BASICS OF FORENSIC SCIENCE

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TOPICS TO BE COVERED

- Introduction to Forensic Science
- Basic Principles of Forensic Science
- Functions of Forensic Science
- Scope of Forensic Science
- Need for Forensic Science
- Ethics and moral values in Forensic Science
- Disciplines of Forensic Sciences and Their Applications

MAJOR DEVELOPMENTS IN FORENSIC SCIENCE HISTORY

- 700s AD- The Chinese used fingerprints to establish the identity of documents and clay sculptures
- 1000-Roman courts determined that bloody palm prints were used to frame a man in his brother's murder
- 1149- King Richard of England introduced the idea of the coroner to investigate questionable deaths

- 1200s- A murder in China is solved when flies are attracted to invisible blood residue on a sword of a man in the community

- 1598- Fidelus was the first to practice forensic medicine in Italy

- 1670-Anton Van Leeuwenhoek constructed the first high-powered microscope

- 1776-Paul Revere identified the body of General Joseph Warren based on the false teeth he had made for him

- 1784-John Toms convicted of murder based on a torn edge of a wad of paper in a pistol matching a piece of paper in his pocket

- 1859, Gustav Kirchhoff and Robert Bunsen developed the science of spectroscopy.
- 1864 - Crime scene photography was developed
- 1879 - Alphonse Bertillon developed a system to identify people using particular body measurements
- 1896 - Edward Henry developed the first classification system for fingerprint identification
- 1900 - Karl Landsteiner identified human blood groups

- 1904-Edmond Locard formulated his famous principle, "Every contact leaves a trace."
- 1922-Francis Aston developed the mass spectrometer.
- 1959-James Watson and Francis Crick discover the DNA double helix
- 1977-AFIS was developed by the FBI and was fully automated in 1996
- 1984-Jeffreys developed and used first DNA tests to be applied to a criminal case

People of Historical Significance

Mathieu Orfila (1787-1853)

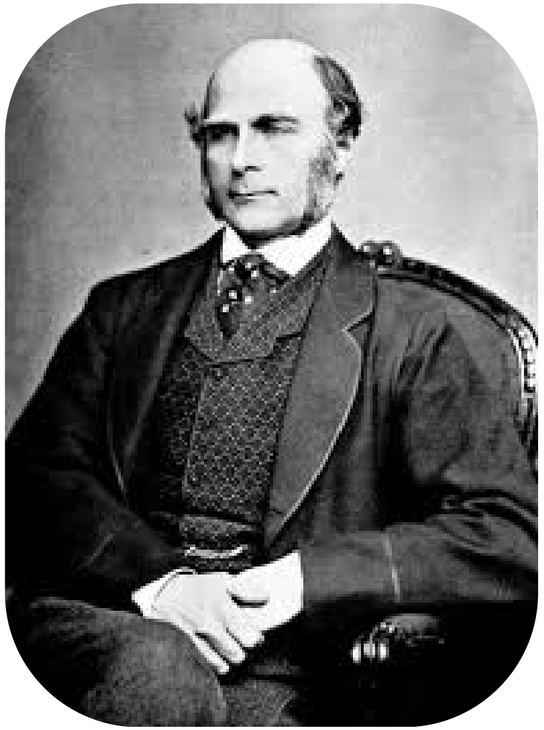
- Spanish born but did work in France
- Father of Forensic Toxicology
- 1814 published a Treatise on the detection of poisons

Alphonse Bertillon (1853-1914)

- French Scientist
- Father of Anthropometry
- Developed a system to distinguish one person from another based on certain body measurements.
- 1879 devised first system of person ID using a series of body measurements
- Devised the first crime scene kit - still used today

Francis Galton (1822-1911)

- British Scientist.
- Father of Fingerprinting
- Developed fingerprinting as a way to uniquely identify individuals.
- 1892 published the book "Finger Prints" which contained the 1st statistical proof supporting the uniqueness of fingerprints.
- Laid the foundation of modern fingerprints.

