Handout 2

Name: ______________________________

## History of Forensic Science

From Superstition to Science

Homework #1 - Outline the significance of the following terms using the attached information concerning forensic history.

"Trial by Ordeal"

Forensic Science

Hsi Duan Yu

Early "Medical Evidence"

Pathology

England, 1816

over ⇨

Arsenic

Toxicology / Joseph Orfila

Alphonse Bertillion / Anthropometry

Fingerprints / Dr. Henry Faulds

Grand Rapids, Michigan

Edmund Locard's Principle of Interchange

# From Superstitions to Science

Crime is as old as man. From earliest time, men have stolen, murdered, cheated, and betrayed. Naturally, they have tried to conceal their guilt. Just as naturally, societies have set up organizations to catch them and punish them. Often these organizations failed to achieve their purpose, as we know from the famous unsolved crimes of history. Systems of justice were cumbersome and influenced by superstition. Many countries' legal systems required the accused person to undergo **"trial by ordeal."** A woman accused of witchcraft, for example, would be bound and lowered into the village pond. If the water "accepted" her-that is, if she sank-her innocence was proved. If she floated- she was judged guilty. Often, a person's guilt was "proved" by torturing him until he confessed to the crime.

While many innocent people were being subjected to such cruel and absurd punishment a reasonably clever criminal could often manage to elude justice. He simply avoided being, seen actually committing tile crime and took care not to leave any glaringly obvious traces of his presence at the scene. But within the past 20 years or so, criminals have found it more and more difficult to escape capture. Legal systems have become more just, and police departments have become more thorough. Science plays an ever-increasing role in these developments. Even clever criminals invariably leave some trace of their presence at the scene of the crime. As scientists have refined their techniques, they have often been able to help law officers make use of physical evidence.

Scientists who specialize in helping to solve to solve crimes have called their work ***forensic science*** from a Latin word referring to a court of law. The forensic scientist is a fairly recent member of the law enforcement team. But he does have some predecessors: men working in the various branches of science who have occasionally contributed their knowledge to the investigation of crime.

The earliest evidence of doctors applying medical knowledge to crime detection is a Chinese book. ***Hsi Duan Yu*** (The Washing Away of Wrongs), which appeared in 1248. Although it contains many unscientific theories, it also offers some useful bits of advice-such as how to distinguish drowning water in the lungs) from strangulation (pressure marks on the throat and damaged cartilage in the neck). Two and a half centuries passed before any other book even hinted that medicine might be useful in criminal investigation. Even then, ***The Penal Code In the Diocese of Bamberg*** published in Germany in 1507, only made the suggestion. It gave no advice comparable to that in the Chinese book.

When medical evidence did begin to be used in court, it was often far from scientific. In London, in 1665, a much-respected judge, relying on "expert" medical evidence, sentenced two women to death for practicing witchcraft. They were charged with afflicting children with "disease caused by the aid of the Devil." The children's father testified in court that they were seized with fits and saw visions of witches. He stated that during these fits they coughed violently, bringing up phlegm, and vomited "crooked pins and a twopenny nail with a very broad head." He then produced as "evidence" 40 bent pins and a twopenny nail! In a similar case, not long afterward, an eminent physician, Dr. Thomas Browne of Norwich, was called in as an expert witness. He gave an elaborate account of how the Devil, working on the body, could cause the vomiting of pins and nails.

These are extreme cases of superstition masquerading as science. More encouraging is the fact that in the previous century a few men had begun to practice legal medicine in a truly scientific manner. Ambroise Pare, a French army surgeon, systematically studied the effects of violent death on the internal organs. Two Italian surgeons, Fortunato Fidelis and Paolo Zacchia, laid the foundations of modern ***pathology*** (the study of changes occurring in tile structure of the body as a result of disease I with their well- research. From the mid-1600's onward, there was a small but growing band of physicians and surgeons helping the police. Although we have no record of any contributions they made to actual cases, we do have their writings. The most important were ***A Treatise on Forensic** Medicine and Public Health* by the French physician Fodere and ***The Complete System of Police Medicine*** by the German medical expert Johann Peter Franck. Both appeared in the late 1700's and both dealt with forensic medicine as well as with public health. A few years later, Napoleon's ***Code of Criminal Procedure*** appeared. Among its many other points this document acknowledged the growing importance of science to the judicial system in France.

