technology, today's scientists have a wealth of technological gadgets and tools that can help us turn these clues into powerful witnesses. Today's forensic scientists use the most sophisticated technological equipment to unravel the mysteries from even subatomic particles or micro cells like DNA. Anything to everything that is conspicuously absent or present in / on / near the victim/suspect / crime scene, surrounding area, neighborhood, etc., and even dust, pollen, bloodstain, bullet, glass, paint, hair, ash etc., serve as 'silent speakers' of truth. These very materials can become valuable pieces of evidence in the hands of forensic scientists who seek truth and nothing but truth.

Forensic Science is the science that deals with analysis of physical evidence collected from all possible sources criminal and victim are associated with. **Forensic Scientists** are the scientific experts engaged in extensive scientific investigation who perform crucial tasks with their technical expertise, experience and skills using the best scientific techniques to tie the loose ends in order to link the crime with the criminal. Like picking up bits and pieces of flesh from the crime scene to compare and match DNA, matching skulls with faces, deciphering invisible traces of writings from age old documents - the list is endless. As true seekers of truth, these technical sleuths have certainly come a long way from the so-called 'magnifying glass combing operations' of Sherlock Holmes to the modern day's most powerful Scanning Electron Microscope which can magnify even the tiniest object to 2,00,000 times.

India's first full-fledged Forensic Science Laboratory was established in 1952 in Calcutta by upgrading the Chemical Examiner Lab started in 1840's. The first Finger Print Bureau was started in Calcutta in 1897 by Sir Edward Henry, the Father of fingerprint system and the first Document Examiner's lab was established in 1906 in Shimla. A Serologist lab was established in 1950's in Calcutta. Today, most of the States in India have full-fledged Forensic Science Laboratories and some of them have also established Regional and District Forensic Science Laboratories. There are also four Central Government Forensic Science Laboratories, CFSL's, situated in New Delhi, Chandigarh, Calcutta and Hyderabad and 3 Document Examiner labs, GE S QD in Shimla, Calcutta and Hyderabad. Some states have Document Examiner labs outside the purview of FSLs. There are Fingerprint Bureaus in all states as a part of State Crime Record Bureaus (SCRB's). There is a Central Fingerprint Bureau in New Delhi as a part of National Crime Records Bureau (NCRB).

The AP State Forensic Science Laboratory was established in November 1974 with only six sections, namely Ballistics, Biology, Chemistry, Documents, Physics and Toxicology. As the crime rate increased the number of cases handled by FSL also has gone up. With growing ingenuity of modern criminal, more and more complex crimes are referred to FSL by the Law Enforcement agencies. Considering the magnitude and variety of crime, new sections have been created in FSL Headquarters. Alongside, Regional FSLs were also established in the last ten years at Visakhapatnam, Vijayawada, Warangal, Guntur, Tirupati and Kurnool (Anantapur). Scientific Investigation Teams called CLUES to assist and guide the investigating officers at the scenes of offence were also established initially at Hyderabad, Visakhapatnam, Vijayawada, Cyberabad and Ranga Reddy District and extended to all District Headquarters in 2002. Today, APFSL has twelve sections broadly divided into Biological, Chemical, General and Physical Divisions. APFSL is the first and only Laboratory in India to establish advanced technology-centric sections like DNA, Computer Forensics and Forensic Engineering to cater to the ever

growing demands from Police, Judiciary and other Central and State Government Departments and Public Sector undertakings. Today APFSL is considered as a Model Lab in India and analyses cases referred by CBI, RBI, Defence, Customs, Foreign Embassies, passports Authority, Banks, Insurance Companies besides several Central Government agencies and States like Tamilnadu, Keral, Karnataka, Maharashtra, Bihar, U.P., Jammu and Kashmir, Goa etc.

APFSL has 12 sections to undertake a wide range of examinations on varied nature of evidence samples collected from the crime scenes, victims, suspects and other connected places.

Ballistics Section undertakes the examination of

Firearms

To ascertain their caliber, make, model, working condition, status of recent firing.

Parts of Firearms

To ascertain their nature, type and whether they come under Arms Act.

Cartridges

To ascertain their caliber, make, whether live or not.

Cartridge cases

To ascertain their make, caliber, and to establish a possible link to the firearms and crime.

Bullets

To ascertain their make, caliber, type and to establish a link to the firearm and crime.

Pellets/Wads

To ascertain their make, size, to ascertain the shot size number, nature of firearm through which they were discharged and range of firing.

Clothes and other materials affected by firing

To ascertain type, caliber of firearm used, number of shots, range of firing etc.

Biology Section deals with the examination of

Hair

To find the origin, individualization and comparative analysis/matching.

Fibres

To find the origin, individualisation and comparison/ matching.

Diatoms

To confirm drowning by death or otherwise the site of drowning.