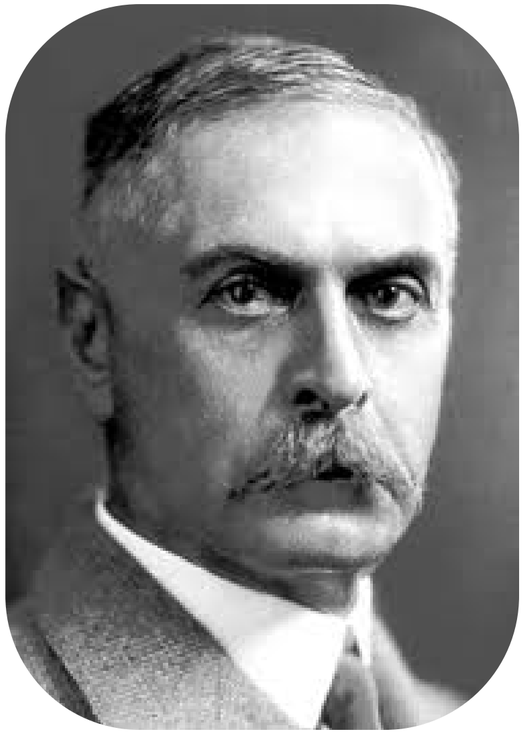


James Marsh

- British Chemist
- First to introduce chemical evidence of arsenic in a body during a trial in 1839.
- invented the Marsh test for detecting arsenic.

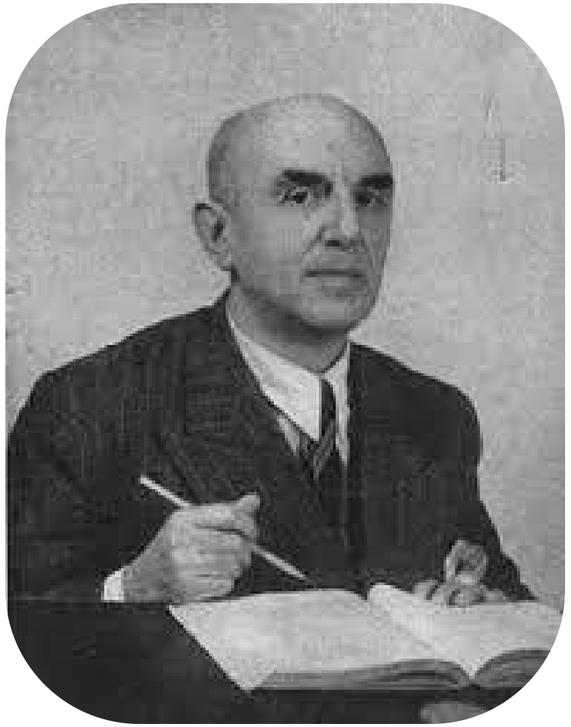
Karl Landsteiner (1868-1943)

- An Austrian who immigrated to the U.S.
- In 1901, discovered that human blood could be grouped into different categories (A, B, AB and O).
- 1930 Won Nobel Prize.
- 1940 helped to discover the Rh factor in human blood.



Leone Lattes (1887-1954)

- Italian Scientist
- Father of Bloodstain Identification
- 1915 devised a procedure by which dried bloodstains could be grouped as A, B, AB or O
- His procedure is still used today by some forensic scientists



Calvin Goddard (1891-1955)

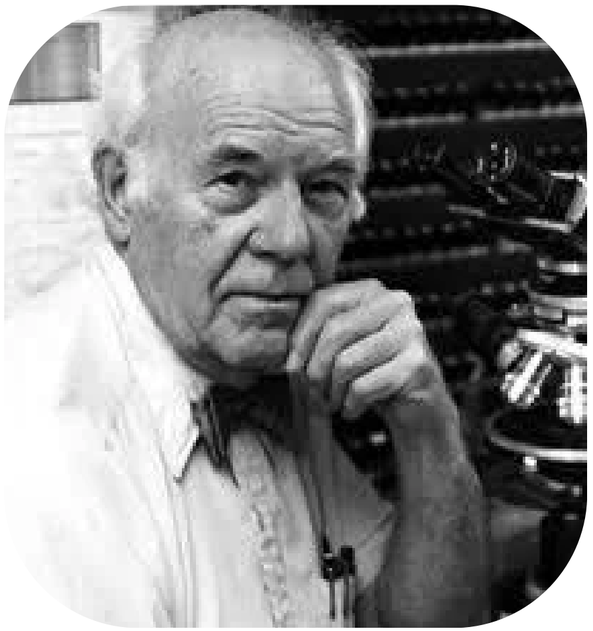
- U.S. Army colonel
- Father of Ballistics
- Developed the Comparison Microscope
- Refined the techniques of determining if a gun had fired a specific bullet. (Ballistics)
- Developed the technique to examine bullets, using a comparison microscope, to determine whether or not a particular gun fired the bullets.

Albert S. Osborn (1858-1946)

- American Scientist.
- Father of Document Examination
- His work led to the acceptance of documents as scientific evidence by the courts.
- 1910 published the book "Questioned Documents."
- The book became a primary reference for document examiners.

