

DNA Doppelganger Dilemma

By Robert Whiston FRSA

[21st Aug 2004. Ver 2.0 Revised Sept 2007]

Another rape trial has just come to an end in what would otherwise be the idyllic leafy English county of Kent. The conclusion, after many months waiting for the case to come to trial, followed by several weeks where the evidence could be presented, can now be published.

Antoni Imiela, aged 49, from Kent in southern England, who had denied raping five women and three girls during 2001 and 2002, was found guilty on seven of the nine charges and sentenced in March 2004 to seven life sentences. His victims ranged in age from 10 to 52.

The case was said to be one of the more distressing, involving serial rape and violence. In addition to the several life sentences, Imiela was given 10 years for the kidnap of a 13 year old, 7 years for indecent assault, and 12 years for the attempted rape and indecent assault of a 10 year old girl.

Each year, slightly more sex offenders are found guilty (as distinct from merely being charged) of what are termed 'indictable sexual offences', and which covers a gamut of lesser offences.

In 1989 they totalled 613, but ten years later (1999) there were 631 such cases ¹. See Appendix A. Thankfully, few are as perplexingly severe as this one.

During the trial it was revealed that as a child Imiela was beaten by his father, that his father and mother had separated when he was 15 (his mother left home), and that, aged 17, he was sent to Borstal (a young offenders prison) for offences involving firearms.

When he moved to Kent, in the late 1990s, he already had a wife and had just completed an eight-year prison sentence for committing several armed robberies, threatening in one incident, to "blow the head off" staff and shoppers and clubbing an elderly man over the head. That was his *modus Vivendi*.

The repetitive nature and cruelty of the rapes led police profilers to assume that they were looking for a serial attacker who had a history of sex offences. For some unexplained reason they settled on Antoni Imiela who had no such background other than one of robbery with violent tendencies. Nonetheless, his violent tendencies but lack of sexual offence history was portrayed in court as a suitable breeding ground for a budding rapist. Criminal profilers associated with the proceedings were unable to say why a man with no previous record of sexual offences should suddenly embark on a series of sex attacks.

Is it unclear why he should turn to sexual offences, knowing as he must, from his previous detention at 'Her Majesty's Pleasure', that such offenders are viewed as the 'lowest of the low' both inside prison and in civilian life.

To those with a passing interest in 'behaviourism' it must also be curious that he should sexually interfere with both adult women and children.

'Liberals' and criminologists will have at once noted that the press and court placed no particular emphasis on the fact that he was from a 'broken home' and that his mother had apparently abandoned him and his brother. If he had been brought up by a 'domineering mother' they could also have drawn consolation from the 1980's study into rapists, which showed a large proportion of them displayed "displaced anger" toward their mother and directed that anger towards other women. ²

A child raised by his father, according to the literature, is less likely to offend, be anti-social or 'go off the rails'. This alone should have attracted attention.

¹ Home Office Criminal Statistics, Table 5.12, Offenders found guilty at all courts for indictable sexual offences, rape of a female, actual numbers in all courts.

² Criminal Justice and Behavior, Vol. 14,p. 403-26 (US) - boys brought up predominantly by a mother, ie fatherlessness, are 14 times more likely to commit rape and 80% of rapists, who are motivated by displaced anger, come from mother-headed households

We have no idea whether Antoni Imiela was or was not guilty and we hold no brief one way or the other but his case follows the pattern of many others and in that regard we can explore the issues premised on this one instance. We must all hope justice was served; that he was guilty and that he is rightfully in jail.

However, the man in the street cannot fail to have been fascinated by the simple fact that in court none of the victims could identify his face, and none of them noticed the bold tattoos that ran the full length of both arms.

This too should have attracted attention. It was remarkable that the 'photo-fit' picture (an amalgam of jaws, noses, ears and eyes, etc) compiled by his victims and released by the police months after the first attack, bore little resemblance to Imiela's face. However, police claimed that it was the photo-fit picture that led to his arrest.

In fact, the photo-fit picture looked far more like Mr. Russell Court, a co-worker with Antoni Imiela and a witness at the trial, than it did of Mr. Imiela.³ This, it should hastily be added, is not to impugn Mr. Court in any way, or to suggest that Mr. Court was in any way connected to the rapes. Rather it demonstrates in this case a reliance on, at best, loosely fitting evidence and in particular the overawing effect DNA can have on police courts and juries.

The public's perception of DNA can and does prejudice the integrity of the whole judicial process. We are by now accustomed to expecting convictions after evidence has been presented that the chances of anyone else having the same DNA as the alleged perpetrator was in the order "200 million to 1", or "1,000 million to 1"; but courts will convict on much lower probabilities. That surely is indicative of a 'on the balance of probabilities' criterion - not the criminal standard of 'beyond all reasonable doubt' ?

In both the Omagh bombing case of Aug 15th 1998, and the murder of Peter Falconio in the Australian outback in July 2001, DNA was used to convict the accused.⁴

However, between sentencing and appeal the judiciary appears to have realised that there is more than one form or technique of DNA identification and that it is fallible. The method used in many cases including the Omagh bombing and Peter Falconio instances is the LCN (low copy numbers) or LCC (low copy count) technique. This new (and controversial) technique is used when the DNA of both perpetrator and victims is believed to be mixed.⁵

Crucially the presiding judge, Mr Justice Weir, pointed to DNA's fatal flaw when he said that there was currently no international standards had been set for it. This followed the defence team's fierce challenges on the reliability of the LCN (low copy number DNA) technique exposing the prosecution's experts as having different views on how reliable they believed their own evidence to be.

In the Falconio murder case for instance, Dr Katrin Both,⁶ an experienced forensic scientist, who gave evidence at the trial said she had "a large number of concerns" about LCN; "I think it [LCN] is very dangerous, she said. "He is pushing science to its limits" (referring to Whitaker, British forensic scientist associated with LCN). The judge, by inference, acknowledged doubts over the LCN technique when he concluded that LCN did had a "sufficient scientific basis."⁷

Publicity surrounding DNA has always trumpeted its "uniqueness". But what method of identification is so inadequately unique that it has to be measured in 'probabilities' of not being someone else's DNA ?

The public rightly assumes forensic testing facilities are run to a high standard and are most likely free of commercial considerations. However, forensic testing in the UK while it may still be very good is now marketed worldwide like any other household product.

³ "Rapist was 'just one of the boys'", 4th March, 2004, <http://news.bbc.co.uk/1/hi/england/3528657.stm>

⁴ Bradley John Murdoch convicted in 2005, appealed in 2006, for murder and rape in 2001. Sean Hoey, 37, of County Armagh denied 29 counts of murder as a result of the 1998 Omagh bombing.

⁵ 'Judge to consider Omagh verdict', 17 January 2007, http://news.bbc.co.uk/2/hi/uk_news/northern_ireland/6271235.stm

The judge who considered the Omagh verdict viewed the DNA techniques used as "a relatively new and very sensitive form of testing. Hoey's defence raised a range of issues including questions over the integrity of evidence in order to "beef up" witnesses statements In the Falconio case the judge concluded that LCN had a "sufficient scientific basis" and the results produced by the British forensic scientist were admissible.

⁶ Forensic Science Centre, Adelaide

⁷ For DNA analysis and court room use go to <http://www.nutteing2.50megs.com/dnapr.htm>

Forensic testing is undertaken by The FSS (Forensic Science Service Ltd.), is a trading name of which is a UK Government owned company (GovCo).⁸ It is this facility in Birmingham that determines DNA matches and is closely involved with LCN.

LCN which has its detractors is relatively new, and for technical reasons the FBI, which first used "mtDNA" (mitochondrial DNA) techniques in 1996, believes LCN is not a reliable technique for courts in the USA. Nonetheless, LNC is used regularly in Britain, Australian and New Zealand. Among mtDNA critics is William M. Shields, of the State University of New York⁹ he has given expert testimony in several leading DNA cases, e.g. *Tennessee v Ware*, 1996 (appealed 2004).

We are all aware that DNA *per se* is unique (except for twins), but DNA 'profiles' are not unique. In a field where uniqueness is the forte anything that dilutes utter exclusivity renders it useless. The system used in the Britain (ABI SGM Plus) is said to have a chance random match of more than 1 in 100 Billion, i.e. 100,000,000,000 or 20 times the population of the earth.

However, critics point out that there are many pairs of people with different DNA, but matching DNA profiles. This can lead to an increased number of people wrongly 'caught' because their DNA profile just happens to match a scene-of-crime sample profile.

The figure for false matches is said to be about 1 in 240,000.¹⁰ Then there is the number of "unresolved matches" in DNA databases that forensic science will not address. If inter-relatedness / co-ancestry is factored into the analyses, the "match probability" figure is brought down dramatically.¹¹

Only a year before the Antoni Imiela case, a 73-year-old man from Waterford (Ireland) was jailed for seven years. He was accused of raping a distantly related 12-year-old girl in 1997, who later gave birth to a child. At the trial, in 2001, forensic scientist Mr Michael Burrington said DNA samples showed a 350 to 1 probability that the man was the baby's father.¹²

Should we suspend our disbelief that a 70 year old can be so virile in his sperm count and not suffer erectile dysfunction? Is '1 in 350' acceptable when the criteria for a guilty verdict is "beyond all reasonable doubt"? Newspaper articles of the time not surprisingly did not reveal the DNA technique used. Haven't eye witnesses been shown on innumerable occasion to have innocently identified the wrong person? Is the same happening with DNA? Is it sometimes identifying the wrong person?

Who among us would be prepared to be convicted and serve jail time based on an eye witnesses or fingerprint that experts knew was not uniquely ours but was a "close" fit? Should a judge feel comfortable handing down a sentence when it he stands a 1 in 350 chance of being right, i.e. that the fingerprint is yours?

It is the alleged uniqueness of DNA that has given covering fire for authoritarian demands to have every person's DNA on a central file and that every new born be similarly treated.

