V. DNA TECHNOLOGY IN UNITED KINGDOM AND UNITED STATES OF AMERICA

This chapter narrates DNA technology in the United Kingdom and the United States of America. This chapter critically analyzes the constitutional validity for collection and retention of DNA as well as the admissibility standards for admitting DNA in both the countries.

5.1. DNA TECHNOLOGY IN UNITED KINGDOM

The United Kingdom introduced the world’s first comprehensive National DNA Database on 10th April 1995. It has the distinction of inventing what is now colloquially known as “DNA fingerprinting”. In 1984 Professor Allec Jeffrey of the University of Leicester inadvertently stumbled on a way of establishing a human’s genetic identification. Since its inception, the United Kingdom has been at the forefront of the development of forensic DNA procedures, both technologically, and in the regulatory and legislative response to the technology. 312

5.1.1. STATUTES DEALING WITH DNA IN UNITED KINGDOM AND THE ESTABLISHMENT OF NATIONAL DNA DATA BASE (NDNAD)

The use of DNA in law enforcement stem from the Colin Pitchfork case in the mid-1980s. In this case, law enforcement officials took DNA samples from about 5,000 residents in the area surrounding the location of two rapes and murders. Officials then compared these individual samples to crime scene samples taken from the two related murder scenes. The forensic use of DNA resulted in the arrest and confession of Colin Pitchfork, a local man responsible for the crimes. The impetus for the creation and expansion of a centralized DNA database was that the successful use of DNA identification technology in crime detection and law enforcement was dependent upon the scope and coverage of the collection of reference profiles to which crime scene samples could be compared. 313


313 Available at http://www.law.emory.edu/fileadmin/journals/eilr/23/23.2/Nydick.pdf, viewed on 18/02/2014 at 04.30pm
As stated earlier, Britain was the first country to have a national DNA database. The Royal Commission on Criminal Justice recommended the establishment of the DNA database in 1993, and the Home Office officially announced its creation a year later. At the same time, the Home Office also commissioned a pilot study to examine the use of DNA in the context of a forensic database. In 1995, the Criminal Justice and Public Order Act (CJPOA) mandated establishment of the England and Wales National DNA Database (NDNAD), and it had since became the largest forensic database in the world.\textsuperscript{314}

The basic document for the regulation of the forensic use of DNA typing in England and Wales was the Police and Criminal Evidence Act 1984 (PACE). All further changes in DNA regulations were amendments to PACE.\textsuperscript{315} Prior to the enactment of the Criminal Justice and Public Order Act 1994, collection of evidence from suspects was permitted pursuant to the 1984 PACE, which required a serious arrestable offense and only allowed the police to collect fingerprints. Additionally, an officer could only take fingerprints without consent in the following circumstances:\textsuperscript{316}

(1) If an officer of at least the rank of superintendent authorized the taking, and
(2) If the person was informed that he or she would be reported for such an offense.

In 1994 amendments to PACE, the Criminal Justice and Public Order Act, gave additional powers to obtain and retain CJ samples (cheek scrapes or rooted hairs). Mouth swabs were now considered non-intimate and did not require consent. The pool of criminal suspects from which CJ samples were available was widened further by the fact that non-intimate samples were now permitted to be taken without consent in connection with any recordable offense. Provisions were also made for the speculative searching of profiles derived from samples. The 1996 Criminal Procedure and Investigation Act widened the power of the Police to use samples by permitting them to search samples from across the United

\textsuperscript{314} Available at http://www.highbeam.com/doc/1G1-257610123.html , viewed on 20/01/2014 at 06.45am

\textsuperscript{315} Available at http://www.ethical-perspectives.be/viewpic.php?TABLE=EP&ID=1072, viewed on 02/02/2014 at 08.30pm

\textsuperscript{316} Available at http://www.law.emory.edu/fileadmin/journals/eilr/23/23.2/Nydick.pdf, viewed on 18/02/2014 at 04.30pm
Kingdom, including Scotland, Northern Ireland, Jersey, Guernsey, and the Isle of Man.\textsuperscript{317}

The Criminal Justice and Police Act of 2001 authorizes the government to indefinitely retain the DNA profiles of both suspects and arrestees and convicted offenders. DNA profiles of persons who are later acquitted or whose charges are dropped are also kept indefinitely on the database. DNA profiles generated from samples obtained from crime scenes are stored until identified or a match is found.\textsuperscript{318}

The 2003 amendment to PACE, the Criminal Justice Act (CJA), encouraged further expansion of the NDNAD by allowing police to sample, profile, and database of individuals arrested but not subsequently charged with or convicted of a recordable offense.\textsuperscript{319} Since April 2004, when this law came into force, anyone arrested in England and Wales on suspicion of involvement in any recordable offense (all except the most minor offenses) had their DNA sample taken and stored in the database, whether or not they are subsequently charged or convicted.\textsuperscript{320}

The Serious Organized Crime and Police Act 2005 extended the uses of the National DNA Database to include the identification of deceased persons or body parts.\textsuperscript{321}

In 2008, the Counter-Terrorism Act extended police powers to allow DNA and fingerprints to be taken from persons subject to control orders. The DNA sample can be collected during any authorized secret surveillance and retained indefinitely. It can also be searched against material held by the Security Service or Secret Intelligence Service and has to be used in the interests of national security.\textsuperscript{322}

\textsuperscript{317} Available at http://www.law.emory.edu/fileadmin/journals/eilr/23/23.2/Nylick.pdf , viewed on 18/02/2014 at 04.30pm

\textsuperscript{318} Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship , viewed on 18/02/2014 at 05.00pm

\textsuperscript{319} Available at http://www.law.emory.edu/fileadmin/journals/eilr/23/23.2/Nylick.pdf , viewed on 18/02/2014 at 04.30pm

\textsuperscript{320} Available at http://en.wikipedia.org/wiki/United_Kingdom_National_DNA_Database , viewed on 18/02/2014 at 05.30pm

\textsuperscript{321} Available at http://www.genewatch.org/sub-537968 , viewed on 21/02/2014 at 06.30pm.

\textsuperscript{322} Available at http://www.genewatch.org/sub-537968 , viewed on 21/02/2014 at 06.30pm.
In 2010, the Crime and Security Act is adopted in response to the judgment of the European Court of Human Rights in the Marper case. It allows the retention of innocent people's DNA records and fingerprints for 6 years after arrest. Innocent people's Police National Computer records will continue to be kept indefinitely. DNA samples taken on arrest, which are currently stored in commercial laboratories, will be destroyed once the computerized DNA profiles have been obtained from them, not later than 6 months after the sample is taken.\textsuperscript{323}

The Protection of Freedom Act 2012 gained assent on 1\textsuperscript{st} May 2012. Section 1-25 of the Act covered DNA and fingerprint retention. There had a time limit to these sections of the Act into force. The Act was constituted by the United Kingdom’s response to the 2008 of the European Court of Human Rights in Marper \textit{v. United Kingdom}.\textsuperscript{324} In that case, the court ruled that blanket retention of DNA taken from innocent people posed disproportionate interference with the right to private life, in violation of Article 8 of the European Convention on Human Rights. The Act mainly aimed to strike a balance between protecting the privacy and human rights of the public, and protecting them from crime by keeping the right people on the DNA and fingerprint databases. The Act required all DNA samples to be destroyed within six months of being taken. This allowed sufficient time for the sample to be analyzed and a DNA profile to be produced for use on the database. In exceptional circumstances a court order could be made allowing longer retention of the DNA sample for use in complex court cases.\textsuperscript{325}

For how long and for what offenses, Fingerprints and DNA samples can be retained by the police under the Protection of Freedom Act 2012, have been listed in the table below. The table is classified under two heads-one is convictions table and another one is non-convictions table.

<table>
<thead>
<tr>
<th>Occurrence</th>
<th>Fingerprint and DNA Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult – All offenses</td>
<td>Indefinite</td>
</tr>
<tr>
<td>Under 18 – Qualifying offense</td>
<td>Indefinite</td>
</tr>
<tr>
<td>Under 18 – Minor offense</td>
<td>First conviction: Five years (Plus length of any custodial sentence), or indefinite if the custodial sentence is five years or more</td>
</tr>
<tr>
<td>Second conviction</td>
<td>Indefinite</td>
</tr>
</tbody>
</table>

*Qualifying offenses are serious violent or sexual offenses, terrorism offenses, and burglary offenses.

\textsuperscript{323} Id
\textsuperscript{324} [2008] ECHR 1581
NON-CONVICTIONS

<table>
<thead>
<tr>
<th>Occurrence</th>
<th>Fingerprint and DNA Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifying offense - Arrested and charged</td>
<td>Three years plus possible two years extension by court</td>
</tr>
<tr>
<td>Qualifying offense - Arrested not charged</td>
<td>Possible three years on application to Biometrics Commissioner (Or Indefinite retention if holds a previous conviction for a recordable offense) plus two-year extension possible</td>
</tr>
<tr>
<td>Minor offense - Penalty Notice for Disorder</td>
<td>Two years</td>
</tr>
<tr>
<td>Minor offense – Arrested or charged</td>
<td>None – But speculatively searched</td>
</tr>
</tbody>
</table>

*Qualifying offenses are serious violent or sexual offenses, terrorism offenses, and burglary offenses.

In the Protection of Freedom Act, 2012, if a person is arrested but not convicted, the Act allows a speculative search of their DNA and fingerprints against crimes stored on the databases, to check if they match to any crime on the database. Once a speculative search has been completed, the profile and fingerprints are deleted. As set out in the table above, for qualifying offenses the Act allows Chief Constables to apply for extensions to the given retention periods for DNA profiles and fingerprints if deemed necessary for prevention or detection of crime. The Act requires a Biometrics Commissioner to be appointed. In addition to assessing applications for extensions as above, the Biometrics Commissioner will have a general responsibility to keep under review the retention and use of DNA and fingerprints, including reviewing any applications for retention made on national security grounds. The first Biometrics Commissioner, Alastair MacGregor QC, has now been appointed and has taken the post on 4th March 2013.326

The Act also provides that if a person has been arrested for a minor offense, but never convicted, any DNA and fingerprints taken from a person by the police must be destroyed. To aid the investigation of crime, every person arrested will have their DNA and fingerprints speculatively searched against the crimes stored on the national DNA and fingerprint databases before deletion.327

The first Part of the Act amends or omits Sections from the Police and Criminal Evidence Act 1984, and Crime and Security Act 2010, relating to the


327 Id
retention of fingerprints. In Part 1, Section 24 of Chapter 1 instructs the Secretary of the State to make arrangements for a National DNA Database Strategy Board to oversee the operation of a DNA database. In Part 1, the Chapter 2 requires schools and colleges to obtain consent of one parent of a child under 18 for acquiring and processing the child's biometric information and gives the child right to stop the processing of their biometric information regardless of any parental consent, it also states if any parent of the child objects to the processing of biometric information it must also be discontinued.328

In December 2012, the destruction of DNA samples (the biological material which contains a person’s genetic information) began. DNA samples were being destroyed for all individuals, even those convicted of crimes, because of the sensitivity of the material and the fact that it was no longer needed once a DNA profile had been obtained. In May 2013, the Government reported significant progress in deleting 11,36,000 innocent people’s DNA profiles from the National DNA Database and destroying 63,41,000 DNA samples. Destruction of DNA samples was completed on 31st May 2013. The Act came into force on October 2013.329

In Northern Ireland, The Criminal Justice Northern Ireland Order 2004 on DNA collection is more or less identical to the law governing England and Wales. It allows the police to obtain DNA samples without consent from anyone aged 10 or over who is arrested or detained in connection with a recordable offense. A leading nonprofit policy research and genetics watchdog group in the UK, GeneWatch UK, notes that the law was introduced by the secretary of state for Northern Ireland whilst the Assembly was suspended, in order to bring Northern Island’s legislation into line with England and Wales. Starting in October 2005, Northern Ireland began exporting DNA profiles to the NDNAD.330

328 Available at http://en.wikipedia.org/wiki/Protection_of_Freedoms_Act_2012#Part_6:_Freedom_of_Information_and_Data_Protection , viewed on 19/02/2014 at 07.30pm


330 Available at http://books.google.co.in/books?id=kGDxQxyVRmQC&pg=PA172&lpg=PA172&dq=laws+regulating+DNA+data+banks+in+united+kingdom&source=bl&ots=dVvP8zW5u1&sig=UVeHk5DQmn5Tlm2zQxK3g8hB5g8&hl=en&sa=X&ei=ZgAFU86CGomOrQf95oHgDQ&ved=0CEsQ6AEwBTge#v=onepage&q=laws%20regulating%20DNA%20data%20banks%20in%20united%20kingdom&f=false , viewed on 20/02/2014 at 06.30pm
In Scotland, The Criminal Procedure Act, 1995 is used more cautiously regarding DNA technology. The information commissioner for Scotland believes that the retention of DNA profiles of individuals who are arrested but are not convicted of any offense is an intrusion into their private lives. In May 2006 the Scottish Parliament rejected the permanent retention of DNA taken from individuals who are not convicted of a crime. Under these circumstances the DNA profiles are deleted from the Scottish database and the U.K. NDNAD, and the biological samples from which the profiles are generated are destroyed.\textsuperscript{331}

\section*{5.1.2. NATIONAL DNA DATABASE (NDNAD)}

The National DNA Database (NDNAD), created in 1995 in England and Wales, was the World’s first DNA database.\textsuperscript{332} The Criminal Justice and Public Order Act was passed in 1994 and authorized the creation of the NDNAD.\textsuperscript{333} Initially, only DNA profiles collected in England and Wales were uploaded to the system. Subsequently Northern Ireland and Scotland developed forensic DNA databases with their own criteria for inclusion. However, they too submit their profiles to the NDNAD.\textsuperscript{334} NDNAD holds two types of DNA profile. One is individuals DNA profile. The police take a DNA sample from every arrested individual, using a swab on the inside of the cheek. The DNA sample is then sent to an accredited laboratory, which analyzes the sample to produce a DNA profile-a string of 20 numbers representing only a tiny fraction of that individual’s DNA, but which allows that individual to be identified (the chance of two unrelated individuals having the same DNA profile is more than a billion to one). The DNA profile is loaded to the NDNAD where it can be searched against crimes. A DNA

\textsuperscript{331} Available at http://books.google.co.in/books?id=kGDxQxyVRmQC&pg=PA172&lpg=PA172&dq=laws+regulating+DNA+data+banks+in+united+kingdom&source=bl&ots=dVvP8zW5ul&sig=UVeHk5DQnm5TIm2zQxsK3g8hBSg8&hl=en&sa=X&ei=ZgAFU86CGomOrQf95oHgDQ&ved=0CEsQ6AewBTge#v=onepage&q=laws%20regulating%20DNA%20data%20banks%20united%20kingdom&f=false , viewed on 20/02/2014 at 06.30pm

\textsuperscript{332} Available at http://hstlj.org/wp-content/uploads/2011/08/v2i2romansantos.pdf , viewed on 20/02/2014 at 09.30pm

\textsuperscript{333} Id

\textsuperscript{334} Available at http://books.google.co.in/books?id=kGDxQxyVRmQC&pg=PA172&lpg=PA172&dq=laws+regulating+DNA+data+banks+in+united+kingdom&source=bl&ots=dVvP8zW5ul&sig=UVeHk5DQnm5TIm2zQxsK3g8hBSg8&hl=en&sa=X&ei=ZgAFU86CGomOrQf95oHgDQ&ved=0CEsQ6AewBTge#v=onepage&q=laws%20regulating%20DNA%20data%20banks%20united%20kingdom&f=false , viewed on 20/02/2014 at 06.30pm
A DNA profile also includes an X/Y chromosome marker to indicate gender, for example:

14,18; 30,31.2; 16,17; 13,14; 28,14; 12,14; 19,23; 6,7; 12,14; 21,23; X,Y.

