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History of Forensic Science

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1.1 Introduction

In ancient world, the king used to decide the culprit and punish them, which were very cruel in nature. These punishments were applied in favor of their existence, just to show how powerful they are. Gradually everything changed; the man with knowledge replaced the king, and punishments were given with respect to the intensity of the crime the culprit had committed. Now when a crime occurs, the court of law decides the culprit, and punishment are based on the evidence and statements produced by the authorized officials in front of the court. During the time of Romans, the incident was narrated in front of the public. The culprit and the victim were given a chance to deliver their words based on their side of the story to prove their innocence and escape from the punishment and further procedures or consequences of committing a crime at that time. The individual with the best argument would win the debate of proving the crime, and based on the points of argument, the public or the people with higher power determine the outcome of the case.

Our ancestors applied forensic science in various fields, without knowing the science behind it. Now, forensic science has turned into a wide branch, which is used to solve crimes and in other purposes also. In this chapter we are mainly discussing about the main branches of forensic science that include forensic chemistry, forensic toxicology, and forensic behavioral science, questioned document, fingerprint forensics, digital forensics, cyber forensics, forensic anthropology, criminology, forensic biology, forensic ballistics, forensic serology, and so on. One of the important parts of forensic science is that the contamination of the sample collected and crime scene is low as compared to earlier centuries. The analyzed records are being preserved for the future requirements. The forensic investigators follow a particular procedure during their investigation including seizing the crime

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Technology in Forensic Science: Sampling, Analysis, Data and Regulations, First Edition.
Edited by Deepak Rawtani and Chaudhery Mustansar Hussain.

scene, collection of evidences, forwarding to the laboratories, questioning, and making reports of the statements given by witnesses, suspect, victim, and scientific officer, till they produce their concluded report to the court (Rawtani et al. 2019).

Forensic science in its modern form is not a new methodology, especially to the Indian investigation. In India, the ancestors around 2300 years ago had mentioned the application of science for investigating in *Arthashastra* (Grover and Tyagi 2014) written by Kautilya (also known as Chanakya), the prime minister of The Great Mauryan Empire (Ranade 2011). Kautilya discussed about the maintenance of law and order by the ruling government. The laws that were discussed in his book *Arthashastra* were derived from four sources. These four sources are dharma, scared law based on truth (Ranade 2011); vyahara, evidence based on the witnesses (Ranade 2011); charita, history and custom based on tradition accepted by the people (Ranade 2011); and rajasasana, edicts of the king, i.e. the laws as promulgated (Ranade 2011).

In earlier days Indians used signature occasionally without knowing science behind it. It is being mentioned in the ancient Chinese records that the fingerprints were used by the ancient kingdom of south India. They named the handprints as Tarija (Grover and Tyagi 2014) and these were inimitable. Under a chance of probability, it is believed that the Indian ancestors had the knowledge about the persistency and individuality of fingerprint.

In 1849, the first chemical examination laboratory was established under the department of health in Madras Presidency (Nabar 1988), since many people died due to the consumption of poisonous substances in the nineteenth century. This was introduced to detect and analyze the various poisonous substances and their poisons; they took over the chemical analysis and toxicological analysis. After the independence, the modernization of the techniques in crime investigation needed a great improvement. In the year 1897, the first fingerprint bureau was established in Calcutta (Nabar 1988). The history of forensic science is shown in a chronological fashion in Table 1.1.

A special branch of laboratories is being introduced in each country to analyze the evidences collected. After all it's a chance of prediction and probability to reach the accurate result. Forensic science helps in criminal profiling, identifying the cause and manner of death, and prevention of criminal activity, and all of which are discussed in this chapter.

1.2 History of Origin of Forensic Science

1.2.1 Origin of the Word "Forensic"

Forensic science is the application of scientific knowledge and methodology to criminal investigation and legal problems. It is applied in the procedure of criminal investigation to prove a crime and bring the accused in front of the court to punish according to the type and manner of crime he/she has committed. After all it is a probability that links the evidence with the crime and suspected people to prove a case. Till now, the origin of the concept of forensic science is unknown. Most of the historical experts agree that the concept of

Table 1.1 Chronological history of forensic science.

