

It is Not Elementary, my Dear Watson

Present to
The Literary Club
Cincinnati, Ohio

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The year is 1990, the place West Palm Beach, Florida. Our person of interest, Marlene Warren, is at home. The day is superb, blue sky, a few fluffy clouds, the temperature is so perfectly cool. It is a wonderful day for finding a few new porcelain dolls, just small clown dolls. Her son who is ten years old would be delighted to help his mother in her quest. When the breakfast dishes are done, they will go to some antique shops and boutiques to search for these little prizes. They are Marlene’s hobby and maybe, even her personal passion. She will add them to her growing collection. How many does she have so carefully placed through her home? Dozens! If she found even two or three more, the day would be so successful.

The door bell rings. So early in the morning? Too early for the mailman. Maybe it’s a neighbor who needs some assistance. She answers the door. Behold, there is a clown standing there with flaming red hair and bulbous, red, Rudolph nose. The clown is holding some flowers in one hand, balloons in the other inscribed “You are the greatest!”. Surprised but smiling, our victim gratefully accepts the flowers and balloons and bows to smell the fragrance of the blossoms. But the clown has more nefarious plans. Our gift bearing clown pulls out a gun and shoots and kills Marlene Warren and calmly walks away!

The police are baffled, stymied because there are just no clues. The son could only describe the clown, its red hair and bulbous nose. There is no weapon, no known or obvious enemies. Just mysteries. After six months of intensive investigations, the detectives declare it a cold case, bundle up the balloons, flowers and the few other items of potential interest and store them in the cold case room. The surviving husband remarries a year later and with his son and new wife move to Virginia.

It is standard procedure for police departments to reopen cold cases at intervals. Several of the West Palm Beach detectives decided to take one more crack at the “Clown Murder Case”. They pulled out the stored flowers and balloons and, just in case, tested them for DNA. Eureka! There were unique DNA molecules present on both the balloons and flowers. And they had a perfect match in their files. They belonged to Sheila Kane, the new wife of our victim’s husband, both now living in Virginia. This is a true story. Sheila Kane now is in prison, indicted for first degree murder, and is awaiting trial. The husband, previously arrested and convicted of fraud for which he served three years in prison, is still under investigation but probably was involved having had an affair with Sheila Kane prior to the murder.

From trace evidence, a mysterious murderer was identified and captured a quarter of a century after committing the crime, by techniques not extant at the time of the

misdeed. And in the news in the last year, other methods of DNA analysis have been utilized to identify other criminals, no less the Golden State Killer and Rapist. But more on that later.

Forensic science and investigations of crime have an interesting history. Already in the early 19th century, Edmond Locard wrote in his seven volume treatise on criminal investigations, “It is impossible for a criminal to act,...without leaving a trace....” This idea became known as the Locard’s Exchange Principle, which implies that every contact leaves a trace.” Locard suggested that even the tiniest particles like dust in ear wax, despite good hygiene, could be obtained, identified and used to apprehend criminals. Paul Kirk wrote about criminals, “Wherever he steps, whatever he touches, whatever he leaves even unconsciously, will serve as a silent witness against him.”

There were no police forces to undertake criminal investigations until the 19th century. Prior to that time, the guilty were at times identified by trials of fire. Europe was mostly Christian and many people, certainly the Catholic Church, accepted the Bible as literally true, word for word. And so when Christ said, “And these signs will accompany those who believe in my name They will...pick up snakes with their hands; and when they drink deadly poison, it will not hurt them...”, people thought the innocent would be protected in physical trials. In one such recorded case, certainly apocryphal, a Catholic priest was debating an Arian clergyman about the divinity of Jesus. The priest was certain Jesus was God. The Arian thought Jesus was a human prophet, not a god. One of them had to be a heretic, a serious crime in those days. To determine which man held the true belief, the two were told that a ring would be dropped into a pot of boiling water. Each was to take a turn grabbing the ring from the pot and placing it on his finger. The one with the burned hand was the heretic. The story as recorded indicates the Catholic priest was unharmed.