In 1784 in Lancaster, England, John Toms was tried and convicted for murdering Edward Culshaw with a pistol. Pistols in those days were muzzle-loaded. First a black powder charge was rammed down the barrel, and then a wad was pushed in to keep it in place. Next the ball was dropped in, followed by a second wad to prevent it from rolling out. Wads were usually odd scraps of crumpled paper. Shortly before the killing, Toms had brought a broadsheet ballad (a sort of newspaper in verse) and torn off part of it to make it wad for his pistol. He folded the rest and kept it in his pocket. When the dead body of Culshaw was examined, a pistol wad was recovered from the wound in his head. When cleaned and spread out, the wad was discovered to be a piece of a broadsheet ballad. Its torn edge fitted perfectly with the will tile torn broadsheet found in Tom's pocket. This case was one of the first in which genuine scientific evidence was used in court.

Another early case of forensic science at work took place in Warwick, England, in 1816. A farm laborer was tried and convicted or the murder of a young maidservant. The girl had been sent to deliver yeast to a neighboring house, but failed to return. Her body was found next morning in it shallow pool. She lead been drowned, and bore the marks of a violent assault. Near the pool, in the damp earth, the police found footprints and signs of a struggle. There were also scattered grains of wheat and chaff. One of the marks in the earth had been made by some corduroy material that had on it a patch of the same fabric. The patch had not been sewn accurately in place, so that the ribs of the patch did not align with the ribs of the original material. The scattered grains and chaff caused the police to suspect a farm laborer known to leave been threshing wheat the previous day. His corduroy breeches were found to have a knee patch corresponding exactly to the impression in the earth near the pool. Although he tried to provide an alibi, the objective evidence against him was overwhelming, and he was convicted.

More cunning murderers often turned to poison to achieve their ends. With science in a primitive stage of development, a poisoner could be fairly certain that his murder weapon, once absorbed by the victim's body, would not be found.

In the 700's an Arab alchemist named Jabir became the first man to prepare arsenious oxide; commonly called simply ***arsenic***). A white, tasteless, odorless powder that is violently poisonous, it apparently left no trace in the body. Jabir's preparation seemed the ideal poison and became a favorite murder weapon of the Middle Ages. Because the symptoms-violent stomach pains and vomiting were same as those of ***cholera*** (a common disease of the time) arsenic poisoning often went undetected.

In 1775 a Swedish chemist Karl Willielin Scheele, devised a way of detecting tile white powder in corpses but only in quantity. Small doses of arsenic in body tissues still could not be traced. Although Scheele's discovery left lawyers and judges unconvinced, it excited many chemists. In 1806 a young German chemist, Valentin Rose, carried the detection of arsenic a few steps further. He found how to detect the poison in the walls of a victim's stomach immediately after death, although the substance soon disappeared. Joseph Bonaventure Orfila, a brilliant French physician and chemist who specialized in identifying poisons spent years trying to solve the mystery of the vanishing arsenic. He improved on Rose's method, but still he often failed to find traces of arsenic even in experimental animals to which lie lead administered the poison.

The real breakthrough in arsenic detection came in 1836. James Marsh, an English chemist, had used Rose's proof of arsenic poisoning in a murder trial. But lie found this tails proof rejected and so much hocus-pocus by the jurors. He then set out to find a completely convincing proof. Eventually he secured a deposit of arsenic that members of jury could actually see. This test, in a refined form, can identify one thousandth of a milligram of the poison.

But even Marsh's remarkable work was not the end of the arsenic hunt. A new technique, called ***neutron activation analysis*** uses properties of radioactive decay It can detect and accurately measure a trace of arsenic one thousand times smaller than can be detected by any chemical test.

