DNA fingerprinting on trial: the dramatic early history of a new forensic technique

Jay D. Aronson

Department of History, History and Policy Program, Carnegie Mellon University, Pittsburgh, PA 15213, USA

The early history of ‘DNA fingerprinting’ in the UK might have been different were it not for the accounts of two dramatic courtroom trials, made by the participants and the media, in the mid-1980s. But these reports, which misrepresented the importance DNA evidence had in the trials, left a strong impression on the British public and on judges on both sides of the Atlantic. These trials, widely considered to be the first ‘victories’ for DNA fingerprinting, have been frequently cited as proof of the utility and reliability of the technique, in both the UK and beyond. But in reality, it was the threat of DNA evidence being used rather than the integrity or validity of it that resolved these cases. At that time, DNA fingerprinting was still in its infancy, an untried and untested technology.

Introduction

Soon after its invention in 1984, genetic identification technology or ‘DNA fingerprinting’ started to be used in the British legal system. Two trials, in particular, stand out as landmarks in this context: the immigration tribunal hearing of a young British boy of Ghanaian descent; and the investigation into a double murder that would ‘take the hearing of a young British boy of Ghanaian descent; and the investigation into a double murder that would ‘take four years, a scientific breakthrough, the largest manhunt in British crime annals, and the blooding of more than four thousand men before the real killer [was] found’ [1]. Both trials received widespread media coverage, which portrayed DNA evidence as the decisive factor (that was also objective) in arriving at the ‘truth’. However, a closer inspection reveals that it was the mere existence of DNA evidence rather than its probative value or validity that proved decisive in both instances. Furthermore, at that point the methodology and practice of forensic DNA-analysis was still changing significantly, and none of the results it had produced in either case had been exposed to open scientific scrutiny.

The Ghanaian boy

When his plane touched down at Heathrow airport in London, 15-year old Andrew Sarbah expected to sail through immigration; although he spoke little English, he was, after all, returning to the city of his birth. Andrew had been born in London to parents of Ghanaian descent, but after his parents had separated he returned to Ghana with his father at the age of four. Eleven years later, Andrew was returning to the UK to live with his mother and several siblings [2]. He carried an up-to-date Ghanaian passport showing that he had been born in London, as well as a British passport containing a picture of him as a young baby. His nightmare began at the immigration desk, when the authorities denied his application to enter the UK as a British citizen. According to press reports, there was a suspicion that the British passport had been doctored and that the young man trying to enter the country was actually one of Andrew’s cousins. However, Andrew was granted a ‘temporary admission’ until his actual immigration status could be resolved.

The Sarbah family obtained legal counsel from Sheona York, an immigration attorney based in London. At the time, individuals denied admittance to the UK had two avenues of appeal: the first was a standard appeal process through the immigration tribunal; the second was to get a local Member of Parliament to lobby the Home Secretary directly [3]. York quickly undertook both legal approaches and began collecting photographic and testimonial evidence to support Andrew’s claim. The Sarbah family also obtained serological testing, which proved that Andrew was Christine Sarbah’s son with 98% certainty. The only other scientifically feasible explanation for the result of the test was that Andrew was a child of the same father and one of Christine’s sisters. Although there was a good fit between the testimonial and serological evidence, the Home Office maintained that Andrew’s passport had been tampered with. This did not bode well for the Sarbah family. Despite overwhelming evidence in his favor, Andrew’s options were running out.

Just after York had filed the final appeal, a colleague showed her a newspaper article that described a new genetic technique for uncovering family relations [4]. The article proclaimed ‘scientists have discovered a method of identifying people by their genes – a genetic “fingerprint” so precise it can even tell you who your father is’. The test, developed by Alec Jeffreys, was so powerful that it was able to ‘distinguish every individual, even the children of a first-cousin marriage’ [5].

York was ‘overjoyed’. She got in touch with Jeffreys to see if he was prepared to try out his technique on a real case [6]. Despite his expectations that ‘everything would go haywire and I’d have to say that it simply doesn’t work
Alec Jeffreys and ‘DNA fingerprinting’

‘DNA fingerprinting’ was discovered unintentionally by Alec Jeffreys and a group of his students at Leicester University (http://www.le.ac.uk/) while they were studying the evolution of globin genes in sea-dwelling mammals. They noticed that a particular 33-nucleotide sequence appeared in a variety of repetitive patterns that were present in almost all of the globins. Further examination revealed that these motifs seemed to be present in the genomes of most mammals and that the patterns they generated appeared to be different in each animal. This was an exciting discovery. Jeffreys and his colleagues reasoned that these repetitive ‘mini-satellites’ might act as markers, pinpointing the genes responsible for particular traits – the Holy Grail of human medical genetics in the 1980s. In an attempt to verify this, Jeffreys set up an experiment to look for the mini-satellites in the human genome.

