Chapter 2
History of Forensic Science

Abstract The History of forensic science is a key to understanding where we were, and where we are now in issues relating to crime investigations. Forensics originates from the latin word 'forensis' which means 'a forum'. Generally, Forensic is an adjective which refers to "of or used in courts of law or forensic science." In recent times, forensics (used interchangeably with forensic science) is closely related to legal issues, the court, and different disciplines. In academic literature, forensic science could be traced as far back as the end of the 19th century. Forensic science is of great importance when we need to present evidence to the court of law to either convict or acquit a suspect of a particular crime. Unfortunately, Nigeria and other African countries have not utilised the advantages of forensic science in solving the numerous crimes that happen in this continent. With the proper usage of forensic science, the evidence acquired could be used in the court of law to fight crimes. In this chapter, the history of forensic science is carefully covered and some lessons learnt from reviewing this history is presented.

Keywords Forensic science · Nigeria · Africa

2.1 History of Forensic Science

In the ancient days, confessions and witness testimony were used as criteria to prove the innocency or guilt of a person. This approach has several flaws, due to the fact that individuals with high lying capabilities could easily escape punishment. Furthermore, an individual could convince people to bear false witness against his opponent and as such incriminate an innocent person.

The first recorded case about the use of forensic science is around the 44 BC. It was a case where Julius Ceasar was assassinated which was due to 23 stab wounds. This was performed in the form of autopsy by Roman physician Antitius. He discovered that out of the 23 stab wounds, it was the second that was fatal and it was around the breast.

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The focus in this chapter is to treat the forensic science history from 250 BC to 2017. Emphasis is placed on major events that has happened in this field and how forensic science was used in each of the major event. Considering these events and forensic science applications, the history is treated through these phases.

2.1.1 250 BC: Lie Detector Test

Around 250 BC, a Greek physician and anatomist Erasistratus attempted to detect deceit by feeling the pulse of the individual under investigation [1]. A story was told of a stepson (Antiochus) falling in love with his step-mother (Stratonice), but he tried his best to hide it from his father (Nicator). Due to Antiochus extreme love for Stratonice, he began loosing weight and was very sick from an unknown disease. Nicator then invited Erasistratus who was well knowledgeable in brain and nervous system functions to examine his son. Before the examination, Erasistratus was told of the suspicion that, it appeared Antiochus extremely love Stratonice and that could be the cause of sudden loose of weight and sickness. Using this information, Erasistratus spoke with Antiochus and felt his pulse. When the decency and beauty of Stratonice was raised as a point of discussion, Antiochus' pulse rhythm intensity increased which confirmed the suspicion.

2.1.2 400s: Determination of Death Causes

This was the time when Germanic and Slavic societies made a law about determination of the cause of death. They stated that medical experts were the only people permitted to carry out such test. This is closely related or could be termed as an early practice of legal medicine or forensic medicine. It is reported that Hippocrates and some other persons debated about some medicolegal questions which are considered undisputed. Some of the questions include: what could be the average pregnancy duration?, how fatal it was in different parts of the body?, and what is the feasibility of existence of children born prematurely.

Another account of the practice of legal medicine around the 400s is the story of Alexandria in Egypt submitting a report about a suicide which was suspected to be a murder case [1, 2].

2.1.3 600s: Identity Determination Using Fingerprints

An Arabic merchant, Soleiman first used fingerprints as a proof of validity. So what he did was debtors fingerprints were placed on a bill which will be handed over to the lender. This served as a proof of debt and was legally recognised around this time [1].

2.1.4 1248: First Forensic Medicine Textbook

A collection by Song Ci titled [3] "Collected Cases of Injustice Rectified" stated that China started solving crimes using a forensic approach around this time. A conspicuous case that shows the existence of forensic practice in China around this era is a murder case story of a person which was implemented using a farm sickle. At the crime scene, it was observed that the victim was slashed repeatedly by a tool suspected to be a sickle. All the workers were instructed to lay down their sickles even though they were clean. It was noticed that flies were attracted to one particular sickle which was as a results of the blood smell. The owner of the sickle later confessed of the murder.