S. no.	Year	History
1	44 BCE	Roman physician Antistius performed the autopsy on the body of Roman politician Julius Caesar (Sheldon 2017)
2	3000 BCE	Egyptian started the practice of removal of the examination of internal organs after the death (Mark 2017)
3	First century CE	Roman orator and jurist Quintilian used basic forensics to acquit an innocent at the thirteenth century (Sheldon 2017)
4	Thirteenth century	The first literature to determine cause of death is *Xi Yuan Li* by Song Ci (Asen 2017)
5	Sixteenth century	Fortunato Fidelis and Paolo Zacchia studied the changes in the structure of the body due to a disease and laid the foundation of modern pathology (Hernigou 2013)
6	1773	Carl Wilhelm Scheele developed a chemical test to detect the presence of Arsenic in a dead body (Acocella 2013)
7	1775	Paul Revere an amateur dentist identified the dead body of American revolutionist Dr. Joseph Warren using his dental work (Bruce 2010)
8	1814	Mathieu Orfila wrote the first book on forensic toxicology *Traite des Poisons* (Bertomeu-Sánchez and Nieto-Galan 2006)
9	1835	Henry Goddard connected a bullet to a murder weapon as a physical analysis (Goddard 1927)
10	1836	James Marsh developed arsenic detection process called Marsh test (Bell 2009)
11	1879	Alphonse Bertillon developed anthropological technique called anthropometry (Sonderegger and Peter 2012)
12	1879	Wilhelm Wundt founded his first laboratory in Germany for forensic psychology
13	1880	Sir Francis Galton developed the first technique of fingerprint (Sonderegger and Peter 2012)
14	1889	Dr. Oscar Amoedo published his book on forensic odontology named *L'Art Detaire en Medicine Legale* (Bruce 2010)
15	1896	Henry's classification system developed by Edward Henry (Sonderegger and Peter 2012)
16	1910	Edmond Locard formulated the principle of exchange (Sonderegger and Peter 2012)
17	1930	Karl Landsteiner was awarded with Nobel Prize for the discovery of blood grouping (Harbison 2016)
18	1976	Donn Parker published the first book on digital evidences in computer crimes named *Crime by Computer* (Eoghan 2004)
19	1984	DNA fingerprinting was developed by Alec Jeffrey (Horwin 2019)
20	1984	FBI launched a computer analysis response team

forensic science was originated in the sixteenth century (Museum 2008). It is believed that the concept is being discussed in the book *Ming Yuen Shih Lu* (true record of clarification of wrongs) (Fleming 2014) by Chich-Ts'Si (Svarney and Svarney 2018). It is the first written document about forensics. But copy of the book is not yet founded. In the tenth century, Ho Ning discussed the concept of forensic science in his book *Records of Doubtful Criminal Case* (Svarney and Svarney 2018).

The word "forensic" comes from the Latin word "forensis" that means "of or before the forum" (Svarney and Svarney 2018), and the term science has been derived from the Latin word "scire," which means "to know" (Jena 2017). The history of the term forensic originates from Roman times. In 44 BCE, Brutus and Cassius led a group of Roman senators; they violently plunged their blades into Julius Caesar. Antistius, who was a Roman physician at that time performed an autopsy and found out that there were 23 wounds that are stab wounds; out of the 23 wounds, none of them caused death, except the second wound in the breast. This was the first record in history where a pathologist gives his opinion as an expert. This crime and the autopsy report that took place more than 2000 years ago is still important and used by many historians, criminologist, and doctors to seek knowledge about the evolution of forensic science and medical discovery; this was the first homicidal investigation that occurred. Antistius delivered his opinion in an open court before the forum, which gives rise to the term "forensic" meaning "before the forum" in Latin (Sheldon 2017).

1.2.2 Origin of Procedures (Identification of Cause and Manner of Death: Autopsy)

After death, the body reaches a stage called decomposition by a process called autolysis; in this process, the organic substances are broken down into simpler organic matter. In order to prevent a body from decomposing, it is necessary to deprive the tissues of moisture and oxygen. This can be done by the procedures of mummification. This particular practice had started in ancient Egypt 3500 BCE. Mummification was a ritual practice done by the ancient Egyptians believing that there is life after death, and the preserved body is required to live in their next world. This preserved body is called mummy (Mark 2017). Those civilizations provided a significant contribution to the field of forensic under medicine. This can be considered as an example of autopsy in history or the procedure that led to the development of autopsy to determine the cause of death.