Early in September 1984, Jeffreys and a graduate student came into the lab on a Monday morning to check the results of this experiment; they were astounded by what they saw. The probes had picked up several mini-satellites in the human genome, but surprisingly these mini-satellites appeared to be uniquely distributed among individuals and passed down through families in Mendelian fashion. Following the publication of this discovery in *Nature* in early 1985 [7], Jeffreys et al. worked out how frequently various mini-satellite fragments appeared in 20 ‘unrelated British Caucasians’. In a second *Nature* paper, published later that year, they concluded that the probability that two individuals would have the same DNA fingerprint was less than 1 in 33 billion (3 × 10^{-11} – 5 × 10^{-18}).

In neither of these papers did the authors spell out that this technique was still in development, and had to be perfected before it could be used in forensic casework. They did acknowledge that small DNA fragments were difficult to visualize and measure accurately, and pointed out that new mini-satellites arose at these hyper-variable regions in about 0.4% of individuals. However, Jeffreys and his coauthors did not consider these issues grave enough to prevent the technique from being used in practical situations, which seems to have been one of Jeffreys’ main goals. Indeed, his careful choice of the name ‘DNA fingerprinting’ was an attempt to piggyback on the long-standing credibility of traditional fingerprinting [8]. Only several months after the papers had been published in *Nature* would Jeffreys and others publicly discuss the limitations of the technique, by which time the development of the next generation of genetic identification technology was already well underway.

DNA typing enters the immigration tribunal

On the day of the final appeal to the immigration tribunal in the Sarbah case, Jeffreys arrived with a copy of his original 1984 *Nature* paper and evidence that reputedly supported the claim that Andrew was Christine’s son (Figure 1). York recalled that just before the hearing started, a statistician sent by the the Home Office (http://www.homeoffice.gov.uk/) questioned Jeffreys’ claims about DNA fingerprinting, and the two of them had a heated discussion in the hallway outside the courtroom. Once the hearing got under way, she was expecting there to be a major duel between Jeffreys and the statistician. But there was to be no such confrontation. York describes the actual hearing as follows:

Once before the tribunal, the Chair [of the proceeding] effectively pointed to our client’s bundle of evidence, which stood about one feet high on his table, and the Home Office evidence, which was nothing, and said that he was not about to take the responsibility of deciding an immigration appeal on the basis of some startling but untried scientific evidence: that would have to be left to the High Court if necessary. However, he did not believe it would be necessary. He said he had considered the Appellant’s evidence, and said that “unless the Home Office had a rabbit to pull out of a hat, they should concede the case.” [9]

Following a short recess to enable the Home Office lawyers to talk to their superiors, the Home Office withdrew the case. The validity of the DNA evidence...
was never addressed during this hearing. According to York: ‘the Tribunal did not wish to take the huge step of effectively decreeing that such evidence was valid’ [10]. Instead, they left the issue for another legal body to evaluate.

Jeffreys admitted that the genetic evidence he brought to court that day was never subject to independent replication. ‘We were the only lab to get this technology going, and, at the time, it was tricky as well,’ he said [11]. In an effort to develop the scientific credibility of DNA fingerprinting and to begin the process of serious peer review, Jeffreys and his colleagues sent a report of the Sarbah case to Nature. When the journal sent the report out to be peer reviewed it received very negative feedback from one referee, who stated that the primary function of DNA evidence was merely to support traditional blood grouping data. At this point, Jeffreys was forced to intervene in the publication process in an effort to get the paper into print:

I actually had to enter into a dialogue with the editor, pointing out gently that that wasn’t quite a fair representation of the significance of the paper, and also they should be aware that this evidence is being considered by the Home Office for being accepted. This promised, in principle, to change the entire basis of immigration control in the UK and we felt that that was of sufficient significance for Nature to consider’ [12].

This seems to have done the trick; the article appeared a few months later and DNA fingerprinting received its first major validation in the scientific community – despite negative peer review.

Public reaction
The popular press jumped on the Sarbah case: most major British newspapers published stories about DNA fingerprinting, lauding it as a new way to depoliticize controversial immigration decisions. Amid all these news reports, only Nature reported that it was the existence, not the validity, of DNA evidence that persuaded the Home Office to drop the case [13]. This fact was quickly lost in the hype surrounding this new form of scientific evidence. The headline in the Guardian, for instance, proclaimed ‘Son rejoins mother as genetic test ends immigration dispute’ [14]. Another story in the Guardian stated that although the Home Office authorities did not believe Andrew Sarbah, ‘Dr. Jeffreys’ methods proved the boy right!’ [15].

