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DEPARTMENT OF HUMAN ANATOMY

INTRODUCTION TO FOORENSIC SCIENCE (ANA 406)

GROUP ONE

HISTORY AND DEVELOPMENT OF FORENSIC SCIENCE

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**INTRODUCTION**
Crime in some form or the other has existed since the beginning of human race. With the advancement in science and technology the concept of crime as well as the methods adopted by criminals in its commission have undergone a phenomenal change. On one hand the intelligent criminal has been quick to exploit science for his criminal acts, on the other hand the investigator is no longer able to rely on age old art of interrogation and methods to detect crime.
In this context FORENSIC SCIENCE has found its existence.

**FORENSIC SCIENCE:**

Definition:
The term **forensic** is derived from the Latin word (**forensis:** which means belonging to courts of justice or to public discussion and debate). It therefore means the science which is used in courts for justice. **CRIMINALISTICS** is synonym used in U.S.A. Forensic science, also known as criminalistics is the application of science to criminal and civil laws, mainly on the criminal side during criminal investigation, as governed by the legal standards of admissible evidence and criminal procedure.

Forensic scientists collect, preserve, and analyze scientific evidence during the course of an investigation. While some forensic scientists travel to the scene of the crime to collect the evidence themselves, others occupy a laboratory role, performing analysis on objects brought to them by other individuals. In addition to their laboratory role, forensic scientists testify as expert witnesses in both criminal and civil cases and can work for either the prosecution or the defense. While any field could technically be forensic, certain sections have developed over time to encompass the majority of forensically related cases.

**THE HISTORY AND DEVELOPMENT OF FORENSICS**

The practice of forensic techniques has been used throughout history to solve crimes; initiating from the early existence of man, Forensic Science was intact in its simplest forms and kept on expanding throughout the prehistoric era. Prehistoric forensics is also considered as the building blocks of modern forensic techniques. In the first instance a case indicating the use of forensics was reported in ancient Rome circa in 1000 A.D. An attorney Quintilian used a handprint full of blood to prove that a blind man had been wrongly accused for the murder of his own mother.

During this time period over 700 years, mankind discovered vast amounts of knowledge in all the diverse fields of forensics. Acknowledgment and attention to detail increased towards the end of the 16th century so much so that documents had been published showing the fine detail of fingerprints. Henceforth this aided the world of forensics in successfully developing and recognizing individual human characteristics.

In 1000 A.D. crime scene investigation, advanced to an extent where an attorney Quintillion was able to identify and examine hand prints covered in blood, to prove that a blind man had been trapped for the murder of his own mother.Additionally the Chinese went on further, in 1248 AD the development of the first written documentation for identifying distinctive crime via a book was published in china. In ancient China clay seals were found to consist of thumbprints. Subsequently this was one of the first books published named Hsi Duan Yu, which means The Washing Away of Wrong. This book consisted of medical knowledge which helped establish the differences in the recognition of crimes such as drowning and strangling. Consequently this book is considered as the first recorded evidence combining medicine to crime solving practices. It also consists of recorded information that outlines the basis of forensic pathology. The book “His Duan Yu” aided the development and enhancement of pathology and is still is considered as a valuable resource.

In 1249 an Italian surgeon Hugh of Lucca took an oath as a medical expert in the city of Bologna; he gained fame for his comprehension regarding the antiseptic treatment of wounds. More than 50 years later in the year 1302 an Italian named Bartolommeo da Varignana from the same city of Bologna carried out a medical autopsy regarding a case of a murder suspect, involved in the murder of a noble man.

Nearly a century and half later in 1447 a body was identified as that of Charles French Duke of Burgundy from the absent teeth which were the clue in solving the murder; his body consisted of teeth which had been knocked out whilst he was still alive and recognition of these missing teeth and scars gave an indication to his identity. Therefore this case can be considered as one of the first indications of Forensic Odontology.

The French have also played a remarkable role in discoveries through the years. A French Surgeon from the year 1509-1590, called Amboise Pare wrote and published reports in court; thus producing a book which is deliberated as being the first conclusive test on legal medicine.

During the 1600’s the world of science had opened up with an expansion of discoveries which were taking place at a phenomenal rate. In 1601 the first treatise on systematic document examination was published in France by a French man called Francois Damelle. This document was written before the developments of inks and paper. However comparison of handwriting could be subjected to analysis and identified. Modern day handwriting analysis is conducted by a Forensic Document Examiner, who detects forgeries e.g. signatures. Moreover a Forensic Document Examiner has the task of examining documents created using photocopiers and fax machines; this is done by examining the ink and paper alongside the handwriting and its other foreign inclusions.