By the thirteenth century, the first literature to determine cause of death was written by Song Ci in China, and the literature work was named as *Xi Yuan Li* (Asen 2017). This book is widely known as *Collected Cases of Injustice Rectified* or *Washing Away of Wrongs* (Asen 2017). This book was written based on the real incidents and experiences that are linked to his scientific knowledge to avoid injustice in the future. Most of the topics covered are based on scientific knowledge, and few of them are post-mortem examination, emergency treatment,

causes of death, different kinds of death, procedures of receiving the victims after hanging, etc. This book is considered as the handbook of coroners.

1.3 History of Important Branches of Forensic Science

There has been a wide range of forensic science and its branches. Fathers of different branches have been discussed in Table 1.2.

1.3.1 Forensic Entomology

During the seventh year (1247) of the Chunyou era of Emperor Lizong of southern song, the first printed edition of the book *Washing Away of Wrongs* was released. The original copy of the book does not exist. Later during the Yuan dynasty, the earliest print edition was printed, and it is held in the collection of Beijing University library. This book has fifty-three chapters in five volumes. This was a turning point for "forensic entomology;" and for the very first time, a case was reported under forensic entomology for judicial means.

In the year 1235 a villager was stabbed to death, and the authorities who investigated determined that the person was murdered with a sickle. At that time sickles were used for cultivation purposes, and this particular fact leads to the suspect (peasant). To find the sickle used, the investigator asked the suspected peasants to place their sickles in one particular open place, and waited for the blowflies to attract the sickle. The blowflies were attracted to the sickle that contained traces of blood (which is not visible with our naked eyes) due to its scent. In a crime, it is important to find the cause and manner of death. Understanding the manner and cause of the crime may help to link the evidences and suspected

Table 1.2 Important branches of forensic science.

S. no.	Branches	Father of branch
1	Forensic toxicology	Mathieu Orfila
2	Forensic pathology	Rudolf Virchow
3	Forensic odontology	Oscar Amoedo y Valdes
4	Forensic entomology	Bernard Greenberg
5	Forensic ballistics	Calvin Hooker Goddard
6	Digital forensics	Michael Anderson
7	Forensic anthropology	Thomas Dwight
8	Forensic DNA analysis	Alec Jeffrey
9	Forensic anthropometry	Alphonse Bertillon
10	Questioned document	Albert Osborn
11	Forensic psychology	Wilhelm Wundt

persons to solve a crime. This would help us to control the crime in future by predicting (Wecht and Rago 2006).

1.3.2 Forensic Pathology

During the sixteenth century, the medical practitioners of army found it important to find the cause and manner of death. At that time, the violent deaths were reported in a huge number, and a French army surgeon Amboise Pare (Hernigou 2013) started studying about "how the internal organs are affected in the case of violent death." The two Italian surgeons Fortunato Fidelis (Suter and Earnest 2010) and Paolo Zacchia (Suter and Earnest 2010) started studying the changes that can be seen in a body because of a disease. This observation led to the development of modern pathology. Later in the eighteenth century, writings regarding this topic appeared.

1.3.3 Forensic Toxicology

In 1773, Carl Wilhelm Scheele (Bell 2009), a Swedish chemist, developed a chemical test to detect the presence of arsenic in a dead body. He independently discovered oxygen, chlorine, and manganese. He also studied about arsenic acid, molybdic acid, and tungstic acid. In 1775 (Stewart 1947), he did an experiment that developed a colorless gas that smells weirdly of garlic that was evolved alongside the hydrogen when zinc was added to arsenic that is dissolved in sulfuric acid:

$$As_2O_3 + 6Zn + 12HNO_3 \rightarrow 2As_3 + 6Zn(NO_3)_2 + 3H_2O$$

In the year 1786, he passed away prematurely, due to his frequent experiment with cyanide and arsenic without proper ventilation. His findings and experiments were used by many scientists. In 1787 Johann Daniel Metzger (Lyle 2017) found a way to detect arsenic in solution, and he also discovered that an arsenic mirror is formed on the charcoal surface when arsenic is heated with charcoal (Lyle 2017). German chemist Valentine Rose (Lyle 2017) in the year 1806 expanded his experiment, and with its application, he found out how to detect poison in the walls of stomach.