Furthermore, Song Ci recorded that [3]: "A forensic medical doctor must be serious, conscientious, and highly responsible, and must also personally examine each dead body or that of a wounded person. The particulars of each case must be recorded in the doctors own handwriting. No one else is allow to write his autopsy report. A coroner must not avoid performing an autopsy because he detests the stench of corpses. A coroner must refrain from sitting comfortably behind a curtain of incense that mask the stench, let his subordinates do the autopsy unsupervised, or allow a petty official to write his autopsy report, leaving all the inaccuracies unchecked and uncorrected."

Additionally, Song Ci explained some forensic processes that could be used to differentiate between drowning (water in the lungs) that could be caused as a result of accidents and strangulation (murder cases).

2.1.5 1348–1350: Black Plague and Autopsies of Victims

Around 1348–1350, a deadly plague came into existence which was popularly referred to as black plague that claimed several lives across Europe. A pope around this time in Avignon, Holiness pope Clement VI instructed his surgeon, Gui de Chauliac to carry out an autopsy on the plague victims to further investigate the cause of this plague. This is recorded to be the first authorised autopsy to be performed outside the medical study in the universities [4].

Stilson [5] wrote that around 1665 a physician reported in the Great plague of London how severe the black plague was after an autopsy was performed:

> A skin so beset with spots black and blue more remarkable for multitude and magnitude than any I have yet seen.

2.1.6 1447: Missing Teeth Used as Identify

In 1447, the French Duke of Burgundy was killed. It was very difficult to identify his remains due to the fact that he was naked and partly devoured by wolves. However, when he was alive he felled and lost his upper teeth and this was used to identify his remains.

John of Troyes wrote:

> And in this place, the next Monday which was following the battle, the groom told us straight that the Duke of Burgundy was dead, totally naked and surrounded by forty men who were also naked and lying on the ground. And the Duke had a gash from the ear to the teeth which had been made by a halberd, two wounds in the thighs made by a spear and a third one on the lower part of one of his legs. Six elements allowed us to clearly recognize the Duke of Burgundy. The first and most important element came from his upper teeth which he had lost when he had fallen once [6].

2.1.7 1600: Pathology Reported

Ambroise Pare, a French army surgeon was interested in the cause of death. He would dissect people that were killed in the battlefield and examine their internal organs to determine how these organs behaved after the person died. The causes of death due to diseases were examined by Fortunato Fidelis and Paolo Zacchia which were both Italian surgeons. This appears to be the birth of pathology which is used till date.

In the late 1600s, Giovanni Morgagni conducted autopsies, collected the data and correlated findings to match different diseases.

2.1.8 1784: John Toms Convicted Using Physical Evidence

In Lancaster, Edward Culshaw was murdered. An examination on the corpse revealed that he was shot in the head. An evidence that accompanied the head wound was a torn edge of a wad[1] of newspaper which was found to match a torn piece of newspaper later found in the pocket of John Toms who was a suspect for the murder. When Toms was further investigated based on this evidence, he admitted that he committed the crime.

[1] A crushed piece of paper used to ensure the gunpowder and shot/ball was tightly in place in the muzzle of the weapon.

2.1.9 1806 and 1814: Poisoned Deaths Investigation

Valentin Ross, a German chemist developed an approach in investigating deaths caused by poison. The stomach of the victims were investigated for detecting arsenic. Later in 1814, Mathieu Orfila in Spain published the first paper on detection of poisons. Some refer to him as the Father of Forensic Toxicology.

2.1.10 1816: Clothes and Shoes Used as Physical Evidence

A young lady was found drowned in a shallow pool in Warwick. The investigator observed some evidence around the crime scene which were footprints, a piece of cloth (appeared to be carduroy) and scattered grains of wheat and chaff near the shallow pool. The investigators investigated all the farmers in the nearby fields and a particular young man wore a trouser that was made of carduroy. Therefore, the cloth and shoes of this labourer were examined and they matched those left at the crime scene. He was tried and convicted of the murder.