It was this alleged uniqueness that has lead Gill and Rob Smith from Chipping Sodbury to favour a universal DNA database. In 1995 their 18-year-old daughter went missing. Her body was found Seven weeks later hidden in a quarry, she had been raped and murdered.¹³

In Sept 2007 BBC's 'Panorama' revealed that 66% of those questioned said they would approve of a New law requiring all adults to give a sample of their DNA to help with the prevention and detection of crime. This is an unhealthy situation.

⁸ Registered office and headquarters: Trident Court, 2920 Solihull Parkway, Birmingham Business Park, Birmingham, B37 7YN, UK Reg'd in England and Wales: No 5607780. Website http://www.forensic.gov.uk/forensic_t/inside/about/index.htm and <http://www.forensic.gov.uk/>

⁹ William M. Shields, Department of Environmental and Forest Biology, State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210 USA. Papers include "Peer Review and the Validity of the FBI's Validation Studies of P.C.R. Amplification and Automated Sequencing of Mitochondrial DNA for Forensic Use." See also 'Forensic Bioinformatics', 3rd Annual Conference 'DNA from Crime Scene to Court Room: An Expert Forum' August 2004. http://www.denverda.org/DNA_Documents/ware.pdf

¹⁰ Attested by the number of people 'caught' because their DNA profile happened to match a scene-of-crime sample profile. The figure for false matches is now about 1 in 240,000. <http://www.nutteing2.50megs.com/dnapr.htm>. Compare claims shown at Footnote 10.

¹¹ The Promega company (<http://www.promega.com/geneticidproc/eusymp2proc/11.pdf>) manufactures the kit for doing DNA profile analysis. It calculates (on their web-page) that ABI SGM Plusi the chance for a random match- more than 1 in 100 Billion i.e. 100,000,000,000 or 20 times the population of the earth. This statement is criminal in its falsity. About 2/3 way down this file

¹² "Man (73) sent to jail for raping girl (12)", <http://www.ireland.com/newspaper/ireland/2001/0519/courts2.htm>. The Irish Times, 19/05/2001

¹³ The law then changed in Eng & Wales. Samples of the innocent can be legally retained bringing a national/universal database ever closer.

While DNA is still under suspicion, with senior forensic scientists like Professor Allan Jamieson, warning the public not to blindly trust DNA results, we have senior police officers making plain that a charm offensive is underway.

“Having everyone on the database would help solve more crimes – but that winning public approval is key before it can become a reality” - Chief Constable Tony Lake.

Arguably, fingerprints are more likely to be unique than DNA but no one has dared, in their 100 year history, to infringe our civil liberties by calling for a national finger print database – not even in two world wars.

The Madeleine McCann kidnapping (May 2007) has revealed the dangers of DNA. What was said to be her DNA found inside the hire car was later accepted as probably being her sister's or mother. ¹⁴

Fingerprint integrity, unlike DNA, is not compromised by intergenerational considerations. ¹⁵ In that regard it is ‘cast iron’ and superior to DNA.

The general public may not appreciate that DNA is as much an art as a science. It is subject to many pitfalls, approximations and coincidences that when repeated, have a cumulative effect on the veracity of the evidence and therefore conclusions. Too few people realise that identification of a suspect using DNA relies on two contradictory hypotheses and it is this which can prove its Achilles heel. ¹⁶

The premise for the two competing hypotheses begin like this:-

1. The DNA of the suspect is the same as the evidence left at the crime scene and the suspect **is not** the person leaving the evidence.
2. The DNA of the suspect is the same as the evidence left at the crime scene and the suspect **is** the person leaving the evidence.

Put simply, if you shake someone's hand and they touch nothing with that hand until they are 100 mile away, your DNA is found 100 miles away. This is called “transference”. Depending on the transferring agent several items might be contaminated on that journey proving you took that path.

DNA is not robust and it deteriorates easily and quickly. American experience has shown that if stored or shipped in the trunk of a squad car and subject to light and heat fluctuations it can be unusable after 12 hours. This is sometimes referred to as ‘environmental insults’.

DNA degrades over time even when stored properly, and if there is, say, a two year gap between crime and arrest, retrieval and testing and or retesting the DNA might be unsafe and or unusable.

Contaminations and cross-contaminations can easily occur (ref. McCann and Falconio cases).

The public first glimpse of how DNA can be used by a defendant and how contamination can occur was in the infamous OJ Simpson murder trial. The DNA did not convict him when arguably it should, but instead it released him as a free man.

Throughout the trial of Antoni Imiela insisted he was “gay” and had been for most of his life. He told the court he had a relationship with a man between 1979 and 1981. The judge dismissed this, but given that many of his formative years were spent in male-only environments, the possibility remains a valid one. Perhaps his marriage only masked the inner conflict of homosexuality and the rage against women exhibited itself not against his wife, but other women ?

Whatever the merits of those particular aspects, the sentencing of Antoni Imiela affords a fascinating glimpse into rape proceedings and the whole ‘ensemble’ of attitudes towards sexual offences.

¹⁴ “DNA sample in McCanns’ car ‘has 100% match to Madeleine” – The Times, September 11, 2007, Parents have a lot of explaining to do, say police <http://www.timesonline.co.uk/tol/news/world/europe/article2427017.ece> . A forensic sample from the car hired by the McCann’s five weeks after she disappeared has a 100 % match to Madeleine McCann.

¹⁵

The British first began using fingerprints in July 1858, when Sir William Hershel, Chief Magistrate of the Hooghly district in Jungipoor, India, first used fingerprints on contracts entered into by natives. Personal contact with the document, was believed to make the contract more binding than if they simply signed it. Thus, the first wide-scale, modern-day use of fingerprints was predicated, not upon scientific evidence, but upon superstitious beliefs.

¹⁶ See ‘DNA Fingerprinting Probabilities’, <http://biomath.biology.usu.edu/Fipse/Labs/Dna/DownloadPage/DNAFINGE.pdf>

It contrasts markedly with the handling of the recent SIDS case (2003) surrounding the expert evidence of Sir Roy Meadow and the interpretation of “probabilities” of child murder where the defendant is not a man but a woman.

Although something of a witch hunt of Sir Roy Meadow later developed, it was fortunate for the defence that that murder was the charge and not rape. This permitted him to mount a legitimate and robust defence. Incremental changes over the last 20 years have meant rape defendants have had their rights to defend themselves in court gradually eroded.

Throughout Imiela’s trial great emphasis was laid on DNA evidence by the prosecution. This sure-fire *magic bullet* is widely used in most serious trials - and to devastating effect.

So shrouded in “science” is DNA that it takes on the mantle of a Black Art. Few but the brave, or the fool hardy, would think to argue against it. It makes for an unarguable case.

We are all supposed to have a unique DNA ‘fingerprint’.¹⁷

No one is supposed to question it, especially an accused - but Antoni Imiela did. He was not a smart lawyer, a gifted physicist or a clever chemist just a simple railway workman.

When asked how he could explain why his DNA was found on one item of clothing he could offer no explanation.

He might not have known that humans share up to 99.2% of their genetic make-up with the chimpanzee and over 90% with the mouse. In the past it has been difficult even for laboratories to pinpoint the genetic factors that define the human species.¹⁸

When asked if he doubted the evidence Imiela told the jury that he had no idea whose DNA it was, but it wasn’t his. Initially, this sounds a weak reply to make until one realises that throughout the case the prosecution experts varied their estimates of the reliability of the DNA from 3 million to one, to 114 million to one, to one 1,000 million (1bn) to one, depending on which fragment of evidence was under scrutiny.

How could Imiela have known that a considerable number of acknowledged experts had misgivings about the accuracy of DNA ? In one paper given to a forensic conference the dilemma was posed thus:

“Until we understand the frequency and pattern of mutation and the heteroplasmy it can cause the amplification and sequencing of mtDNA (mitochondrial DNA), to provide forensic evidence about identity will remain problematic at best and at times, may be completely unreliable.”¹⁹

The same learned paper went on to consider possible levels of contamination; expected errors in mtDNA comparisons; the uncertainty about the meaning of a match; FBI methodology in mtDNA matches using its database; the potentially biased estimate in the likelihood of matching, given that databases are small; expected frequency of control region matching ranges (from 1 in 114 to 1 in 468) in the different ethnic databases.

In the UK, a senior forensic scientist, Professor Allan Jamieson has said that, “People put too much faith in DNA. They’re giving it an infallibility which it does not have.”

On the other hand, Professor James Fraser, director of the centre for forensic science (University of Strathclyde), said on LCN’s introduction, “This is a breakthrough because it has the potential to provide evidence in a range of cases that hitherto would not be found.” If nothing else this tells us that DNA has strict limitations in some areas

¹⁷ Addendum. Mistakes can happen. ‘Duplicate’ DNA can occur. In Swindon a man with Parkinson’s disease (Ray Easton) was arrested, and charged with a burglary in Bolton because his DNA sample - police claimed - matched that of the crime scene. Eventually the Crown Prosecution Service (CPS) conceded he was too frail and handicapped to have claimed through a small window. – BBC Panorama: “Give Us Your DNA” 24 September 2007 <http://news.bbc.co.uk/1/hi/programmes/panorama/7010687.stm>

¹⁸ The Wellcome Trust, Human Genome http://genome.wellcome.ac.uk/doc_WTD020881.html

¹⁹ “Peer Review and the Validity of the FBI’s Validation Studies of P.C.R. Amplification and Automated Sequencing of Mitochondrial DNA for Forensic Use”, <http://www.bioforensics.com/conference/mtDNA/mtdnapap1.pdf>

Emerging is the prospect of a justice regime where an absence of standards in one branch of the law is compounded by variable standards in another. The examples of poor standards of DNA competence in rape and murder trials is exacerbated by the Roy Meadow versus Trupti Patel and Sally Clark debacle where the courts demanded an impossibly high threshold of probability (i.e. absolute certainty). What is becoming clear through the swirling mists, is that Britain must adopt its version of the US "Frye Test"²⁰ (*Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923)).