Later in 1836, Alfred Swaine (Lyle 2017) developed a test to arsenic in human tissue. Then in the same year, an arsenic detection process was developed by English chemist James Marsh (Stewart 1947). He combined the experiments of Carl Wilhelm Scheele and Johann Daniel Metzger, and his revolutionary detecting method is known as Marsh test. This was a great contribution to the field of "forensic toxicology" in the cases were arsenic is used as a poison. It is a highly sensitive detection method. Arsenic in the form of white arsenic trioxide can be easily implemented into food and drinks, and they are odorless and difficult to collect. In 1832, John Bodle (Norwood 2016) poisoned his grandfather by adding arsenic to his coffee. James Marsh was asked to detect the presence of arsenic in suspect fluid by the prosecution for the trial of John Bodle. James Marsh conducted the standard test, that is, the hydrogen sulfide is

passed through the suspected fluid. As a result, a yellow precipitate was formed, indicating the presence of arsenic. But by the time of submitting the result to the prosecution, it was deteriorated. The jury was unsatisfied and not convinced regarding the proof and results that James Marsh submitted. And the prosecution acquitted John Bodle. Later he confessed that he indeed killed his grandfather by poisoning. This circumstance made him to develop a revised test to demonstrate the presence of arsenic, although the Marsh test was successful in producing a desired result in forensic toxicology. The very first application was the analysis of evidences in 1840 for Lafarge poisoning case. Marie Lafarge (Acocella 2013) murdered his husband by adding arsenic to his diet. The crime scene had the presence of arsenic and the evidences collected also contain arsenic. But the analysis of the samples concluded that arsenic was absent in the dead body. The court was unsatisfied by the result and ordered a Spanish chemist and physician Mathieu Orfila to conduct the analysis again. Mathieu Orfila concluded that the Marsh test was not conducted properly and found out the traces of arsenic in the sample. These reports proved Mrs. Lafarge was guilty. Mathieu Orfila in the nineteenth century wrote a book on forensic toxicology, and this is the first recorded start of forensic toxicology (Bertomeu-Sánchez and Nieto-Galan 2006). As a part of forensic medicine, he developed a chemical analysis that was used for the study of asphyxiation, the decomposition of bodies and exhumation. In a forensic context, he developed the test to find out the presence of blood. He used a microscope to assess blood and semen stains. In many criminal cases, he was considered as a medical expert. He proposed many controversial facts regarding the cases he attended. He argued that arsenic is also present in the soil around the grave. This could be drawn into the body and the later analysis would mistake it as a poisoning case. Orfila conducted many studies and concluded that soil should be analyzed as the part of the procedure of exhumation cases. Mathieu Orfila is known as the father of toxicology. He wrote the book *Traite des Poisons* that classifies the poisons favored by the criminals. In 1823, Romeyn Becks (Chaille 1950) published a book that contains the theory of forensic toxicology: *Elements of Medical Jurisprudence*. However, Mathieu Orfila is considered as the father of toxicology because he developed a link between the science of toxicology and criminal court of law.

1.3.4 Forensic Anthropometry

In 1879, Alphonse Bertillon (Sonderegger and Peter 2012) developed an alternative to fingerprint by developing anthropological technique called Bertillonage (Sonderegger and Peter 2012), which is also known as anthropometry. This anthropological technique consists of five initial measurements that are head length, head breadth, length of middle finger, length of left foot, and length of the cubit. He also used photography along with this measurement, which is now known as mug shot. These two identification methods were combined together to form an easy system to the law enforcement agency and to get the images and information immediately. In 1884, in France, this system was used and 241 repeat offenders were captured. It started to spread worldwide.

1.3.5 Forensic Ballistics

In 1835. Henry Goddard (Tewari 2000) became the first person to use physical analysis to link bullet to the murder weapon to identify the criminals involved. He identified a defect in the surface of the bullet that was not from the barrel or the result of an impact. At that time, the people used to manufacture bullets by themselves, and this made him to believe that the defect in the surface may be due to the manufacturing defect. Later, the person was suspected for committing the crime. Henry Goddard reached the suspect's house and examined the suspect's bullet and proved the case. But by that time, the suspect confessed his crime. The important thing in this was the individualization that Goddard explained. Later Henry Goddard's brother Calvin Goddard used these applications and developed the field of ballistics.