Another one is crimes DNA profile. DNA is recovered from crime scenes by the police crime scene investigators. Nearly every cell in the body contains a complete copy of person’s DNA, so there are many ways in which an offender may leave his/her DNA behind at a crime scene, for example in blood or from skin cells left behind on clothing or even just by touching something. The Crime Scene Investigators (CSIs) look in places where the perpetrator of the crime is most likely to have left traces of their DNA behind. Items likely to contain traces of DNA are sent to an accredited laboratory for analysis. If the laboratory recovers DNA, they will produce crime DNA profile which can be loaded to the database for searching.

Beginning in 1995, the Chief Scientist of the Forensic Science Service was responsible for management of the National DNA Database. In July 2005, the management of the database was transferred to the Home Office, which then transferred custodianship to the National Policing Improvement Agency.

Since 1st October 2012, the National DNA Data Base (NDNAD) has been run by the Home Office on behalf of United Kingdom Police forces. The Strategy Board oversees the operation of the NDNAD, ensuring that it provides an effective service for the police, used the most suitable technology and operates in an ethical manner. The Strategy Board also ensures transparency by providing information to the public. The Strategy Board is chaired by the national policing lead for DNA and has representatives from the Home Office, Scottish Police, Northern Ireland Police/Department for Justice, the Information Commissioner, Forensic Science Regulator and DNA Ethics Group. The Ethics Group is an independent group, set up in 2007 to provide advice to Ministers and the Strategy Board.


Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship, viewed on 18/02/2014 at 05.00pm
Board on the ethical operation of the National DNA Database. Any laboratory carrying out DNA profiling work for loading to the NDNAD must be approved by the NDNAD Unit and the NDNAD Strategy Board.\textsuperscript{339}

5.1.2.1. MISSING AND VULNERABLE PERSONS DNA DATABASES

The National DNA Database holds DNA profiles taken from the arrested individuals and crimes scenes. Previously it also held profiles taken in relation to missing persons and from individuals at risk of harm, for the purposes of identifying a body should one be found. These profiles are held on their own database, in order to separate DNA profiles given with consent for identification purposes from those taken from arrestees.\textsuperscript{340}

\textit{a. MISSING PERSONS DNA DATABASE (MPDD):} The Missing Persons DNA Database (MPDD) holds DNA profiles obtained from the belongings of people who have gone missing, or from their close relatives (who will have similar DNA). It also contains profiles taken from the bodies of unidentified people. The database matches missing people (or via their relatives) to unidentified bodies, and can also eliminate a missing person if an unidentified body is found matching their description, helping police investigations and bringing closure for families that are searching for their loved ones. In 2012-13, the Missing Persons DNA Database has produced 5 matches.\textsuperscript{341}

\textit{b. VULNERABLE PERSONS DNA DATABASE (VPDD):} The Vulnerable Persons DNA Database (VPDD) holds DNA profiles who are at risk of harm, for instance due to child sexual exploitation or honor based violence, and have asked for their profile to be added. If the person subsequently goes missing, their profile can be checked against the main National DNA Database to see if they match to any material such as blood or an unidentified body found at a crime scene, helping the police investigates their disappearance.\textsuperscript{342}

5.1.2.2. FORENSIC SCIENCE REGULATOR (STANDARD MONITOR)

An independent Forensic Science Regulator was appointed in 2008 to set and monitor standards for organizations carrying out forensic analysis for use in

\textsuperscript{340} Id
\textsuperscript{341} Id
\textsuperscript{342} Id
court. The required standards are published in the Regulator’s codes of practise and include accreditation of forensic laboratories to international standards. Every company supplying the police with forensic services as part of the national procurement framework is accredited and meets the standards set by the Regulator.\textsuperscript{343}

The Home Office spent 1.4 million in 2012-13 for running the National DNA Database on behalf of all United Kingdom Police forces.\textsuperscript{344}

5.1.2.3. LATEST TECHNIQUES USED IN THE NDNAD

\begin{itemize}
  \item \textit{(a) Familial Searching,}
  \item \textit{(b) Low Copy Number (LCN) DNA Testing, and}
  \item \textit{(c) Post Conviction DNA Testing.}
\end{itemize}

\textbf{(a) Familial Searching}: Criminals whose DNA profile has never been entered into a DNA database because they were never arrested, prosecuted, or convicted of a crime which can still be identified through a technique called familial searches. Nowadays, persons DNA kinship can be sufficient to link a person to a crime.\textsuperscript{345}

\textbf{(FIGURE-5A)}\textsuperscript{346}

According to the National District Attorneys Association:

‘Familial searching is a technique whereby a crime scene profile is deliberately run through the offender databank in the hopes of getting a list of profiles that are genetically similar to the DNA evidence and using this information as an investigative lead to interview family members of the near matches.’\textsuperscript{347}

Since 2002, the United Kingdom (UK) has been the pioneer in the use of familial searches and routinely performs them on violent crimes (murder, rapes,

\textsuperscript{343} Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship , viewed on 18/02/2014 at 05.00pm
\textsuperscript{344} Id
\textsuperscript{345} Available at http://www.dnaforensics.com/familialsearches.aspx , viewed on 25/02/2014 at 03.40pm
\textsuperscript{346} Id
\textsuperscript{347} Id
child rapes, and terrorism). They match the DNA profile of the perpetrator which has been found at crime scenes with family members who are already in the DNA database. These matches have helped United Kingdom law enforcement solve a number of high profile cases, some of them cold cases.\(^{348}\)

One of the reasons that the United Kingdom has been the leader in familial searches is because British software is more useful in identifying a relatives' DNA than the software used in the United States. The British technology can narrow the search down to Y-STR (Short Tandem Repeats found on the male-specific Y chromosome). These searches highlight individuals with the same paternal lineage.\(^{349}\)

In addition, the United Kingdom has already entered the DNA profiles of more than 5% of its population (from England, Wales, and Northern Ireland), which makes familial searches more tempting. On 18\(^{th}\) March, 2008, the Yorkshire Post has reported, that Britain holds DNA profiles on a higher proportion of its population than any other country, with one in 14 United Kingdom citizens and samples from 3,80,000 unsolved crime scenes in the database. On 28\(^{th}\) October, 2009, The Telegraph has reported that the DNA database of England and Wales holds 5.5 million DNA profiles. When the DNA profiles of Scotland and Northern Ireland are added then it is almost 6 million people.\(^{350}\)

Case laws decided through familial searching were discussed below:

1. **The Loner: Jeffrey Gafoor.**\(^{351}\)

   The fact of the case was that one Lynette White, a 20-year-old prostitute who was brutally stabbed more than 50 times on Valentine's Day in Cardiff, Wales in 1988. Three local men were wrongly accused of the murder and sent to jail. They became known as the Cardiff Three - Stephen Miller, Tony Paris, and Yusef Abdullahi all spent time in jail for a crime they did not commit. They were

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\(^{348}\) Available at http://www.dnaforensics.com/familialsearches.aspx, viewed on 25/02/2014 at 03.40pm

\(^{349}\) Id

\(^{350}\) Id

\(^{351}\) Borrowed from http://www.dnaforensics.com/familialsearches.aspx, viewed on 25/02/2014 at 03.40pm
cleared on appeal in 1992 and they had a civil action against the South Wales police department. In March 2009, thirteen police officers involved in the case, some still serving and others retired, were summoned with conspiracy to pervert the course of justice by putting three innocent men in prison.

In 2000, a DNA profile of the actual killer was obtained, but no match was found in the United Kingdom DNA Database. In 2003, a familial search was performed and a close match to a 14-year-old boy with a similar genetic profile was found in the database. The DNA profile showed a rare gene variant found only among family members of the suspect. Because the boy was not even born when the crime was committed, law enforcement looked at his close relatives. This led police to the boy's 38-year-old paternal uncle, Jeffrey Gafoor. Gafoor confessed and received a life sentence for the killing of Lynette White.

2. **The Shoe Rapist James Lloyd.**

The most famous familial search case that made headlines around the world was the case of the Shoe Rapist. Between 1983 and 1986, women who wore stiletto shoes in South Yorkshire were attacked and raped by a serial rapist. He made a habit of stealing the shoes of his victims and was therefore named the shoe rapist. He was never caught.

In March 2006, the United Kingdom DNA Lab ran the rapist's DNA through its database as a familial search and got a hit. It matched the DNA of the rapist's sister who had been arrested for a DUI (Driving Under the Influence) offense in 2000. The accused was finally arrested and it was discovered that the shoe rapist was 50 year-old James Lloyd, a respected businessman in his town who was married and had three teenage children. When police searched his business they discovered 124 shoes hidden in a crawl space. Lloyd pleaded guilty to 4 rapes and 2 attempted rapes. Police suspected that he might have raped at least 10 women. On 4th September, 2006, Lloyd was given a life sentence and the judge ordered that he must serve at least 15 years in prison before becoming eligible for parole. In September 2007, Lloyd's sentence was reduced to seven years.

352 Borrowed from [http://www.dnaforensics.com/familialsearches.aspx](http://www.dnaforensics.com/familialsearches.aspx), viewed on 25/02/2014 at 03.40pm
3. **Killer Paul Hutchinson.**\(^{353}\)

In the evening of 30\(^{th}\) October, 1983, Colette Aram, a trainee hairdresser, was walking to her boyfriend's house. Sadly, she never made it there. She was abducted by Paul Hutchinson. He dragged her into the back of his stolen car, beaten over the head with a bottle and raped. He then strangled her with his bare hands and left her body in a nearby field. After the crime, Hutchinson went to a nearby pub to clean himself and purchased a drink and a sandwich. The next morning Colette's body was found. A man of the same description was seen in that pub and police retrieved hundreds of items from the pub hoping there would be something from the killer. Police were able to recover paper towels with blood and semen on it. The biological samples of victim and the suspect were identified. But, the suspect was never identified.

Hutchinson soon left the town. He shaved his head, told his family that he had cancer and moved away. Later, Hutchinson moved back to the same area, even taunting police by sending letters as if he was Jack the Ripper, telling them that he was still free and that they will never get him. Over the years, Hutchinson went on to get a psychology degree, married twice, and had four children. He was employed as a youth worker and later became a businessman.

In 2007, police developed a full DNA profile of the killer from the DNA recovered from the paper towels left at the pub near the crime scene. They passed it through the DNA database on a regular basis but obtained no hits. However, in June 2008 police got a break. Hutchinson's 20 year-old-son was arrested for a driving offense when he crashed into a parked car and had to give a DNA sample. On 26\(^{th}\) March, 2009, the police obtained a near identical match to the DNA of Colette’s killer. It was a familial match with Hutchinson and his two brothers. All three men were arrested on April 7 and gave a DNA sample. Paul Hutchinson's DNA was a perfect match and he was subsequently arrested. On 25\(^{th}\) January, 2010, he was sentenced to life. He will serve a minimum of 25 years for the rape and murder of Colette Aram, a crime he had committed in October 1983.

\(^{353}\) Borrowed from http://www.dnaforensics.com/familialsearches.aspx , viewed on 25/02/2014 at 03.40pm
So far, the practise of familial searches has never been challenged in a British court of law or in front of European Court of Human Rights (ECHR). Perhaps one reason is that familial searches enjoy wide public support because of its success. Since 2003, British law enforcement has routinely used familial searches to help solve violent crimes such as rapes and murders - crimes that would not have been solved otherwise.\textsuperscript{354}

\textit{(b) LOW COPY NUMBER (LCN) DNA TESTING:} The United Kingdom has also championed LCN DNA testing, a technique that seeks to generate a DNA profile from a minuscule amount of DNA, such as trace DNA left behind when a person touches an object. Standard DNA analysis is employed for DNA samples that contain as little as 1 nano gram (ng) of DNA, or as few as 160 human cells, or the sizes of a tiny blood spot down to 250 picograms ([PG], where 1 pg is one trillionth of a gram) of DNA or about 40 human cells. LCN, by contrast, is used on samples of less than one-tenth this size (100pg) or 16 cells, or about 1,000 times smaller than a grain of salt. This technique has been highly controversial among forensic scientists, and may have questioned its accuracy and reliability. Because the technique relies on such small amounts of DNA – such as DNA transferred to a murder weapon or left behind from a fingerprint - the analysis is highly subject to “allelic dropout” (where some alleles do not appear in the analysis because the signal is so low) and increased “stutter” (“stutters” are usually small peaks in the output of the DNA analyzer that are artifacts from DNA amplification and form as a result of halted polymerase activity from the polymerase chain reaction [PCR]).\textsuperscript{355}

In combined appeals of \textit{R. v. Reed and Reed and R. v. Garmson},\textsuperscript{356} the Court of Appeal considered the use of LCN DNA analysis as an evidentiary tool which was challenged in these appeals. In two different cases, the appellants appealed against their convictions to the Court of Appeal. The Reed brothers had

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{354} \textit{Available at} http://www.dnaforensics.com/familialsearches.aspx, viewed on 25/02/2014 at 03.40pm
\item \textsuperscript{355} \textit{Available at} http://books.google.co.in/books?id=kGDxQxyVRmQC&pg=PA172&lpg=PA172&dq=laws+regulating+dNA+data+banks+in+united+kingdom&source=bl&ots=dVvP8zWSul&sig=UVEhK5DQmn5TIm2rQxK3g8hB5g8&hl=en&sa=X&ei=ZgAFU86CGomOrQf95oHgDQ&ved=0CEsQ6AEwBTge#v=onepage&q=laws%20regulating%20DNA%20data%20banks%20in%20united%20kingdom&f=false; Also Available in Sheldon Krimsky, Tania Simoncelli, Genetic Justice: DNA Data Banks, Criminal Investigations, and Civil Liberties, P. 175-176
\item \textsuperscript{356} [2009] EWCA Crim 2698
\end{itemize}
\end{footnotesize}
been convicted of murder and the forensic scientist had used LCN testing on two pieces of plastic fragments found at the murder scene. Similarly, in Garmson’s trial for kidnapping, rape and sexual assault, LCN testing was used in respect of DNA found on four items. Lord Justice Thomas held, in dismissing the appeals, that LCN DNA could be used to obtain profiles capable of reliable interpretation if the quantity of template DNA was above a minimum stochastic threshold of between 100 and 200 picograms. In cases within the range of 100 to 200 picograms, evidence might be necessary as to whether in a particular case a reliable interpretation could be made.\footnote{Dr. Gokulesh Sharma, Legal evidentiary value of DNA profiling and its forensic use in court, P.79. \textit{Borrowed from}, http://ijtr.nic.in/JTRI%20Journal%202012.pdf , viewed on 19/02/2014 at 04.30pm}

Despite the ongoing controversy about LCN, the UK has used the technique in more than 20,000 cases and remains the only country to use it routinely. Sweden and Australia have also allowed LCN to be presented as evidence in a few high-profile cases.\footnote{Available at http://books.google.co.in/books?id=kGDxQxyVRmQC&pg=PA172&lpg=PA172&dq=laws+regulating+DNA+data+banks+in+united+kingdom&source=bl&ots=dVvP8zWSul&sig=UVehK5DQnm5Tlm2rQxK3g8hBSg8&hl=en&sa=X&ei=ZgAFU86CGomOrQf95oHgDQ&ved=0CEsQ6AEwBTge#v=onepage&q=laws%20regulating%20DNA%20data%20banks%20in%20united%20kingdom&f=false; Also Available in SheldonKrimsky, Tania Simoncelli, \textit{Genetic Justice: DNA Data Banks, Criminal Investigations, and Civil Liberties}, P.177}

\begin{enumerate}
\item[(c)] \textbf{POST CONVICTION DNA TESTING}: The National DNA Database (NDNAD) is mainly used at the pre-conviction stage to identify potential suspects, rather than to exonerate potentially innocent individuals post-conviction. There have been only two known cases where convictions were overturned post-appeal on the basis of new DNA evidence.\footnote{Available at http://www.innocencenetwork.org.uk/wp-content/uploads/2011/11/Naughton-and-Tan-IJEP-Nov-2010.pdf , viewed on 25/02/2014 at 05.45pm}

The first was the case of Michael Shirley who spent 16 years in prison maintaining his innocence for the murder of Linda Cook. His conviction was quashed in 2003, however, when testing of the semen found on swabs taken from the deceased yielded DNA which did not match Shirley nor the victim-new evidence which was ruled by the Court of Appeal (Criminal Division) to render his conviction unsafe.\footnote{R v. Shirley[2003]EWCA Crim 1976;\textit{Borrow from} http://www.innocencenetwork.org.uk/wp-content/uploads/2011/11/Naughton-and-Tan-IJEP-Nov-2010.pdf , viewed on 25/02/2014 at}
Recently, Sean Hodgson, convicted for the 1979 murder of 22 year old Teresa De Simone, overturned his conviction in March 2009 after 27 years of wrongful imprisonment during which he had always maintained his innocence, when DNA testing of the semen sample collected at the crime scene did not match his profile.  