Although Marsh's test for arsenic was not discovered until 1836, the great publicity and research that followed Scheele's discovery in 1775 had caused some potential poisoners to turn to a variety of natural vegetable poisons. Many of these have valuable medicinal qualities when taken in small amounts. In larger doses, however, they are efficient poisons and were once virtually untraceable.

Most of them come from common and easily obtained plants, such as hemlock. laburnum. deadly nightshade (belladonna), foxglove, and tobacco (nicotine). Various lethal and potentially lethal compounds, including strychnine, morphine, and cocaine, also come from plants.

In the early 1800's legal experts lamented the fact that tests for these vegetable poisons could identify them only in pure samples-not when they were contained in body tissue. In 1847, after a long series of experiments, even Orfila the father of modern ***toxicology*** the science of poisons declared that the vegetable poisons might never be isolated from tissue.

Orfila's pronouncement proved wrong only four years later, when a young chemistry professor discovered a method for detecting these poisons. In Belgium, a count and his wife were involved in a mysterious death of the countess's brother. Because the dead man's mouth and throat were scarred with burns, the police suspected murder by acid. They took various organs from the body, bottled them in alcohol and asked Jean Servais Stas, a chemistry professor from Brussels, to analyze them for the cause of death.

Stas was not convinced that acid had been the weapon. He attributed the burns to the vinegar that the count and countess said they used to wash the body for burial. Had the vinegar been used to mask the presence of poison? Stas set to work analyzing the contents of the victim's stomach, intestines and bladder. Something about their odor made him suspect a vegetable poison. First, he set to work to separate what he suspected to be the poison from any traces of "animal matter" in the organs. This he did by repeatedly washing and filtering the substances in acidified alcohol and acidified water alternately. This method was successful because a vegetable poison, an alkaloid, is soluble in both alcohol and water (and so will pass though the filter, whereas body substances are soluble in one or the other, but not in both. Any body substance that passed through the filter with alcohol, for example, would be caught by the filter when washed with water and vice versa.

Once he had obtained a pure solution of the poison. Stas needed to separate the poison from the solvent. Ether-then newly discovered helped him to do the job. He added ether to the water containing the poison. The ether, being lighter than the water, separated from it, carrying the poison with it. Eventually, the ether evaporated, leaving an oily substance. Using a variety of established tests, Stas was able to prove that this was nicotine.

Stas informed the police of the results of his experiment. Following this new line of inquiry, they discovered that the count had spent several months in his own laboratory, learning to extract nicotine from tobacco leaves. Eventually, the count was convicted of murder. Stas received great acclaim from the scientific community for his discovery. His method, in a modified form, is still used to detect the presence of vegetable poisons in the body.

While this progress was being made in the identification of poisons, the identification of people-specifically criminals-was still being done in a rather haphazard manner. Detectives would attend lineups and try to memorize convicts' faces so that they could recognize a man if he were involved in a later crime. Photography, a new invention at the time, was just beginning to be used to record the faces of criminals. In the Surete (the Paris criminal investigation department) records were kept of every known criminal, including a detailed description of his appearance.

One obvious flaw in each of these three systems of identification was that the criminal could easily change his appearance by growing a beard. Moreover, many of the photographs were useless because the subjects had made faces in order to distort the picture. And the verbal descriptions were full of such vague terms as "tall" and "average."

These obvious defects irritated Alphonse Bertillon, a young assistant in the Surete, whose tedious job it was to transfer information to the filing cards. Seemingly marked for failure himself, Bertillon came from a family distinguished in science. Perhaps it was from them that he acquired a passion for exactitude. The idea began to form in his mind that criminals should be classified according to data that could be determined objectively. The method that seemed to him most promising was a system of body measurements, called ***anthropometry***, which his father and grandfather had studied.

Bertillon got permission from his supervisors to measure convicts brought in for registration. Painstakingly, he took a series of measurements for each man, noting in particular the length and breadth of leis head, the length of his middle finger, and the length of his little finger. After gathering extensive data, Bertillon calculated that if 14 different measurements were taken, the odds against any two people having the same measurements were 286,435,456 to 1. He also devised a system of cataloging the data so that a clerk could discover fairly quickly whether a newly arrested and measured criminal had in fact been arrested before.

