From 1860 Miescher to 1986 Jeffreys: A Times Past View of Forensic DNA Analysis

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The utilization of deoxyribonucleic acid (DNA) evidence in the field of forensics science was introduced much more recently than both the usage of fingerprint evidence and the use of blood spatter evidence. In fact, it wasn't until 1986 that DNA was used as evidentiary material in a criminal case. Although it is a newer discover, DNA is responsible for more convictions of defendants who refuse to admit to the crimes they have committed than any other form of physical scientific evidence (National Research Council, 1996). The fact of the matter is, if an offender's DNA is identified via rape kit (sexual assault evidence collection kit) by a medical examiner after examining a female decedent, the offender's lack of confession is essentially insignificant. DNA, or the lack thereof, will often make or break a case in the minds of jurors. However, DNA did not evolve overnight into the irrefutable physical evidence that it is in criminal cases today. Steps were taken from its initial discovery to more recent technological breakthroughs to get it there. The purpose of this piece is to highlight the major events throughout the short history of DNA, specifically 1) the first discovery of its existence, 2) Watson and Crick's discovery of its three-dimensional double helix form and more, 3) Dr. Alec Jeffreys' and the first conviction in a criminal case using DNA as scientific evidence, and 4) the recognition of identical twin DNA and the doubt it brings forth.

"Swiss chemist Friedrich Miescher first identified DNA in the 1860s" (University of West Florida Science, 2019). To be exact, this very momentous year in genetics research was 1869. Miescher, a doctor of physiological chemistry, initially named what is currently known as DNA, *nuclein* because he located it within the *nucle*us of a human white blood cell. *Nuclein*'s

name then became nucleic acid, which then became deoxyribonucleic acid (DNA), which is how it is referred at present time. Much like the accidental discovery of penicillin by Dr. Alexander Fleming in 1928, Miescher did not set out to make the groundbreaking discovery of DNA when he entered his laboratory that fateful day. He originally set out to simply explore the already discovered protein components of white blood cells. In doing so, he "made arrangements for a local surgical clinic to send him used, pus-coated patient bandages; once he received the bandages, he planned to wash them, filter out the leukocytes, and extract and identify the various proteins within the white blood cells" (Pray, 2008). It was during that process that Dr. Miescher located material from one cell's nucleus that had chemical properties distinct from any other protein he has studied prior. Upon further delving into this unknown substance, he found that it had a "much higher phosphorous content and resistance to proteolysis (protein digestion)" (Dahm, 2008). By the end of his study, he managed to both isolate and characterize what is now called DNA. That was the it hit him. Dr. Miescher understood that he had discovered a previously unknown component of a cell. Recognizing the incredible importance of his conclusion, Dr. Miescher wrote, "It seems probable to me that a whole family of such slightly varying phosphorous-containing substances will appear, as a group of nucleins, equivalent to proteins" (Wolf, 2003).

While Dr. Miescher is credited with discovering DNA, Dr. James Watson and Dr. Francis Crick are attributed as being "the first scientists to formulate an accurate description of this molecule's complex, double-helical structure" (Pray, 2008). In 1953, this American biologist / English physicist duo unleashed their revolutionary finding that "the DNA molecule exists in the

form of a three-dimensional double helix" (Pray, 2008). The pair went on to explain that the DNA helix's double-strand is linked by hydrogen bonds. They also found that four bases are found within a molecule of DNA including adenine (A), cytosine (C), guanine (G), and thymine (T). These scientists verified that adenine is always paired with thymine, and that cytosine is always paired with guanine, proving that adenine is never paired with cytosine – and vice versa, adenine is never paired with guanine – and vice versa, thymine is never paired with cytosine – and vice versa, and thymine is never paired with guanine – and vice versa. DNA was shown to have "outer edges of the nitrogen-containing bases [ACGT] which are exposed and available for potential hydrogen bonding" (National Human Genome Institute, 2023). Drs. Watson and Crick did not stop here. These men of science exhibited that "most DNA double helices are right-handed; that is, if you were to hold your right hand out, with your thumb pointed up and your fingers curled around your thumb, your thumb would represent the axis of the helix and your fingers would represent the sugar-phosphate backbone" (National Human Genome Institute, 2023). In fact, they identified the one and only DNA type that is left-handed and named it Z-DNA. Dr. Watson and Dr. Crick were an incredible scientific twosome, indeed.