5.1.3. CONSTITUTIONAL VALIDITY FOR COLLECTION AND RETENTION OF BIOLOGICAL SAMPLES FOR DNA ANALYSIS

In England the rule against self-incrimination and right to privacy are basic rights available to an accused person at the time of police investigation. The rule against self-incrimination is a common law privilege and is also provided in Article 6(1) of the European Convention of Human Rights. The right to privacy is provided in Article 8 of the European Convention of Human Rights. Article 8 reads as follows:

1. Everyone has the right to respect for his private and family life, his home and his correspondence.

2. There shall be no interference by a public authority with the exercise of this right except such as in accordance with the law and is necessary in a democratic society in the interests of national security, private safety, or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health and morals, or for the protection of the rights and freedom of others.

Thus the rights provided are not absolute. The public authorities can intrude into those rights without arbitrariness. The present law regarding the extent of the right of privacy of an accused person against police interference for the collection of forensic samples was explicitly laid down by the English Appellate Court in R. v. Constable of South Yorkshire. In this case the appellant challenged the validity of a 2001 Act passed by the British Parliament authorizing the police authorities to compel a person for fingerprints, bodily samples and DNA profiles, despite right to privacy as provided in Article 8 of the Human Rights Act, 1998. Balancing the public importance of protecting the public against

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363 Id
the consequences of crime with the individual’s right to privacy, Lord Woolf, CJ., held that the particular provision in the 2001 Act would not violate Article 8 of the Human Rights Act, 1998. Regarding this Lord Waller, LJ, observed:

‘The answer to Liberty’s point is I see it as follows. First the retention of samples permits

(a) The checking of the integrity and future utility of the DNA data base system;
(b) A reanalysis of the upgrading of DNA profiles where new technology can improve the discriminating power of the DNA–matching process;
(c) Reanalysis and thus an ability to extract other DNA-markers and thus offer benefits in terms of speed, sensitivity and the cost of searches of the database;
(d) Further analysis in investigations of alleged miscarriages of justice; and
(e) Further analysis so as to be able to identify any analytical or process errors.

It is these benefits which must be balanced against the risks identified by Liberty. In relation to those risks, the position in any event is first that any change in the law will have to be itself convention-complaint; second any change in practise would have to be convention-complaint; and third unlawfulness must not be assumed. In my view thus the risks identified are not great, and such as they are outweighed by the benefits in achieving the aim of prosecuting and preventing crime.’

5.1.3.1. CHALLENGES TO DNA RETENTION IN UK - S AND MARPER’S CASE

On 16th August, 2004, two British citizens, Mr. Michael Marper, and S (request made by applicant not to have his name disclosed was granted by the court) brought two separate applications against the United Kingdom of Great Britain and Northern Ireland alleging violations under Article 14 of the Convention for the Protection of Human Rights and Fundamental Freedoms. S had been arrested on 19th January, 2001, at the age of 11 and charged with attempted robbery. His fingerprints and DNA sample were taken pursuant to the Police and Criminal Evidence Act, 1984. On 14th June, 2001, S was acquitted of the crime but his DNA profile remained on the United Kingdom National DNA Database.

Mr. Marper was arrested on 13th March, 2001, and charged with harassment. At the time of his arrest his DNA and fingerprints were taken. No

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365 Id, P.218
366 Borrow from http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship, viewed on 23/02/2014 at 05.15pm
charges were ever pressed and criminal proceedings were never initiated. His DNA profile remained on the database.

Both S and Marper asked for their fingerprints and DNA to be destroyed but police refused in both cases. S and Marper applied for judicial review of the officers’ decisions not to destroy the samples. On 22\textsuperscript{nd} March, 2002, the Administrative Court denied the applications. S and Marper appealed the decision to the Court of Appeal, which, on 12\textsuperscript{th} September, 2002, upheld the Administrative Court’s decision. Lord Justice Walker (of the Court of Appeal) used a balancing test to determine whether the DNA samples should be retained. He found that the risks in keeping genetic material were outweighed by the benefits in achieving the United Kingdom’s goals of prosecuting and preventing crime.

On 22\textsuperscript{nd} July, 2004, the House of Lords dismissed an appeal brought by S and Marper.

In applying the balancing test, the House of Lords concluded that the retention of fingerprints and DNA samples did not constitute an interference with the right to respect for private life, but that even if there was interference it was modest indeed. The judges noted that the modest interference was justified by the purpose of retaining DNA profiles: the prevention of future crime and the right of other citizens to be free from crime. In response to S’s and Marper’s argument that retention of their DNA profiles on the database without a conviction created suspicion in respect of persons who had been acquitted. The Home Secretary argued that retention of DNA had nothing to do with the past (the offense the person was acquitted for) but retention was to aid officers in their investigations of future crimes. The applicants and other similarly situated would only be impacted by the retention of their profiles if their profiles were a match for samples found at a future crime scene. The House of Lords determined that the retention of DNA profiles provided the law enforcement with an enormous benefit and did not create a privacy intrusion under Article 8 of European Convention on Human Rights.

S and Marper brought their case before the European Court of Human Rights’ Grand Chamber. Liberty and Privacy International, two non-governmental organizations, filed third-party briefs detailing the private nature of genetic material found in DNA samples. Liberty called attention to the important rights
granted under the Convention: that government interference with an individual’s rights must be necessary in the democratic society and have a legitimate goal of addressing a pressing social need. Furthermore, the privacy interference must be in proportion to the goal and subject to the Court’s review and approval. S and Marper focused on the personal nature of the DNA samples along with their indefinite retention, stressing the data could be used to determine highly private information about medical conditions. They further claimed that the retention had negative psychological implications because it exposed them to a certain negative criminal stigma.

The United Kingdom government argued that the Police and Criminal Evidence Act of 1984 authorized the collection of the samples and retention of the profiles. The government further alleged that their activities did not fall within the purview of Article 8 of European Conventions on Human Rights because it was used only as a means of accurate identification and did not reveal any personal information about the individuals. The government stressed the legitimate goal of identifying future criminals as weighed against the minimal intrusion of collecting the samples.

The 17-judge bench unanimously ruled that the retention of the DNA samples in England, Wales, and Northern Ireland was a violation of Article 8 and awarded 42,000 pounds each to S and Marper. The Court stressed that the government interference with intimate details of individuals’ personal information is of the utmost importance to the individual. The Court looked at how other Member States dealt with DNA collection and retention, focusing on Scotland. The Court determined that Scotland had developed a rational and proportionate method for the DNA issue: indefinite retention for convicted individuals, destruction of samples and profiles for those acquitted or whose charges were dropped. The judges decided that in dealing with issues such as this, where personal and important private information is at stake, Member States need to be given a narrow margin in how the individual states act. In this case, the Court declared that the United Kingdom was outside the margin and indefinite retention did not achieve the proper balance.
5.1.3.2. UNITED KINGDOM REACTION TO S AND MARPER’S CASE

In response to the decision the Home Office announced in May 2009 a consultation on how to comply with the ruling. The Home Office proposed to continue retaining indefinitely the DNA profiles of anyone convicted of any recordable offense, but to remove other profiles from the database after a period of time - generally 6 or 12 years, depending on the seriousness of the offense. The practice of taking DNA profiles upon arrest is not affected by the decision. On April 2010 the Crime and Security Act 2010 established that DNA profiles and fingerprints of anyone convicted of a recordable offense will be stored permanently, while those obtained on arrest, even when no conviction follows, will be stored for 6 years, renewable on new arrests.\(^{367}\)

On 18th May, 2011, the United Kingdom Supreme Court has also ruled, by a majority, that the present Association of Chief Police Officer (ACPO) DNA retention guidelines are unlawful because they are incompatible with article 8 of the European Convention on Human Rights (ECHR). However, not wishing to step on the toes of Parliament discussing the same issue, they grant no other relief.\(^{368}\)

Finally on 1st May, 2012, the Protection of Freedoms Act 2012 received Royal Assent, bringing in a new framework for police retention of fingerprints and DNA data for innocents on NDNAD.\(^{369}\) Commencement orders were expected in September 2013, when UK Police forces should have finished deleting the DNA records and biometric samples of innocents they no longer could keep under the new legislation.\(^{370}\)

Destruction of DNA samples were completed on 31st May, 2013. The Act came into force on October 2013.\(^{371}\)

\(^{367}\) Borrowed from http://en.wikipedia.org/wiki/United_Kingdom_National_DNA_Database, viewed on 18/02/2014 at 05.30pm

\(^{368}\) Id

\(^{369}\) Id

\(^{370}\) Id

\(^{371}\) Available at http://en.wikipedia.org/wiki/Protection_of_Freedoms_Act_2012#Part_6:_Freedom_of_Information_and_Data_Protection, viewed on 19/02/2014 at 07.30pm
5.1.4. ADMISSIBILITY OF DNA

Although relatively new, DNA evidence has become one of the frequently adduced types of evidence during a criminal trial. Because of the high cogency it is extremely important that results of DNA examination of crime stains and subject samples are presented in a proper way and that the expert witness who adduces the evidence does not comment on points he is not entitled to during his.\textsuperscript{372}

Before the commencement of trial, the prosecution should disclose to the accused all the evidences on which the prosecution is to rely to secure conviction. As provided by Section 13(1) of the Criminal Procedure and Investigations Act 1996 (CPIA) the prosecution is obliged to comply with primary disclosure under Section 3 as soon as reasonably possible after the accused has been committed for trial. In addition to disclosure of the evidence which will be used by the prosecutor against the defendant, Section 3(1) of the CPIA stipulates that the prosecutor must disclose to the accused any prosecution material which has not previously been disclosed to the accused and which might reasonably be considered capable of undermining the case for the prosecution against the accused or of assisting the case for the accused. In making the decision as to the disclosure, the prosecutor has to consider whether this evidence can be used by the defense to undermine the prosecution case in cross-examination or suggest an explanation or partial explanation of the accused action.\textsuperscript{373}

DNA evidence which the prosecution intends to adduce at the trial typically confirms to a format devised by the Forensic Science Service (FSS) although statements provided by other laboratories may show minor variations. The statement dealing with DNA analysis usually contains the name, expertise, experience, and qualifications of the expert, the list of items received for examination, the information given to the scientist about the alleged circumstances of the case, the purpose of examination, various technical issues, results, and conclusions.\textsuperscript{374}

Where the expertise was performed by a team of scientists this should be clearly stated in the statement and the contribution of each member of the team

\textsuperscript{372} Available at http://www.medicalgenomics.co.uk/pdf/Barrister_vol32-2007.pdf , viewed on 18/02/2014 at 05.50pm
\textsuperscript{373} Id
\textsuperscript{374} Id
indicated. Usually this is provided separately from the statement in a forensic examination record which is neither a statement nor an exhibit and is served separately.  

Being a specialized area of knowledge, DNA evidence needs to be properly explained to the jury. It is done by scientist who is either personally involved in obtaining the evidence or is personally supervised the team of scientists who produce the data. The purpose of the expert is to provide the jury with the information which is outside the scope of their knowledge to help them to form the opinion on issues linking the defendant and the scene of crime.  

In England and Wales the following guidelines for presenting DNA evidence in court were laid down in the ruling of R v. Doheny and Adams.  

1. The scientist should adduce the evidence of the DNA comparisons between the crime stain and the defendant’s sample together with his calculations of the random occurrence ratio [although this is the requirement laid out in the ruling, the use of random occurrence ratio to express the strength of DNA evidence is erroneous-the correct index which must be reported by the scientist is Random Match Probability. UK forensic scientists recognize the difference between these indices and correctly report Random Match Probability in their statements]  

2. Whenever DNA evidence is to be adduced the Crown should serve on the defense details as to how the calculations have been carried out which are sufficient to enable the defense to scrutinize the basis of the calculations.  

3. The Forensic Science Service should make available to a defense expert, if requested, the databases upon which the calculations have been based.  

4. Any issue of expert evidence should be identified and, if possible, resolved before trial. This area should be explored by the court in the pre-trial review.
5. In giving evidence the expert will explain to the jury the nature of the matching DNA characteristics between the DNA in the crime stain and the DNA in the defendant’s blood sample.

6. The expert will, on the basis of empirical statistical data, give the jury the random occurrence ratio – the frequency with which the matching DNA characteristics are likely to be found in the population at large.

7. Provided that the expert has the necessary data, it may then be appropriate for him to indicate how many people with the matching characteristics are likely to be found in the United Kingdom or a more limited relevant sub-group, for instance, the Caucasian, sexually active males in the Manchester area.

8. It is then for the jury to decide, having regard to all the relevant evidence, whether they are sure that it was the defendant who left the crime stain, or whether it is possible that it was left by someone else with the same matching DNA characteristics.

9. The expert should not be asked his opinion on the likelihood that it was the defendant who left the crime stain, nor when giving evidence should he use terminology which may lead the jury to believe that he is expressing such an opinion.

10. It is inappropriate for an expert to expound a statistical approach to evaluating the likelihood that the defendant left the crime stain, since unnecessary theory and complexity deflect the jury from their proper task.

11. In the summing-up careful directions are required in respect of any issues of expert evidence and guidance should be given to avoid confusion caused by areas of expert evidence where no real issue exists.

12. The judge should explain to the jury the relevance of the random occurrence ratio in arriving at their verdict and draw attention to the extraneous evidence which provides the context which gives that ratio its significance, and to that which conflicts with the conclusion that the defendant was responsible for the crime stain.
In relation to the random occurrence ratio, a direction along the following lines may be appropriate, tailored to the facts of the particular case:

‘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.’

When assessing DNA evidence (as well as other type of evidence) in criminal proceedings the problem is the law has to confront the extent to which experts are allowed to influence the jury’s decision on disputed issues, upon which the final verdict will depend, have to be clearly separated in the mind of the expert from those on which he is entitled to give an opinion. The ultimate issues are unacceptable at common law to be commented on by an expert witness. These issues are ultimately for the jury to decide according to the standard of proof determined by law. The expert must not abuse his position, deliberately or inadvertently, by expressing opinion on the matters he is not entitled to nor should he be asked to express such an opinion.

In relation to DNA evidence specific ultimate issues are the following:

1. Whether or not the accused is the source of DNA found in the crime stain

From the legal standpoint, it is in the realm of the jury to decide whether or not the accused is the source of the DNA from the crime stain sample and consequently whether or not the accused was at the scene when the crime was committed. In arriving to this decision the jury bases their conclusion on vast amount of evidential information provided to them by the prosecution and defense. Even more importantly, the jury possesses the means of verifying this information. The forensic scientist does not have access to any of this. He cannot be sure whether or not the background information about the case which was provided to him by police is true and does not have any means to check this.