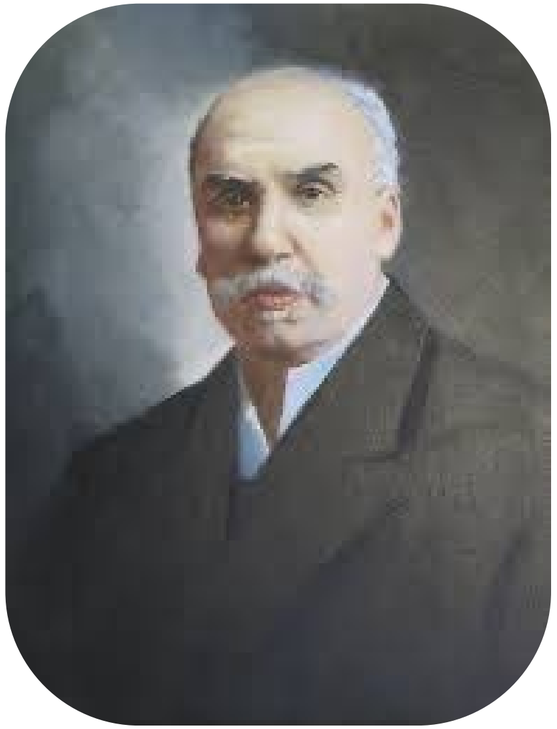
Walter McCrone (1916-2002)

- Father of Microscopic Forensics
- He developed & applied his microscope techniques to examine evidence in countless court cases



Hans Gross (1847-1915)

- Lawyer and Judge in Austria
- 1893 Published the first treatise on applying science criminal investigation
- Started the forensic journal "Kriminologie”

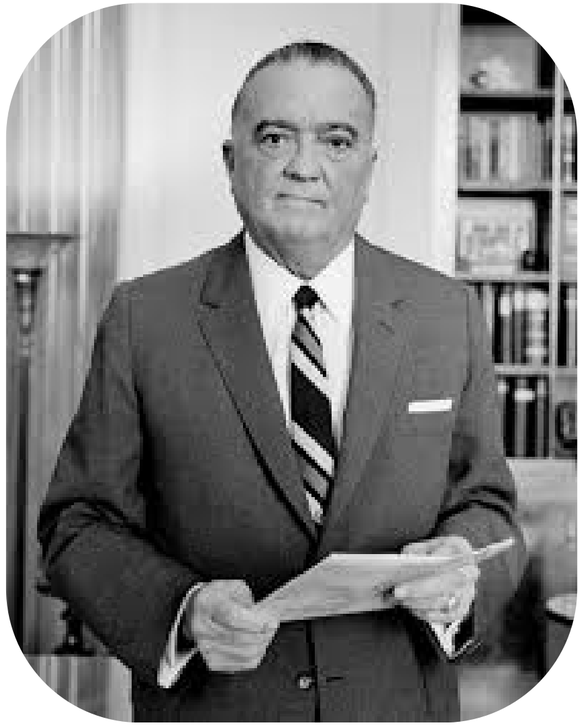


Edmond Locard (1877-1966)

- 1910 set up the first Forensic Lab in Lyons, France
- Used the scientific method in criminal investigation. The background was medicine and law.
- Father of criminalistics.
- Father of Forensic Science
- Founder and Director of the Institute of Criminalistics @ the University of Lyons
- Formulated the Locard's Exchange Principle

J. Edgar Hoover (1895-1972)

- Director of the FBI (1924-1972)
- FBI was established in 1905 by Teddy Roosevelt as the Bureau of Investigation
- 1924 National Fingerprint file organized
- 1932 Crime Lab Established.
- 1935 National Police Academy formed
- 1935 Bureau renamed FBI



Sir Alec Jeffreys

First to develop a DNA profile (DNA fingerprint)

1984

BASIC CONCEPTS IN FORENSIC SCIENCES

Forensic Science :

Forensic Science is the application of scientific methods and principles to investigate crimes and assist in the administration of justice.

Forensic Expert :

A trained professional who applies specialized scientific knowledge to examine evidence and presents expert opinions in legal proceedings.

Crime Scene:

The location where a crime has occurred or evidence related to the crime is found. It is systematically examined to recover evidence.

Evidence :

Any object, document, or material that can provide information about a crime. Types include: Physical evidence (weapons, tools), Biological evidence (blood, hair, saliva), Digital evidence (emails, CCTV footage)

Chain of Custody :

A documented process that records the handling, transfer, and storage of evidence to ensure it is legally admissible and untampered.