It must be unusual for the police to concede that Mr. Imiela (the railwayman) took 'very effective steps' to ensure that he left little or no DNA traces on his victim.²¹

If the rapes were as violent as stated, then television crime series such as 'CSI' would have us believe that skin cells from the frantic scratching would have been recovered from under the nails of at least one of his many victims. But from all his victims only about 3 partial and/or compromised examples were ever found - nothing pristine.

This contradicts police statements to the press, prior to Imiela's trial, which asserted that DNA tests proved he had "struck for a 10th time".²²

In the prelude to the trial Imiela was dubbed the "Trophy rapist" by police and media because he took items of clothing from his victims as memento. However, his propensity to take souvenirs from his victims did not give rise to a large cache of pertinent DNA samples and the absence was not made an issue as reported upon by the media at his trial.

In the aftermath of the trial and conviction, the FSS states that "LCN was one of the DNA techniques used to find the smallest traces of DNA from items of clothing and medical samples in the investigation into a series of rapes". The FSS found a DNA link between "the first rape in Kent in November 2001 and a second offence in Surrey several months later." It does not state that it found any other links.²³

"Are you suggesting there is someone else in the country with the same DNA ?", the prosecution mockingly asked Imiela.

His answer, of course, should have been 'Yes', for though there may not be a billion people in Great Britain, the probability of a duplicate, i.e. a match, does not depend on there being a population of one billion citizens but relates to the possibility of there being a duplicate from the sample size and or the intersection of a particular series of markers. These are serious limitations.²⁴ See Appendix B.

It may be difficult to grasp but in a population of, say, 35 million it is possible to have both a) only 1 person with the correct DNA (35m to 1) but b) concurrently have 2, 3 or even 6 people with apparently the same DNA from the same population.

Equally, in a city with a population of 10 million and in a case where the probability is "1 million to 1", the other 9 potential defendants are ruled out of the equation because other evidence puts only one suspect at the crime scene. But how unreliable has this approach (of allowing other evidence to counter the Crown's centrepiece) proven to be in the decades prior to the invention of DNA ?²⁵

While in this example there may hypothetically be 9 people other than the defendant, whose DNA 'profile' matches that of the DNA found at the crime scene, it is said to be incorrect to assert that any of those nine people is "equally likely" to have contributed the DNA at the crime scene because of other evidence. However, DNA transference can negate that 'other evidence'.

²⁰ The Frye Test is the accepted mechanism through which relatively recent scientific developments are subjected to professional scrutiny before acceptance as a legal entity. The test set out in Frye was essentially that scientific evidence was admissible only if it had "gained general acceptance in the particular field in which it belongs." It therefore becomes highly relevant in analyzing the admissibility of scientific evidence and to allowing new information to be adopted by courts which increases their ability to deliver justice.

²¹ "Railway worker gets seven life sentences for M25 rapes" Mar 2004 <http://news.independent.co.uk/crime/story.jsp?story=498025>

²² "Appeal to ex-lovers of rapist", Sun 3 Nov 2002 <http://news.scotsman.com/topics.cfm?tid=489&id=1222952002>

²³ FSS Case studies: Antoni Imiela - convicted in March 2004 of 7 rapes, and the kidnap, indecent assault and attempted rape of a 10-year-old girl and given 7 life sentences. http://www.forensic.gov.uk/forensic_t/inside/news/documents/DNA_Low_Copy_Number_000.doc

²⁴ Addendum:- one month after this article first appeared the discoverer of DNA fingerprinting, Sir Alec Jeffrey, alerted the world to its limitations.

²⁵ James Hanratty, one of the last men hanged in Britain, was said to have had an alibi that put him 200 miles away from the murder.

For China, with a population of more than a billion,²⁶ and the Indian sub-continent with a population of hundreds of millions, one can only suppose that relying on DNA probabilities, even in the region of 100 million to 1 will, in the future, be fraught with difficulties.

Both instances are further complicated by the migration of peoples both from pre-history to the mass migrations during the two centuries of British colonial rule to and from Europe; in what used to be called Indo-China; the areas north and west of India; of the Chinese and Japanese to South Africa and America, resulting in the possibility of randomly identical or similar DNA occurring thousands of miles away when only a limited number of markers (less than 12) are used.

This is only one of several confounding and potentially contradictory factors, the most notable of which is the “theta factor”. All populations, no matter how defined, are inbred to some degree. The technical term Population Substructure is another way of referring to inbreeding. In calculating the probabilities the “theta factor” approach accounts for this in a way that favours the defendant by replicating the higher frequencies that are expected when there is inbreeding. Any defence counsel should be aware of this and would be well advised to make sure the statistics applied in their client’s case were calculated using one of the two approaches advocated by the NRC II. It is, after all, the prosecution’s onus to prove guilt – not likely guilt.

The DNA databases built up in the UK and the US are racially biased. They contains more black than white profiles. Seeking a match for a black defendant may prove more successful than for a white suspect. Seeking a match may actually throw up a black person’s name when, in actuality, the offence was committed by a white man.²⁷ These are again concerns recently expressed by DNA inventor, Sir Alec Jeffreys.

For in reaching a DNA profile that matches, only a portion of the DNA is compared – not the whole string. Anyone who uses an internet ‘search engine’ will immediately see the parallels and pitfalls. Typing in too few key words or not to dissimilar words or similar phrases can lead the search in a wholly unwanted direction. For example, *human*, *humanoid*, *human-like*, all carry the ‘human’ stem string but a search of the web would bring very different results.

The professional advice to prosecutors states that a DNA match is only one piece of all the evidence pointing to the defendant’s guilt.²⁸ The operative words being ‘one piece’ and ‘pointing’. DNA should never, of itself, be considered or used as evidence that is overwhelmingly and or conclusive.

As stated earlier, this article holds no brief for Mr. Imiela, known as the *M25 Rapist* (aka Trophy Rapist) for the nine rapes that occurred in areas adjoining that highway, but in common with every accused, he does have the right to a fair trial. He may be guilty as charged and rightfully jailed but his defence sparked off some doubts; his tattoos, for instance, were never mentioned in any statements given by his alleged victims nor the alleged ‘northern’ accent of their assailant.

The court heard from one ‘expert’ who said the chance of the DNA matching anyone other than Antoni Imiela was about three million to one.

On another occasion, the court heard from a forensic scientist who said the chances of the DNA "bands" (taken from the left ear of one woman), matching anyone other than Mr Imiela were about 114 million to one. The latter estimate, apparently, was made having allowed for the possible cross-contamination posed by the DNA of her husband.

At another point during the trial forensic experts said that the chances of DNA samples taken from scenes of attacks coming from somebody else were one in a billion, i.e. 1 in 1,000,000,000.

²⁶ 1995 United Nations Population Projection, 1,226.7m http://www.iiasa.ac.at/Research/LUC/ChinaFood/data/pop/pop_7.htm

²⁷ Concerns involve the expected frequency of control region matching ranges in the different ethnic databases. <http://www.bioforensics.com/conference/mtDNA/mtDNApap1.pdf>

²⁸ Advice to US prosecutors http://www.ndaa-apri.org/publications/newsletters/silent_witness_volume_8_number_1_2003.html

It was interesting that the prosecution, in a small change of wording, asked whether the DNA found matched the *profile* of Mr Imiela. Interesting, because DNA profiles occur between generations and in this context may imply an inexact fit. Fathers can be traced via DNA profiles of their sons and grandsons and vice versa. This takes the reader into the area of bio-ethics and personal freedoms and futuristic considerations for policing policy.

Dr Walker, the “expert” witness called by the defence, also analysed the results. Whereas the prosecution said ‘components’ (note, components) had a one in three million chance of matching Mr Imiela’s DNA, or coming from an unrelated person, the defence expert said that figure was, in his view, one in thirty thousand, i.e. 1 in 30,000.

Thus we have a range of probabilities from 1 billion to one, all the way down to 1 in 30,000.

How are we, as non-scientists, to choose ?

How, as potential jurists can we render safe verdicts ? Indeed, how are these probabilities calculated? A DNA scientist might say that 1 in 30,000 was too insignificant and that 30 million to 1 was also too inaccurate to make a positive identification. Even the claims of a “1 billion to 1” match are challenged by some academics and DNA experts.

We the public, and certainly any jury, should know whether the probabilities are based on the nation’s population as a whole, or are derived from comparing the bank of DNA results already held by the authorities, or whether it is based on the peculiarities of randomness that is said to be at the heart of *genetic sequencing* and DNA research.

Would it be more reassuring, and objective, to hand over the findings to independent mathematicians or statisticians to calculate and double check the probabilities, rather than seems the present custom, of allowing a genetic scientist to apply a rigid formula ? Do physicists and policemen make good statisticians ? The public and the courts ought to have this spelt out clearly.

Whatever the merits of such a change it is intriguing to see not only the probabilities vary so wildly but the values placed upon them. It was less than 12 months ago (Dec 2003) that the probabilities (one in 73 million), advanced by Sir Roy Meadow, regarding the chances of a mother murdering her one child and then another were ruled ‘unsafe’ by the Court of Appeal.

(Ref. Sally Clark found guilty in 1999 of killing two of her three sons; Trupti Patel charged in 2001 but acquitted in 2003 of murdering her 3 children between 1997 and 2001; ²⁹ Angela Canning convicted in 2001 of the murder of her baby sons in 1991 and 1999, *et al*).

In the textbook, *Forensic Pathology*, (1989) it was an American specialist, Professor, Dominic Di Maio, who concluded that while one cot death might be an accident, two was suspicious and three was murder. Sir Roy conveyed to the court that the chances of two cot deaths occurring by chance in the same family were one in 73 million. This was dismissed by the Appeal Court (in the Canning case) as “wholly erroneous”. Professor Di Maio says in his book:

“It is the authors' opinion that while a second [cot] death from a mother is improbable, it is possible and she should be given the benefit of the doubt. A third case, in our opinion is not possible and is a case of homicide.”