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378 Borrowed from http://www.medicalgenomics.co.uk/pdf/Barrister_vol32-2007.pdf, viewed on 18/02/2014 at 05.50pm
379 Id
2. The personal opinion of the expert as to the weight of DNA evidence expressed in a non-numerical way using a verbal scale (eg. Extremely strong support, strong support, moderate support, etc).

When presenting the results using the verbal scale, the wordings express either a personal opinion of the scientist on the strength of the support to one of the hypotheses or the personal opinions of the scientist who developed this verbal scale. This contravenes the above rules of presenting DNA evidence in court. When a scientist expresses the strength of the scientific support he appears to be commenting on the ultimate issue which in most cases is whether or not the accused is the source of the crime stain.

3. Whether as a result of a specific act the accused left his/her DNA at the scene of crime.

Even in cases when there is strong indication as to the identity of donor of DNA found in a crime sample how the DNA was deposited is not the domain of the expert to be commenting on. For example, female DNA found on penile swab of a male suspected of rape or indecent assault could have resulted from a vaginal, anal, and oral intercourse as well as being transferred there using hands if the male touched alleged victims genitals first and then used the same hand to masturbate himself. The forensic scientist does not have all necessary information to be able to comment on how the DNA from the alleged victim had found its way onto his penile shaft.

4. The size of the relevant population (i.e. the population the perpetrator comes from).

It is not in the domain of the forensic scientist to express his opinion on the likelihood of someone to commit the crime in question and, consequently to be included in the population relevant to the case. The idea about the type, size, and boundaries of the relevant population (sex of the offender, his/her age, location, etc.) is formed in the minds of the jury based on the adduced prior to DNA evidence. This evidence is not available to the forensic scientist making him in no position to comment on the size of the relevant population.
5. The number of people who potentially could contribute their DNA to the crime sample (as opposed to giving the minimum number of contributors to the DNA mixture based on the results of DNA analysis).

The scientist could estimate the number of contributors to a DNA mixture by analyzing the number of peaks and their morphology. However, the jury is in the position to know how many people have been at the scene of crime and consequently can estimate the number of people who could have potentially contributed to the mixture. Usually, when reporting results of mixture evaluation forensic scientists give the number of potential contributors in the form of “no less than”, thus indicating the minimum number of the individuals who could potentially have contributed their DNA to the mixture.

6. The likelihood of error during examination of DNA evidence.

It is for the jury to decide whether or not the results of DNA analysis have been affected by a laboratory or other error taking into consideration the information about the types of laboratory and reporting errors possible in each particular case, the genotyping error rate of a particular laboratory (if it is available, ideally the results of external blind proficiency tests) and the effect of errors on probative value of DNA evidence.

The rules laid down in *R v. Doheny and Adams,*\(^{380}\) clearly indicate that the expert should not be asked his opinion on the likelihood that it was the defendant who left the crime stain nor when giving evidence … use terminology which may lead the jury to believe that he expressing such an opinion.

When the report contains personal opinion of the expert on the strength of DNA evidence this opinion should never be allowed to be aired in court as it will contravene the decision of the Court of Appeal. If the prosecuting expert during his testimony expresses a personal opinion on the strength of evidence the defense should make an application to the judge to instruct the jury to disregard this part of the expert’s testimony.

\(^{380}\) (1997) 1 Cr.App.R.369; Borrowed from http://www.medicalgenomics.co.uk/pdf/Barristervol32-2007.pdf, viewed on 18/02/2014 at 05.50pm
5.1.5. BACKLOG OF CASES IN UNITED KINGDOM

There is no backlog of cases in the United Kingdom. The report of Rand Corporation, a non-profit institution that helps improve policy and decision making through research and analysis has analyzed under the head of toward a comparison of DNA Profiling and Databases in the United States and England. The report also suggests that England has no backlogs of cases waiting to be analyzed. The report has analyzed the best features of United Kingdom databases. The following reasons are:

1. In England, all forensic services are provided to police forces by private or privatized labs. There is a national forensic framework agreement essentially, a list of approved suppliers of forensic services. Those approved suppliers compete to provide services to police forces. There are 4 major players in the market: the Forensic Science Service, LGC Forensics, Orchid Cellmark, and Key Forensic Service. These approved suppliers conduct DNA tests and then load the profiles on to the NDNAD themselves.

2. Regulation in England: There is a position called the forensic science regulator. The regulator’s role is to be a single point of regulation of forensic science for policing purposes from the scene of crime right through the court processes (National Policing Improvement Agency, 2009). The regulator has a small staff and chairs in the Forensic Science Advisory Council, which includes police, lawyers, judges, scientists, and members of the Criminal Cases Review Commission.

3. Turnaround time: DNA analysis is conducted much more quickly in England (average 3 days).

4. England’s forensic DNA analysis process has more fully integrated productivity-enhancing technologies-specifically, laboratory information management systems (LIMS) and automation-than do America’s public laboratory processes. Information technologies designed to improve

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Borrowed from http://www.rand.org/content/dam/rand/pubs/technical_reports/2010/RAND_TR918.pdf, viewed on 23/02/2014 at 07.00pm
laboratory workflow which is generally referred to LIMS. LIMS can receive and catalogue requests, track evidence and sample location and status during analysis, and facilitate the creation, dissemination, and archiving of reports. For case management, the FSS created a LIMS that has allowed the English system to manage requests from police departments relatively easily.\textsuperscript{387}

5.2. DNA TECHNOLOGY IN UNITED STATES OF AMERICA

The United States currently has the largest DNA database in the world. Until a few years ago, the United Kingdom had the largest.\textsuperscript{388} Now, all 50 states have statutory legislation providing for obligatory DNA banking in the United States.\textsuperscript{389} It analyzes the statute dealing with DNA in the United States and the establishment of National DNA Index System (NDIS) and CODIS, the constitutional validity for the collection and retention of biological samples for DNA analysis, and the admissibility of DNA evidence in the courtrooms of United States as well pitfalls regarding DNA technology.

5.2.1. STATUTES DEALING WITH DNA AND THE ESTABLISHMENT OF NATIONAL DNA INDEX SYSTEM (NDIS) AND COMBINED DNA INDEX SYSTEM (CODIS)

On 13\textsuperscript{th} September, 1994, President Bill Clinton signed an act of Congress amending the Omnibus Crime Control and Safe Streets Act of 1968. The act made a number of changes in the original act, including authority to grants to increase the number of police officers hired by police departments, expanding and improving co-operative efforts between law enforcement agencies and members of the community to address disorder problems, and regulating and codifying the testing of DNA samples in the nation’s forensic laboratories. The act became Public Law 103-322 and was codified in the United States Code, Title 42 (The Public Health and Welfare), Chapter 136 (Violent Crime Control and Law Enforcement), and Sections 14131 through 14133.\textsuperscript{390} The act came into effect as of 1\textsuperscript{st} January, 1994.

\textsuperscript{387} Id
\textsuperscript{388} Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship, viewed on 18/02/2014 at 05.00pm
\textsuperscript{389} Available at http://www.alsme.org/DNA_ELSI_Grant, viewed on 25/02/2014 at 06.00pm
\textsuperscript{390} Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51&dq=united+states+laws+dealing+DNA+evidence&source=bl&ots=5AxxD27c8h&sig=bMeuZ-
The first section 14131 requires the Federal Bureau of Investigation (FBI) to establish standards for DNA laboratories to ensure that their work meets reasonable scientific criteria for such research. The section also calls for hiring of an independent firm to do the so-called blind external proficiency testing of DNA laboratories. Blind external proficiency testing is a testing carried out by some authenticating agency to determine the proficiency of a testing laboratories work without that the laboratory knows the real purpose for which the test is being conducted. Finally, the section calls for the creation of an advisory board of scientific experts in the field of DNA typing to advise the FBI on technical questions relating to DNA testing.391

The second section 14132 provides for the creation of a DNA index that contains DNA records obtained by both federal and state agencies consisting of four kinds of records:

1. Those collected from persons convicted of crimes;
2. Those recovered from crime scenes;
3. Those recovered from unidentified remains; and
4. Those voluntarily contributed from relatives of missing persons.

The section also provides for a system by which federal and state governments can exchange DNA records with each other.392 In response to this congressional mandate, the FBI established the Combined DNA Index System (CODIS).393

The third section 14133 deals specifically with standards and procedures for DNA typing conducted by members of the Federal Bureau of Investigation (FBI). It sets standards for the training of such individuals, provides for their blind external proficiency testing, and clarifies privacy requirements for individuals for

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391 Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51
392 Available at http://en.wikipedia.org/wiki/DNA_Analysis_Backlog_Elimination_Act_of_2000, viewed on 19/02/2014 at 07.45pm
393 Id
whom DNA samples are collected. The section also prescribes penalties for government employees who violate any provision of this section of the act.\textsuperscript{394}

In 2000, Congress passed the DNA Analysis Backlog Elimination Act (DNA Act), 42 U.S.C. Section 14135 et seq., which authorizes the Attorney General to make grants to eligible States . . . to carry out, for inclusion in the Combined DNA Index System of the Federal Bureau of Investigation, samples of DNA analysis of samples taken from individuals convicted of a qualifying State offenses. 42 U.S.C. Section 14135(a) (1). Moreover, the DNA Act provides that the Director of the Bureau of Prisons shall collect a DNA sample from each individual in the custody of the Bureau of Prisons who is, or has been, convicted of a qualifying Federal offense and that the probation office responsible for the supervision under Federal law of an individual on probation, parole, or supervised release shall collect a DNA sample from each such individual who is or has been, convicted of a qualifying Federal offense.(42 U.S.C. Section 14135a(a)(1)-(2)). In addition, Congress has mandated the collection of DNA samples from each individual in the custody of the Bureau of Prisons who is, or has been convicted of a qualifying District of Columbia offense or any individual under the supervision of the Agency who is on supervised release, parole, or probation who is, or has been convicted of a qualifying District of Columbia offense.(42 U.S.C. Section 14135b(a)(1)-(2)). Congress left to the District of Columbia the responsibility of determining which offenses under the District of Columbia Code should be deemed qualifying offenses. (42 U.S.C. Section 14135b(d)). The District of Columbia has determined that forty-nine separate offense qualify for collection under the DNA Act. (See, D.C. Code Section 22-4151(1)-(46)). These qualifying offenses include, for example, arson, aggravated assault, burglary, kidnapping, robbery, attempted robbery and carjacking.\textsuperscript{395}

Once a DNA sample is entered into the CODIS database, the information can only be released:

(1) To criminal justice agencies for law enforcement identification purposes;
(2) In judicial proceedings;
(3) For criminal defense purposes, to a defendant, who shall have access to samples and analyses performed in connection with the case in which such defendant is charged; or

\textsuperscript{394} \textit{Id}
\textsuperscript{395} Available at http://en.wikipedia.org/wiki/DNA_Analysis_Backlog_Elimination_Act_of_2000, viewed on 19/02/2014 at 07.45pm
(4) If personally identifiable information is removed, for a population statistics database, for identification research and protocol development purposes, or for quality control purposes [42 U.S.C. Section 14132(b) (3)].

In addition, the DNA Act imposes criminal penalties for individuals who improperly disclose sample results or improperly obtains or uses DNA samples. (42 U.S.C. Section 14135e(c)).

5.2.1.1. PRESIDENT’S DNA INITIATIVE (2003)

By the beginning of the 21st century, DNA typing had become widely accepted by forensic scientists and law enforcement officials as one of the most valid and reliable methods of identifying an individual involved in a crime. One remaining problem with the use of DNA typing, however, was the delay involved in collecting, analyzing, and interpreting DNA samples collected from an individual or a crime scene. In August 2001, Attorney General John Ashcroft decided to attack this problem. He directed the National Institute of Justice (NIJ) to develop recommendations for way of reducing the delay involved in the use of DNA typing. In response to the charge, the NIJ convened a working group consisting of experts in forensic science and DNA typing from local, state, and national levels. That group submitted a report to the Attorney General in late 2002 that becomes the basis of the President’s DNA initiative and a group of bills dealing with the use of DNA technology in law enforcement.

President George W. Bush announced his President’s DNA initiative on March 11, 2003. The initiative called for the investment of more than $1 billion for funding, trading, and assistance of federal, state, and local forensic laboratories and law enforcement personnel with the goal of ensuring that DNA typing is used to its greatest potential in solving crimes, protecting the innocent, and identifying missing persons. The initiative was given the name of Advancing Justice through DNA technology. The initiative had a number of specific objectives, including elimination of the backlog of unanalyzed DNA samples, improvement of crime

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396 Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51&dq=united+states+laws+dealing+DNA+evidence&source=bl&ots=5Ax6D276c8h&sig=bMeaZ-aM79fV33VZyKcH6G97jll&hl=en&sa=X&ei=VOMlU7LrB8mXrAB7YC4Aw&ved=0CCYQ6AEwAA#v=onepage&q=united%20states%20laws%20dealing%20DNA%20evidence&f=false; Also Available in David E. Newton, DNA Evidence and Forensic Science, Infobase publishing, 2008, P.59-60
laboratories efficiency in analyzing DNA samples, stimulation of research on new DNA technologies, development of training programs for technicians who work with DNA evidence, and access to DNA testing not present or made available at a trial.\textsuperscript{398}

The National Institute of Justice report was also instrumental in the adoption of legislation that dovetailed with the President’s DNA initiative. The most important of that legislation was H. R. 5107, the Justice for All Act, introduced on September 21, 2004, by Representative F. James Sensenbranner, Jr. the Bill was passed by the House of Representatives on 6\textsuperscript{th} October, by the Senate on October 9, and signed into law by President Bush on 30\textsuperscript{th} October, 2004. Then, it became Public Law 108405. The law provided directions and funding to the department of Justice and other agencies with the goal of carrying out many of the objectives stated by President Bush in his March 2003 announcement of the president’s DNA initiative.\textsuperscript{399}

The first part of the Justice for All Act, 2004, the Scott Campbell, Stephanie Roper, Wendy Preston, Louarna Gillis, and Nila Lynn Crime Victim’s Rights Act, dealt with the rights of the victims of crime in general. The second part of the act, the Debbie Smith Act of 2004, focused on methods for reducing the backlog in cases of DNA typing awaiting completion and expansion of the FBI’s CODIS database. The third part of the act, DNA sexual Assault Justice Act of 2004, dealt with a number of miscellaneous issues related to DNA typing, including ensuring the compliance by public crime laboratory with federal standards; training and education in DNA typing for identifying missing persons; and the establishment of penalties for improper use of DNA information. The fourth part of the act, the Innocence Protection of Act of 2004, made a number of provisions for the use of DNA typing in the exoneration of prisoners wrongfully convicted of crimes, including grants to states to improve the quality

\textsuperscript{398} Id., P.59-60

\textsuperscript{399} Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51&dq=united%20states%20laws%20dealing%20DNA%20evidence&hl=en&sa=X&ei=VOMlU7LrB8mXrAfB7YC4Aw&ved=0CCYQ6AEwAA#v=onepage&q=united%20states%20laws%20dealing%20DNA%20evidence&f=false; Also Available in David E. Newton, DNA Evidence and Forensic Science, Infobase publishing, 2008, P. 60
of representation for such individuals and compensation to those who had been wrongly incarcerated.\textsuperscript{400}

Congress further expanded DNA legislation with the passage of the Violence Against Women Act of 2006 and Adam Walsh Protection and Safety Act of 2006. These acts permitted federal officials to obtain DNA from any person arrested for a federal felony and federal detainees who were neither US citizens nor permanent resident aliens.