On 15 April 1920, two Italian born American anarchists Nicola Sacco and Bartolommeo (Goddard 1927) were arrested for murdering a security guard and robbing a factory. The investigating team approached Calvin Goddard for the analysis of the bullet. By that time, it was easy to trace the automatic pistol if bullet and casing were recovered. The automatic pistol can be traced by the unique marking, firing pin indentations, extraction marks, etc. Calvin Goddard used comparison microscope and heliometers for the examination of .32 Savage Model 1907 that was recovered from the crime scene. He test-fired the bullets in the presence of a defense expert for the comparison and concluded that firing pin marks on .32 Savage Model 1907 spent casing matched a test shell casing known to have been fired from Sacco's pistol. In 1925, Calvin Goddard who was a forensic scientist, army officer, academic researcher, and a pioneer in forensic ballistics wrote an article for the army ordinance "Forensic Ballistics." In this article, he discussed about the firearm investigation using compound microscope. In 1925, he established the forensic ballistic bureau in New York City to provide identification of firearm throughout America. Later in 1929, he was appointed to examine the bullet casings of St. Valentine Day Massacre (Editors 2009). On Valentine's Day morning, seven members and associates of Chicago's North Side Gang gathered at a Lincoln Park garage when four unknown attackers dressed up like a police officer shot the seven members by lining them up against the wall. Calvin Goddard analyzed the bullet casings and concluded that the bullets does not belong to the police officers, and the investigators easily concluded that the crime was committed by organized criminals such as a mafia. This particular crime occurred at the period were certain regulations were started to come in action to control the organized detecting gunshot residue. This was developed by a team of scientists at the aerospace corporation in California.

1.3.6 Fingerprint Forensics

Before knowing the science behind the fingerprints, the Indians used fingerprints as a unique character that differentiates one individual from another. Fingerprints were used as signature in 200 BCE by Minoan, Greek, Chinese, etc., and they were used to sign the written contracts in Babylon (Sonderegger and Peter 2012). In ancient India, Agasthya (Dhingra 2007)[rishi] wrote a text named Naadi that pre-

dicts the past, present, and future lives just from their thumb prints. During the Qin and Han Dynasties (Sonderegger and Peter 2012), clay seals were used, which bear friction ridge impressions. Similarly, the uses of fingerprint started developing rapidly, and in 1788, Mayer declared that friction ridge skin is unique. In the year 1823, Purkinji discussed about nine fingerprint patterns in his thesis. Then in the year 1856, German anthropologist Hermann Welcker studied the friction ridge skin permanence by printing his own right hand.

In 1853, William James Herschel (Sonderegger and Peter 2012) joined east India Company and he was posted to Bengal. Within five years, he became a member of the Indian civil service and was posted to Jungipoor. In the year 1858, he made a contract with Mr. Konai, a local man for the supply of road-making materials. The chance for Konai to deny his signature on this agreement was high so he made him to put the handprint on the agreement. This made him to realize that all the fingers can be used, and he started to collect fingerprints of his friends and family, and the result of the study was that a person's fingerprints do not change over time. He also suggested the other governors of Bengal to use fingerprint as a mode of signature in legal documents, but this was not acted upon. Later in 1863, professor Paul Jean Coulier (Miller 2012) published his observation that by using iodine fuming, fingerprints can be developed in paper, with the use of magnifying glass to analyze the fingerprints, thus identifying the suspect. In 1877, American microscopist Thomas Taylor proposed that finger and palm prints founded from any objects can be used to identify the suspect or to solve the crime.

In 1877, Herschel was appointed as magistrate in Hooghly. He started to take the pensioners fingerprints so that no fraud activity will occur in collecting the pensions. He also used the application of fingerprint to ensure that jail sentences could not be carried by a hired imposter. After the return to England in 1878, he published an article in the journal *Nature* in explaining his experience with fingerprinting. He also publish his work entitled *The Origin of Fingerprinting* in 1916. Herschel applied the fingerprinting in many fields but never realized that he could use it as an administrative tool to catch the criminals.