There were, so to speak, real “forensic scientists” already in the 13th century A.D. Recorded in the book entitled *Collected Cases of Injustice Rectified* written in 1248 during the Song dynasty in China is the case of a mysterious murder. A man was brutally hacked to death with a sickle. The culprit was not known. The town chieftain called the citizens of the town to gather about to search for the offender but no one could identify him. Each of the men was asked to bring to him his sickle. They all were clean and free of any visible blood. The tools were laid on a flat surface in the open air. The people were asked to return in two hours. On their return, the town’s chief quickly identified the murderer. His sickle was covered with flies which detected the minute amounts of residual blood that could not be washed off. The owner confessed and was punished for his crime.

The more formal functions of police departments, i.e., keeping the peace, apprehension and guarding of criminals did not begin until the 19th century. In 1829 British parliament mandated development of a police department, the forerunner for most of the world’s modern police forces. Sir Robert Peel was home secretary and, as such, was the person responsible for establishing the “Metropolitan Police Force for London,

located at a later date at Scotland Yard. His police men were and still are known as Bobbies.

The application of science to detection and apprehension of criminals was not formally established and associated with police work until late 19th century. There were no rules or regulations that governed the investigation of crime regardless of how serious. Early on in England, coroners were not required to have any medical training to determine the cause of death and at times innocent people were convicted for crimes they did not commit. Autopsies were done in laboratories with no running water, sawdust on the floor to absorb body fluids, and naked bodies hanging from hooks.

But a few individuals started to apply science to study of crime. Paul Brouardel and Ambrose Tardieu studied the effects of suffocation and hanging on the body and described tiny blood spots called petechiae on the coverings the lungs and heart, even today called Tardieu spots. Alexandre Lacassagne described *rigor mortis* and the changes in skin color called *lividor corporis* as a function of time. Alfred Swaine Taylor, a pathologist, was appointed to teach forensic medicine in England during the 19th century and he wrote the first text on toxicology (*Manual of Medical Jurisprudence 1873*) He encouraged examiners and police to inspect carefully bodies of victims for marks and blood as well as the room in which the crime was committed, the furniture, dress of deceased and other items. Henry Gross, a professor of criminology, established the standards for investigators at the crime scene. He published his rules in a chapter entitled "Scene of the Offense" in his book entitled *Criminal Investigation*. He stated the first obligation of an investigator is to be absolutely calm and "Never alter the position of, lift, or touch any object before it has been described in a detailed written record."

In 1868, Edgar Allan Poe began publishing his stories including detective mysteries. Poe's early fictional detective tales featuring C. Auguste Dupin laid the groundwork for future detectives in literature. Sir Arthur Conan Doyle commented, "Each of Poe's detective stories is a root from which a whole literature...of future detectives in literature developed..."

Of course, Arthur Conan Doyle is the famed author of Sherlock Holmes. Sherlock Holmes and Doctor John Watson were and continue to be the archetypical heroes of detective fiction. British citizens were apprehensive about police investigating crimes because of their worry about the police being spies for the government, a concept based on the use of spies as police by the French kings. The publication of detective stories illustrating the investigations leading to the apprehension of criminals, especially the stories of Sherlock Holmes, helped in changing this concern in England and stimulated the development of forensic science as a legitimate discipline.

Arthur Conan Doyle was born in 1859 in Edinburgh, Scotland. His family broke up during his childhood years because of his father's problem with alcohol and they lived in squalid poverty. After his father's death, wealthy relatives supported Doyle's schooling mostly in Jesuit schools in England including college. From 1876 to 1881, he studied medicine at the University of Edinburgh Medical College. On 20 September

1879, he published his first academic paper, "Gelsemium as a Poison" in the *British Medical Journal*, a study that was regarded as useful information in a 21st-century murder investigation.

Sherlock Holmes was partially modeled on Doyle's former medical school professor and physician extraordinaire, Dr. Joseph Bell. Arthur Conan Doyle met Bell in 1877, and served as his clerk at the Edinburgh Royal Infirmary. Joseph Bell emphasized the importance of close observation in making a medical diagnosis. He would often pick a stranger, and by observing his hands, shoes, and clothing, deduce his occupation, county of origin, and other personal facts and recent activities. Doyle wrote to Dr. Bell that he intentionally models Holmes after Bell because he wanted to create a scientific detective who solved cases on his own merits and not through the folly of the criminal.