5.2.1.2. STATE LAWS (2007)

All the 50 states and the federal government now require that individuals implicated or convicted of certain crimes submit DNA samples to law enforcement agencies. These samples are then tested, typed, and entered into state and national DNA databases. The results of these DNA typing are then retained in the databases in all cases essentially forever, with no provisions for deletion of the information upon the criminals having completed his or her sentence or other punishment.\textsuperscript{401}

State laws have evolved over a period of almost two decades in a variety of directions, resulting in a crazy quilt array of DNA statutes throughout the 50 states and the federal government. In general, those laws fall into four categories:\textsuperscript{402}

(1) Designation of those individuals who are required to submit DNA samples;
(2) Provision of penalties for misuse of DNA information obtained in such tests;
(3) Specification of those individuals and agencies who are authorized to see and use DNA data; and
(4) Provisions for the retention of DNA samples and information obtained from those samples.

States may have laws in anyone or more of these four categories.\textsuperscript{403} At one time, DNA typing was required by state laws only for individuals convicted of

\textsuperscript{400} Id
\textsuperscript{401} Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51&dq=united+states+laws+dealing+DNA+evidence&source=bl&ots=5AxxD27c8h&sig=bMeaZ-aM79fV33VZyKc6G97jIl&hl=en&sa=X&ei=VOMlU7LrB8mXrAfB7YC4Aw&ved=0CCYQ6AEwAA#v=onepage&q=united%20states%20laws%20dealing%20DNA%20evidence&f=false; Also Available in David E. Newton, DNA Evidence and Forensic Science, Infobase publishing, 2008, P.60
\textsuperscript{402} Id, P. 61
\textsuperscript{403} Id
certain crimes. That practise spread rapidly, however, and as of 2007, 34 states had statutes requiring anyone convicted of a felony to submit a DNA sample. Many states (38 in 2007) also require DNA typing for certain types of misdemeanor crimes, usually those in which violence or sex was involved. More recently some states required DNA typing for individuals who were arrested of a crime, whether or not they tried and or convicted of the crime or not. As of 2007, 7 states- California, Kansas, Louisiana, Minnesota, New Mexico, Texas, and Virginia along with the federal government had laws for the testing of DNA from arrestees as well as from those convicted of a crime. A number of other states were considering legislation to include arrestees in their DNA statutes, and this movement appears to be gaining momentum in the nation. Consideration for the arrestee who was judged innocence was reflected in the fact that most states with arrestee laws-Louisiana, New Mexico, Texas, and Virginia require that DNA information be discarded if a person was found innocent of a crime.\footnote{Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51&dq=united+states+laws+dealing+DNA+evidence&source=bl&ots=5AxxD27c8h&sig=bMeaZ-aM79fV33VZyKcH6G97yll&hl=en&sa=X&ei=VOMlU7LrB8mXrAfB7YC4Aw&ved=0CCYQ6AEwAA#v=onepage&q=united%20states%20laws%20DNA%20evidence&f=false; Also Available in David E. Newton, DNA Evidence and Forensic Science, Infobase publishing, 2008, P.61}

Another recent trend in state statutes has been the adoption of laws allowing and describing the conditions for post-conviction DNA testing. Such a law permits a person who has been convicted of a crime, usually whether or not the conviction involved the use of DNA typing, to request a DNA analysis of evidence available in the case. The law has been passed to some extend as a result of the advocacy of the Innocence Project, an organization that works to assist innocent individuals who have unfairly been convicted of crimes they did not commit. As of 2007, about 2 dozen states had post-conviction DNA laws that, like other DNA laws, differ from each other in some substantial ways.\footnote{Id}

On 24\textsuperscript{th} May 2013, Oklahoma became the 50\textsuperscript{th} and final State to pass a post-conviction DNA testing law. 306 people who were wrongfully convicted of crimes had been exonerated by DNA evidence in the United States since DNA testing first became available as a forensic tool in 1989. Representative Lee Denney (R-Cushing) and Senator Jim Halligan (R-Stillwater) supported the law,
HB 1068. The law was incited by a proposal issued by the Oklahoma Justice Commission in November 2013. Laws like HB 1068 passed in Oklahoma give many wrongfully convicted individuals the opportunity to gain access to DNA testing. Without such laws, innocent prisoners do not have a statutory right to testing and are required to rely on judges and prosecutors to grant access to DNA testing.\textsuperscript{406}

5.2.2. ESTABLISHMENT OF NATIONAL DNA INDEX SYSTEM (NDIS) AND COMBINED DNA INDEX SYSTEM (CODIS)

DNA databases are the most controversial areas in DNA fingerprinting. A DNA database is a larger number of DNA samples. Many people think that DNA databases help to identify the criminal in society. Others feel that these DNA databases represent an invasion of privacy.\textsuperscript{407} The United States of America has a DNA database in the name of the Combined DNA Index System (CODIS). The Combined DNA Index System (CODIS) is the world’s largest DNA database. The CODIS program began in 1990 with only twelve forensic laboratories.\textsuperscript{408} CODIS is a computer software program that operates local, state, and national databases of DNA profiles.\textsuperscript{409}

In 1989, the Virginia Division of Forensic Sciences implemented DNA testing in its criminal investigation, becoming the first state crime lab to introduce such a policy.\textsuperscript{410} The Virginia DNA Data Bank legislation was initially passed in July 1989 covering only felony sex offenders, but was expanded in 1990 to include all convicted felons. The legislation was again expanded in July 1996 to include all juveniles 14 years and older who were convicted of what would be considered a felony if they had been an adult. The Virginia DNA Data Bank and the blood samples collected from convicted offenders were maintained in the Forensic Biology section of the headquarters laboratory of the Virginia Division of Forensic Science located in Richmond, Virginia. Forensic casework DNA analysis was conducted in the Richmond laboratory, as well as in the Division’s

\textsuperscript{406} Available at http://law.scu.edu/northern-california-innocence-project/post-conviction-dna-testing-laws-enacted-in-all-50-states/ , viewed on 19/02/2014 at 08.00pm

\textsuperscript{407} Available at http://www.wpi.edu/Pubs/E-project/Available/E-project-090408-022926/unrestricted/Lincoln_Kayla_Marisa_IQP_Final.pdf , viewed on 19/02/2014 at 08.55pm

\textsuperscript{408} Id

\textsuperscript{409} Available at https://www.ncjrs.gov/pdffiles1/ijji/194197.pdf , viewed on 19/02/2014 at 09.50pm

\textsuperscript{410} Available at http://www.pbs.org/wgbh/pages/frontline/shows/case/revolution/databases.html , viewed on 19/02/2014 at 10.00pm

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three regional laboratories. The forensic casework DNA profiles from the three regional laboratories were housed in the CODIS local computer system in each individual laboratory, while all the convicted offenders DNA profiles and all forensic casework DNA profiles statewide were housed in the CODIS state computer system in the Richmond laboratory for searching purposes.\(^{411}\)

In 1994, Congress has authorized the Federal Bureau of Investigation (FBI) to establish and oversee the National DNA Index System (NDIS). When the NDIS launches in 1998, only nine states have participated. Currently, laboratories in all 50 states, the District of Columbia, the federal government, Puerto Rico, and the U. S. Army Criminal Investigation Laboratory participate in the NDIS. The NDIS has been provided by federal, state, and participating local crime laboratories.\(^{412}\) Originally, CODIS consists of the Convicted Offender Index and the Forensic Index, but in recent years, the Arrestee Index, the Missing or Unidentified Persons Index, and the Missing Persons Reference Index have been added. The Convicted Offender Index contains profiles of individuals convicted of crimes. State law governs which specific crimes are eligible for CODIS. (All 50 states have passed DNA legislation authorizing the collection of DNA profiles from convicted offenders for submission to CODIS.). The Forensic Index contains profiles developed from biological material found at crime-scenes.\(^{413}\) Every state in the Nation has a statutory provision for the establishment of a DNA database that allows for the collection of DNA profiles from offenders convicted of particular crimes. CODIS software enables state, local, and national law enforcement crime laboratories to compare DNA profiles electronically, thereby linking serial crimes to each other and identifying suspects by matching DNA profiles from crime scenes with profiles from convicted offenders.\(^{414}\)

CODIS is implemented as a distributed database with three levels: local, state, and national. All three tires contain the forensic and convicted offender

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\(^{411}\) Available at http://www.promega.com/~/media/files/resources/conference%20proceedings/ishi%2011/oral%20presentations/ll.pdf?la=en , viewed on 19/02/2014 at 07.58pm

\(^{412}\) Available at https://www.fas.org/sgp/crs/misc/R41800.pdf , viewed on 19/02/2014 at 07.45pm

\(^{413}\) Available at https://sites.google.com/site/dnareplicationsystem/combined-dna-index-system; Also available at http://en.wikipedia.org/wiki/Combined_DNA_Index_System , viewed on 18/02/2014 at 05.30pm

\(^{414}\) Available at https://www.ncjrs.gov/pdffiles1/nij/194197.pdf , viewed on 19/02/2014 at 09.50pm
indexes and a population database file. The hierarchical design provides state and local laboratories with the flexibility to configure CODIS to meet their specific legislative and technical needs. A description of the three CODIS tiers as follows.

The Local DNA Index System (LDIS) is installed at crime laboratories operated by police departments or other state agencies. All forensic DNA records originate at the local level and are transmitted to the state and national levels. Each state participating in the CODIS program has a State DNA Index System (SDIS) that enables exchange and comparison of DNA profiles within a state. SDIS also links the local and national levels, and is typically operated by the agency responsible for maintaining a state’s convicted offender DNA database program. The National DNA Index System (NDIS) is a single central repository of DNA records submitted by participating states, and is administrated by the FBI. NDIS allows forensic laboratories throughout the United States to share and exchange DNA profiles. NDIS is maintained by the FBI under the authority of the DNA identification Act of 1994. In 1994, to facilitate the storage and use of DNA fingerprints, Congress has passed the DNA Identification Act as part of the Violent Crime Control and Law Enforcement Act.

Congress passed the DNA Analysis Backlog Elimination Act, 42 U.S.C Section 14135 in 2000. The statute authorized federal officials to collect DNA samples from people convicted of specific violent crimes who were in federal custody, including probationers, parolees, and people on supervised release. In 2004 Congress passed the Justice for All Act, which expanded DNA collection to any person convicted of any federal felony. Congress further expanded DNA legislation with the passage of the Violence against Women Act of 2006 and the Adam Walsh Protection and Safety Act of 2006. These acts permitted federal

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415 Available at http://www.wpi.edu/Pubs/E-project/Available/E-project-090408-022926/unrestricted/Lincoln_Kayla_Marisa_IQP_Final.pdf, viewed on 19/02/2014 at 08.55pm

416 Id

417 Available at http://www.wpi.edu/Pubs/E-project/Available/E-project-090408-022926/unrestricted/Lincoln_Kayla_Marisa_IQP_Final.pdf, viewed on 19/02/2014 at 08.55pm

418 Available at https://www.ncjrs.gov/pdffiles1/ncjrs/194197.pdf, viewed on 19/02/2014 at 09.50pm

419 Available at http://www.archives.gov/records-mgmt/rcs/schedules/departments/department-of-justice/rg-0065/n1-065-06-009_sf115.pdf, viewed on 19/02/2014 at 08.55pm
officials to obtain DNA from any person arrested for a federal felony and federal
detainees who were neither United States citizens nor permanent resident
aliens.\footnote{Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship, viewed on 18/02/2014 at 05.00pm}

On 27\textsuperscript{th} July, 2006 the new amendments to DNA Analysis Backlog
Elimination Act, 2000-Section 14135a was added. This amendment authorized
DNA samples to be collected from individuals who were arrested, facing charges,
or convicted or from non-United States persons who were detained under the
authority of the United States. The statute stated that any felony was any
qualifying federal offense for purposes of the Act. The Act proscribed a criminal
penalty for individuals who failed to cooperate in the collection of samples –
failure to comply will result in the individual being guilty of a Class A
misdemeanor and punished in accordance with Title 18.\footnote{Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship, viewed on 18/02/2014 at 05.00pm}

The DNA Act requires the Attorney General, the Director of the Bureau of
Prisons, or the corresponding probation office to give every DNA sample taken
pursuant to (a) to the Director of the FBI. The FBI will then analyze each sample
and create a DNA profile. State and federal agencies submit locally analyzed
DNA profiles to the National DNA Index System (NDIS). The FBI uses its
software program, the Combined DNA Index System (CODIS) to link the profiles
already contained in the state and federal databases.\footnote{Id}

There are safeguards built into the statute and government policies that
protect the genetic information and limit the reach of the Act. First, the Act
requires the Director of the FBI to expunge the DNA record from CODIS when a
conviction is overturned or when, if the sample is taken following an arrest, the
charge is dismissed or results in an acquittal or no charge is timely filed. In order
for the FBI to expunge the record, the individual must send a certified copy of the
final court order establishing the final disposition of the arrest or conviction.\footnote{Id}

There are two additional government policies that are not explicitly part of
the statute but are important in protecting against the misuse of information. First,
there are no names or other personal identifiers stored in CODIS. The database contains only the DNA profile, a number identifying the agency that submitted the DNA profile, a Specimen Identification Number (a number the FBI assigned sequentially at the time the sample is collected that does not correspond in any way to the individual’s social security number, criminal history identifier, or correctional facility identifier), and information identifying the laboratory personnel associated with creating the profile. The end result is that a CODIS user can only access a very limited amount of data, none of which can be used to identify the source of the DNA profile.424

Second, the FBI has established a policy of using only “junk DNA”. Junk DNA refers to non-genetic stretches of DNA not presently recognized as being responsible for trait coding. The strict practise of analyzing and storing only “junk DNA” guarantees that important personal genetic information that reveals physical characteristics and medical conditions are not stored in CODIS.425

5.2.2.1. STANDARDS MAINTAINED BY THE NATIONAL AND CONGRESSIONAL INFLUENCES ON FORENSIC DNA TYPING

The forensic DNA typing community, the relevant scientific community and the United States Congress have all played a role in establishing national quality assurance standards for laboratories performing forensic DNA testing. These standards have helped to ensure the reliability of forensic DNA testing, which in turn has served to benefit and enhance the American judicial system.426

In 1988, the forensic DNA testing community through the Technical Working Group on DNA Analysis Methods (TWGDAM) began to address various issues regarding forensic DNA testing. TWGDAM was established in 1988 under the FBI Laboratory Division sponsorship and consisted of government and private sector forensic DNA scientists and other related experts from the United States and Canada. In 1989, 1991 and 1995, TWGDAM issued guidelines for quality assurance in DNA analysis. The TWGDAM guidelines served as the

424 Available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_scholarship, viewed on 18/02/2014 at 05.00pm
425 Id
426 Available at https://www.promega.com/~media/files/resources/profiles%20in%20dna/302/the%20evolution%20of%20quality%20standards%20for%20forensic%20dna%20analyses%20in%20the%20united%20states.pdf?la=en, viewed on 28/02/2014 at 05.00pm
de facto standards for forensic DNA testing until October 1998, when the subsequent DNA Advisory Board (DAB) standards went into effect. The DAB was created by the DNA Identification Act of 1994 and became operational in 1995. The TWGDAM guidelines and subsequent DAB standards covered the following quality assurance program areas for forensic DNA testing laboratories: planning and organization, personnel qualifications and training, equipment, materials and facilities, evidence handling procedures, validation, analytical procedures, proficiency testing, casework documentation, interpretation, report writing and review, safety, and audits.427