2.1.11 1836: Cause of Death Determined by Chemical Testing

An English chemist James Marsh, utilised chemical processes for the determination of arsenic which he showed was the cause of the death when investigating a murder trial case.

2.1.12 1843: Forensic Psychiatry Established

McNaughton shot with an intention to kill the Prime minister of Great Britain, Sir. Robert Peel. The bullet however, shot his secretary, Mr. Drummond who died after 5 days. However, when McNaughton was checked both mentally and physically, it was observed that due to insanity, he was not found guilty.

2.1.13 1854–1859: Criminal Identification Based on Photos

In the US, a man named San Francisco was the first to use systematic photography for the identification of criminals.

2.1.14 1868–1950: Chemical Microscopy

Emile M Chamot and Clyele W. Wason wrote "Handbook of Chemical Microscopy" [7]. It is considered to have the most constructive information about microscopy. They pointed out its applications to the study of crystals and cyptocrystalline aggregates, fibrous materials, particle size, illumination, photomicrography and preparation techniques [7].

2.1.15 1880: Uniqueness of Fingerprints Discovered

In the British Journal of Nature, Henry Faulds and William James published that fingerprints were unique. Therefore, it was adapted to be used in the court as evidence by Francis Galton. The fingerprints were classified by Galton into: Plain arch, tented arch, simple loop, central pocket loop, double loop, lateral pocket loop, plain whorl and accidental. Later in the 1880s, Sir Edward R. Henry improved this fingerprint classification.

2.1.16 1887: Coroner's Act in the USA

An act referred to as the Coroner's Act was established that stated that only Coroners[2] were to determine the causes of sudden, violent and unnatural deaths. Around this same time, Arthur Lonan Doyle published the first Sherlock Holme's story. Again, A Treatise on forensic medicine and public health written by Fodere and The complete system of police medicine written by John Peter Franck were published around this era.

2.1.17 1888: Anthropometry Developed

A French scientist called Alphonse Bertillon developed a biometric identification system referred to as Anthropometry or Bertillonage. This system involved the measurement of physical features and bones which totaled to 11. His aim was to ensure that criminals who repeated their crimes could be identified as in most cases, criminals tend to change their identities. Chicago was the first city in the USA to adopt this method.

[2] A public officer elected to inquire the causes of any death which could be due to unnatural causes.

2.1.18 1892: Forensic Dactyloscopy

An Argentine police officer, Juan Vucetich was the first to use fingerprint as evidence for murder investigation. He collected fingerprint on the door which supposedly belonged to the murderer. Fingerprint identification and the field of Forensic dactyloscopy was created by Vucetich.

2.1.19 1901: Human Blood Grouping

Serology came into existence around this time when Karl Landsteiner grouped blood into A, B and O. Dieter Max Ritcher adapted this technique and used it for blood stain analysis at crime and accidents scenes. Landsteiner and Ritcher worked together to produce a systematic typing of blood grouping and rhesus factor.

2.1.20 1901: Fingerprinting Method Used in Scotland

Scotland yard officially introduced the use of Galton-Henry system of fingerprint classification. Literature shows that it is still used throughout the world today.

2.1.21 1903: Fingerprint Prisoner ID Used in New York

In order to identify criminals, the New York prison system initiated fingerprint classification and the collection of relevant information about criminals.

2.1.22 1909: Switzerland Establised the First Forensic Science School

Rodolphe Archibald Reiss founded the first forensic science school in Switzerland. The name is “Institut de Police Scientifique” at the university of Lousanne.