Doyle was socially and financially very successful including being knighted by Queen Victoria. After publishing 15 enormously popular Sherlock Holmes stories in *The Strand* magazine in England and in *Colliers* magazine in America, he hardly relished his career as the creator of a mythical detective. He considered it a low form of literature. He was unaware that Sherlock Holmes was a spur in England and Europe for the introduction of science into forensics. He had written many more serious works, some historical in nature, that he considered were the best of his work. He was reluctant to be characterized as only the author of Sherlock Holmes, a mythical detective. So in "The Final Problem", his fifteenth adventure, Doyle has Holmes make a final effort to eradicate organized crime from London headed by his archenemy Professor James Moriarty. These two met at Richenbach Falls in Switzerland where, grappling together on a narrow ledge, they both supposedly plunge over the precipice to their deaths.

The outcry was immediate. "Life's darkest moment" one cartoonist cried out on learning of the death of Holmes. "You brute!" wrote one woman. Another hit Doyle with her handbag. Over 20,000 readers canceled their subscription to *The Strand* magazine. Londoners wore black mourning arm bands. The Prince of Wales was upset and the newspapers reported "Tragic Death of Mr. Sherlock." To paraphrase Vincent Starrett, in his ode to Holmes and Watson, "Here dwell together... two men of note who never lived and so can never die: How very near they seem,..." To many Londoners, Sherlock Holmes and John Watson were real and true detectives who kept London safe from crime. Doyle responded to his critics condemning the killing off of Holmes, "This was not a murder but justifiable homicide. Holmes certainly would have killed me." But after a few years, he returned to write many more Sherlock Holmes adventures..

Doyle's first story about Holmes and Watson as detectives is entitled *A Study in Scarlet*, a short novel. The story begins in the deserts of Utah, a man and young girl the only survivors of a doomed wagon train. They are rescued by Mormon elders. Later the girl is coerced into an unwanted marriage that causes her to die of a broken heart. Her fiancé vows revenge on the scoundrels who forced her in marriage. He eventually murders in London two of those involved in the forced marriage. Holmes is asked to solve the crime, which he does successfully.

In the *Study in Scarlet*, Watson recently back from Afghanistan after being wounded meets Holmes working in a laboratory. Both had little money and so they decide to rent together a flat at 221B Baker Street, a fictitious location visited so to speak” even today by loyal fans. In the hospital lab, here was only one student, who was bending over a distant table absorbed in his work...[The student, i.e., Holmes] ...sprang to his feet with a cry of pleasure, ‘I’ve found it! I’ve found it,’ he shouted to my companion, running toward us with a test tube in his hand, ‘I have found a re-agent which is precipitated by haemoglobin, and by nothing else.’ Holmes explains its utility to determine whether dark stains on clothing, skin, shoes or other objects are blood or some other chemical that was unimportant for his investigations. Here Holmes introduces the use of laboratory based science into forensic investigations. / Holmes employed his expertise in science, observation and deduction to. solve apparently unsolvable crimes.

In “The Sign of Four”, Holmes is working on a case in which a retired British military officer who cheated his friends is murdered. Of course, Holmes and Watson solve the case. . Sherlock Holmes notes in this story that he had perfected the use of footprints as an investigative technique. Holmes states, “Here is my monograph upon tracing of footsteps, with some remarks upon the uses of plaster of Paris as a preserver of impressions.” Holmes encouraged examination of the prints for bloodstains, other biological markers and advised removing of floorboards that show bloody footprints.

Footprints can provide very important clues during investigations. There are two types of information that can be gleaned from a shoeprint. The first type provides information about the shoe as manufactured such as tread. The second type of information is based on defects such as cuts or cracks on the soles or wear patterns unique to the owner of that shoe. Wear patterns were used to solve the actual case of the barefoot burglar. In this case, a Scottish burglar would remove his shoes before entering a home and then discard them. Sir Sydney Smith, a pathologist, was asked to examine the three pairs of discarded shoes to determine if they were worn by the same man, the suspected burglar. He made gelatin casts of all the boots and noted that on all three pairs, the inner rim of the left sole was worn more than the outer rim.. . He postulated that the owner of the boots had a deformity of the spine and limped. Our suspected criminal did have a congenital spinal deformity and did, indeed, limp. Confronted with the evidence, the burglar confessed to all of the crimes.