In March 1989, the House Committee on the Judiciary, Subcommittee on Civil and Constitutional Rights, began to hear testimony on the use of DNA technology for identifying violent criminal offenders through evidence left at crime scenes. House testimony from a university professor, an attorney and an American Civil Liberties Union (ACLU) member raised concerns regarding the adequacy of DNA technology to identify violent criminals and the perceived negative effects of DNA technology on individual civil liberties. Also in March 1989, the Senate Committee on the Judiciary, Subcommittee on the Constitution, heard testimony from university professors, an attorney and FBI Laboratory personnel stressing the importance of forensic DNA evidence in criminal investigations and prosecutions and the advantages of DNA technology in identifying criminal offenders.428

In 1990, the Office of Technology Assessment (OTA), an investigative arm of Congress, published Genetic Witness: Forensic Uses of DNA Tests, which reviewed the then state-of-the-art forensic uses of DNA technology. The OTA report addressed policy issues for Congressional action, technological issues, validity, reliability and quality assurance issues, and civil liberty and informational privacy issues. The legal community, in response to the OTA report, concurred that DNA testing was indeed valid but suggested that additional standards and quality assurance measures were still needed.429

427 Available at https://www.promega.com/~media/files/resources/profiles%20in%20dna/302/the%20evolution%20of%20quality%20standards%20for%20forensic%20dna%20analyses%20in%20the%20united%20states.pdf?la=en , viewed on 28/02/2014 at 05.00pm
428 Id
429 Id
In 1992, the National Research Council and National Academy of Sciences issued a report that recommended forensic DNA laboratories should establish formal quality assurance programs, should use external mechanisms of review such as certification, accreditation or regulation and should receive increased National Institute of Justice (NIJ) funding for education, training and research in forensic DNA testing. In 1996, the National Research Council issued a second report recommending that forensic DNA testing laboratories should adhere to high standards, should make every effort to become accredited, should regularly participate in proficiency testing, and where feasible, should preserve remaining forensic samples or portions for additional independent testing. Both the 1992 and 1996 National Research Council reports recommended that DNA technology be used in the resolution of criminal and civil cases but also stressed the need for additional quality assurance measures and programs.430

5.2.2.2. FOCUSED CONGRESSIONAL ACTIONS

After the 1989 Congressional hearings and the 1990 OTA report, in June 1991, Joint House and Senate Congressional hearings considered the use of DNA technology to identify criminal offenders and the need for standards to ensure the accuracy of DNA testing results. These 1991 hearings also proposed recommendations for Federal legislation. In March 1993, the DNA Identification Act of 1993 legislation proposed grants to state and local governments for establishing and improving forensic DNA testing capabilities and directed the establishment of standards for DNA testing laboratories. In 1994, the Congress passed and funded the Violent Crime Control and Law Enforcement Act of 1994, which included Title XXI and the DNA Identification Act of 1994. Title XXI and the DNA Identification Act of 1994 authorized grants to state and local law enforcement for establishing or improving DNA testing in forensic laboratories, established standards for forensic DNA testing through a national DNA Advisory Board, and required the FBI to establish a national index of convicted offenders’ DNA profiles.431

430 Available at https://www.promega.com/~media/files/resources/profiles%20in%20dna/302/the%20 evolution%20of%20quality%20standards%20for%20forensic%20dna%20analyses%20in%20the%20 united%20states.pdf?la=en, viewed on 28/02/2014 at 05.00pm

431 Id
5.2.2.3. THE DNA ADVISORY BOARD (DAB) STANDARDS

The DNA Identification Act of 1994 created and funded the DNA Advisory Board (DAB), which was staffed and implemented in 1995. The first chairman of the DAB was Nobel Laureate Dr. Joshua Lederberg. During his tenure, the Quality Assurance Standards for Forensic Testing Laboratories were created and approved by the Director of the FBI. These standards took effect on October 1, 1998. In 1998, Dr. Arthur Eisenberg was appointed the chair of the DAB and during his tenure the Quality Assurance Standards for Convicted Offender DNA Databasing Laboratories were finalized, approved and took effect on April 1, 1999. These standards now governed the use of forensic DNA testing and databasing in the United States and had required a consistently high degree of quality in forensic DNA analysis.432

These comprehensive standards address the following quality assurance program areas for forensic DNA testing: goals and objectives, organization and management, personnel qualifications and training, facilities, sample control, validation, analytical procedures, calibration and maintenance, proficiency testing, corrective action, documentation, review, safety, audits, and subcontracting of analytical testing.433

The DAB standards require comprehensive annual audits, and every two years the audit must have external participation. The audits are required to cover the following areas: quality assurance program, organization and management, personnel, facilities, evidence control, validation, analytical procedures, calibration and maintenance, proficiency testing, corrective action, reports, review, safety and previous audit compliance. The American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB), an international accrediting body for crime laboratories, cites specific required accreditation criteria from the DAB standards for forensic DNA examiners’ education, training, experience and proficiency testing.434

432 Available at https://www.promega.com/~media/files/resources/profiles%20in%20dna/302/the%20evolution%20of%20quality%20standards%20for%20forensic%20dna%20analyses%20in%20the%20united%20states.pdf?la=en , viewed on 28/02/2014 at 05.00pm

433 Id

434 Id
A functional National DNA Indexing System (NDIS) database has been implemented. The use of database DNA profiles in unsolved crimes during the early operations of NDIS indicates that it will be a significant and effective tool for the criminal justice system and the protection of society. The DNA typing of forensic samples in criminal cases has clearly a major beneficial effect on the criminal justice system. In 1995, the National Institute of Justice has published a book titled Convicted by Juries, Exonerated by Science, which cites the use of DNA technology not only for the conviction of offenders, but also for the exoneration of wrongly charged or convicted individuals in criminal cases. The DAB standards and preceding TWGDAM guidelines have helped to ensure the reliable use of DNA technology in the scientific resolution of judicial matters, regardless of the adversarial legal system imperfections.\textsuperscript{435} The DNA Advisory Board has been disbanded at the end of 2000, placing the responsibility for recommending revisions or additions for the guidelines to the FBI Director back to Scientific Working Group on DNA Analysis Methods (SWGDAM).\textsuperscript{436}

5.2.2.4. LATEST TECHNIQUES USED IN THE NDIS

(a) Familial Searching,  
(b) Low Copy Number (LCN) DNA Testing, and  
(c) Post Conviction DNA Testing.

(a) Familial Searching

Following the success of familial searching in the United Kingdom, two major studies brought the issue of familial searches to the forefront in the United States. In 2004, the United States Justice Department published a report that concluded that almost half (48\%) of all prison inmates surveyed, reported to have a close relative who had also been imprisoned. Usually it was a sibling, primarily a brother. In 2006, a study was published in Science Magazine by Frederick R. Bieber, Charles H. Brenner and David Lazar entitled “Finding Criminal Through DNA of Their Relatives” which calculated that familial searches could produce 20\% to 40\% more useful leads if used by law enforcement and prosecutors.\textsuperscript{437}

\textsuperscript{435} Available at https://www.promega.com/~media/files/resources/profiles%20in%20dna/302/the%20evolution%20of%20quality%20standards%20for%20forensic%20dna%20analyses%20in%20the%20united%20states.pdf?la=en , viewed on 28/02/2014 at 05.00pm

\textsuperscript{436} Available at http://www.forensicmag.com/articles/2005/02/evolution-quality-assurance-documents-dna-laboratories , viewed on 28/02/2014 at 06.00pm

\textsuperscript{437} Available at http://www.dnaforensics.com/familialsearches.aspx , viewed on 25/02/2014 at 03.40pm
The issue of familial searching has not yet been supported by Congress due to 4th Amendment concerns and the fear of creating unwilling genetic informants. Many constitution and defense attorneys, civil libertarians, and numerous citizens believe that a specific law allowing for familial would violate the 4th Amendment’s protection from unreasonable search. Individual states, however, have taken the lead and passed their own procedures to apply familial searches.\(^{438}\)

Case laws which have been decided through the use of familial searching were discussed below:

1. **BTK Serial Killer of Wichita.**\(^{439}\)

The most famous familial search case took place in 2005 with the identification and arrest of the “BTK” – Bound Torture & Kill serial killer, Dennis Rader. Rader was responsible for ten horrific murders in Wichita, Kansas from 1974 to 1991. The DNA profile that Rader left on his victims had been run periodically through CODIS without obtaining a hit. In 2004, law enforcement focused on Rader after he sent an anonymous package to police with a story about his crimes on a computer disk. The disk was traced back to a computer at a church where he volunteered. Before police arrested Rader they wanted to be sure that he was the killer. A warrant was issued to obtain genetic material from Rader's daughter, a 5-year old pap smear which was stored at the Kansas State University Hospital where she had been a student. When the daughter's DNA profile was compared with the DNA profile of Rader it was found to be a perfect familial match. Law enforcement was confident that they had found the serial killer and arrested Rader. In June 2005, Rader entered a guilty plea for the ten killings and two months later he was sentenced to life for each murder.\(^{440}\)

2. **Exonerating the Innocent – Darryl Hunt.**\(^{441}\)

The first accidental familial search in North Carolina had led to the exoneration of an innocent man. In 1984, Darryl Hunt was convicted of the

\(^{438}\) Id

\(^{439}\) Borrowed from http://www.dnaforensics.com/familialsearches.aspx , viewed on 25/02/2014 at 03.40pm

\(^{440}\) Id

\(^{441}\) Borrowed from http://www.dnaforensics.com/familialsearches.aspx , viewed on 25/02/2014 at 03.40pm
murder of 25 year-old Deborah Sykes in Winston-Salem and sentenced to life in prison. In 1994, retrospective DNA testing of Hunt did not match the DNA profile from the crime scene. Despite the result, Hunt's appeals were rejected. At the request of Hunt's attorney in 2003, the State Bureau of Investigation's DNA Lab ran the DNA profile found at the Sykes crime scene through its offender profiles database. They got a partial match (16 out of 26 alleles) from Anthony Brown. Law enforcement investigated further and discovered that Anthony had a brother, Willard Dennard Brown. Police questioned Willard Brown and during the interview they offered him a cigarette. When it was discarded, the police recovered the cigarette butt and tested his DNA. It matched the DNA found at the Sykes crime scene. In December 2003, Brown confessed to the 1984 rape and stabbing death of Deborah Sykes. On 6th February, 2004, Superior Court Judge Anderson Cromer vacated Hunt's murder conviction and Hunt was freed later that year.442

3. Tony Oliveo Mack.443

In 2006, Tony Oliveo Mack, was sentenced to 30 years in prison (after a plea bargain) for the 1989 murder of Joyce Robinson in Sumter, South Carolina. Mack was linked to the murder when a partial DNA hit matched his brother who was already incarcerated and whose DNA profile was in the offender's DNA database. In addition, Mack's fingerprints were also found on a purse in Ms. Robinson bedroom and on her bathroom sink.444

In the United States, individual states have the option to pass their own familial searching laws. Four states – California, Colorado, New York, and Florida have taken the lead in the area of familial searching. So far, only Maryland has categorically banned familial searching. The ban took place in 2003 and was facilitated with the help of defense attorney Stephen Mercer.445

Since March 2011 the Commonwealth of Virginia allows the use of DNA familial searching and the Virginia Department of Forensic Science will consider

442 Id
443 Id
444 Id
445 Borrowed from http://www.dnaforensics.com/familialsearches.aspx , viewed on 25/02/2014 at 03.40pm
requests from law enforcement agencies to conduct familial DNA searches in cases involving unsolved violent crimes against persons where other investigative leads have been exhausted and critical public safety concerns exist.\footnote{Available at http://www.denverda.org/DNA_Documents/Familial_DNA/Familial_Searching_UK_FSI_Genetics_2013.pdf , viewed on 25/02/2014 at 04.50pm}

In the United States, most of the States follow the FBI’s interim policy on partial DNA matches in CODIS databases. The FBI defines a partial match as ‘… the spontaneous product of a regular database search where a candidate offender profile is identified as not being identical to the forensic profile but because of a similarity in a number of alleles shared between the two profiles, the offender may be a close biological relative of the source of the forensic profile’. By contrast, a familial search is ‘… an intentional or deliberate search of the database conducted after a routine search for the purpose of potentially identifying close biological relatives of the unknown forensic sample associated with the crime scene profile’.\footnote{Available at http://www.denverda.org/DNA_Documents/Familial_DNA/Familial_Searching_UK_FSI_Genetics_2013.pdf , viewed on 25/02/2014 at 04.50pm} California, Colorado, Virginia, and Texas perform limited-familiar searching against their State DNA databases, yet all 50 States face the possibility of being involved in a partial match. The FBI restrictions on the reporting of partial matches include:\footnote{Id}

\begin{enumerate}
\item The profile must be a single-source DNA profile;
\item Additional confirmatory testing may be requested;
\item The partial match must contain data at all 13 CODIS core loci;
\item Expected Match Ratios (EMR) and Expected Kinship Ratios (EKR) must be calculated;
\item Police and Prosecution Authorities must commit to investigate and pursue Prosecution of any individual identified by a partial match;
\item The State holding a possible relative’s information is solely responsible for a legal review to determine if releasing the information is permissible under State law or policies.
\end{enumerate}

The FBI does not regulate familial searching at a State level.

(b) \textit{LOW COPY NUMBER (LCN) DNA TESTING}

In the United States the New York Medical Examiner’s Office is the only lab to till date that admits to using the techniques in some cases. The FBI does not allow the Low Copy Number (LCN) DNA testing to be used in criminal
investigations and uses it only in missing-persons investigations where trace DNA samples are known to have come from a single source.\textsuperscript{449}

(c) \textit{POST CONVICTION DNA TESTING}

Post-conviction DNA testing has received considerable attention in recent years. Since the advent of forensic DNA analysis, a number of people convicted of crimes have been subsequently exonerated through DNA analysis of crime scene evidence that was not tested at the time of trial. Additionally, newer technologies have substantially increased the successful DNA analysis of aged, degraded, limited, or otherwise compromised biological evidence. As a result, crime scene samples once has been thought to be unsuitable for testing in the past may now yield DNA profiles. Moreover, samples that previously generated inconclusive DNA results may now be amenable to reanalysis using newer methods.\textsuperscript{450}

In the USA, ‘Innocence Projects’ have been reviewing the convictions of offenders on death row for over 10 years.\textsuperscript{451} The Innocence Project is a non-profit legal organization that is committed to exonerating wrongly convicted people through the use of DNA testing, and to reforming the criminal justice system to prevent future injustice. The Innocence Project has been found in 1992 by Barry Scheck and Peter Neufeld. To date, the work of the Innocence Project has led to the freeing of 312 wrongfully convicted people, including 18 who spent time on death row.\textsuperscript{452}

The Innocence Project was established in the wake of a landmark study by the United States Department of Justice and the United States Senate, in conjunction with the Benjamin N. Cardozo School of Law, which found that incorrect identification by eyewitnesses was a factor in over 70\% of wrongful

\textsuperscript{449} Available at http://books.google.co.in/books?id=OEJemQWU3hsC&pg=PA51&lpg=PA51&dq=united+states+laws+dealing+DNA+evidence&source=bl&ots=5AxxD27c8h&sig=bMeaZaM79iV33VZyKc6G9y7jIl&hl=en&sa=X&ei=VOMlU7LrB8inXRaB7YC4Aw&ved=0CCYQ6AEwAA#v=onepage&q=united%20states%20laws%20dealing%20DNA%20evidence&f=false; Also Available in David E. Newton, DNA Evidence and Forensic Science, Infobase publishing, 2008

\textsuperscript{450} Available at http://nij.gov/topics/justice-system/wrongful-convictions/Pages/dna-testing.aspx, viewed on 23/02/2014 at 05.00pm

\textsuperscript{451} Available at http://gujarathighcourt.nic.in/Articles/NBCI.pdf, viewed on 23/02/2014 at 04.50pm

\textsuperscript{452} Available at http://en.wikipedia.org/wiki/Innocence_Project, viewed on 22/02/2014 at 03.30pm
convictions. The original Innocence Project was found in 1992 by Scheck and Neufeld as part of the Cardozo School of Law of Yeshiva University in New York City. It became an independent 501©(3) non-profit organization in 2003, but maintained strong institutional connections with Cardozo. The current Executive Director of the Innocence Project is Madeline deLone.453

The Justice for All Act of 2004 authorized the establishment of the Kirk Bloodsworth Post-conviction DNA Testing Grant Program.454

This competitive grant program provides funding to states to help defray the costs associated with post-conviction DNA testing. States may use funds in cases involving violent felony offenses (as defined by state law) in which actual innocence may be demonstrated. Funds may be used to review the cases and to locate and analyze biological evidence associates with them. The goals of the program are:455

1. To review appropriate post-conviction cases to identify those in which DNA testing could prove the actual innocence of a person convicted of violent felony offenses as defined by state law.
2. To locate biological evidence associated with such post-conviction cases.
3. To perform DNA analysis of appropriate biological evidence.