In 1870s, Henry Faulds (Sonderegger and Peter 2012) observed the fingerprints in ancient potteries, and it developed an interest in studying the importance of fingerprint. Then in 1880, Dr. Henry Faulds (Sonderegger and Peter 2012) requested assistance to Charles Darwin in developing a system for classifying fingerprints. Charles Darwin couldn't assist Henry Faulds and asked his cousin sir Francis Galton to assist him. But they did not engage in much correspondence; they devised very similar fingerprint classification system in the following decade. It is still in a doubt whom to give the credit for the classification system. Francis Galton (Sonderegger and Peter 2012) also studied fingerprint to seek out hereditary traits and racial difference in fingerprint. Fingerprints does not change in a lifetime; it remains constant and he also concluded that no two fingerprints are alike. He estimated the probability of two people having the same fingerprint. In 1892, he published his book on his findings and classified them into eight categories – plain arch, tented arch, simple loop, double loop, lateral pocket loop, central pocket loop, plain whorl, and accidental. Galton's classification system is still used in the twentieth century, but he couldn't find any evidence that fingerprint types were heritable.

In 1891, Edward Richard Henry read the book *Finger Prints* written by Francis Galton. He visited Francis Galton's laboratory in Kensington (Sonderegger and Peter 2012). Francis Galton shared his knowledge about fingerprint and also the research works of Herschel and Faulds. This helped Edward Richard Henry to develop a mathematical formula to classify and organize the 10 fingerprints.

Fingerprint was used as an evidence to solve a murder case in 1892 in Argentina (Sonderegger and Peter 2012). On 19 June 1892, two children Ponciano Carballo (six years old) and Teresa (four years old) were murdered brutally by hitting their head with a weapon. Francisca Rojas, the mother of the two children, gave the witness statement mentioning that a guy named Velasquez had committed the crime in anger of the negligence and rejecting his proposal to get married. While questioning, Velasquez agreed with the statement that he visited Rojas' house for the proposal and got aggressive to Rojas and her children but never murdered them. Inspector Alvarez on visiting the crime scene collected the fingerprint that had blood in it, from the wooden door expecting it to be the murderer's fingerprint. Later it was confirmed that the fingerprint belongs to Rojas itself. She committed this murder to get married with someone else other than Velasquez, because children were a burden for her new wedding. She was arrested by the police and sentenced for life imprisonment.

1.3.7 Digital Forensics

In 1976, Donn Parkers (Pollitt 2010) authored a book *Crime by Computer*, which has been expected as the first book to use the digital information's to investigate a criminal activity with the help of a computer. The first computer crimes were recognized in the 1978 Florida Computer Crimes Act (Eoghan 2004). This included legislation against unauthorized modification or deletion of a data on a computer system. Over the next two years, there was a huge increase in the crimes related to digital evidences with the application of computer, and this made the investigating agencies to develop a different branch for cases related to it. Many acts and laws were enacted related to it.

1.3.8 Forensic Odontology

In the year 1773, Paul Revere (Bruce 2010), an amateur dentist, did the dental work for Dr. Joseph Warren, and in 1775 the dental work was repeated. In 1775 during the battle of Bunker Hill (Bruce 2010) in New England or during the battle of bread hill (Bruce 2010), Dr. Joseph Warren was killed. The dead body was buried in a mass grave by a British red coats and then reburied with American. After ten months, an exhumation was done and Paul Revere identified his work and Dr. Warren. On 8 April 1776, Dr. Joseph Warren was reburied with all the respect as the leader of American revolutionaries. Dr. Oscar Amoedo is said to be the father of odontology (Bruce 2010), and he was a professor of Dental School of Paris University. In 1897, he published an article in dental cosmos that described the identification procedures used in the disaster and postulated a methodology to be used as a basis in future. He did this based on a mass forensic identification by dentition. On 4 May 1897, in the aftermath of fire of the Bazar

de la Charite that began around afternoon, the incandescent gas mantle projector lamp exploded and started to catch fire. Around 126 people died and 200 were seriously injured. By noon only 30 dead bodies remained unidentified. This bazaar was held by the greatest ladies of France to help the poor and needy (Bruce 2010). These countesses, duchesses, and other ladies had the money to afford dentistry. And all the 30 unidentified bodies were identified using dental records. In 1889, Dr. Oscar Amoedo publishes his work *L'Art Detaire en Medicine Legale* (Bruce 2010).