Sir Thomas Browne (1605-1682) was an English Physician and Historian who acknowledged that a substance known as Adipocere was formed on the body of the deceased. He described this substance as fatty, waxy and soap like. It also came into recognition that Adipocere was formed on human corpses; mostly buried in moist and air free places. Persistently this substance was under analysis and a French chemist known as Antoine François (1755-1809) discovered the chemical speciality of Adipocere whilst examining bodies; recognising its chemical similarity to soap. Subsequently this discovery was of huge progression dating back to prehistoric times (44 BC) where Antistius found that only one stab wound proved fatal during the killing of Julius Caesar. Therefore understanding of pathology was growing at an astounding rate and people started discovering the solution to crimes via science instead of relying on witchcraft.

Also in 1686 Marcello Malpighi a professor of anatomy at the University of Bologna went on further to allow documentation of the different characteristics of fingerprints e.g. whorls, ridges, loops and spirals. Although Malpighi documented the patterns of fingerprints he did not mention there importance in the use of crime detection and how they are part of an individual’s characteristics; hence the vital importance they play when used as identification methods. However a layer of skin approximately 1.8mm thick is named after him and is known as the Malpighi layer.

A crucial discovery was made in 1775 by Karl Wilhelm Scheele. He discovered that it was possible to change Arsenious Oxide into Arsenious acid; when reacted with zinc it produces arsine. Subsequently this procedure proved to be of vital importance in forensic detection of arsenic.

One of the first uses of documented physical matching was established in 1786, when John Toms an Englishman was convicted of murder. Evidential proof showed a torn wad of paper found in a pistol matching another piece in his pocket.

Early 19th – early 20th centuries

1. MATHIEU ORFILAfather of modern toxicology. In the early part of the 19th century he established in Paris methods of scientific chemical analysis of poisons, which are in use even today.
2. Hans Gross applied scientific methods to crime scenes and was responsible for the birth of criminalistics. He published a book on criminal investigation; (**'Handbuch fur Untersuchnugsrichter')**
3. Edmund Locard expanded on Gross' work with Locard's Exchange Principle which stated "whenever two objects come into contact with one another, materials are exchanged between them". This means that every contact by a criminal leaves a trace.
4. Alexander Lacassagne, who taught Locard, produced autopsy standards on actual forensic cases.
5. Alphonse Bertillon was a French criminologist and founder of Anthropometry (scientific study of measurements and proportions of the human body). He used anthropometry for identification, stating that, since each individual is unique, by measuring aspects of physical difference there could be a personal identification system. He created the Bertillon System around 1879, a way of identifying criminals and citizens by measuring 20 parts of the body.
6. Frances Glessner Lee, known as "the mother of forensic science", was instrumental in the development of forensic science in the US. She lobbied to have coroners replaced by medical professionals, endowed the Harvard Associates in Police Science, and conducted many seminars to educate homicide investigators. She also created the Nutshell Studies of Unexplained Death, intricate crime scene dioramas used to train investigators, which are still in use today.
7. ALPHONSE BERTILLON of France was 1st to evolve a scientific system of personal identification. In 1879 he developed the science of **ANTHROPOMETRY,** a systemic procedure of taking a series of body measurements to facilitate distinguishing one individual from another. With the invention of photography he was the first to use it in criminal investigation. In 1881, he began to take standard pictures of all French criminals and file them in the Bureau of Identification then in Paris. His efforts have earned him the distinction of being known as the **Father of Criminal Investigation**.
8. FRANCIS GALTON of U.K. undertook the first systemic study of fingerprints. He developed a methodology of classifying the fingerprints for filing purposes .in 1892, he published a book on **fingerprints** giving a sound statistical proof of uniqueness of individualization through fingerprints.