Footwear evidence is often some of the most abundant at a crime scene such as indicating the number of individuals involved and the sequence of their activities. There is a statistical correlation between shoe length and an individual’s height. The shoe size is approximately 15% of the person’s height. Shoe size also provides information about the person’s gender. The FBI laboratories and a commercial website called *SoleMate* maintain a shoeprint database that contains images and details about sole designs, as well as photos of the upper part of the shoes.

Our scene shifts to London and “The Adventure of the Red Headed League”. . Jabez Wilson, of Irish ancestry and our main character, is a pawnbroker whose business is languishing. He observes in the newspaper an ad published by the Red Headed League

seeking a person with uniquely, bright red hair for some menial tasks, i.e., copying the *Encyclopedia Britannica*, for four hours every morning. Wilson ostensibly is selected from a very large group of men with various shades of red hair but none as red as his. For some weeks he is content to copy away and earn an easy 4 £. Alas, the job ends after a few weeks, long before he has completed his task and before he wished to surrender this sinecure. He consults Sherlock Holmes who quickly recognizes his pawnshop is across the street from a bank. The red hair was but a ruse for thieves to gain access to his pawnshop. He searches the basement of the pawnshop and discovers the robbers are burrowing under the street to the bank vaults. Holmes is an expert on tattoos having done a study on them, he is able to solve this case by recognizing an unusual tattoo on the arm of one of the culprits.

Personal blemishes such as tattoos, scars, or other stigmata were an early and useful method of recognizing repeat felons. After 1843, in France photographs were taken as permanent records. . In some jurisdictions, branding or mutilations like cutting off an ear or nose were used to mark the habitual criminal.

In 1882 in France, a young man, Alphonse Bertillon, developed a system of identifying individuals. He characterized individuals by measuring multiple anthropomorphic parameters such as the length of specific fingers, upper arms, forearms, height and, circumference of head Eye and hair color were recorded. This system of anthropometry was the first of its kind and required eleven bodily measurements that were unchangeable after age 21 years. It was very time consuming and tedious but remarkably accurate. It became the standard for much of Europe for keeping track of known criminals. Sherlock Holmes in “The Naval Treaty” comments on his admiration for this system.

Sherlock Holmes anticipated a major step in solving crimes. In “The Adventure of the Three Gables”, Holmes is asked to solve a burglary of a home with three gables. He examines a sheet of paper that had been discarded by a careless inspector from Scotland Yard. Holmes states that one never knows when a finger mark might be found that would help identify the culprit

His statement anticipated by many years the universal use of fingerprints in forensic science. The English began using fingerprints in July, 1858, when Sir William Herschel, Chief Magistrate of the Hooghly district in India, started using fingerprints on native business contracts. On a whim, and with no thought toward personal identification, Herschel had a local businessman, impress his hand print on the back of a contract. The idea was merely ". . . to frighten [him] out of all thought of repudiating his signature." The native was suitably awed, and Herschel made a habit of requiring palm prints, and later, simply several fingerprints on every contract made with the local natives. Personal contact with the document, the natives believed, made the contract more binding than just a signature. Thus, the first wide-scale, modern day use of fingerprints was predicated, not upon scientific evidence, but upon superstitious beliefs. As his fingerprint collection grew, however, Herschel began to note that the inked impressions could indeed prove or disprove identity. While his experience with fingerprinting was admittedly limited, Sir

Herschel's personal conviction that all fingerprints were unique to the person as well as permanent throughout life.

In 1899 Henry Faulds, a Scottish doctor, wrote a letter to the prominent scientific journal *Nature* (still a most prestigious journal) in which he described furrows on the skin of the finger tip and hands as well as the feet. He had first noted such fingerprints on ancient Japanese pottery. He examined modern pottery and found prints of the artists. He described loops, whorls and arches as common figures. He did extensive studies and then went on to describe how to obtain prints with ink and paper. He suggested bloody prints could help identify criminals.

A little time later, in Argentina, Juan Vucetich, a police investigator, using fingerprints convicted a woman of murdering her two children. This mother claimed to have found at home her two children stabbed to death. She stated she was out of the house at the time of the crime. But a bloody thumb print was found on a door that matched her prints. She confessed she had killed her children to be with her lover who hated children. She was convicted and executed. She is the first person ever to be convicted with use of fingerprints.