1.3.9 Forensic Serology

Blood grouping is one of the important features in identifying and confirming the suspected person. This was introduced by the two scientists Paul Uhlenhuth and Karl Landsteiner (Farhud and Yeganesh 2013) separately in the early twentieth century in Germany. They indicated that there are differences in the blood between different individual. The contribution of Paul Uhlenhuth (Harbison 2016) was that he developed a technique to detect the presence of antibodies, and the main contribution of Karl Landsteiner (Farhud and Yeganesh 2013) is the grouping of blood as A, B, AB, and O, and he combined blood serum from different individual and observed antigen reaction. In 1930, Karl Landsteiner was awarded with Nobel Prize in physiology or medicine for his discovery of blood groups (Farhud and Yeganesh 2013).

The genetic professor Alec Jeffrey (Horwin 2019), in the year 1984, discovered that some patterns of DNA could be used to recognize and distinguish one individual from another; he also used it to recognize the paternity in immigration cases also.

This method was first used in a rape case (Horwin 2019) of two teenagers who were murdered in Narborough, Leicestershire in 1983 and 1986. In 1983, 15 years old Lyndamann was raped and murdered, and after three years, Dawn Ashworth, who was also 15 years old, was raped and murdered. Richard Buckland had confessed to the second crime, and this made the detectors to doubt him for the first crime also. Dr. Jeffrey was asked to analyze the semen samples and compare between both the murders. Jaffrey proved that the DNA fingerprint from the semen found on the two murdered victims was not as same as Buckland's and reached a conclusion that the killer responsible for both the crimes was same. The first DNA dragnet was used. Test were conducted on 4582 men from three towns to identify the killer's blood type and enzyme PGM +1 retrieved from his semen. Jeffrey's genetics fingerprinting technique founded that 10% of men had the same blood type and enzyme as that of the killer (Horwin 2019).

Colin Pitchfork (Horwin 2019), a local baker, hesitated to give his blood for testing. Colin replaced his photo in passport with Ian Kelly's photo and gave his own blood for testing. Months later Ian Kelly admitted that he was paid by Pitchfork to have his blood tester. Later the law enforcement approached Jeffrey to compare the Pitchfork's DNA with DNA of the semen found on the two victims. The result showed that Pitchfork was responsible for both the raped and murders of 1983 and 1986. He was sentenced to life imprisonment in minimum term of 30 years, and it was reduced to two years in the year 2009.

1.4 Conclusions

Forensic science never ends as just a branch of science that deals with crime and investigation. it also influences the people in many other ways. Sir Arthur Conan Doyle (Smith 2012) was a physician who contributed to the evolution of criminal profiling. At a time when real-life investigators found it difficult to catch the real killers, Conan Doyle's fictional Sherlock Holmes used many areas of science including chemistry, bloodstains, and fingerprints to catch the exact criminal. His character Sherlock Holmes also ensures the safety of the crime scene along with the investigation contamination of the crime scene concerned. Conan Doyle also used his knowledge in real life also to solve many cases. Sherlock Holmes contains 56 short stories and 4 full length novels, published between 1887 and 1927. In 1910 Edmond Locard (Sonderegger and Peter 2012) built the first forensic science laboratory with all the facilities. Edmond Locard was an avid reader of Sherlock Holmes. Edmond Locard was known as the Sherlock Holmes of France. He utilized his application of forensic science to legal matters. He developed a theory related to the transfer of trace evidences between the objects, and this theory is commonly known as Locard's exchange principle. He stated that "every contact leaves a trace," and this had a great influence in the field of forensic science. This is being a basic principle to the investigation process. Many scientist contributed their best to the field of knowledge, and as crime increases, the methodology of analysis also develops. The experiments and research that are done in this decade will also become once a history.

Various branches have its own root of origin that gives us simple outline of the forensic science itself. Forensic science cannot be limited to few branches; it is a wide stream of science that relates each and every branch to solve the mystery behind each crime. Day by day, as the technology develops, its applications in forensic science also increases. An unpredictable development has been seen in this chapter in a short content. The advanced techniques help the scientific officers and investigating officers to solve a crime easily. With respect to the evidences collected, the laboratories and branches vary from each other. As technology improves, the type and manner of crime also gets improved. This makes the investigation difficult for the investigating officers to solve a crime. This is where the application of forensic science plays a major role in solving the crime. Still many scientists are working on the advanced techniques for the application of forensic science.

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