That view was repeated in the standard textbook on child abuse, ‘*The Battered Child*’, (5th edition, 1997). It stated, “Should a third infant death without an obvious natural disease process occur in the same family, the cause of death should be identified as asphyxiation, and the manner of death classed as homicide.”

²⁹ For instance “Mother cleared of baby murder had stabbed husband to death”, By Russell Jenkins, The Times, Nov. 10, 2004. “A mother convicted of murdering her four-month-old baby after evidence from the discredited paediatrician Professor Sir Roy Meadows was cleared in a retrial yesterday. In yesterday's case the jury was not told that Mrs Smith [mother-of-nine] had been convicted of murdering Keith, but cleared of killing her 5½-month- old daughter, Kelly, who died in 1992. Nor was it told that Mrs Smith and her second husband, Keith Smith, were jailed for stabbing her first husband to death in 1995. Robert Brannan, 53, was discovered in his bath with 51 stab wounds. <http://www.timesonline.co.uk/article/0,,2-1352134,00.html> . New York - Marybeth Tinning murders each of her 9 babies between 1972 - 85.

Ominously, *'The Battered Child'* was not cited by the Appeal Court judges in the Cannings case. The Appeal Court did not appraise itself of one of the main publications on child abuse. Roy Meadow was quoting from one of the standard world texts.³⁰

In a disguised salute to DNA dilemmas, the Appeal Court judges in the Cannings case observed that, in addition to demonstrating that "even the most distinguished expert can be wrong", it provided a "salutary warning against the possible dangers of an over-dogmatic expert approach".

On appeal by the female defendants, Lord Justice Judge, sitting with Mrs Justice Rafferty and Mr Justice Pitchers, said with reference to the death/homicide of Angela Canning's two children : -

"If the outcome of the trial depends exclusively, or almost exclusively, on a serious disagreement between distinguished and reputable experts, it will often be unwise, and therefore unsafe, to proceed. We recognise justice may not be done in a small number of cases where, in truth, a mother has deliberately killed her baby without leaving any identifiable evidence of the crime. That is an undesirable result which, however, avoids a worse one."³¹

If that is true, the implications for cases run solely on DNA evidence must immediately become suspect. In the same case (ref. Sally Clark), Lord Justice Judge also said that medical science was "still at the frontiers of knowledge" regarding unexplained infant deaths and that prosecutions should not take place while such uncertainty exists, and stated: -

"Unless we are sure of guilt, the dreadful possibility always remains that a mother, already brutally scarred by the unexplained deaths of her babies, may find herself in prison for life for killing them when she should not be there at all."

What is meant by 'sure of guilt' ? What standard of proof does that demand ? The court, in its judgement, rejected both the assertion of the 73 million to one chance (the American calculation used by Sir Roy Meadow), and the medical science, as 'unsafe'. The court, therefore, declared all the women to be innocent, including Angela Canning. But did the court also define absolute proof as the new threshold for a conviction of guilty to be deemed 'safe' ?

The imperative for a version of the US "Frye Test" become all that more pressing.

The same criterion must surely apply to rape cases if we are to have a justice system worthy of the name. To paraphrase Lord Justice Judge, *'we must always concur with that standard, for unless we are absolutely sure of guilt, the dreadful possibility exists that a man may find himself in prison when he should not be there at all.'*

That was always the criterion used when capital offences carried the death sentence. Though it is forgotten now, the legal dogma was that though it might unfair in individual cases, it was far better to let nine murderers go free than for an innocent man to be hung.

If this is a principle worth defending, and we must believe it is held to be so by society at large, then it must be seen to apply to both sexes and regardless of the crime.

The English courts have certainly instructed us not to be content to allow a woman to be convicted where there is a genuine conflict of opinion between experts concerning the evidence. The defendant must be given the benefit of the doubt and, therefore, she must be found 'not guilty'. It therefore follows that in other cases where those same disconcerting inconsistencies apply we cannot countenance the imprisonment of a man where relying on the calculated probabilities of guilt are also not absolute and or not agreed between experts.

The ramifications of the Court of Appeal's judgement means that where three children died 'suspiciously' of SIDS, but later one was found to have truly died from 'natural causes', the Public Prosecutor is to be directed by the judiciary not to bring such cases to trial.

30

"Cot death expert: we were victims of a smear campaign", By Jeremy Laurance, Health Editor, The Independent, 10 April 2004
<http://news.independent.co.uk/uk/legal/story.jsp?story=510194>

31 "Expert Witnesses in the dock", by Brian Thompson, 2004, "The Barrister" journal, "The judgment of Lord Justice Judge, giving the court's reasons for clearing Angela Cannings of the murder of her two baby sons shone a welcome balanced and humane light on criminal court procedure". <http://barristermagazine.com/articles/issue20/expertwitnessesindock.htm> and <http://www.wrestlexpress.com/news/64.html>

This cannot be satisfactory. It gives rise to situations where women who have already been convicted in such circumstances are to be deemed innocent and set free.³²

This represents the cherry picking of the most salient evidence. By way of contrast, is the Jeremy Bamber murder trial (England, 1986), which was reviewed in 2002, the existence of mixed DNA was discounted by the court. It was said to be the 'totality of the evidence' that convicted him, not the cherry picking of evidence that could have freed him.³³ At appeal, Bamber's defence team showed that six of the 10 key points on which the Crown's case centred were contradicted by new evidence. The prospect of his sister, "Bambi", (Sheila Caffell) killing the family and then shooting herself was discounted despite her known history of psychiatric illness (schizophrenia), and in the face of the police destroying DNA evidence that might have proved it one way or the other. The 25 shot .22 semi-automatic rifle was found next to her. Nicholas and Daniel her twin 6 year old sons, who she referred to as "the Devil's children" were also found shot dead. A note was found at the scene saying, "I hate this place".

We have, therefore, moved from an era when the judiciary (and public) relied on expert witnesses and forensic evidence to one where all of it is placed in doubt and subject to assassination by manipulation. Scientist Valerie Tomlinson for instance, told the court at the Imiela trial that the DNA sample taken from one victim had two "bands" which could be found in Mr Imiela's genetic profile. She said the chances of it not being his DNA were just 1 in 14.³⁴ When questioned by Rebecca Poulet, QC, for the defence, Ms Tomlinson agreed a large proportion of the population could carry the same bands.

Ten years ago DNA promised to be the scientific breakthrough in crime fighting that fingerprints had once represented. DNA was heralded as a much more powerful, more modern, and the definitive weapon that removed the dependency of finding clean fingerprint evidence. For over a century, "low tech" fingerprints were regarded as indisputable evidence. Fingerprints carried so much weight as evidence reinforced by the expertise built up over many decades, that attorneys often advised their clients to plead guilty if they could not explain how their prints came to be found at a crime scene.

However, in 1997 all that changed. A detective with Strathclyde Police, Ms. Shirley McKie discovered that her thumbprint had been lifted from the room where a murder victim was found.³⁵ Ms. McKie said that was impossible - she'd never even been to the house. Enormous pressure was put on Ms. McKie to say the print was hers - after all, fingerprints don't lie and they are unique. Even her father, Iain McKie, himself a Strathclyde Police officer for 30 years, admitted: "I didn't believe Shirley for the first few days and imagine a father having to say that about his daughter. But I'd been told for 30 years that fingerprinting was infallible".

With help of an American fingerprint expert, Pat Wertheim, Ms. McKie made history when, for the first time in 100 years, a person successfully challenged an identification made from fingerprints in court.

Some years later, businessman Alan McNamara was accused of burglary. It was again fingerprint evidence that linked him to the crime scene. Police fingerprint experts were certain the print found at the scene was his. Mr McNamara denied ever being there and once again his defence called on fingerprint experts Pat Wertheim. Mr Wertheim, who has 22 years of experience and trains police experts both in the US and the UK, concluded the print wasn't Mr McNamara's.

³² a). Which parent is the killer? By Jenny Booth, Daily Telegraph, 22/09/2002. b). Table 4.4 Home Office, "Criminal Statistics England & Wales" c) "Deaths in Families", US Dept of Justice, NCJ 143498. CDC report: Newborns Face Highest Murder Risk, Most infant victims born outside of hospitals, study finds (Oct 1998). <http://usgovinfo.about.com/library/weekly/aa031202a.htm> Child homicide rates. <http://www.heritage.org/Research/Family/BG1535.cfm>. Unpublished article, R Whiston "Community Care" 2004.

³³ "Bamber appeal told of 'deceit' by police" Sarah Hall, The Guardian, Friday October 18, 2002. Entire family murdered, Essex, (UK) Aug 1985 (when DNA was in its infancy). DNA evidence of both June and Nevill Bamber, his adoptive parents, was first withheld by prosecution and then destroyed by police. http://www.guardian.co.uk/uk_news/story/0,3604,814452,00.html .

³⁴ "Rape trial hears 'emotional scar' claim", 26 January, 2004. She said the chances of it not being his DNA were one in 14. <http://news.bbc.co.uk/1/hi/england/3430661.stm>

³⁵ "Finger of suspicion", BBC 'Panorama' report July 2002, Shelley Jofre <http://news.bbc.co.uk/1/hi/programmes/panorama/1416777.stm>. This topic also appeared in *The Guardian*, July 9th 2001. A Scottish murder investigation in 1997 led to Det Con McKie being charged with perjury for denying her print was at the murder scene. She has since taken early retirement and left the force.

However, unlike Shirley McKie, Alan McNamara was found guilty in July 2001 and sentenced to two and a half years in prison for a burglary he did not commit.

Pat Wertheim's comment was; "Never in my wildest imagination did I think that a jury could convict with no evidence whatsoever except one single fingerprint which in itself is flawed."

How much more likely, one has to ask, would a jury be to convict where the accused was charged with rape and, similarly, there was no collaborative evidence - just a single DNA match ?