Bertillon's superiors considered him a crank and refused at first to lists to his pleas that they adopt his system. Finally, in 1882, after nearly four years' effort, Bertillon's father persuaded the new Prefect of Police to give the system a trial. Bertillon was grudgingly given three months to put his methods of identification to the test. He was assigned two clerks as assistants and told them to record the measurements of every suspect brought in by the Paris police. There was one condition to be fulfilled for his experiment be judged a success. During the 90-day period he had to identify positively by using his system, at least one man who had previously served a sentenced and who had given a false name when arrested for some later crime.

Three months is hardly long enough to prove such a system, but Bertillon was lucky. Soon after the experiment began, a man was brought in who gave his name as Dupont. Bertillon took the necessary body measurements and went to his files. He at once discovered that just over two months earlier had registered a man named Martin who had identical measurements. An inquiry soon established that Dupont was in fact Martin.

Within a few years, Bertillon's system was in use not only in France, but also in many other European countries. Its supporters considered almost infallible. But some police officials-notably those of Scotland Yard had doubts. Even using a number of different measurements, the system did not seem capable of producing a unique description for each individual. A better method was needed. That method-fingerprinting-was discover about the same time as anthropometry was gaining favor, and was at first overshadowed by it. Eventually, however, fingerprinting became the stanch method of conclusive identification throughout most of the world.

Before the late 1800's relatively few people had paid any attention to the grooves on human fingertips. The Chinese used thumbprints on seals made hundreds of years ago. Presumably they believed that such prints varied significantly from man to man. The individuality of fingerprints was also noted by an English naturalist, Thomas Bewick.

In 1823 a Czech physiologist. J.E. Purkinje, published a description of the nature of fingerprints in which he classified tile different kinds. But nowhere in his work is there any suggestion that fingerprints might be useful to identify individuals.

Not until 1880 was this use of fingerprints publicly proposed. The suggestion appeared in the British Journal *Nature*. Dr. Faulds suggested that fingerprints found at the scene of a crime could provide positive identification of the offender. Sir William Herschel of the Indian Civil Service had been using this method of identification in India for about 20. He used thumbprints in registry documents to identify illiterates who could not sign their names.

But it was Faulds who first drew attention to the possibility of using fingerprints in criminal investigation. In fact, Faulds is said to be the first man to have helped solve a crime by using fingerprints. The Tokyo police were investigating a burglary and had found some fingerprints on a cup. Faulds discovered, by chance, that he had identical fingerprints in his small experimental collection. They belonged to a servant in a nearby household, and when the man was questioned lie confessed his guilt.

Fauld's letter and Herschel's reply stimulated considerable research into fingerprints. The first thoroughly scientific work on the subject. *Fingerprints* by Dr. (later Sir) Francis Galton, appeared in 1892. A few years later Edward Henry (later head of Scotland Yard), and an Argentinean police researcher, Juan Vucetich published details of two classification systems for fingerprints. The work of these men laid the foundations of modern fingerprint science.

It was due mainly to the efforts of Vucetich that Argentina became the first country to adopt fingerprint identification in its police department. Vucetich had been given the task of introducing Bertillon's system of anthropometry in La Plata and other Argentine cities. After reading an early article on fingerprinting by Sir Francis Galton, he realized that this method was superior to anthropometry. Against the wishes of his superiors he set to work collecting fingerprints and working out a classification system for them. Although his fingerprint study did not impress his superiors, it soon proved useful in solving a particularly brutal murder.

In Necochea, a small town in Argentina, two young children had been beaten to death. When the local police failed to find the murderer, Police Inspector Alvarez was dent from La Plata to investigate the crime. Alverez was one of the few people who had shown interest in Vucetich's fingerprint work. While searching the scene, he found the print of a bloodstained thumb on the door. He sawed off that part of the door and took it to the police station where the children's mother was being detained. He took her thumbprint and compared them, under a magnifying glass, with the one on the door. The print from her right thumb and the print on the door matched perfectly. When the young woman was confronted with the matching prints she broke down and confessed. She had killed her children because they stood in the way of her marriage to her lover.