Expert Testimony :

A statement given in court by a forensic expert, explaining their findings and the scientific analysis used.

BASIC PRINCIPLES OF FORENSIC SCIENCE

There are 7 basic principles of Forensic Sciences:

1. Law of Individuality.
2. Principle of Exchange.
3. Law of Progressive Change.
4. Law of Comparison.
5. Law of Analysis.
6. Law of Probability.
7. Law of Circumstantial Facts

1 **Law of Individuality :**
"Every object, person, or substance is unique."
No two items in nature or man-made are identical. This allows for individual identification using characteristics like fingerprints, DNA, handwriting, etc.

2 **Principle of Exchange (Locard's Exchange Principle) :**
"Every contact leaves a trace."
When two objects come in contact, there is always a mutual transfer of materials. This is crucial in linking suspects, victims, and crime scenes.

3 **Law of Progressive Change :**
"Everything changes over time."
Evidence (especially biological) is subject to environmental and temporal changes. Hence, timely collection and preservation are critical.

4 **Law of Comparison :**
"Unknown evidence must be compared with known standards."
Identification or matching of evidence (like bullets, handwriting, or fibers) requires a control or reference sample.

5 **Law of Analysis :**
"Evidence must be analyzed using valid and standardized scientific methods."
Analysis should follow proper protocols to maintain accuracy and ensure results are legally acceptable.

6 **Law of Probability :**
"Forensic conclusions are based on likelihood, not absolute certainty."
Many forensic findings are expressed in terms of probability (e.g., chance of a random DNA match).

7 **Law of Circumstantial Facts :**
"Facts do not lie."
Physical evidence and facts derived from it are more reliable than eyewitnesses or confessions. They remain unaffected by emotions, memory lapses, or biases.

FUNCTIONS OF FORENSIC SCIENCE

- Crime Detection – Helps identify how, when, and by whom a crime was committed.
- Evidence Examination – Analyzes physical, biological, chemical, or digital evidence.
- Expert Testimony – Forensic experts present scientific findings in court.
- Link Establishment – Connects suspect, victim, weapon, and crime scene.
- Legal Support – Assists in both civil (e.g., paternity) and criminal cases.

- Crime Scene Management – Involves documentation, collection, and preservation of evidence.
- Identification – Identifies unknown bodies using DNA, fingerprints, etc.
- Database Maintenance – Supports criminal databases (e.g., DNA, fingerprints).
- Research & Training – Advances forensic techniques and educates professionals.
- Disaster & Terror Response – Assists in victim identification and analyzing terror-related evidence.

SCOPE OF FORENSIC SCIENCE

- Criminal Investigations – Helps solve crimes like murder, theft, assault, and fraud.
- Civil Disputes – Used in cases involving paternity, property disputes, and insurance claims.
- Law Enforcement Support – Assists police and investigative agencies in evidence analysis.
- Courtroom Evidence – Provides scientific basis for expert testimony in courts.
- Cyber Forensics – Investigates digital crimes like hacking, data theft, and online fraud.

- Identification of Individuals – Identifies suspects, victims, and missing persons using DNA, fingerprints, etc.
- Terrorism and Disaster Management – Aids in victim identification and evidence recovery in mass disasters.
- Wildlife and Environmental Forensics – Solves crimes involving poaching, pollution, and illegal wildlife trade.
- Forensic Psychology and Psychiatry – Assesses the mental health and behavior of criminals.
- Research and Development – Enhances forensic methods, tools, and scientific accuracy.

NEED FOR FORENSIC SCIENCE

- Crime Solving – Essential for identifying offenders and reconstructing crime scenes.
- Scientific Evidence – Provides objective, reliable proof in criminal and civil cases.
- Legal Justice – Helps courts make informed, fair decisions based on expert analysis.
- Identification – Accurately identifies unknown individuals through DNA, fingerprints, etc.
- Crime Prevention – Acts as a deterrent through accurate and fast investigations.

- Link Establishment – Connects suspects, victims, and evidence to the crime scene.
- Expert Testimony – Forensic professionals assist the judiciary with technical insights.
- Support for Law Enforcement – Strengthens police investigations and improves conviction rates.
- Evidence Integrity – Ensures proper handling, preservation, and chain of custody of evidence.
- Advanced Crime Types – Necessary to investigate complex crimes like cybercrime, terrorism, and white-collar crimes.