Commenting in general terms and of other cases, Chief Constable Ben Gunn later said, "It may be an identification, but it isn't fact, it is opinion." This was as close as the police, institutionally, conceded that fingerprint experts can be fallible. However, that conciliatory tone was not in evidence at the Imiela trial. A fingerprint found on a bag carried by a 14-year-old rape victim was said to be "absolutely conclusive evidence" that Imiela had carried out the attack.

Should the jury have been told it was only an opinion ? Speaking of absolute proof, a DNA scientist in a BBC programme proposed that such an assertion was in itself 'unscientific'.³⁶

One therefore has to ask how long it will be before a similar situation arises over the veracity of DNA evidence. Is the world of DNA built on facts and uniqueness or is it really only probabilities, assertions of likelihoods, and expressions of an opinion ?

Is this where the many pitfalls, approximations and coincidences highlighted above gather to give their collective bite ? If the cumulative effect negatively impacts the veracity of the evidence it therefore invalidates any conclusions.

If our knowledge is more limited than we think it is, then at what point in the future will we recognise that 'DNA Doppelgangers' could be a reality ?

Fifty years ago it was the microscope that represented the 'cutting edge' of forensic science. However, the outcome in one case totally undermined its invincibility as an unimpeachable forensic tool.

An apparently watertight case depended on the identification of a fibre as black in colour. Tested and checked in every conceivable way the conviction, based on the black fibre as black, was handed down; 'Guilty'. It was not until much later that it was discovered (on appeal) that the examination had been undertaken by a back-lit microscope, thus causing the blue fibre (or any colour fibre) offered in evidence to appear black.

A stunning forensic breakthrough was made in the late 1940s when American chemist, Willard Frank Libby, showed that radioactive Carbon-14, based on its half-life, could date the death of living organisms as far back in time as 50,000 years. Unlike fingerprinting and DNA probability calculations, this technique is devoid of human input and interpretation. Today experts in many specialisms depend upon its consistency and reliability.

Unfortunately, radioactive dating, using Carbon-14 is seen as controversial in some quarters. It is held that when scientists attempted to date dinosaur bones using the Carbon 14 method the age of the bone sample indicated thousands of years old, not millions of years old.

It is now realised that a specimen can be contaminated by carbon from surrounding soil, water, vegetation, and animal matter. The release of carbon dioxide from fossil fuel burning significantly dilutes carbon 14, and researchers have no accurate way to calibrate this dilution factor.³⁷ There are several additional factors that seriously undermine the accuracy of any tests on a given sample.

Consequently, the results are said to vary by as much as 150 million years in some instances.³⁸

Attempts to accurately date the fossils are on-going using, among other methods, potassium argon.

³⁶ Susan Watts, 'Newsnight', DNA & LCN, Oct 2007.

³⁷ The Usefulness of Carbon 14" <http://www.reasons.org/resources/apologetics/carbon14.shtml> also "Problems with Radiometric and Genetic Dating Methods: Assumption, Preconception, Collusion, and Circular Logic" by David Stewart, Jr. <http://www.scripturehistory.com/problemsradiometricgeneticdating.php>

³⁸ Carbon dating is based on the assumption that the amount of C14 in the atmosphere has always been the same. But there is more carbon in the atmosphere now than there was 4 thousand years ago. Since carbon dating measures the amount of carbon still in a fossil, then the date given is not accurate. Carbon dating makes an animal living 4 thousand years ago (when there was less atmospheric carbon) appear to have lived thousands of years before it actually did.

Dendrochronology, or tree ring dating, is commonly used to support and calibrate radiocarbon dates.

Behind the calm exterior that is DNA science, is a sea of discontent and conflicting opinions. Attorneys make use of DNA science as if it is 'fixed given'; an immutable fact. But this is far from being the case. It mimics Carbon dating which has suffered from a succession of crisis in confidence.³⁹ Just how badly wrong things can go can be seen at Annex A where 2,000 DNA cases are thought to be suspect.

The probabilities crucial to DNA determination involve calculations that ask whether the DNA is, or is not, the same as the DNA left at the crime scene and then whether the suspect is, or is not, the person who left the DNA evidence.⁴⁰

After these competing hypotheses have been satisfactorily resolved, one has to bear in mind that this may not distinguish between relative frequencies and probabilities.

Where in the calculations does the scenario of DNA evidence being innocently or accidentally left at a crime scene, say, 48 hours prior to the offence occurring?

Factions within the DNA testing fraternity see specialist camps disagreeing over such items as the 'ceiling' principle, match criteria, band shifting, the use of PCR-based testing of Short Tandem Repeat ("STR"), locations on the DNA molecule and the "product rule".

Published advice to attorneys gives the public a clue to the complexity, "Prosecutors can expect defence challenges to the population statistics associated with a DNA match. Some of these attacks will focus on issues such as the use of the "product rule" to calculate profile frequency statistics, and the database size and/or the populations that were either included, or not included, in the database."⁴¹

Of particular interest to the US, will be consideration of a predominantly all-white DNA database when working out the likelihood and/or finding a match with, say, an African-American and or a Hispanic defendant (or vice versa where an all-black DNA database is used for a white suspect).

In this British case, Imiela was of Polish and German parents.

There is a worry that a country's DNA data bank could become racially skewed. Compared to their number in the population, blacks are disproportionately more likely to be arrested and sentenced for crimes and thus (in Britain) have their DNA placed on file. In the US, only serious crimes, e.g. murder and rape etc, causes the accused's DNA to be filed on a database. Is America's protection of the individual's civil liberties ahead of Britain's and their jurisprudence still alive and active?

A lawyer whose client is not a member of any of the ethnic group(s) that has been used to create the DNA database, or is of mixed ethnicity, could legitimately argue that the results are not applicable and would be prejudicial to his client's right to a fair trial.

In other words, because the population database does not include a specific ethnic group of the lawyer's client, or is drawn mainly from another ethnic group, e.g. client is white but database predominantly black, the random match probability could be inaccurate.

The counter argument is that this anomaly has been allowed for mathematically in arriving at the formula. But has it?

Would any one facing a 25 year sentence, choose to have their fate sealed by an obscure mathematical calculation beyond their understanding - and which could be wrong?

The other criticism of DNA databases is that they are too small and are derived from a self-selecting population which is not truly random.⁴² This is a perennial problem that impacts all 'low tech' surveys written studies and questionnaires.

³⁹ "Radioisotopes and the age of the earth" (edited by Larry Vardiman, Andrew Snelling, Eugene F. Chaffin. Published by Inst. for Creation Research; Dec 2000) outlines the flaws of carbon dating methods.

⁴⁰ <http://biomath.biology.usu.edu/Fipse/Labs/Dna/DownloadPage/DNAFINGE.pdf> Note: The measure of information and complexity are defined on probability distributions. But these are unknown for practical data like e. g. measurement data, texts, DNA, etc.. In that case, the probabilities have to be approximated by relative frequencies while calculating the measures. Be aware that we do not distinguish between relative frequencies and probabilities in the notation of this article.

⁴¹ "Meeting Defense Challenges to DNA Evidence", US National District Attorneys Association. (meeting challenges to DNA and databases etc) http://www.ndaa-apri.org/publications/newsletters/silent_witness_volume_8_number_1_2003.html

⁴² "A database too far?" - In Britain, the number of samples in the police's database is 940,000 but it is planned to expand this to about three million in the next three years (by 2004). Friday, 19 January, 2001. <http://news.bbc.co.uk/1/hi/uk/1126047.stm>

The counter argument cites the manner in which public opinion polls, which often only ask only 200 to 1,000 people, overcome the drawback, and yet manage to provide an accurate guide to people's opinions, albeit with a 5% degree of confidence. The argument runs that when sampling is done appropriately, the results are highly accurate.

That may be so, but a respondee need not give a considered opinion, simply his or her first reaction and it is of no consequence to them if they think better of it. An opinion poll does not, after its collation, have to be subjected to a mathematical calculation. It is a simple case of totalling the "Yes, I do like" and the "No, I don't like". It is unlikely to be life threatening if the sampling is done incorrectly. However, those facing a 20 year sentence or a life sentence might not concur with this laid back approach to their future where a 5% error could see them incarcerated or set free.

It goes without saying that we do not want 5 defendants falsely jailed for every 95 villains correctly found guilty. The science of statistical "standard deviations" and 'levels of confidence', e.g. 95% sure of some fact, has quite properly in the past been confined to factory outputs and consumer matters. Most people are able to differentiate between an opinion poll that carries no negative impact but do they realise the same technique can lead to a guilty verdict with all its horrible implications ?

Some, but not all of us, know that humans and primates share 99% of their genome but with the DNA of mice and monkeys so close to that of humans, can we afford a 5% error ?

The fact that this estimate has since been downgraded to between 97% and 95%, strongly reinforces the point that we are on a steep learning curve with no 'givens' and no absolutes.⁴³

How 'safe' (using the Clark, Cannings and Patel template) will convictions, and our confidence in them, become if the ratio of likelihood is allowed to vary wildly from one court case to another ? By which is meant a 5% or 7% error is acceptably safe in a rape or murder case but anything more than 1% is (unless "we are absolutely sure of guilt") is unacceptable in a child murder case. Indeed, the present climate of terrorism and secret 'rendition' makes the implications more pervasive and more persuasive.

It would appear that the standard of proof with regards DNA presently lacks the appearance of standardisation. It apparently not only varies between crimes but between court circuits and between forensic experts called to give testimony (should we fear this most ?). It resembles something more akin to a moveable feast than a professionally structured, competent and stable set of criteria normally associated with the steering boards of the professions that enforce ethical standards and competency.

The future may yet reveal that our simplistic view that all DNA is different is misplaced, and that relying on that 'difference' (as evidence) to identify people has wrought miscarriages of justice. We may find in, say, 5 years time, that identical DNA profiles might exist outside of biological twins. We might find, as in the case of fingerprints, that occasional DNA duplicates are possible (or even widespread).