2.1.23 1910: Hair Usage for Forensics

In a study by Balthazard and Lambert published in Le Poil de Lhomme et des Animaux (The hair of man and animals), they carried out a study which is referred to

as Forensic Trichology. This study was targeted at mammals/animals hairs. When this hair from mammals/animals were investigated under a microscope, it could distinguish the different mammals/animals body mass, approximate age, drug/alcohol intake and could serve as a deduced forensic evidence. This approach was used on a French woman named Rosella Roussean who was convicted for a murder which is a first legal case involving hairs.

2.1.24 1910: Police Crime Forensic Laboratory Developed in France

In Lyon, the first police department of police crime laboratory was established by Edmund Locard.

2.1.25 1912: Guns Identified to be Unique

Victor Balthazard developed different methods of matching bullets to a gun using photography. This was done because he had discovered that no two different gun barrels left the same markings. However, a particular gun left groves on each bullet fired through it to be identical (signature mark).

2.1.26 1923: Los Angeles Built a Crime Laboratory

Los Angeles became the first place a crime Laboratory was established in the US.

2.1.27 1930: Police Station Usage of Lie Detector

The prototype polygraph that was developed in 1921 by John Larson was developed to be used in the police station. This could be referred to as the polygraph or lie detector prototype.

2.1.28 1932: Federal Bureau of Investigation (FBI) Built a Crime Laboratory

FBI established their own crime laboratory which is the most famous crime laboratory in the whole world. In the same year, Harvard established a chair of legal medicine.

2.1.29 1937: Luminol Developed by Walter Specht

Walter Spetch developed chemiluminescent reagent luminal as a tentative test for blood.

2.1.30 1877–1966: Locard's Exchange Principle

Edmund Locard wrote about the famous Locard's Exchange principle:

> Transfer evidence, such as dust, is microscopic and it may not last long, but the transfer does occur, and it is the task of the forensic scientist to find those traces and use them to establish the link.

This principle was used to examine a young man (Emile Gourbin) that was a suspect to a lovers murder (Marie Latelle). The young man was investigated and thoroughly checked until it was discovered that under his fingernails, minute particles of the ladies face powder were deposited.

2.1.31 1950: Tape Lift Method Developed

Max Frei-Sulzer developed the tape lift method of collecting evidence at a crime scene. This way, evidence which included fibres, hairs, particles of dust and other particles could be moved from the crime scene to the laboratory for further forensic examination.

2.1.32 1960: Recorded Voice Used as Evidence in the Court of Law

It was discovered that voice could be recorded by a sound spectrography. Voice prints from recordings of phones, answering machines or tape recorded were used as court evidence in the court of law and for general forensic investigations around this era.

2.1.33 1967: FBI Established National Crime System

This was the first national crime system that was established by the FBI. This was a computerised filling system that contained data around the world of wanted people, stolen/missing vehicles, stolen or missing weapons and other weaponry in general.

2.1.34 1974: Gunshot Residue Detection

Aerospace corporation in the USA developed a technology that could detect gunshot residue. When a weapon was fired, it was expected that a residue should be left on the clothing, hands or other items in close vicinity. Gun related crimes could be forensically examined using this approach.

2.1.35 1975 and 1979: FBI Installed Fingerprint Reader and AFIS Used by Royal Canadian Mounted Police

The first fingerprint reader of the FBI was installed by the Rockwell International. However, what is considered today as AFIS was installed by the Royal Canadian Mounted Police in 1979.

2.1.36 1983–1986: Deoxyribonucleic Acid (DNA) Fingerprinting and Profiling

DNA fingerprinting and profiling techniques was developed by Sir Alec Jeffreys in 1984. This technique was useful in tracking down Colin Pitchfork which had raped and killed two different ladies, Lynda Mann (killed 1983) and Dawn Ashworth (killed 1986). Vaginal swabs of both victims were collected, examined and the semen samples were linked to the same person. They proved to have come from the same person. After DNA was taken on Pitchfork, it confirmed that he carried out the two rape cases and was sentenced to life imprisonment.