Plant material-Wood, Leaves, Seeds, Fruits, Flowers, Pollens, etc., & Cigarettes, Beedies, Zarda, etc.,...

To determine origin, species and comparison with control/standards.

Insects, flies, maggots etc.,...

To ascertain the time since death and place of death.

Skull along with the photograph of the deceased

To ascertain whether the skull actually belongs to the person in the photograph or not by means of superimposition technique.

Skeletal remains, tissues, skin of human and animal origin

To determine the origin, sex, age, stature etc.,

Chemistry Section deals with the examination of

Explosives, its remnants, residues, components etc.

To determine the nature, composition, damage potential, quantitative estimate of explosive used.

Arson and fire residues

To know the nature and composition of fire accelerants.

Suspected Petrol, Diesel and Other Motor Oils

To determine whether it is adulterated or not and to find the nature and percentage of adulterant.

Unknown substances in the form of solids, liquids or gases

To know the qualitative and quantitative composition.

Suspected Cosmetics, Toiletry, and Cement etc.

To know whether they conform to the specifications of brand or trademark or spurious.

Suspected Metals, Jewellery, Ornaments, and Alloys etc.

To find out the percentage metallic composition.

Acid burn cases :

To confirm or otherwise the acid used for skin burns.

Computer Forensic Section deals with examination of

Software

To find out whether it is original or pirated, authorized or unauthorised and stolen or altered source code.

Hardware

Configuration, working condition, capabilities, network connections (Intranet, Internet).

Computer Peripherals & Products

To determine their use and applications, genuineness, authorised or not, abuse capability.

Computer Data, Text, Images

To take replica/image of the suspected storage media such as hard disks and to determine whether they are genuine or not authorized or not used for fraudulent purpose or not and to establish any deletion/overwriting/manipulation of text etc. and slack space analysis.

Audio and Video Files in storage Media

Whether they are produced by interaction between the individuals based on the text, voice and image profiles.

DNA Section deals with the examination of Samples of Human Origin :

Liquid blood, bloodstains & swabs, semen, seminal stains & swabs, Tissues, Bones, Hair, Teeth, Saliva, Skeletal remains.

To individualise and identify the persons beyond doubt, to fix the paternity of children.

Samples of Animal Origin : Blood, Blood Stains, Tissues, skin, bones, Teeth etc.

To individualise and identify the Animals.

Samples of Plant Origin : Tobacco, Chilli Powder, Wood, Leaves, Seeds, Pollen etc.

To individualise and identify the source and origin.

Documents Section undertakes examination of Handwriting in the form of running matter, signatures, initials, numerals, etc.

To ascertain the authorship.

Erasures, obliterations, alterations, overwriting, secret writing etc.

To know whether there is any tampering of documents and to decipher the original writings, text etc.

Typewriting, printed matter and photocopies

To identify the typewriter, printing machine and photocopying machines.

Inks and paper

To determine the nature and establish whether any tampering of documents took place.

Stamp impressions

To ascertain whether or not they are genuine.

Photostat, fax and carbon copies

To ascertain the original writings or text.

Forensic Engineering Section deals with the examination of**Road/Train/Vehicular Accident Materials**

To reconstruct the scene of accident to determine the probable cause, time and mode of accident.

Building materials such as bricks, cement mortar, Steel, etc.

To ascertain whether the materials individually and in combination possess required strength or not and ascertain whether they meet the specifications required for a structure or not to determine negligence, fraud, cheating etc.

Mechanical, Electrical, Electronic components, engineering materials, metals, plastics, etc.

To determine the strength of materials and there by finding the nature and cause of accidents, failures etc.

Narcotics Section deals with analysis of**Suspected Powders, Liquids, Plant products etc.**

To identify the nature of substance so as to establish whether it comes under the purview of NDPS Act and to estimate the percentage composition.

Suspected Toddy, Liquor

To estimate whether the sample is adulterated or not and the nature and quantity of adulterant.

Components used for preparation of Adulterated Toddy, Liquor etc.

To ascertain the nature, composition and its harmful effects in combination.

Physics Section undertakes examination of**Glass Fracture studies**

To know the origin, director and causation factors.

Glass pieces and fragments

To find the nature, composition and whether they match with control samples.

Paint flakes, chips and smears

To find the nature, composition and whether they match with control samples.

Footprints, Shoe prints, Type impressions, and Tool marks

for identification and matching.

Suspected Currency notes

To establish whether the currency is genuine or counterfeit.

Erased numbers on vehicles, firearms etc.

To establish tampering if any and to decipher original numbers.

Spurious articles

To establish whether the article is an infringement of Trade Mark Act.

Voice analysis

To link suspects to crime or otherwise

Polygraph Section undertakes examination of**Persons viz, suspects, witnesses or complainants**

To ascertain whether or not the statements given by them are true.