The public little realises that the road to judicial acceptance of DNA evidence as a tool for identification has been anything but smooth. Judicial acceptance has been paved with good intentions, but strewn with boulders and contradictory contentions. New breakthroughs have dominated and have almost precluded the coalescence of a consensus.⁴⁴

The huge technological strides made in DNA typing and sub-specialisms in the early 1990s created an initial period of enthusiastic acceptance of DNA across the judicial spectrum.

But by the late 1990s and early 21st century a gathering cloud of consternation was becoming widespread as DNA experts realised that the amazingly small probabilities (i.e., in DNA matches) said to be associated with a matching type in an unrelated individual were exaggerated (National Research Council, 1996).

⁴³ Paul Orwin has a good explanation of the technical details underlying the original measurement and the more recent reappraisal. He omits to mention the interesting fact that the technique used to make the 99% measurement, the so-called CoT curve (the bane of every first-year Biology grad student's existence), was developed by the same investigator who now published the 95% result.
<http://www.godofthemachine.com/archives/00000137.html>

⁴⁴ "DNA Identification: Some Lingering and Emerging Evidentiary Issues". An initial period of enthusiastic acceptance gave way to widespread apprehension that the vanishingly small probabilities said to be associated with a matching type in an unrelated individual were exaggerated (see National Research Council, 1996). <http://homepages.law.asu.edu/~kayed/pubs/genlaw/97-promega7.htm> and <http://homepages.law.asu.edu/~kayed/pubs/dna/97-promega7.htm>

In his summing up in *R v. Doherty*, [EWCA Crim 728] (1996). Lord Justice Phillips gave this model of how, in his view, scientific evidence should be treated:-

“Members of the Jury, if you accept the scientific evidence called by the Crown, this indicates that there are probably only four or five white males in the United Kingdom from whom that semen stain could have come. The Defendant is one of them. If that is the position, the decision you have to reach, on all the evidence, is whether you are sure that it was the Defendant who left that stain or whether it is possible that it was one of that other small group of men who share the same DNA characteristics.”

The future may reveal DNA matching not as a tool to identify and convict culprits but to set free an accused. In part this is already happening.

In the US the FBI is testing the DNA of men already convicted and jailed. Some 30% are said to have DNA not found at the crime scene.⁴⁵ The task of releasing those inmates falsely imprisoned has fallen most notably to Peter Neufeld and Barry C. Scheck, prominent criminal attorneys who co-founded the *Innocence Project* .

To date the DNA testing programme is well established. In 2002 the regime freed its 100th victim of a miscarriage of justice. So far more than 200 men have been cleared using DNA testing.⁴⁶

Britain has no comparable scheme and no plans to introduce similar measures. However, a paper describing forensic procedures in the US and UK indicates that whereas the custom in the US is to take DNA samples when offenders are about to be released (72 percent), the British take DNA tests at the time of, or shortly after, sentencing.

In a Minority Report - rejected by Betty Moxon of the Home Office and SORT (sexual offences review team) entitled, “*Rape Reform: When Justice Collides with Science*” (June 2000) an attempt was made to highlight the findings of the FBI work, namely that, “Every year since 1989, in about 25% of the sexual assault cases referred to the FBI, where results could be obtained, the primary suspect has been excluded by forensic DNA testing . See Appendix C.

The fabled doppelganger scenario once confined to the machination of *Cold War* warriors could not only creep out of the closet but is already in our midst undetected. The fear that a complete stranger, could compromise a Security Service, breach firewalls and wreak havoc simply by visually being identical to someone else has in a technologically driven age returned but with a vengeance.

Today’s doppelganger’ need not look like someone else but, like a computer virus, simply have enough DNA markers that match ‘the target’.

END

⁴⁵ U.S. Department of Justice 1996, “*Convicted by Juries, Exonerated by Science: Case Studies in the Use of DNA Evidence to Establish Innocence After Trial* “. Report quote “roughly between 20% (if DNA excludes an accused), to 40% (if inconclusive DNA is added).

⁴⁶ “DNA to clear 200th person”, USA Today. Former US Army cook spent nearly 25 years in prison for a rape he did not commit. He was the 200th person exonerated by DNA evidence. http://www.usatoday.com/news/nation/2007-04-22-dna-exoneration_N.htm?csp=34

PostScript

The story of DNA is an ever evolving one. There is the possibility of finding new DNA and of perhaps finding DNA within DNA in the same way as atoms gave way to sub-atomic particles.

The narrative of this papers have been validated by events since it was first published in 2004, e.g. BBC 'Panorama', Sept 2007. As recently as Oct 2007, BBC 'Newsnight' carried a story by their Science Editor Susan, Watts, about the unreliability of LCN.

Susan Watts also itemised the pioneering DNA work of Craig Venter. Viewed by some as a brilliant but maverick scientist, Venter speeded up the decoding of the human genome by applying supercomputers and a technique called "shotgun sequencing". He shunned public funding and it's slow pace opting for private sector funding. Starting in 1995 he had startling results by 1999. He claimed to have discovered 95% of the human genome and caused worldwide consternation in the scientific community by threatening to patent them.⁴⁷

If Venter's vision of the future, 50 years from now, is accurate we will see not only DNA used medically to overcome disease and human handicaps but literally mated to other forms of DNA, i.e. to unrelated animal genomes to create complete new 'life forms'.⁴⁸ This might suggest a Frankenstein future but Venter sees the new life forms as specific species designed more likely to absorb carbon, green house gases or to economically split water into hydrogen and oxygen to create a pollution-free hydrogen car engine and economy etc.

Human Right violations

Whose human rights and who is being violated. The issues of humanity moral principles and ethics have yet to properly surface in the field of DNA usage.

The public as we have seen in the Panorama survey is sleep walking into a potential minefield.⁴⁹ Since 2001 anyone arrested for a recordable offence now has to give their DNA sample for the database. The offence has to be one normally one punishable by a prison sentence (of any length) and can be as petty as a motoring offence. If they are later acquitted or innocent their DNA will still be kept on file for ever. In a previous era fingerprints so taken were destroyed and the innocent were never put on a permanent file.

Not only accused but any victims and helpful witnesses who have volunteered their DNA are also on the database. This can have inter-generational consequences with grandchildren tracked and sentenced because an ancestor did their public duty 50 years earlier (this assumes DNA is accurate).

At present in England, Wales (and Northern Ireland) there are over 4 million DNA profiles on the police database (more than the USA).⁵⁰ The changes were predicted to increase the number of samples in the police's database from 940,000 (in 2001) to about three million by 2004.⁵¹ In Scotland, only the DNA samples of those found guilty of an offence may be retained.

⁴⁷ The president of Celera Genomics Group, Professor Craig Venter, says his company has filed preliminary patents on 6,500 whole or partial human genes, but will take only a few of them through the full patent process. Professor Venter said Celera would keep a promise made to the US Congress last year that it would seek to patent no more than 100 to 300 genes. <http://news.bbc.co.uk/1/hi/sci/tech/487773.stm>

⁴⁸ Creating life from scratch, http://www.bbc.co.uk/pressoffice/pressreleases/stories/2003/02_february/27/newsnight_dna.shtml

⁴⁹ On behalf of Panorama, ICM interviewed a random sample of 1,006 adults aged 18 and over (by telephone) between 24 and 26 August 2007. Of those questioned 66% said they would approve any new law requiring all adults to give a sample of their DNA to help with the prevention and detection of crime. http://www.bbc.co.uk/pressoffice/pressreleases/stories/2007/09_september/24/dna.shtml

⁵⁰ According to the FBI, the CODIS program has 1,321,854 offender DNA profiles on file (in NDIS, April 2003). Additionally, 41 State CODIS laboratories reported 463,209 offender samples that were expected to be part of the laboratory backlog by June 30, 2003.

⁵¹ "A database too far?" Friday, 19 January, 2001. <http://news.bbc.co.uk/1/hi/uk/1126047.stm>

Appendix A

In 1989 the number of rape convictions totalled 613 (Eng & Wales). Ten years later (1999) there were 631 such cases (see Table 5.12).

Table 5.12 Offenders found Guilty at all courts for indictable sexual offences
(Rape of a female) (actual numbers).

a.	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Rape convictions	613	561	559	529	482	460	578	573	599	656	631

Source : Criminal Statistics England & Wales 1999

b.	1989	1997	1998	1999
Rapes Reported	3,305	6,281	6,523	7,139

Source : Criminal Statistics England & Wales 1999

c.	1988	1992	1995	1997	1998/99
Rape of a female	2,855	4,142	4,986	6,281	7,139

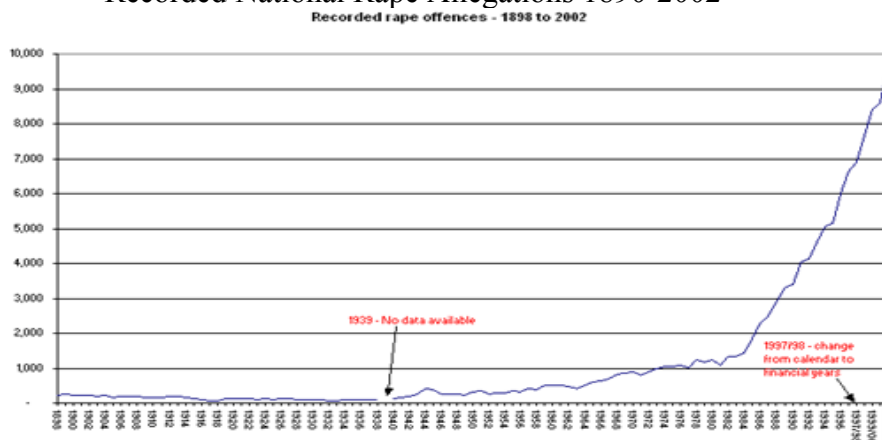
Home Office "Criminal Statistics England and Wales 1998" (page 49) 05/11/00

Alleged rape figures for ‘reported’ incidents (see b above), produced by both ONS and Home Office have varied over the decades (necessitating c above for comparison). For instance, are not listed as Technical collation changes have seen notifiable offences, i.e. reported incidents, re-titled in official statistics as ‘recorded’, indicating they actually happened.