Fast-forward to the year 1977, when British geneticist Dr. Alec Jeffreys' started formulating an in-laboratory method that could identify specific individuals via their DNA samples. A mere seven years later, Dr. Jeffreys and his team developed a precise technique to examine a particular property of DNA which showed "isolated areas of great variability between individuals called restriction fragment length polymorphisms (RFLP), for forensic identification—the original DNA fingerprint" (Visible Proofs, 2006). At that point, the expertise

of Dr. Jeffreys was common-knowledge among those in the forensic science community, so "in 1986, police asked Jeffreys for help in finding a man who had raped and killed two girls" (Visible Proofs, 2006). At the time, Mr. John Buckland was the police's prime suspect. However, Dr. Jeffrey's tests on the seman retrieved from vaginal swabs of the deceased adolescents were not a match with Buckland's DNA. After ruling out Buckland, and "through a genetic dragnet, police found the perpetrator, Colin Pitchfork" (Visible Proofs, 2006). This was the very first time DNA was used to convict a criminal in a court of law. "Not only did Jeffreys' work, in this case, prove who the real killer was, but it exonerated Richard Buckland, who likely would have spent his life in prison otherwise" (Johnson, 2006). Since 1986, DNA evidence has been responsible for the exonerating of the wrongfully accused and the convicting of the guilty offenders the world over.

Today it is clear, in *most* criminal cases where DNA evidence is present, who the offender is according to their unique DNA fingerprint. However, this is not true in *all* cases. In cases of an offender having an identical twin, while the DNA analysis may be crystal clear, the person to whom the DNA belongs may be quite blurry. "According to a 2021 study, an estimated 15 percent of identical twin pairs may have one member that exhibits significant genetic variation from their twin" (Healthline, 2023). This indicates that a whopping eighty-five percent of monozygotic twins share the same exact DNA without any genetic mutations. In fact, "monozygotic twins differ on average by 5.2 early developmental mutations and that approximately 15% of monozygotic twins have a substantial number of these early developmental mutations specific to one of them" (Jonsson, et. al., 2021). In other words, if an

identical twin who is in this minute fifteen percent of the population leaves DNA behind at a crime scene, it will be linked directly to that individual and the other twin will be ruled out as having been there. That being said, if an identical twin who is in the vaster eighty-five percent of the population leaves DNA behind at a crime scene, either twin could be the culprit due to the lack of distinguishing factors. Though rare, there have indeed been occurrences where the wrong twin was arrested, charged, tried, convicted, sentenced, and imprisoned while their womb-mate has stood by silently. For example, in Chicago, Illinois, "Kevin Dugar was convicted of murder in 2003, but in 2017, his identical twin, Karl, confessed to the murder while serving his own 99-year prison term for attempted murder during the commission of a burglary" (Schaffer, 2018). Having been appointed the role of madam foreperson in New York State criminal court ample times while serving jury duty, I must say that if I was told that an identical twin was on trial, and this set of twins was in the eighty-five percent discussed earlier, uncertainty would indeed exist in my mind.

DNA has come a long way since its first discovery by Dr. Miescher in Switzerland in the late 1800s. As Watson and Crick discovering DNA's three-dimensional double helix form built upon the work of Miescher, Dr. Alec Jeffreys' work of exonerating and convicting using DNA built upon the work of Watson and Crick. Perhaps future scientists can build upon Dr. Jeffreys' work to locate some differentiating matter within DNA for the eighty-five percent of identical twins, so the seed of doubt can be swept away permanently.

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