20th century

1. Alec Jeffreys invented the DNA profiling technique in 1984.
2. In the 20th century several British pathologists, Mikey Rochman, Francis Camps, Sydney Smith and Keith Simpson pioneered new forensic science methods. Alec Jeffreys pioneered the use of DNA profiling in forensic science in 1984. He realized the scope of DNA fingerprinting, which uses variations in the genetic code to identify individuals. The method has since become important in forensic science to assist police detective work, and it has also proved useful in resolving paternity and immigration disputes. DNA fingerprinting was first used as a police forensic test to identify the rapist and killer of two teenagers, Lynda Mann and Dawn Ashworth, who were both murdered in Narborough, Leicestershire, in 1983 and 1986 respectively. Colin Pitchfork was identified and convicted of murder after samples being taken from him matched semen samples taken from the two dead girls.
3. Forensic science has been fostered by a number of national and international forensic science learned bodies including the Chartered Society of Forensic Sciences, (founded 1959), then known as the Forensic Science Society, publisher of Science & Justice; American Academy of Forensic Sciences (founded 1948), publishers of the Journal of Forensic Sciences; the Canadian Society of Forensic Science (founded 1953), publishers of the Journal of the Canadian Society of Forensic Science.
4. EDMOND LOCARD in 1910 established a police laboratory in Lyons and later founded the Institute of Criminalistics at the University of Lyons. he propounded the famous PRINCIPLE OF EXCHANGE , which forms the basis of forensic examination of physical evidence.
5. KARL LANDSTEINERin 1901 discovered that blood could be grouped into different categories. Following this Dr. Leone Lattes of Italy devised a relatively simple procedure for determining the blood group of dried bloodstains and immediately adopted this technique for criminal investigation.
6. ALBERT OSBORN developed fundamental principles of document examination, which gave acceptance to documents as scientific evidence by the courts. in 1910 he wrote the classic “**QUESTIONED DOCUMENTS”** which is primary book of reference for document experts.

21st century

In the past decade, documenting forensics scenes has become more efficient. Forensic scientists have started using laser scanners, drones and photogrammetry to obtain 3D point clouds of accidents or crime scenes. Reconstruction of an accident scene on a highway using drones involves data acquisition time of only 10–20 minutes and can be performed without shutting down traffic. The results are not just accurate, in centimeters, for measurement to be presented in court but also easy to digitally preserve in the long term. Now, in the 21st century, much of forensic science's future is up for discussion. The National Institute of Standards and Technology (NIST) has offered the community some guidelines upon which the science should build. NIST recommends that that forensic science rethinks its system. If local laboratories abide by these guidelines, 21st century forensics will be dramatically different from what it has been up till now. One of the more recent additions by NIST is a document called “NISTIR-7941”, titled "Forensic Science Laboratories: Handbook for Facility Planning, Design, Construction, and Relocation". The handbook provides a clear blueprint for approaching Forensic Science. The details even include what type of staff should be hired for certain positions.

IMPROTANCES AND DIFFERENT ASPECTS OF FORENSIC SCIENCE

Forensic Evidence may be used to:

1. Prove elements of a crime2. Verify or discredit victim or suspect statements3. Identify decedents or suspects4. Establish a connection to a crime or crime scene

Therefore, Forensic evidence involves both evidence used by during the criminal investigation and those presented before the courts. Forensic scientists can also testify as expert witnesses for the benefit of either the prosecution or the defense. There are different aspects of Forensic evidence, they include Ballistics, Anthropometry, Fingerprints, DNA, Maturation, and Ear print analysis, Chemistry, Entomology, Geology, Geomorphology, Geophysics, Odontology, Optometry, Pathology, and Toxicology amongst others.

i. DNA –Scientifically called Deoxyribonucleic Acid, this is the material on which genetic information in living things are stored. It is a scientifically prove fact that no two human beings can have the same DNA, thus, evidence is gotten to link a suspect to a crime or crime scene by compares of DNA profiles. A DNA database is often needed for this purpose.ii. Fingerprints – Scientifically called Forensic dactyloscopy, fingerprints have been proven to be unique to a person. Thus, evidence may be gotten from surfaces, objects or the weapon used in the commission of a crime. Generally, fingerprints are one of the most common ways of ensuring authenticity in a database.iii. Ear print analysis –This is a similar tool to fingerprinting. An ear print is a two-dimensional reproduction of the parts of the outer ear that have touched a specific surface.iv. Geomorphology – This involves the study of the ground surface of a suspected crime scene in the quest to discover location(s) of buried objects.v. Entomology – Insects in, on and around human remains also assist in determining and proving time and location of death. It may also be helpful in determining movement of the body after death.vi. Geology – Forensic geology involves trace evidence which may be in form of soils, minerals and petroleum.vii. Toxicology – This evidence is gotten as a result of the effect of certain drugs and poisons on or in the human body. This is mainly used in autopsy, where suspected cause of death is poisoning.viii. Bloodstain pattern analysis – Blood spatter patterns found at crime scenes are also used in reconstructing or deriving evidence on the events of the crime.ix. Optometry – This involves the study of glasses and other eyewear found at crime scenes for investigations.x. Odontology – The uniqueness of dentition is also used as evidence in crime investigation. It may be used to identify a victim’s body or the bite mark of an accused on the other hand.xi. Podiatry – Forensic podiatry involves the study of the footprints or footwear found at a crime scene to establish an identity.