Home Office research shows that nearly all rapes are committed by someone the victim knows. The same research shows that up to 80% of reported rapes cannot be substantiated because no evidence can be found (NFA 31%) and in 25% of cases the allegations are acknowledged as fabricated (No-crimed). Only 11% remained unsolved 31% of cases going to the CPS.⁵²

The following graph is the impression given to the public Note the use of “allegation”:-

Recorded National Rape Allegations 1890-2002 ⁵³



⁵² HORS 196, & HORS 293, Table H. Harris & Grace Survey (1999), page 2, (Initial sample size 483).

⁵³ Source: http://www.met.police.uk/sapphire/sapphire_stats.htm#top Rape enters the political agenda in 1988

Appendix B

Inventor of DNA fingerprint testing warns flaw could lead to miscarriages of justice

By Jason Bennetto, Crime Correspondent, The Independent, 09 September 2004

<http://news.independent.co.uk/uk/crime/story.jsp?story=559682>

The scientist who invented DNA fingerprinting two decades ago warned yesterday that the huge expansion of the national database - which now contains details of 2.5 million criminals - could contain mistakes and lead to miscarriages of justice.

Professor Sir Alec Jeffreys said forensic specialists might not be using a sufficiently accurate DNA match when comparing suspects with forensic material retrieved from a crime scene. Only 10 different DNA markers were used on the database to distinguish between individuals, he said.

"If you have a database of 2.5 million people you will start having matches. The current DNA database uses 10 distinct markers and I think there is still a residual risk of a false match. They should use about 15 markers because otherwise it leaves open the possibility that the match from the crime scene sample is genuine but a fluke."

He also warned that if the police kept profiles of suspects who were later cleared - which they can now legally do - that could lead to a disproportionate representation of minority ethnic groups, especially in the major cities, on the database.

Sir Alec was working in a laboratory at the University of Leicester on 10 September 1984 when he stumbled across the key to the future of genetic research and development. He found a stretch of DNA that is unique to every individual (except identical twins). The findings have had effects on criminal cases, paternity, immigration and conservation as well as led to life-saving developments in medical research.

Genetic "fingerprints" exist in blood, bone, hair follicles, saliva, semen, skin and sweat. They are the same in every cell and retain their distinctiveness throughout a person's life.

His discovery led to the establishment of the British DNA database, the biggest in the world with more than 2.5 million profiles from criminals and suspects, and more than 200,000 DNA samples from unsolved crimes, including blood and semen stains. The Home Office says the database is being used on average to link suspects to 15 murders, 31 rapes and 770 car crimes every month.

The ability of forensic specialists to retrieve DNA from ever smaller crime samples has enabled the police to re-examine unsolved cases dating back 30 years and convict the guilty. As a result of its success the Government is giving the police greater powers to retain samples taken from anyone who has been arrested and from people who have given material voluntarily.

A new forensic technique developed in the US has also helped Scotland Yard identify the ancestral origins of an offender for the first time. Sir Alec also believes that techniques will be further developed in the future so more details on how a person looks will be gleaned from a DNA extract. Genetic fingerprinting could allow police to determine the eye colour, hair colour and even facial features of criminal suspects, he said yesterday. Scientists can already identify samples from people with red or ginger hair.

He said: "The research is at the science fiction stage but our physical appearance is largely determined by our genetic make-up.

"The problem is that facial features depend on age, and if you have not got the age it will be very complicated. Also some of the variations behind these genes will lie behind severe clinical problems.

The police would then be accessing information of profound medical significance and I would argue the police have no right to access such information."

Sir Alec said the application of the fingerprint technique that gave him most satisfaction was its use in immigration disputes. "These families have done nothing wrong whatsoever. The fact that we have managed to bring thousands of them back together makes me very proud," he said.

He welcomed the idea of a global database containing DNA information on every individual but said that police should not have access to the profiles unless the people had been convicted of a criminal offence.

Commenting on his discovery in Leicester 20 years ago, Sir Alec said: "I regard this as a wonderful triumph of British science. We have consistently led the world in the application of DNA."

Appendix C

The Innocence Project

The F.B.I. has an overarching remit not seen in the UK to ensure the administration of good justice - past, present and by implication, future. As an agency technically outside governmental control the FBI regulatory measures include the routine internal and external monitoring of the US justice system. It is also empowered to takeover investigations first launched by local police forces and Sheriff's departments.

The FBI could be accused of self-investigation of regulating itself but the federal composition negates this possible criticism and is held in generally high regard

To ensure the administration of good justice in England referrals have to be made to the Appeal courts system

This is to ask the 'poacher to turn gamekeeper' for miscarriages of justice are, in the main, suspected to stem from judicial or police inadequacies

The other sources of reviewing the good administration of justice are via the Attorney General and the newly created Criminal Cases Review Commission (CCRC). Arguably, media interest in a particular case could be said to influence both these bodies' decisions to act or not

The preponderance of lawyers found within that the CCRC inflames criticism that could lack detachment.

The FBI, however, is not driven lawyer nor predominately a police force. It is pro-active in some various and regularly checks the validity of convictions by supporting something called the 'Innocent Project'. This project compares the DNA of prison inmate and checks it against the crime scene DNA. The task of releasing those falsely imprisoned has fallen most notably to Peter Neufeld and Barry C. Scheck, prominent criminal attorneys who co-founded the '*Innocence Project*'.

There is a drive by reformers, like the *Innocence Institute*, to improve eyewitness identification techniques within police departments. The Innocence Institute suggests, "Police should use a 'double-blind' photo identification procedure where someone other than the investigator - who does not know who the suspect is - constructs photo arrays with non-suspects as fillers to reduce suggestiveness." Secondly, if false accusations are as common as '1-in-4', that still means 75% of reports are probably accurate or have substance meaning all accusations deserve a thorough and professional investigation. If this proves physically impossible then police will need to consider a screening device.

Thirdly, the 1-in-4 figure has extraneous aspects that could influence the results. For example, Neufeld and Scheck mention only sexual assault cases that were referred to the FBI where results could be obtained. It is not clear what percentages of all reported assaults are represented by those cases and what cases omitted or not referred to the FBI.

In an article in the US magazine 'Newsweek' (Jan 1993) researcher Kevin Krajik wrote that "... the FBI tested the DNA evidence of men already convicted of rape and serving time (based mostly on verbal testimony from victims) and found that in one third of the cases the DNA evidence from the crime scene did not match the person convicted." Britain, in 2007, has no plans to copy this 1993 idea.

In the late 1990s the U.S. Department of Justice published "*Convicted by Juries, Exonerated by Science: Case Studies in the Use of DNA Evidence to Establish Innocence After Trial* (1996).

The study documents 28 cases which, "with the exception of one young man of limited mental capacity who pleaded guilty, consist of individuals who were convicted by juries and, then, later exonerated by DNA tests. At the time of release, they had each served an average of 7 years in prison.

One riveting passage reads:-,

Every year since 1989, in about 25% of the sexual assault cases referred to the FBI, where results could be obtained, the primary suspect has been excluded by forensic DNA testing .

Specifically, FBI officials report that out of roughly 10,000 sexual assault cases since 1989, about 2,000 tests have been inconclusive, about 2,000 tests have excluded the primary suspect, and about 6,000 have "matched" or included the primary suspect."

Overall the FBI found on its prison sorties that about 30% of those tested and serving time in jail were not linked to DNA found at the crime scene.

This means they were innocent of the crime with which they were charged.

This means the legal system got it wrong and they are released.

There is much we could learn from the American experience. For instance, the report states that "these percentages (25%) have remained constant for 7 years, and the National Institute of Justice's survey of private laboratories reveals a strikingly similar 26% exclusion rate."

The relatively low estimate of 25% to 26% is probably accurate, especially since it is supported by other sources. However, if the foregoing results were to be extrapolated, then the rate of false allegations / reports is roughly between 20% (if DNA excludes an accused), to 40% (if inconclusive DNA is added). Before analysing the competing figures, however, caveats regarding the above are necessary. Firstly, the category of 'false accusations' does not distinguish between 1/. accusers who lie and 2/. those who are honestly mistaken. Nor does it indicate that a rape did not occur, merely that the specific accused is innocent.

In the light of this, the position of Britain judiciary and government is to pretend that it has a superior legal system and doesn't need these post sentencing checks. But most people who have been even remotely touched by the legal machinery know that not to be true.

In a Minority Report - rejected by Betty Moxon of the Home Office and SORT (sexual offences review team) entitled, "*Rape Reform: When Justice Collides with Science*" (June 2000) an attempt was made to highlight the findings of the FBI work, namely that, in around 25% of cases the crime scene DNA did not match the prisoners.

In our opinion, the Home Office position has been one of "denial". It has not wanted to look too closely. For instance, in 1999 it refused to consider the possibility of a wrongful conviction in the case of sex offences. It simply didn't have the concept and intellect to deal with such a proposition.

After 12 months they conceded they had no procedures. This despite the Home Office also not knowing that 2 men were serving life sentences and had no idea what crimes had been committed. (HO Criminal Statistics, 2002).

Competency

Competency has been a thread running throughout this paper. The everyday inter-changeability of the terms 'rape' and 'sexual assault' are as confusing and potentially as misleading as TV reports of the AIDS epidemic in Arica which then incompetently (?) slides into deaths caused by HIV.

A similar competency concern was expressed by Dr Guy Norfolk, president The Faculty of Forensic & Legal Medicine in testimony given by experts in rape cases.

He argues that though it is impossible to accurately estimate the number of cases that are lost because of inadequacies or incompetence in the medical evidence (not least because we can never really be sure what was in the jury's mind when it acquits), the commonest problems encountered by expert forensic witnesses can be identified as and this has direct bearing on the presentation of DNA evidence:

- 1/. Over interpretation – this may be born out of
 - a). ignorance
 - b). a lack of impartiality
 - c). a failure to recognise that there may be alternative accounts of what took place
 - d). simply an eagerness for the medical evidence to be granted greater importance than it actually deserves.