Fingerprints quickly replaced the Bertillon system of anthropometry. But not quite quickly enough. In 1911 the *Mona Lisa* by Leonardo da Vinci was stolen from the Louvre. The police searched for 10 years for the painting and the thief. Fingerprints were left at the scene and Bertillon had a thumb print of the thief and his identity in his anthropometric files. But the files were not examined. So ten years passed, before an Italian art dealer who had hidden the painting under his bed attempted to sell it and was quickly apprehended. It has been said that this sensational theft catapulted the reputation of the *Mona Lisa* into becoming the world's most famous and greatest portraits. For some of us including myself who have seen the actual painting in the Louvre, we might agree that its theft was its most interesting attribute.

In 1893, the British established a section at Scotland Yard dedicated to fingerprints. In 1910, Edmund Locard established a fingerprint laboratory and the rules for their use. Fingerprints were used in American prisons beginning in 1903 but the FBI was late in utilizing fingerprints and did not begin a systematic collection of prints until 1924.

Today there are huge repositories of fingerprints in virtually every country and in international laboratories that can be used to quickly identify a person locally or internationally. The FBI has the Criminal Justice Information Services building in Clarksburg, Va. In its multibillion dollar computer system, it stores upwards of 60,000,000 prints. The facility is connected to similar laboratories around the world. Prints taken off IED's in Iraq or Afghanistan are sent there for storage and later for comparison to known terrorists. It processes 200,000 requests daily and can often identify a person within seconds. In the last few years a new computer system was installed at Clarksburg that has a 99% accuracy compared to the 92% of its predecessor.

Today we have so many new, unheard of or unimagined ways to identify individuals including the sound of their voice or even their facial features recognizable to computer scanners even in crowded places like airports and jam-packed sidewalks. For those of you who have read or saw recently at the Cincinnati Shakespeare Theater the work by George Orwell, *1984*, we might recognize the ubiquitous, all seeing, electronic eyes and ears of “Big Brother” watching our faces and listening to our voices.

DNA analysis is one of the really newer, informative and interesting techniques in forensic science as well as in the disciplines of genealogy, medical genetics, anthropology and other sciences. All of these advances depended on the determination of the chemical and physical structure of DNA, i.e., Desoxyribo Nucleic Acid, the molecules that code our genetic inheritance. James Watson, Francis Crick and Maurice Wilkins shared the Nobel Prize in 1964 for elucidation of the double stranded structure of DNA. Determination of an entire human genome, the DNA sequence of an individual, required techniques to sequence all the nucleotides in all twenty-three pairs of chromosomes. The original methods were time consuming, labor intensive and very expensive. As technology improved, a project to sequence the complete human genome was begun in the 1990’s and declared complete in 2003. Most but not all of the nucleotide sequences in that one person’s genome were determined.

DNA is unique to each individual except, of course, for identical twins. There are two common types of DNA analysis of particular interest for this paper. The first is DNA fingerprinting or profiling. The second is genomic identification.

Sir Alec John Jeffreys noted what he calls “a eureka” moment in 1984 while working in his lab. He observed that DNA, cut into smaller fragments by certain enzymes, produced unique patterns for each person when analyzed by a method called electrophoresis. He could separate and identify the various members of the family of his lab staff. He commented that it was this moment that changed his life. This technique called DNA fingerprinting or DNA profiling won him the Nobel Prize and it became the method to solve so many crimes and identify so many criminals as well as being used in paternity suits.

DNA profiling or finger printing differs from genome analysis, a technique we will return to later. There are combinations of the same two or three or more nucleotides that are repeated a few to as many as 50 times. They are called repeats. The length of one or two or a few of these repeats can be shared by a number of individuals. But an individual has dozens of different repeats. The pattern of 15 or 20 repeats taken together is unique to an individual. Statistical methods can be used to calculate the probability of finding a DNA profile in another living human. The probabilities are usually in the order of one in a billion that another person might have this particular, specific DNA profile. The profile does not identify an individual as such or tell too much about his genome that determines hair and eye color and other traits. But it can indicate a sample of DNA in semen, saliva, hair, or other sources of cells belongs to this individual and that individual only.