This case caused a sensation in Argentina. Eventually, Vucetich succeeded in persuading the police to use his system. From Argentina, it spread to other South American countries. In England, the appointment of Edward Henry as head of Scotland Yard in 1901 was soon followed by the adoption of his fingerprint classification system in that country. Other European countries followed suit, as did the United States. Since then fingerprint identification has proved its value. As blood is shed in many crimes of violence, it is not surprising that evidence involving it has figured in court cases for many years. No one can say when scientific evidence on this subject was first given in a court of law, but it must have been at least 150 years ago. Records from the French Royal Academy of Medicine for 1828 show that French experts had by then been working for some time on the problem of bloodstain detection.

For many years, microscopic examination of the red cells was the method used in identifying blood species. Because the size of cells varies from one species to another, and because some species' blood cells have nuclei while others do not, this method would have been quite useful in cases in which complete cells could be isolated. In practice, however, it is extremely difficult to recover intact cells from bloodstains. Usually they are damaged and broken up as the blood dries. The forensic scientists of the 1800's knew the significance of identifying bloodstains, but could not always convince the courts that they knew how to make identifications. Today, the situation is quite different. Various chemical tests enable the scientist to determine whether a stain is in fact blood, what species of blood it is, and to which group it belongs. Such evidence is respected by the courts and can play an important part in solving criminal cases.

Even in the early stages or its development, the camera promised to play an important role in crime detection. One of the first crime investigators known to leave used the camera regularly in his work was Alphonse Bertillon, who found it useful in his anthropometric system of identification. He supplemented the list of measurements for each criminal with a full-face and a profile photograph taken in such a way as to ensure an almost perfect likeness of the man. He also developed techniques for photographing the scene of a crime.

The camera was also beginning to be used to apprehend a criminal. One such case, recorded in the *American Police Review and Parade Gossip* concerned the photographing of two thieves at work. The tills in a hardware store in Grand Rapids, Michigan, had been trapped again and again and the police had failed to catch the thief. Finally they rigged up a camera so that it focused on the cash drawer and it was connected in such a way that it would take a picture when the drawer was opened. In due time, the burglars broke in again. They were a bit startled when a flash went off as they were opening the drawer, but as nothing else happened they finished the job. With the help of the photograph, the police were soon able to find the burglars. When shown the picture, the men broke down and made a full confession.

By the late 1800's, various branches of science had made many contributions to crime detection. It remained for several far-sighted men to establish forensic science as an integral part of any system of justice.

One of these men was the lawyer Hans Cross, Professor of Criminal Law at the University of Graz, Austria. In 1892, he published a book called *Criminal Investigation* which has regularly been revised and is known today as *Gross's Criminal Investigation*. The entire art of criminal detection is still influenced by what he wrote. He is considered by some people to be the first man to understand fully the importance of scientific evidence.

Another pioneer was Edmund Locard of the University of Lyons, France. Locard is remembered chiefly for his ***principle of interchange***, formulated in 1910. He was the first man to theorize that when a man commits a crime he always leaves something at the scene that was not there before, and carries away something that was not on him when he arrived. This is one of the fundamental principles of criminal investigation. It is the basis of the "clue" in crime literature. Locard's theory applies not only to such obvious traces as fingerprints at the scene of the crime and bloodstains on clothing or weapons, but also to such telltale evidence as transferred fibers, wood chips, glass fragments, and paint flakes.

Among the earliest university departments to teach all aspects of forensic science was one set up at the turn or the century by Professor R. A. Reiss at the University of Lausanne, Switzerland. In 1902 Reiss's course was known as Forensic Photography. Later his department grew into what is today the Lausanne Institute of Police Science. This institute currently runs a four-year course leading to a diploma in "*Criminology and Criminalistics*" (another term for forensic science). The syllabus covers natural science, sociology, penal law, penal procedure, human anatomy, and forensic medicine. Laboratory work covers organic, inorganic, and physical chemistry, and document examination. The scope of this curriculum is a convincing sign that forensic science has finally come of age.