Toxicology Section deals with analysis of**Viscera and Body fluids**

To determine the nature, composition, and quantitative estimation of the poison present.

Suspected poisonous substances in Plant materials, Food, Syringes, Needles, Tablets, Powders, etc.

To know the nature, composition and quantitative estimation of the poison present.

Bones, Ash, Skin, Vomit, Exhumed remnants

To ascertain whether they contain any poisonous substances and its nature, quantitative estimation.

Serology Section undertakes analysis of

Blood, Semen, Saliva, Other body fluids, Skin Tissues etc.,

To ascertain whether they are of human or animal origin and to establish their blood group and enzymic characterization.

Check list of Physical Evidence-Section Wise and Crime Wise
A Quick summary for Investigating Officers

S.No	Section APFSL	Types of Physical Evidence	Nature of Crime
1	Ballistics	Firearms, Parts of firearms, Cartridge cases, Bullets, Pellets/Wads, Clothes and other materials affected by firing	Murder, Assault, Suicide, Attempt to Murder, Dacoity
2.	Biology	Hair, Fibres, Diatoms, Tobacco products, other plant materials like Pollen, Leaves, Wood, Seeds, Fruits, Flowers etc., and insects such as Maggots, Flies, skull, skeletal remains, Skin and Tissues, Photographs	Rape, Murder, Suicide, Drowning, Cheating, Suicide, Murder
3.	Chemistry	Petrol, High Speed diesel, Lubricating oils etc, Detergents, Cosmetics, Cement etc., Explosive materials, Arson & Fire residues, Acid burning residues, unknown chemicals, remnants of mechanical explosions, Chemical Explosions.	Explosive cases, Accidents, Arson, Fire, Acid Burning.
4.	Computer Forensics	Software, Hardware, Computer Peripherals, Storage Media, Communication devices, Voice files, Image files, Computer Printouts.	Hacking, Source Code Alteration, Obscene e-mails, Data Manipulation, Virus Spreading and Child Pornography, Computer related crimes.
5.	DNA	Liquid blood, Blood Stains & Swabs, Semen, Seminal Stains & Swabs, Tissues, Bones, Hair, Teeth, Saliva, Skeletal remains	Rape, Murder, Disputed Paternity, Swapping of new born babies
6.	Documents	Handwritings, Erasures, Obliterations, Alterations, Over-Writings, Secret writings etc. Type writings, Printed matter, Inks and paper, Stamp impressions, Fax, Carbon Copies,	Cheating, Forgery, Misappropriation, Murder, Suicide Frauds, Financial Scams.

		Xerox copies	
7.	Forensic Engineering	Materials recovered in substandard construction of buildings, roads, dams & Road, Train or Air Accidents, Failures of machines and structures	Fraud, Misappropriation, Negligence, Cheating
8.	Narcotics	Plants and Plant products containing Narcotics, and psychotropic substances Adulterated Liquor, Adulterated toddy	Cheating, NDPS Act cases, Central Excise cases.
9.	Physics	Glass Pieces and Fragments, Paint Flakes, Chips and Smears, Foot Prints, Shoe Prints, Type impressions, Tool marks, Counterfeit currency, Erased numbers on vehicles and other valuable gadgets, Spurious articles, Voice analysis.	Cheating Burglary, Rape Accident, Murder, Hit and Run cases.
10.	Polygraph-Lie Detector	Suspects, Witnesses or Complainants	Burglary, Dacoity, Theft, Arson, Rape, Murder, White Collar offences
11.	Serology	Blood, Semen, Saliva, other body fluids, skin tissues etc.	Rape, Murder, Assault
12.	Toxicology	Poisonous substances, Drugs, Intoxicating substances like Alcohol, Sedatives, barbiturates etc.	Suicide, Murder, Accident, Mass disasters, Food poisoning.

Some of the Major Equipment in FSL & their Applications:

1. Scanning Electron Microscope (SEM) with Energy Dispersive X-Ray Analyser (EDX)

SEM can magnify any object 2,00,000 times as against the magnifying power of 1000 times of a conventional microscope. SEM is useful to study the morphological, surface characteristics by scanning the surface of any tiny sample such as pollen, gun shot residue, dust, fibres, hair, tool marks, explosion residue, metallic fragments etc., The built-in computer has the capacity to store a large number of micrographs of samples for reference and subsequent comparison. The elemental composition of the sample can be instantly checked with X-ray Microanalyser simultaneously.

2. Gas Chromatograph coupled with Mass Spectrometer (GCMS)

While the GC facilitates separation of various constituents of organic compounds like poisons, narcotics, explosives and other chemical substances, the MS identifies the separated components by means of their molecular weights and fragmentation patterns for unequivocal and absolute identification. The built-in computer library of compounds facilitates this identification fast.