HISTORY OF THE TECHNIQUES USED IN FORENSICS SCIENCE

1. Toxicology

A method for detecting arsenious oxide, simple arsenic, in corpses was devised in 1773 by the Swedish chemist, Carl Wilhelm Scheele. His work was expanded, in 1806, by German chemist Valentin Ross, who learned to detect the poison in the walls of a victim's stomach.

Apparatus for the arsenic test, devised by James Marsh

James Marsh was the first to apply this new science to the art of forensics. He was called by the prosecution in a murder trial to give evidence as a chemist in 1832. The defendant, John Bodle, was accused of poisoning his grandfather with arsenic-laced coffee. Marsh performed the standard test by mixing a suspected sample with hydrogen sulfide and hydrochloric acid. While he was able to detect arsenic as yellow arsenic trisulfide, when it was shown to the jury it had deteriorated, allowing the suspect to be acquitted due to reasonable doubt.

Annoyed by that, Marsh developed a much better test. He combined a sample containing arsenic with sulfuric acid and arsenic-free zinc, resulting in arsine gas. The gas was ignited, and it decomposed to pure metallic arsenic, which, when passed to a cold surface, would appear as a silvery-black deposit. So sensitive was the test, known formally as the Marsh test, that it could detect as little as one-fiftieth of a milligram of arsenic. He first described this test in The Edinburgh Philosophical Journal in 1836.

1. Ballistics

Henry Goddard at Scotland Yard pioneered the use of bullet comparison in 1835. He noticed a flaw in the bullet that killed the victim and was able to trace this back to the mold that was used in the manufacturing process.

Anthropometry

Frontispiece from Bertillon's Identification anthropométrique (1893), demonstrating the measurements needed for his anthropometric identification system.

The French police officer Alphonse Bertillon was the first to apply the anthropological technique of anthropometry to law enforcement, thereby creating an identification system based on physical measurements. Before that time, criminals could be identified only by name or photograph. Dissatisfied with the ad hoc methods used to identify captured criminals in France in the 1870s, he began his work on developing a reliable system of anthropometrics for human classification.

1. Fingerprints

Sir William Herschel was one of the first to advocate the use of fingerprinting in the identification of criminal suspects. While working for the Indian Civil Service, he began to use thumbprints on documents as a security measure to prevent the then-rampant repudiation of signatures in 1858.

In 1877 at Hooghly (near Kolkata), Herschel instituted the use of fingerprints on contracts and deeds, and he registered government pensioners' fingerprints to prevent the collection of money by relatives after a pensioner's death.

1. Uhlenhuth test

The Uhlenhuth test, or the antigen–antibody precipitin test for species, was invented by Paul Uhlenhuth in 1901 and could distinguish human blood from animal blood, based on the discovery that the blood of different species had one or more characteristic proteins. The test represented a major breakthrough and came to have tremendous importance in forensic science. The test was further refined for forensic use by the Swiss chemist Maurice Müller in the 1960s.

1. DNA

Forensic DNA analysis was first used in 1984. It was developed by Sir Alec Jeffreys, who realized that variation in the genetic code could be used to identify individuals and to tell individuals apart from one another. The first application of DNA profiles was used by Jefferys in a double murder mystery in the small English town of Narborough, Leicestershire, in 1985. A 15-year-old school girl by the name of Lynda Mann was raped and murdered in Carlton Hayes psychiatric hospital. The police did not find a suspect but were able to obtain a semen sample.

In 1986, Dawn Ashworth, 15 years old, was also raped and strangled in the nearby village of Enderby. Forensic evidence showed that both killers had the same blood type. Richard Buckland became the suspect because he worked at Carlton Hayes psychiatric hospital, had been spotted near Dawn Ashworth's murder scene and knew unreleased details about the body. He later confessed to Dawn's murder but not Lynda's. Jefferys was brought into the case to analyze the semen samples. He concluded that there was no match between the samples and Buckland, who became the first person to be exonerated using DNA. Jefferys confirmed that the DNA profiles were identical for the two murder semen samples. To find the perpetrator, DNA samples from the entire male population, more than 4,000 aged from 17 to 34, of the town were collected. They all were compared to semen samples from the crime. A friend of Colin Pitchfork was heard saying that he had given his sample to the police claiming to be Colin. Colin Pitchfork was arrested in 1987 and it was found that his DNA profile matched the semen samples from the murder.

Because of this case, DNA databases were developed. There is the national (FBI) and international databases as well as the European countries (ENFSI : European Network of Forensic Science Institutes). These searchable databases are used to match crime scene DNA profiles to those already in a database.

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