In an interview conducted in September 2001, Jeffreys described DNA fingerprinting as science saving Andrew from deportation. ‘It was science acting for the individual against bureaucracy and the state, I mean, it was just wonderful’ [16]. He went on to remark that the public image of DNA fingerprinting might have been very different had the test not clearly demonstrated a mother–son relationship. He said: ‘what the public would have seen in terms of real casework would be some poor kid being dragged, kicking and screaming, onto a plane at Heathrow, being thrown out to Africa. That would have been tragic; that would have set us back a lot’ [17].

As word of DNA fingerprinting made its way into immigration law and immigrant communities, Jeffreys and his colleagues at Leicester – who operated the only laboratory in the world that was practicing the technique – were deluged with requests to help resolve immigration disputes. ‘It was crazy, just impossible,’ remembers Jeffreys. ‘We just simply couldn’t cope. It lasted precisely two years and it was two years I wouldn’t like to live through again. We had enquiries by the thousand – box file after box file after box file of enquiries’ [18].

At the same time, Jeffreys’ lab also began to perform some paternity testing, and by early 1986, DNA evidence had been accepted by the magistrate’s court as valid and reliable. There is no definitive count of how many cases (each involving several individuals) Jeffreys worked on, but he estimates that it was about 200.

In response to the demand for DNA fingerprinting, especially from the realm of immigration, Jeffreys and the Lister Institute (which funded his research, http://www.lister-institute.org.uk/) agreed that Imperial Chemical Industries (ICI, http://www.ici.com/ICIPLC/home/index.jsp) – the largest chemical company in the UK and one of the biggest multinational corporations in the world – should be granted a license to develop the commercial potential of the technology. Early in the summer of 1987, ICI opened a DNA testing laboratory that offered DNA testing to anyone willing to pay the £105 fee for each sample tested.

In the Blood Test Regulations Amendment of 1989, DNA profiling was given official recognition as a legal method of determining paternity in immigration cases. However, this formal acceptance was something of an anticlimax: the Home Office had already begun to use the technique in forensic casework and it had been accepted as evidence in numerous other courts.

The blooding
The first criminal investigation to make use of DNA fingerprinting gained so much notoriety that an American crime writer – Joseph Wambaugh – published a popular and entertaining account of the case entitled The Blooding. The story begins in November 1983, when a passer-by discovered the body of 15-year old Lydia Mann on a secluded path near the village of Narborough, Leicestershire. The rape and murder of this girl created a swirl of fear in this quiet and peaceful part of the UK, and the police launched a major investigation to try and catch the culprit. But in spite of the efforts of the police and the attention the murder aroused, the case went unsolved. Nearly three years later, in July 1986, a similar crime was carried out in the neighboring village of Enderby. This time, 15-year old Dawn Ashworth was found in a similar location, stripped of her clothes and strangled.

As in the Mann case, the police launched a massive investigation. This time, however, they had a suspect – a 17-year old boy who worked in the kitchen of a local mental hospital (Carlton Hayes Hospital). Apparently, he had become very excited and agitated about the murder, which occurred near the hospital, and somebody alerted the police about his odd fixation with the crime. Upon being questioned by the police, the young kitchen porter, who had a rather low IQ, confessed to Ashworth’s murder.
What happened next is ‘open to debate’ [19]. According to one version of the story, the kitchen porter’s father had read about DNA testing in a popular magazine and asked his solicitor to have the test conducted on his son to prove his innocence. In another version, the police had heard about the use of DNA fingerprinting in immigration cases and hoped that it might link the kitchen porter to the rape and murder of Mann three years earlier. Whichever story is true, the Leicestershire police asked Jeffreys to compare a sample of DNA from the kitchen porter with a DNA sample obtained from materials collected in the Mann investigation.

Jeffreys agreed to undertake the analysis in September 1986. He succeeded in extracting DNA from sperm collected from the three-year-old crime scene, but there was insufficient genetic material to carry out the multilocus DNA fingerprint test that he used in paternity and immigration cases. However, Jeffreys had been developing probes that could interrogate a single locus, an approach that required only minute quantities of DNA. Much to his surprise, this new technique produced results: the DNA profile of Mann’s murderer did not match that of the kitchen porter (Figure 2). This was a setback for the police. Almost at a loss as to how to proceed, they gave Jeffreys a sample of DNA from the second crime scene. The results were astonishing: the DNA from both murders was identical, but the profile did not match that of the kitchen porter [20]. The police had a serial killer on their hands, but had to rule out their prime suspect.