2.1.37 1986: DNA Testing in US

Edward T Blake in a civic case People v. Pastinikas provided DNA evidence. The evidence showed that different autopsy samples were from the same person.

2.1.38 1987: DNA Profiling Introduced in US

This helped to convict Tommy Lee Andrews of several sexual assault in Orlando, Florida.

2.1.39 1996: DNA Certified to be a Reliable Evidence

The reliability of DNA evidence was announced by the National Academy of Sciences.

2.1.40 1999: FBI Established Faster Fingerprint IDs

The Integrated Automatic Fingerprint Identification System (IAFIS) which reduced the fingerprint query response time from two weeks to 2 h was established by the FBI.

2.1.41 2001: DNA IDs Improved to be Faster

DNA profiling usually took between 6 and 8 weeks. Around this time, it was reduced to between 1 and 2 days which was a huge improvement in technology.

2.1.42 2007: Police Footwear Detection System Developed in Britain

Police developed an online footwear coding and detection system in the Great Britain. The Footwear Intelligence Technology (FIT) usually assists police to identify marks left behind from a footwear at a crime scene and possibly link it to a crime suspect or other crimes.

2.1.43 2008: Fingerprint Detection After Cleaning of a Particular Surface

Leicester university forensic research centre, UK developed a new method to lift fingerprints at a cleaned crime scenes. This was developed with a focus on visualisation

of fingerprints previously wiped down or corroded on metals that had needed fingerprints for forensic examination. Their technique is effective for detecting weaponry in corroded gun barrels and other weapons in general.

2.1.44 2011: Human-Drawn Sketches and Mugshots

Michigan state university developed a software that has an automatic matching capability of human-drawn facial sketches to mugshots stored in databases.

2.1.45 2011:X-ray Matching System

A novel dental X-ray matching system was developed by Japanese researchers that could bring out positive match in less than 4 s.

2.1.46 2013: Establishment of International Workshop on Biometrics and Forensics (IWBF)

The IWBF was established to foster forensic biometrics as it has recently attracted much attention. As such, the IWBF 2013 was first held in Portugal. This workshop produces important research in the area of biometrics and forensics and its held annually.

2.1.47 2016: Amelographics for Person Identification Proposed

Ameloglyphics was proposed for person identification [8]. This method is very effective because when a victim is exposed to harsh conditions such as high temperature and acid, the tooth prints are resistant but other body features may be deformed.

2.1.48 2016: Application of Power Laws to Biometrics, Forensics and Network Traffic Analysis

Iorliam [9] proposed the use of power laws for tampering detection of biometric images. He also proposed the classification and source identification of biometric

images. Furthermore, he proposed the use of Benford's law and Zipf's law for keystroke dynamics to differentiate between the behaviour of human beings and non-human beings. Also, he used the Benford's law and Zipf's law to analyse the TCP flow size difference for the detection of malicious traffics on the Internet.

2.1.49 2017: Identification of Individuals by Trait Prediction

The use of whole genome sequencing data and machine learning was proposed for the prediction of individual faces and other traits.

2.1.50 2017: Technology Improvement for Forensic Purposes

3D printing, drones, laser scanners etc. has greatly improved the quick documentation of crime and accident scenes for forensic investigations.

2.2 Conclusion and Lessons Learnt

We are physical humans that operate everyday and touch physical things as well as carry out online transactions. Do we necessarily need witnesses in court to testify for each case? With forensic science, I really don't believe so because what we do either physically or online if carefully examined could serve as evidence worth presenting in the court.

Lessons learnt from the outcomes of forensic science applied to different fields is that it has proved to be very effective in every area that it has been properly applied. It is shown that over time, forensic science has solved controversial cases and particular crimes that has been committed. This is the time to correctly utilise and apply forensic science techniques in solving crimes in Nigeria and Africa.

The next section focuses on technical issues considering different subdivisions of forensic science. The technical aspect focuses on how forensic science works in these subdivisions and at what extent can it effectively investigate crimes.

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