ETHICS AND MORAL VALUES IN FORENSIC SCIENCE

- Honesty and Integrity – Forensic experts must provide truthful, unbiased reports and testimony.
- Objectivity – Avoid personal bias or pressure; base conclusions purely on scientific evidence.
- Confidentiality – Maintain strict confidentiality of case details, victims, and findings.
- Accountability – Be responsible for the accuracy, reliability, and consequences of your analysis.

- Impartiality – Serve justice, not one party. Work for truth, not for prosecution or defense alone.
- Professional Competence– Keep up with advancements and apply proper techniques with skill and care.
- Respect for Human Rights – Treat victims, accused, and evidence with dignity and fairness.
- Avoiding Misuse of Expertise – Do not exaggerate findings or make claims beyond scientific limits.
- Proper Documentation – Maintain clear, accurate records and preserve the chain of custody.
- Testifying Ethically – Provide clear, honest, and scientifically supported statements in court without misleading the judge or jury.

- Maintain Objectivity – Never allow personal interest or gain to bias or distort a report or testimony.
- Claim Only Your Work – Never claim results or accomplishments that are not your own.
- Stay Within Scientific Limits – Limit reports/testimony to conclusions that can be properly drawn from the evidence and analysis.
- Use Clear and Precise Language – Avoid misleading, ambiguous, or easily misunderstood terminology.
- Ensure Accurate Representation – Use accepted standards for images and data; avoid distortion or sensationalism.
- Respect Confidentiality – Uphold client confidentiality, like the attorney-client relationship, unless it may cause a miscarriage of justice.
- Charge Fairly – Set reasonable, transparent fees for services; never work on a contingency (outcome-based) basis.

DISCIPLINES OF FORENSIC SCIENCES

1. Forensic Biology

- Studies biological evidence like blood, hair, or saliva.
- Used in DNA profiling and body fluid identification.

2. Forensic Chemistry

- Examines chemical substances from crime scenes.
- Identifies drugs, explosives, and unknown materials.

3. Forensic Toxicology

- Detects and interprets toxins in body fluids and tissues.
- Common in cases of poisoning, drug overdose, and DUI.

4. Forensic Anthropology

- Identifies human remains through bones and skeletal features.
- Helps in disaster victim identification and homicide cases.

5. Forensic Odontology

- Applies dental science to legal investigations.
- Used in bite mark analysis and identifying unknown bodies.

6. Forensic Entomology

- Studies insect activity on decomposing bodies.
- Estimates time since death (postmortem interval).

7. Forensic Psychology

- Applies psychological principles to legal matters.
- Assists in criminal profiling and suspect interrogation

8. Forensic Psychiatry

- Deals with mental illness in the context of crime.
- Evaluates criminal responsibility and sanity.

9. Digital / Cyber Forensics

- Recovers and analyzes digital evidence from electronic devices.
- Crucial in hacking, fraud, and cybercrime investigations.

10. Forensic Ballistics

- Examines firearms, ammunition, and bullet trajectories.
- Matches bullets and casings to specific weapons.

11. Questioned Document Examination

- Analyzes handwriting, inks, and paper.
- Used in detecting forged signatures and counterfeit documents.

12. Fingerprint Analysis (Dactyloscopy)

- Studies ridge patterns of fingers for identification.
- Compares prints from crime scenes with suspects.

13. Forensic Pathology

- Investigates causes of death through autopsy.
- Determines if death was natural, accidental, or homicidal.

14. Forensic Serology

- Tests blood, semen, and saliva for forensic purposes.
- Helps identify bodily fluids and potential suspects.

15. Wildlife Forensics

- Investigates crimes against animals and endangered species.
- Used in illegal hunting and wildlife trafficking cases.

16. Environmental Forensics

- Analyzes environmental pollutants and contaminants.
- Traces sources of pollution in air, water, or soil.

17. Forensic Engineering

- Examines structural or mechanical failures.
- Applied in accident reconstruction and product liability.

18. Forensic Nursing

- Provides care while collecting legal-medical evidence.
- Works in cases of abuse, assault, and trauma.

19. Forensic Linguistics

- Studies language in legal and criminal contexts.
- Identifies authorship of anonymous threats or letters.

20. Criminology

- Scientific study of crime and criminal behavior.
- Helps develop crime prevention and control strategies.

21. Forensic Geology

- Analyzes soil, rocks, and minerals as evidence.
- Matches earth materials from suspects and crime scenes.

22. Forensic Biotechnology

- Uses molecular biology techniques in crime investigation.
- Involves PCR, genetic markers, and recombinant DNA.

23. DNA Analysis

- Identifies individuals through genetic material.
- Highly accurate for linking suspects to biological evidence.

THANK YOU