The police officials who received the news were shocked by the results of the DNA analysis, but they accepted it at face value because they felt they had no choice. ‘We couldn’t challenge it,’ one officer told Wambaugh. ‘How do you challenge brand-new science? Nobody else in the “bleedin’ world knew anything about it’ [21]. Even if it was only intuition, the police officers had good reason to question the validity and reliability of this novel technique. Indeed, in a 1996 interview, Jeffreys admitted that the single-locus probe technique had not been fully developed: ‘We were basically flying by the seat of our pants’, he said. Had there been a match, it would have been necessary to estimate the probability of it being a chance occurrence; whereas the mismatch between the DNA from the crime scene and the suspect meant that the kitchen porter could be excluded from the investigation without any need for complex statistics. ‘In a way it was good that we had an exclusion’, said Jeffreys [22].

The Home Office’s rapidly developing Forensic Science Service (FSS) at Aldermaston confirmed Jeffreys’ conclusions, and a few days before his trial, police dropped all charges against the kitchen porter. He was released from jail – the first criminal suspect exonerated by DNA evidence.

With no leads and pressure mounting from the community to find the double murderer, Leicestershire police investigators took an unprecedented step: they requested voluntary blood and saliva samples from all men between the ages of 17 and 34 living within the vicinity of the crime scenes. This, they hoped, would enable them to eliminate suspects from their investigation. Although the samples would initially be tested using traditional blood markers, all individuals who could not be eliminated in that way would be subject to DNA typing. From Wambaugh’s account of this genetic manhunt, it is clear that police investigators were deeply skeptical of the reliability of the technique but felt that they had no other alternative. Three years of traditional police-work had yielded no valuable leads on who had committed these atrocious crimes.

Thus, the Leicestershire police force set about organizing the massive task of collecting samples from what eventually amounted to 4582 young men, while the Home Office raced to finish their first dedicated DNA analysis laboratory in Huntingdon, Cambridgeshire in time to perform the actual DNA fingerprinting tests. Once the operation at Huntingdon was up and running, the Home Office set about DNA typing more than 500 individuals that could not be eliminated by standard blood typing. Much to the chagrin of police investigators and forensic scientists, none of the samples matched those of the killer. The investigation seemed to have reached yet another dead-end.

But things took an astounding turn in mid-September 1987, when the police received a call from a woman who worked at a bakery in Leicester. She told them that one of her co-workers, Ian Kelly, had let slip over a lunchtime pint that he had fooled the police during ‘the bleeding’ by giving a sample in place of a cake decorator employed at the bakery. The police arrested Kelly. Upon questioning,
he quickly laid out the entire plot. The cake decorator, Colin Pitchfork, convinced Kelly that he had already given blood on behalf of a friend who had been convicted of flashing in order to help him out. Reluctantly, Kelly had agreed to cover for Pitchfork and gave blood in his name in late-January 1987.

Based on this information, Pitchfork was arrested in his home, where he promptly confessed to both murders. Subsequent DNA fingerprinting revealed that his profile matched that of the murderer exactly. Pitchfork pleaded guilty in January 1988 and was sentenced to two life terms for the murders, plus additional time for rape and indecent exposure (Figure 3). The case was hailed as the first significant success for the use of DNA typing in forensic investigation. ‘Had it not been for genetic fingerprinting, you might still be at liberty’, the judge told Pitchfork at sentencing. This quotation had a great deal of impact around the world; it was reprinted widely [23]. However, the case was actually solved by an old-fashioned tip-off from an informant.

Conclusion

By 1988, British governing institutions and courts had come to accept DNA evidence without much question. However, as subsequent challenges would show, this acceptance did not rest on firm scientific foundations. Instead, it relied on the drama of two early cases in which DNA played an exciting and new, but not legally definitive or scientifically sound, role in the British legal system.
Free journals for developing countries

The WHO and six medical journal publishers have launched the Access to Research Initiative, which enables nearly 70 of the world’s poorest countries to gain free access to biomedical literature through the Internet.

The science publishers, Blackwell, Elsevier, the Harcourt Worldwide STM group, Wolters Kluwer International Health and Science, Springer-Verlag and John Wiley, were approached by the WHO and the British Medical Journal in 2001. Initially, more than 1000 journals will be available for free or at significantly reduced prices to universities, medical schools, research and public institutions in developing countries. The second stage involves extending this initiative to institutions in other countries.

Gro Harlem Brundtland, director-general for the WHO, said that this initiative was ‘perhaps the biggest step ever taken towards reducing the health information gap between rich and poor countries’.

See http://www.healthinternetwork.net for more information.