The essential elements of a post-conviction review are the preservation of and access to crime-scene exhibits; a mechanism to enable re-testing of the DNA evidence obtained; and funding for the re-testing and verification of DNA results, where available. Justification for post-conviction review lies in the principle that conviction of innocent person is not sustainable in any sense. In the same manner that the prosecution may seek to use DNA sample as evidence in prosecution, convicted persons may seek to use that very technology to search for new evidence in regard to a past conviction. Request for post-conviction DNA testing can be made before the court by the accused. It should not be DNA tested previously, or if tested previously, the requested DNA test would provide results that are significantly more accurate and probative of the identity of the perpetrator.

453 Id
454 Available at http://nij.gov/topics/justice-system/wrongful-convictions/Pages/exonerations.aspx , viewed on 23/02/2014 at 05.00pm
455 Available at http://nij.gov/topics/justice-system/wrongful-convictions/Pages/exonerations.aspx , viewed on 23/02/2014 at 05.00pm
or accomplice or have a reasonable probability of contradicting prior test results.⁴⁵⁶

There should be legislative provisions establishing a process of considering applications for post-conviction review from any person who proposes to rely upon DNA evidence that may exonerate him. Without a systematic collection and preservation of crime-scene evidence, there can be no real prospect of using DNA evidence to support challenge against wrongful conviction. The systematic storage of crime-scene exhibits has implications far beyond simply providing opportunities for fresh analysis of DNA evidence. It facilitates not only the requests for post-conviction review by offenders but also the prosecution of persons linked to old, unsolved cases by the DNA database. Statutory provisions are, therefore, required to be made to enable the convicts of specified offenses undergoing sentence, to apply for a court order for preservation of relevant crime-scene DNA evidence during the prescribed period after the expiry of all appeal periods.⁴⁵⁷

Legislative changes made in the United States for enabling convicts of serious offenses to apply for post-conviction DNA testing could provide a useful guide. By ‘Innocence Protection Act of 2004’ which was included in ‘Justice For All Act of 2004’ signed by the President on 30th October, 2004, Chapter 228-A – ‘Post-Conviction DNA Testing’, was inserted in Part II of Title 18 of United States Code, adding Section 3600 – ‘DNA testing’, and Section 3600A – ‘Preservation of biological evidence’. The provisions regarding ‘DNA testing’ prescribed the procedure upon a written motion by an individual under a sentence of imprisonment or death pursuant to a conviction for a federal offense. The court should order DNA testing of specific evidence if it found that all the requirements of section 3600 were satisfied. The provision applied where the applicant asserted that the applicant was actually innocent of the offense for which the applicant was undergoing the sentence of death or imprisonment. The specific evidence to be tested should have been secured in relation to the investigation or prosecution of

⁴⁵⁶ Available at http://gujarathighcourt.nic.in/Articles/NBCI.pdf, viewed on 23/02/2014 at 04.50pm

⁴⁵⁷ Available at http://gujarathighcourt.nic.in/Articles/NBCI.pdf, viewed on 23/02/2014 at 04.50pm
such offense. The specific evidence to be tested should not have been previously subjected to DNA testing and the applicant should not have knowingly and voluntarily waived the right to request DNA testing of that evidence in a court proceeding after the date of enactment of the Innocence Protection Act of 2004 or did not knowingly fail to request DNA testing of that evidence in a prior motion for post-conviction DNA testing. Where the evidence was previously subjected to DNA testing, the applicant could still make a request for DNA testing using a new method or technology that was substantially more probative than the prior DNA testing. The specific evidence to be tested should be in the possession of the Government and had been subjected to a chain of custody and retained under conditions sufficient to ensure that such evidence had not been substituted, contaminated, tampered with, replaced, or altered in any respect material to the proposed DNA testing. In such cases, the proposed DNA testing should be reasonable in scope, be using scientifically sound methods, and be consistent with accepted forensic practices. Furthermore, the applicant had to identify a defense theory which was not inconsistent with an affirmative defense presented at the trial and was such as would establish the actual innocence of the applicant with reference to the offense for which the application was made. If the applicant was convicted following the trial, the identity of the perpetrator should have been at issue in the trial. The proposed DNA testing of specific evidence should be such as might produce new material evidence that would support the theory of defense identified by the applicant and raised reasonable probability that the applicant did not commit the offense. The motion should be made in a timely fashion subject to the conditions of sub-section (10) of Section 3600. The Act, inter alia, provided for notice to the government, preservation order, testing procedures, time limitation in capital cases, reporting test results, retention of DNA samples, post-testing procedures, inconclusive and inculpatory results, and motion for new trial or re-sentencing.458

458 Available at http://gujarathighcourt.nic.in/Articles/NBCI.pdf, viewed on 23/02/2014 at 04.50pm

Under the Post-conviction DNA Testing Assistance Program, National Institute of Justice (NIJ) provides funding to help defray the costs associated with
post-conviction DNA testing in cases that involve violent felony offenses (as defined by State law) in which actual innocence might be demonstrated.459

As of August 2010, 48 States have enacted post-conviction DNA testing statutes; Massachusetts and Oklahoma are the exceptions. These laws provide post-conviction DNA testing procedures to inmates who believe they have been wrongfully convicted. State standards differ for what classifications of convicted people can apply for analysis. Alabama and Kentucky, for example, allow only those convicted of capital crimes to apply for testing, while in Hawaii and Idaho, anyone convicted of a crime can apply. Standards also vary for application content and approval criteria. In Oregon and Pennsylvania, the application must display "a prima facie showing of actual innocence," while Nevada and New Hampshire require a "reasonable probability" that the testing will show innocence.460

On 9th February, 2012, Massachusetts became the 49th State to enact a law that provides a mechanism for post-conviction DNA testing. Senate Bill 1987 (2011), introduced by Senator Cynthia Stone-Creem, enables a convicted person claiming factual innocence to file a motion requesting the testing of biological evidence in the court of their conviction. If their motion satisfies the statutory standards by a “preponderance of the evidence” then the requested samples will be analyzed by an accredited laboratory.461

The law also requires that rules for evidence retention be developed, provides punishments for those who willfully destroy evidence samples and assigns the cost of the testing to the requester, unless they are indigent.462

On 24th May, 2013, Oklahoma became the 50th and final state to pass a post-conviction DNA testing law. Representative Lee Denney (R-Cushing) and Senator Jim Halligan (R-Stillwater) supported the law, HB 1068. The law was

459 Available at http://nij.gov/topics/justice-system/wrongful-convictions/Pages/dna-testing.aspx , viewed on 23/02/2014 at 05.00pm
460 Available at http://www.ncsl.org/research/civil-and-criminal-justice/dna-laws-database-topicsummaries.aspx , viewed on 26/02/2014 at 07.00pm
461 Id
462 Available at http://www.ncsl.org/research/civil-and-criminal-justice/dna-laws-database-topicsummaries.aspx , viewed on 26/02/2014 at 07.00pm
incited by a proposal issued by the Oklahoma Justice Commission in November 2013.\textsuperscript{463}

Along with procedures for post-conviction DNA testing, these laws include or are partnered with provisions for preserving biological evidence. Laws that allow post-conviction testing is meaningless if the relevant evidence has been lost, improperly stored or lose its chain of custody. The evidence often is stored for the length of incarceration or a set number of years. Preservation laws and post-conviction testing are excellent tools to correct unfortunate injustices.\textsuperscript{464}

5.2.3. CONSTITUTIONAL VALIDITY FOR THE COLLECTION AND RETENTION OF BIOLOGICAL SAMPLES FOR DNA ANALYSIS IN UNITED STATES OF AMERICA

In United States, one can see that the search and seizure clause of the Fourth Amendment explicitly provides protection to people against unreasonable searches and seizures not only from the side of private individuals but also from state itself. The clause reads thus:\textsuperscript{465}

‘The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated and no warrant shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.’\textsuperscript{466}

The clause clearly provides the circumstances under which reasonable search and seizure can be conducted. It is implied that the authority must satisfy three conditions viz.

(1) A warrant shall be obtained from a competent court.
(2) The person seeks specific description in the warrant regarding the place, person or things sufficient to guide the officer in executing it.
(3) The person seeks specific description in the warrant regarding the place, person or things sufficient to guide the officer in executing it. Thus in the U. S., police requires warrant based on probable cause to take forensic samples.\textsuperscript{467}

\textsuperscript{463} Available at http://law.scu.edu/northern-california-innocence-project/post-conviction-dna-testing-laws-enacted-in-all-50-states/ , viewed on 25/02/2014 at 08.16pm

\textsuperscript{464} Available at http://www.ncsl.org/research/civil-and-criminal-justice/dna-laws-database-topicsummaries.aspx , viewed on 25/02/2014 at 08.25pm

\textsuperscript{465} Borrowed from Dinkar V. R, Justice in Genes (Evidential Facets of Forensic DNA Fingerprinting), Asia Law House, Hyderbad, 1st Edition 2008, P.207

\textsuperscript{466} Id

\textsuperscript{467} Id, P. 208
In earlier days, the United States Supreme Court took a strict stand and held searches and seizures not conducted on a ‘probable cause’ were unconstitutional (Henry v. United States). However, later, court relaxed the strict interpretation and gave a balancing approach. In Schmerber v. California, the United States Supreme Court considered the question whether the police officer was justified in requiring the petitioner to submit to the blood test. The petitioner was arrested at a hospital following an accident involving an automobile, which he was driving. A police officer smelled liquor on petitioner’s breathe and directed a physician to take blood sample from the petitioner, despite his refusal to consent. The report of the chemical analysis of the blood indicated intoxication, which was admitted in evidence over objection. Petitioner was convicted and the conviction was confirmed by the appellate court, which rejected his claims of privilege against self-incrimination under the Fifth Amendment and of his right not to be subjected to unreasonable searches and seizure under the Fourth Amendment. Regarding the former claim, the Supreme Court held that the privilege of self-incrimination protects an accused only from being compelled to testify against him and the withdrawal of blood and its analysis did not involve any compulsion to these ends. Court clarified that the privilege was a bar against compelling communications or testimony, but that compulsion which made a suspect or accused the source of real or physical evidence does not violate it. In relation to the second issue, court held that there was an unrestricted right on the part of the Government, always recognized under English and American law, to search the person of the accused when legally arrested to discover and seize the fruits or evidences of crime. Court opined that the Fourth Amendment’s proper function was not to restrain all intrusions as such, but against intrusions which were not justified in the circumstances or which were made in an improper manner. After perusing the records, court came to the conclusion that the test was performed in a reasonable manner and the petitioner’s blood was taken by a

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468 361 U.S. 98, 100, 102. (Court strictly interpreted fourth amendment and observed, “The requirement of probable caused has roots that are deep in our history. It is important, we think, that this requirement be strictly enforced, for the standard set by the constitution protects both the officer and the citizen. If the officer acts with probable case, he is protected even though it turns out that the citizen is innocent. And while a search without a warrant is within limits, permissible if incident to a lawful arrest, if an arrest without a warrant is to support an incidental search, it must be made with probable cause”)

469 384 U.S. 757 (1966)
physician in a hospital environment according to accepted medical practices. However, court emphasized that the integrity of an individual was a cherished value of our society.\(^{470}\)

The above mentioned case shows that in United States the judicial opinion is against strict application of search and seizure protection under the Fourth Amendment. Even warrantless search and seizure may be justified if it is conducted to meet the urgency of the situation and necessity of public interest; however, as a general rule, police must persuade a judge or magistrate to show that there is probable cause to believe that the desired forensic sample would produce evidence linking the suspect to the crime.\(^{471}\)

In the below mentioned cases, the court held that an order for search and seizure could be issued though it did not meet the requirement of showing probable cause. This was justified on the ground that only a less serious intrusion was caused to the suspect. In 1969 the Supreme Court decided the leading case Davis v. Mississippi,\(^{472}\) in which the petitioner was arrested for rape with some other Negro youths and brought to the police station for questioning and fingerprinting. Petitioner was thus questioned and fingerprinted, and released. Later the FBI reported that petitioner’s prints matched with those taken from the window of the house in which the rape was alleged to have been committed. Petitioner was subsequently charged and tried for rape, and the fingerprint evidence was admitted as in evidence at trial over petitioner’s objections that the fingerprints should be excluded as the product of an unlawful detention. The Mississippi Supreme Court sustained the admission of the fingerprint evidence and affirmed the conviction. When the case came before the Supreme Court, one of the important issues was whether the fingerprints taken from the petitioner while he was under detention and used at trial constituted an unreasonable seizure in violation of the Fourth Amendment. Regarding this, Justice Brennan, writing for the majority of the court observed:\(^{473}\)

\(^{470}\) Borrowed from Dinkar V. R, Justice in Genes (Evidential Facets of Forensic DNA Fingerprinting), Asia Law House, Hyderabad, 1\(^{st}\) Edition 2008, P. (208-209)

\(^{471}\) Id, P. (209-210)

\(^{472}\) 394 U. S. 721 (1969)

Detentions for the sole purpose of obtaining fingerprints are no less subject to the constraints of the Fourth Amendment... Detention for fingerprinting may constitute a much less serious intrusion upon personal security than other types of police searches and detentions. Fingerprinting involves none of the probing into an individual’s private life and thought that marks an interrogation or search. Nor can fingerprint detention be employed repeatedly to harass any individual, since the police need only one set of each person’s prints. Furthermore, fingerprinting is an inherently more reliable and effective crime solving tool than eyewitness identifications or confessions and is not subject to such abuses as the improper line-up and the third degree. 474

Currently, the majority of United States Circuit Courts views the collection of DNA as parallel to the collection of a fingerprint and have held that the compulsory collection and retention of DNA upon arrest does not violate the Fourth Amendment. The majority view is to analyze the constitutionality of the Act using a reasonableness approach: whether the intrusion is reasonable. The courts apply a totality of circumstances test, balancing the intrusion on an arrestee’s privacy against the Government’s interest in the collection and testing of his DNA. For example, in United States v. Mitchell,475 the Third Circuit weighed the minimal intrusion of the buccal swab combined with an arrestee’s diminished expectation of privacy in his identity against the protections built into the Act, the Government’s stated practise of only analyzing ‘junk DNA’, the current limits of technology, the information stored served only an identification purpose, the DNA served important law enforcement interests which were not equally well served by collecting DNA samples post-conviction and determined the intrusion was reasonable and therefore not a violation of the Fourth Amendment. The Federal Bureau of Investigation’s policy of using only “junk DNA” ensures that the CODIS DNA profiles can only be used for identification. In Mitchell, the Third Circuit found that the use of “junk DNA” creates a “DNA fingerprint” that yields precise information about identity but little or no other personal information.476

474 Id
475 652 F. 3d 387 (3rd Cir. 2011)
476 Borrowed from http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1160&context=student_
5.2.3.1. DNA RETENTION AND THE FOURTH AMENDMENT