And so the minute quantities of DNA left by our clown murderer could pick her out of all other suspects as the killer of our lady in Florida, a crime for which she now has been indicted and awaits trial. She could hardly have guessed that 30 years later she had left enough, unique evidence to bring her to justice. Edmond Locard who stated already in the 19th century that. “It is impossible for a criminal to act,...without leaving a trace...”, has been confirmed again.

DNA can be used in other ways to identify criminals. Genomic DNA codes for our personal traits such as hair and eye color, appearance, body habitus and abilities, susceptibility for diabetes and all of our other traits acquired from our parents. Genomic DNA sequences can be mostly sequenced by modern techniques in a short time and at low cost. The first sequencing of human genome costs millions of dollars as noted and took over a decade. Today it cost about \$100 at commercial labs like Ancestry and 23 and Me. It is likely that many here tonight have had their DNA genome studied. Obviously we share these genes with close and distant members of our family, receiving all of our traits from our parents who inherited them from their parents who inherited them from our great grandparents. In addition to identifying certain traits, these genomic studies can identify other individuals, known or unknown to us, who are related to us, that is, are members of our kinship. I have a friend who had his DNA studied. He was informed of a probable cousin about whom he knew nothing. But the genomic DNA from both suggested a familial relationship. On investigation, he found that another member of his family had a child out of wedlock who was quietly put up for adoption.

Genomic DNA also can be used to identify individuals, for our purposes criminals. A recent case illustrates the special analyses used to identify a particularly heinous criminal. Beginning in the 1970's, in California a series of exceptionally vicious crimes began to be committed, apparently by a single perpetrator and continued intermittently over a period of years. These were rapes and murders. The person behind these crimes taunted the police in letters and phone calls that he could not be caught. There were no clues to identify this person. Of course there were rape kits and other sources of tiny evidence left by the perpetrator. DNA from semen was analyzed, both as a profile but also genomic DNA. But there were no matches in any database of known criminals or non criminals. He was called the “Golden State Rapist and Killer” and he evaded capture for over 25 years.

Several people have developed a website to assist individuals to identify relatives and establish a family tree. One such site is GEDMatch. A person downloads his known genomic DNA pattern into the website and computer programs are used to find potential relatives, greatgreat grandparents, distant cousins or as noted before, closely related individuals about whom their parentage was intentionally hidden.

There was a reward of \$50,000 or more for the identification, capture and conviction of the Golden State Killer. With that incentive, a private firm, using GEDMatch data, compared the DNA genomic data from rape kits available from the investigations on this case. Computers were used to detect potential distant relatives and to construct a family tree. Information from obituaries, marriage licenses, baptismal

records and other sources were combined with the genetic data. Finally the workers identified just a few individuals who could be the rapist. Police recovered a discarded coffee cup from a trash barrel of one of these individuals. . The DNA from that cup was a perfect match with the DNA from the Golden State Rapist/Killer who was arrested two years ago and now is in jail awaiting trial. He was a former policeman who knew how to avoid leaving some obvious trace evidence to mystify investigators but, as Locard's Principle predicts, every criminal leaves a trace. Several other crimes have been solved using these techniques.

There are so many other methods for solving crimes and identifying criminals. Mitochondrial DNA inherited only from our mothers, has been used. Blood typing is widespread. Analysis of bullets and ballistics are common place today although such studies were already used in the 17th century. At a body farm at a Tennessee college, forensic scientists continue to study the effects of the environment on bodies discovered in all varieties of conditions, hot, cold, wet, or submerged in water. The findings are taught as part of the curriculum in forensic science at various colleges. These same programs investigate and identify the types of infestation of bodies by various bugs, worms, maggots and other creepy-crawly creatures, data that are relevant in determining how long a body has lain dead in a given location.

Sherlock Holmes and his partner Dr. John Watson have entertained readers for over a century with their ability to solve the unsolvable. Indeed, Holmes used observation and deduction. He observed the minute, the trivial and put the information into an hypothesis he could test to apprehend the criminal. His methods of crime detection made crime solving "Elementary, my dear Watson." Although there was only a soupçon of forensic science during the times of Holmes and Watson, the idea of using technology came into being, stimulated by these stories and other authors, i.e., Edgar Allen Poe. But Holmes's retorts to Watson on solving a case, the it is all elementary no longer holds so true. Forensic science with all its technology would force Holmes to admit to his partner, Watson, "It really is not so elementary, my dear Watson."