3. X-Ray Diffractometer (XRD)

Identification of a variety of crystalline materials such as soil, paint, gunshot residues, narcotics, poisons, cement etc., for characterisation or comparison.

4. Universal Testing Machine (UTM)

Testing of mechanical properties like bending, stretching, tensile strength, compression strength

etc., of wide range of metallic, engineering and building materials in cases of failure of structures, machines and accidents of road, train or air.

5. High Pressure liquid Chromatograph (HPLC) with Diode Array Detector

Separation, identification and quantification of nonvolatile, thermolabile samples in drugs, narcotics, explosives, dyes, cosmetics, polygrams, plant products etc.

6. Fourier Transform Infrared Spectrophotometer (FTIS)

For unequivocal identification of organic compounds like drugs, pesticides, polymers, explosives, narcotics and other chemicals through characterisation of functional groups by Fourier Transform technique, which gives excellent resolution. For comparison the spectra of Forensic samples are available in the built-in library.

7. High Performance Thin layer Chromatograph (HPTLC)

For separation and screening of multiple compounds into their constituents and identifying them in the case of poisons, narcotic drugs, explosives, plant products etc.

8. Gene Cycler /PCR & Gel Documentation System

To amplify small quantities of DNA from skeletal remains, tissues, blood stains, seminal stains, hair roots etc so that the amplified DNA can be further studied by means of STR analysis to obtain the DNA profile of an individual.

9. DNA sequencer/STR Analyser

For analysis of PCR amplified biological specimens such as blood, semen, saliva, skin tissues for identification of the individuals in case of human samples and matching of species in case of plant and animal origin.

10. Bullet Velocity Measuring System

To determine the velocity of bullet and projectiles fired from firearms and to find the rate of firing in an indoor / simulated environment.

11. Comparison Microscope

For comparison of two objects simultaneously through two objectives and eyepiece for side by side comparison for matching the parameters such as bullet marks, finger print marks, hair, medulla etc.

12. Multi wavelength Image Amplification Digital Imaging System

Light amplification of semi visible and invisible evidence material is one of the proven means of recognition, location and identification of minute objects simultaneously rendering visible the minute variations in the tints, colors etc of various objects like inks, paper, paints, pigment, and dyes etc. The system employs a multi wavelength light amplification system coupled with suitable software for simultaneously amplifying, detecting and visualizing otherwise difficult to distinguish obscure images.

13. Computerised Polygraph

To detect lying by suspect, victim, or eyewitness, the computerized polygraph has software to more accurately differentiate truth from lying by means of built-in validation technique, thus reducing the subjective manual interpretation.

14. Forensic Computer Work Station with Software

For imaging, retrieval and analysis of data relating to crimes committed using computer as a means of storage, manipulation, unauthorized reproduction, creation of pirated software and other computer related frauds and also recapture the data from erased or deleted files to prove the unauthorized use, abuse or misuse of computers.

15. Video Spectral Comparator

To examine and compare the specimens such as handwritings, erasures, alterations on documents as well as study of counterfeit currency stamps, stamp impressions etc. under light of different wavelengths for clear differentiation.

16. Electronic Nose

With metal oxide sensors it distinguishes and identifies characteristic odours emanating from material such as explosives, firearm, residues cosmetics, Flavours etc. It can also distinguish body odours and other gaseous odours for comparison and identification of suspects, thus aiding criminal investigation .

17. X-Ray Fluorescence Spectrometer (XRF)

Fluorescence effects found on impingement of X-rays on various types of objects such as spurious ornaments, metals, counterfeit currency etc. for determining the elementary make-up of samples.

18. Digital Densitometer & Digital Flash Point System

For instantaneous measurement of density of liquids like fuel oils, detergents and solids like glass, plastics etc., and for instantaneous determination of flash point of liquids such as fuels, lubricants etc.

In addition to the above APFSL has a range of microscopes, spectrophotometers, chromatographs, measuring equipment, audiovisual equipment, digital cameras, sound spectrograph, color laser printers, color Xerox, color photography system, computers in network mode and several other latest office management tools including finger print access control system.

With all the rapid strides in terms of new technologies in Medicine, biotechnology, Computers, Communications, Space Science, Engineering and so on, many people around the world today feel unsafe and insecure. Hitech Criminals are using latest gadgets and escaping the long arms of Law by clever exploitation of legal loopholes and technical trivialities. People have become increasingly selfish. And people are not coming forward to tell the truth. Moreover people are easily getting influenced to tell lies out of fear or favour. In order to prevent, control and check these negative influences in a free and open society, Science has increasingly come to play a vital role in criminal investigation in the form of forensic sciences. This small introduction, I hope would serve as a ready reckoner to all those dealing with law enforcement; police, prosecution, judges and many others connected with administration of Justice.