- 2/. An inability to understand or to be able to withstand defence assertions that rape must cause genital injury (it need not).

The dangers of over-interpreting the presence, or absence, of genital injury are primarily two-fold. When over-interpretation is exposed in court it can do serious damage to the Crown's case resulting in a guilty person going free. Conversely, if unchallenged, over-interpretation can also lead to a wrongful conviction.

Genital injuries are seen in only about 30% of rape victims. Some doctors are unaware of this, or are unable to explain to the jury that in cases of rape "normal" can be "normal".

The police have learnt (by experience) and now doctors need to be trained to understand that the medical evidence- even DNA- in rape trials is rarely ever conclusive. Dr Norfolk is also concerned that too many medical experts are a/. from the enlarged EU and b/. are not tutored in the subtleties of examining for sexual assault.

'They have to understand that their evidence is just a small cog in a much larger wheel, necessary to keep things moving but that is all'.⁵⁴

⁵⁴ Technical observations courtesy of Dr Guy Norfolk, LLM, FFLM (Pres.), MRCP, DMJ.

Annex A

DNA errors lead to murder case review

By Stewart Tandler, Crime Correspondent and David Brown. The Times, February 22, 2007

<http://www.timesonline.co.uk/tol/news/uk/crime/article1421333.ece>

Hundreds of murderers, rapists and other serious criminals may have escaped prosecution because forensic scientists failed to test properly for DNA evidence for five years. More than 2,000 cases are being urgently reviewed — including that of Rachel Nickell, the former model murdered on Wimbledon Common — after the Forensic Science Service admitted that it might have missed crucial evidence. The service, which carries out most DNA tests for police forces in England and Wales, expects to recover DNA in at least 200 cases where it had said that none existed. *The Times* has learnt that chief constables believe that the total could be higher. The failure involves the processing between 2000 and 2005 of “low-copy-number” tests, used to identify microscopic quantities of DNA.

The Association of Chief Police Officers wrote to all police forces yesterday asking them to carry out a review of their serious crime cases.

This is likely to include all unsolved serious crimes since 2000 where no DNA samples were found. It could include the murder of Margaret Muller, 27, an American artist, who was stabbed after going jogging in Hackney, East London, in February 2003.

Tony Lake, the association’s expert on the use of forensic science, admitted that there was a huge amount of work to be done to find out how many cases could have been affected. Mr. Lake, the Chief Constable of Lincolnshire, added: “Are we anxious? Are we concerned? Yes, of course we are. We have to establish whether there are offenders out there who could have been caught previously.”

The blunder relates to cases where the Forensic Science Service analysed tiny samples of blood or saliva for a DNA profile. As a result of advances in testing techniques, it was possible, from 2000, to find this DNA evidence in very small traces of body fluids.

The service was apparently using this low-copy-number technique, but for five years was applying it in a different way. This meant that its scientists failed to locate evidence that private forensic laboratories could have picked up.

The failure is the most damaging mistake in the history of the service.

Problems with the tests were identified last summer when Scotland Yard reviewed evidence on the murder of Ms Nickell, who was stabbed 49 times and sexually assaulted in front of her son in July 1992. The Forensic Science Service said that it had not found any positive results when it carried out the low-copy-number tests in 2001 on material from the scene. But in a review of the case last year a private company discovered DNA. Detectives may now charge a convicted sex killer with the murder.

Glossary

DNA Fingerprinting

<http://www.bbc.co.uk/dna/h2g2/A639425>

DNA fingerprinting or profiling is a technique that identifies the DNA from a certain individual without examining the entire three billion letters in the full human genome. It can be used to track down suspects, test the parentage of children, and to follow the evolution of species.

DNA fingerprinting begins by extracting DNA from the cells in a sample of blood, saliva, semen, or other appropriate fluid or tissue.

Only two copies of nuclear DNA are present in human cells, one copy from the biological mother and one copy from the biological father (see Microcondrial DNA and LCN below).

Testing the nuclear DNA, i.e. the 'normal' way, is by far the most common analysis conducted in the United States and in other countries, but new advances are made almost monthly.

DNA - Deoxyribonucleic Acid

Deoxyribonucleic Acid is a molecule found in the nucleus living cells that stores the genome of an organism, or the blueprint required to build proteins. It has a double helix backbone which supports the four bases labelled G, C, A and T; the sequence of these bases is the genetic code which characterises an organism. Although 99.9% of human DNA is identical for different individuals, only identical twins have exactly the same pattern. So in principle, given a single cell, we can identify the individual it came from. DNA fingerprinting works by screening for certain DNA sequences which are found in some individuals, but not others.

DNA Fingerprinting

The fingerprinting process uses enzymes to cut out specific sequences of DNA; these are then arranged in order of length and tagged with radioactive probes. These emit X- rays, so when the sample is photographed they show up. This produces the 'fingerprint' - a series of black lines corresponding to the DNA sequences present.

PCR - Polymerase Chain Reaction

PCR is a powerful technique which effectively 'amplifies' DNA. It can produce many copies of the DNA from a single cell, allowing the tiniest of samples to be tested. The process first heats the sample to unravel and split the double helix; primase and polymerase enzymes are then used to identify DNA sequences and produce a copy of them. The cycle is repeated a number of times, each time doubling the sequence samples.

PCR considerably increases the usefulness of DNA fingerprinting, however, it also increases the risk of contamination with DNA from laboratory staff or anyone who had handled a sample. This would be amplified along with the sample DNA.

MtDNA - Microcondrial DNA

The emergence of mitochondrial DNA Testing (or mtDNA) is another recent forensic breakthrough -though it does have limitations. It is particularly useful for bone fragments and hair samples evidence where nuclear (normal) DNA may not be present. It is also helpful when the cell sample has deteriorated. Where the sample consists of only a few cells and is not suitable to measure the short tandem repeats (STR analysis), microcondrial DNA can be used (see also LCN).

The limitations for criminal forensic identification of mtDNA is that while it [better withstands degradation](#), it is passed down through maternal lines, with all descendants in a given maternal line (only) sharing the same mtDNA sequence. Therefore, while mtDNA may conclusively prove that a particular person is related through maternal lineage to a specified woman, it does not serve the purpose of uniquely identifying the individual in question. Indeed, persons who would appear to be

unrelated may in fact share a common maternal relative at some point in their lineage, and this would lead to the same mtDNA results.⁵⁵

As a result, mtDNA testing can be used in criminal cases to positively include or exclude a person as a possible suspect, but does not provide the discriminatory power that the forensic community has come to expect from nuclear DNA analysis.

STR analysis - Short Tandem Repeats

The most prevalent method of DNA fingerprinting used today is based on PCR and uses short tandem repeats (STR). This method uses highly polymorphic regions that have short repeated sequences of DNA (the most common is 4 bases repeated, but there are other lengths in use, including 3 and 5 bases). Because different people have different numbers of repeat units, these regions of DNA can be used to discriminate between individuals

The polymorphisms displayed at each STR region are by themselves very common, typically each polymorphism will be shared by around 5 - 20% of individuals. The more STR regions that are tested in an individual the more discriminating the test becomes.

STR analysis is used by American police and FBI for their CODIS computer programmed

For highly degraded samples, it is sometimes impossible to get a complete profile of the 13 STRs required for entry into the CODIS database.

AmpFLP - Amplified Fragment Length Polymorphism

Another technique, AmpFLP, or amplified fragment length polymorphism was also put into practice during the early 1990s. This technique was also faster than RFLP analysis and used PCR to amplify DNA samples. It relied on 'variable number tandem repeat' (VNTR) polymorphisms to distinguish various alleles,

"JUNK" DNA

In molecular biology, "junk" DNA is a collective label for the portions of the DNA sequence of a chromosome or a genome for which no function has yet been identified. About 80% -90% of the human genome has been designated as "junk", including most sequences within introns and most intergenic DNA.

Some consider the "junk" label as something of a misnomer, but others consider it apposite as junk is stored away for possible new uses, rather than thrown out; others prefer the term "non-coding DNA".

LCN DNA - Low Copy Number

Frequently items contain an insufficient quantity of DNA (from sweat or skin cells) to obtain complete or even partial DNA profiles using standard forensic genotyping techniques. LCN is used when the sample size shrinks from a tiny but visible sample to microscopic samples.

To increase the low amount of DNA (the number) a gel is used as a medium to multiplied itself. This is called 'amplification'. The drawback is that normally the approach also multiplies any other DNA in the process and can distort readings.

Where an offender is thought to have transferred DNA through touch and the sample could be skin cells, sweat, or fingerprint residue, LCN is said to be the best technique. LCN, sometimes called LCC (Low Copy Count), is used whenever traditional DNA testing has failed to get a satisfactory result. However it is still a controversial technique with alleged suspect accuracy.

LCN is an extension of the routine SGM Plus® profiling technique. It enables DNA profiles to be produced from samples that contain very few cells. It is a useful tool for so-called "cold cases".

LMD – Laser Microdissection technique

This technique was, the New Scientist reports first used in January 2007. Building on LCN technology it enables any sample of male cells to have the Y chromosome it contains extracted. When mounted onto a microscope slide the unique DNA sequences within cells can be highlighted by using FISH (fluorescence in-situ hybridisation).

⁵⁵ See BBC's experiment of Kristy Wark's DNA. According to Professor Brian Sykes, who analysed her DNA, 95% of European women are descended from seven "daughters of Eve" who lived more than 10,000 years ago. But Kristy has a unique set of genetic mutations not previously seen amongst the thousands of DNA samples Professor Sykes has on his database.
http://www.bbc.co.uk/pressoffice/pressreleases/stories/2003/02_february/27/newsnight_dna.shtml

It is calculated that this method will assist in about 90 sexual assault cases each year where it is just too difficult to get a usable DNA profile and particularly where no sperm can be found in the semen, either because of a medical condition or because the male has had a vasectomy. It should also assist where female DNA in any sample overwhelms the male trace.