The United States Supreme Court has not faced the question as to whether the retention of DNA samples or profiles is a constitutional violation. *Boroian v. Mueller*, a First Circuit decision, was the first decision regarding the government’s retention of the sample in CODIS. In Boroian, the First Circuit held the government’s retention of Boroian’s (a former probationer) blood sample and DNA profile pursuant to the DNA Act did not constitute a separate “search” in violation of the Fourth Amendment. The Court based its decision on the fact that the matching process used by CODIS was not a new search because it was limited to a comparison of the identification records already in the government’s lawful possession. Furthermore, subsequent CODIS searches for matches did not reveal any new private information about Boroian or intrude in any way on his reasonable expectations of privacy. Therefore, the subsequent searches were not treated as new searches for Fourth Amendment purposes.477

*King v. Maryland*,478 the defendant, Alonzo Jay King, Jr., was arrested in 2009 on assault charges. Pursuant to Maryland’s law authorizing the collection of DNA from certain arrestees, law enforcement officials collected a buccal swab sample from King on the day of his arrest. An analysis of the sample showed a match with DNA collected from a rape victim in an unsolved case from 2003. On the basis of that match, King was convicted of first-degree rape for the 2003 crime.479 The Maryland Court of Appeals set aside his conviction, finding portions of the Act authorizing DNA collection from felony arrestees unconstitutional. The Supreme Court reversed. The court held that taking and analyzing a cheek swab of the arrestee’s DNA is, like fingerprinting and photographing, a legitimate police booking procedure that is reasonable under the Fourth Amendment when officers make an arrest supported by probable cause to hold and bring the suspect to the station to be detained in custody, for a serious offense. DNA testing involves minimal intrusion that may significantly improve both the criminal justice system and police investigative practises; it is quick and painless and requires no intrusion

477 Id
478 422 Md. 353 (2011)
beneath the skin. When probable cause exists to remove an individual from the normal channels of society and hold him in legal custody, DNA identification plays a critical role in serving interests in properly identifying who has been arrested, ensuring that the custody of an arrestee does not create inordinate risks for staff, for the existing detainee population, and for a new detainee, and in ensuring that persons accused of crimes are available for trials. Identifying an arrestee as the perpetrator of some heinous crime may have the salutary effect of freeing a person wrongfully imprisoned. The Court noted that the test does not reveal an arrestee’s genetic traits and is unlikely to reveal any private medical information.480

5.2.4. ADMISSIBILITY OF DNA

(i) Frye Standard of Admissibility

In the case of Frye v. United States,481 in the Columbia Circuit Court, James Alphonzo Frye was convicted of second degree murder for killing Dr. Robert W. Brown. After the guilty verdict, James Frye’s counsel appealed stating that the trial court was wrong in not allowing the results of a systolic blood pressure deception test taken by Frye to be admitted. The systolic blood pressure deception test was an early “lie detector test” in which blood pressure, heart rate, respiratory rate, and perspiration were monitored to detect changes in a person’s body when he or she told a lie. It was theorized that the telling of a lie created stress which would result in an involuntary physiological change which could be detected and recorded.482

‘The theory seems to be that truth is spontaneous, and comes without conscious effort, while the utterance of a falsehood requires a conscious effort’ [which can be detected physiologically].483

Frye took and passed a systolic blood pressure deception test, and subsequently renounced his earlier confession of the murder. At the time, the trial court refused to allow an expert witness to testify in support of this new technology because it had not gained general acceptance in the scientific

480 Borrowed from http://supreme.justia.com/cases/federal/us/569/12-207/ , viewed on 20/02/2014 at 12.30pm
481 293 F. 1013 (D.C. Cir. 1923)
482 Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-031111-211853/unrestricted/Ryan_and_Lauren_IQP_Final.pdf , viewed on 03/03/2014 at 11.00pm
483 Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-031111-211853/unrestricted/Ryan_and_Lauren_IQP_Final.pdf , viewed on 03/03/2014 at 11.00pm
community. The prosecution argued that the new technique was controversial and unreliable. The defense appeal failed.\footnote{Id} The appeals court affirmed the conviction, concluding that the systolic blood pressure deception test had not yet gained such standing and scientific recognition among physiological and psychological authorities as would justify the courts in admitting expert testimony deduced from the discovery, development, and experiments thus far made. \textit{The court stated:}\footnote{Id}

‘Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.’\footnote{Id}

Although the case did not involve DNA analysis, it set a new standard for what was considered to be acceptable scientific evidence in the eyes of the court. The new ‘Frye Standard’ as it was called and stated that the scientific principle from which testimony was based must be sufficiently established to have gained general acceptance in the particular field in which it belonged in order for the testimony to be admissible in court. The Frye Standard was one of the first such guidelines to be used to monitor the use of scientific technologies in a court of law. It remained in use for over fifty years until it was superseded by the Federal Rules of Evidence which were adopted in 1976.\footnote{Id}

James Frye served three years in prison, but was released after someone else confessed and was convicted of the murder of Dr. Robert W. Brown.\footnote{Id}

(ii) \textbf{Federal Rule of Evidence 702 (1975)}

In 1975, the United States Congress adopted the Federal Rules of Evidence 702 because it was difficult to achieve the Frye Standard for general acceptance in

\footnotesize
\textsuperscript{484} Id
\textsuperscript{485} Borrowed from http://ir.lawnet.fordham.edu/cgi/viewcontent.cgi?article=3374&context=flr , viewed on 24/02/2014 at 08.30pm
\textsuperscript{486} Id
\textsuperscript{487} Available at www.wpi.edu/Pubs/E-project/Available/E-project-031111-211853/ unrestricted/Ryan_and_Lauren_IQP_Final.pdf , viewed on 03/03/2014 at 11.00pm
\textsuperscript{488} Id
the courtroom. Rule 702,\textsuperscript{489} was more lenient and flexible than the Fyre Standard, stressing helpfulness, reliability, and relevance of the technique rather than general acceptance.\textsuperscript{490}

In 1985, \textit{Downing v. United States},\textsuperscript{491} John W. Downing was charged with mail fraud, wire fraud, and interstate transportation of stolen property. Downing was accused of leading a scheme to defraud several vendors by using a bogus company called the Universal League of Clergy (ULC). The government brought in 12 witnesses claiming Downing was the man who had defrauded them (using the name Reverend Claymore). The defense argued that eyewitness testimony was generally unreliable, and asked to bring in a psychologist to refute their testimony. However, the court denied the defense request, ruling the psychologist’s testimony did not meet the ‘helpfulness standard’ of Rule 702. That is, it would not aid the jury in its decision, and might even mislead or confuse the jury instead. Downing was found guilty of mail fraud and wire fraud, but not interstate transportation of stolen property. Downing appealed his conviction claiming that eyewitness testimony is in fact inaccurate. The United States Court of Appeals held that the district court was wrong to exclude the psychologist’s testimony, and remanded the case back to the district court with instructions to conduct an evidentiary hearing on the admissibility of expert testimony. If the district court found the expert testimony should have been included, a new trial should be granted. If not, then the guilty verdict would be reinstated. After the district court hearing, the court still refused to admit the psychologist’s testimony, and upheld the original guilty verdict. The conviction was upheld on the following grounds:\textsuperscript{492}

1) The psychologist’s testimony did not carry with it a sufficient degree of reliability to aid the jury in reaching an accurate resolution,

\begin{itemize}
  \item \textsuperscript{489} Rule702. Testimony by Experts: If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise, if
  \begin{enumerate}
    \item the testimony is based upon sufficient facts or data,
    \item the testimony is the product of reliable principles and methods, and
    \item the witness has applied the principles and methods reliably to the facts of the case.
  \end{enumerate} Available at http://www.law.cornell.edu/rules/fre/rule_702
  \item \textsuperscript{490} Available at www.wpi.edu/Pubs/E-project/Available/E-project-011306-130417/unrestricted/IQP.pdf, viewed on 03/03/2014 at 11.00pm
  \item \textsuperscript{491} 473 U.S. 207 (1985)
  \item \textsuperscript{492} Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-090408-022926/unrestricted/Lincoln_Kayla_Marisa_IQP_Final.pdf, viewed on 26/02/2014 at 06.45.
\end{itemize}
2) Admitting the evidence would overwhelm, confuse, or mislead the jury, and
3) The expert testimony would not be of value because the eyewitness encounters in this case were numerous and of extensive duration.

*Downing v. United States*, 493 established the standard that when there was any question regarding the reliability of evidence, it was important for the court to conduct an ‘evidentiary relevancy hearing’. The pretrial hearing was used to efficiently determine the reliability of evidence. 494

In *Andrews v. State of Florida*, 495 Tommie Lee Andrews was a suspect in more than twenty assaults in the Orlando area in 1986, but he was finally linked to a rape in 1987 when Lifecodes (Valhalla, New York, Lifecodes Corporation Laboratory) matched his DNA to semen left at the crime scene. Because DNA testing had not yet been used in a United States criminal case, a relevancy hearing was performed which concluded DNA testing was scientifically reliable in method, theory, and interpretation, and positively reviewed by peers. The DNA evidence was allowed, but not the impressive statistical evidence that the prosecution could not validate. Although the first trial ended in a hung jury, at the retrial the DNA evidence was again admitted, along with the statistical data (allowed by applying the Downing relevancy test and the Rule 702 reliability test), and Andrew’s traditional fingerprints left on a windowsill, and his identification by the most recent victim in a photo-lineup. It took the jury only a short time to convict him, and he became the first person in the United States convicted of a crime based on DNA evidence. Andrews appealed the verdict, but on November 22, 1988, the original convictions and sentences were affirmed. Soon after the trial, Andrews DNA was found to match that of several victims in the Orlando area, and his prison sentence went from an initial twenty-two years for rape, to over one hundred years for serial rape. 496
Following Andrews v. State, DNA testing can now more easily be applied to future cases involving sexual assault and other crimes of violence.

People v. Castro, represents the most critical assessment of DNA technology. Joseph Castro, a thirty-eight year old Hispanic, was accused of murdering his pregnant neighbor, twenty-year old Vilma Ponce, and her two-year old daughter. Lifecodes Corp. analyzed a bloodstain on Castro’s watch and found it to match to the victims, with the chance of a random match in the hispanic population being one in one hundred million. Ignoring the 1988 Andrews ruling based on the Downing relevancy test, and the Rule 702 reliability test, the New York Supreme Court investigated the admissibility of DNA tests in a pretrial hearing applying the rigorous Frye standard. Following thousands of pages of expert testimony over 12 weeks, in August 1989, Judge Gerald Sheindlin developed a three-pronged test to determine whether DNA evidence should be admitted:

1. Is there a generally accepted theory in the scientific community which supports the conclusion that DNA forensic testing can produce reliable results?
2. Are there techniques or experiments that currently exist that are capable of producing reliable results in DNA identification, and which are generally accepted in the scientific community?
3. Did the testing laboratory perform the accepted scientific techniques in analyzing the forensic samples in this particular case?

On 14th August, 1989, the New York Supreme Court held that Castro prong-1 and prong-2 met the Frye Standard, but not prong-3 in this particular case since Lifecodes did not use generally accepted scientific techniques for obtaining their results. Although the DNA evidence was ruled inadmissible, Castro confessed to the murders in late 1989. The Castro three-pronged tests served as a standard for which other DNA evidence cases were judged, highlighting the need for rigorous experimental standards for performing DNA fingerprinting. Following the rigorous hearing, the FBI created its Technical Working Group on

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497 533 So.2d 851 (1988)
498 Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-011306-130417/unrestricted/IQP.pdf, viewed on 03/03/2014 at 11.00pm
499 143 Misc.2d 956 (1989)
500 Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-011306-130417/unrestricted/IQP.pdf, viewed on 03/03/2014 at 11.00pm
DNA Analysis Methods (TWGDAM), whose universal recommendations remain in effect to this date (Federal Bureau …1998).

In Two Bulls v. United States, the Castro trial brought us the three-pronged test which provided a template to determine whether DNA evidence could be used in a particular trial. The Two Bulls case added two more prongs to the test, requiring a longer pre-trial hearing relying on the trial judge to weigh each side’s argument and decide whether the evidence should be admitted in court.

In a trial of Mathew Sylvester Two Bulls Jr. who was accused of, and found convicted of, aggravated sexual abuse and sexual abuse of a minor in the United States District Court in South Dakota. When the Case went to its pretrial hearing, the court deemed the DNA evidence was going to be admissible during trial based on Castro’s three prongs, but Two Bull’s legal counsel appealed this because they felt that the third prong of the three-pronged standard was not met, as Two Bull’s counsel discovered that the district court had no clue whether the FBI had actually run the DNA testing analysis properly. The Appellate Court decided that the original District court had not complied with prong 3, so the DNA evidence was not admissible.

In response to the ruling, the prosecution felt as if Castro stands alone and provides too stringent a standard, making long drawn out testimonial procedures before trial necessary. They also felt as if Rule 702 or the Frye standard was too unconventional to apply to DNA evidence. The Court of Appeals concluded that the trial court was wrong when allowing the DNA evidence without truly understanding the process from which the FBI obtained the evidence, so required the case be returned to the trial court and be subjected to an extra-long pre-trial hearing in which each side would tell why the evidence should or should not be

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501 Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-011306-130417/unrestricted/IQP.pdf, viewed on 03/03/2014 at 11.00pm
502 918 F.2d 56 (8th Cir. 1990)
503 Borrowed from www.wpi.edu/Pubs/E-project/Available/E-project-101211-181647/unrestricted/Joseph_Peter_Nicholas_IQP_Final.pdf, viewed on 27/02/2014 at 08.23pm
504 Id
allowed in the trial. It became known as the five-pronged Test which stated that the court should decide:

1. Whether DNA testing is generally accepted by the scientific community.
2. Whether the testing procedures used in this case are generally accepted as reliable if performed properly.
3. Whether the test was performed properly in this case.
4. Whether the evidence is more prejudicial than probative in this case.
5. Whether the statistics used to determine the probability of someone else having the same genetic characteristics is more probative than prejudicial under Rule 403 (Rule 403 states that if evidence is meant to cause “unfair prejudice, confusion of the issues, or misleading of the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence” then it may be excluded).

The Two Bull’s case was sent back to the trial court, and they underwent a new pre-trial hearing due to the five prong test. The DNA was deemed admissible to the court and Two Bulls received a guilty verdict of both aggravated sexual assault and sexual assault of a minor.

In 1991, Miles v. Illinois, an Illinois man, Reggie Miles was convicted for rape. His DNA was found to match the DNA found at the crime scene by Cellmark Diagnostics, a major player in the DNA identification field. After his conviction, Miles appealed, arguing that the prosecution had not proved that the techniques used by Cellmark were reliable. However, Cellmark was able to produce accurate statistics and documents to prove that it had followed all TWGDAM guidelines while performing comparison tests in the Miles case. The appeal was denied and showed that TWGDAM and the five-prong test were reliable. Miles v. Illinois gave a big boost to the public’s confidence in DNA profiling.

(iii) The Daubert Standard of Admissibility 1993

The Frye standard of admissibility is no longer acceptable in the federal courts. In 1993, the Supreme Court of the United States determined that the Frye standard had been superseded by the Federal Rules of Evidence and, specifically,
Rule 702. The Frye standard has been superseded by the Supreme Court of the United States while determining the admissibility of scientific evidence in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*

In determining the admissibility of scientific evidence, *Daubert* decision played a considerable role in the United States jurisdiction. Seventeen years after the enactment of the Federal Rules of Evidence, in *Daubert*’s case, the United State Supreme Court rejected the Frye’s general acceptance test as the mandatory requirement for evaluating scientific expert evidence. However, the court retained the test as one of the several factors for determining the admissibility of scientific evidence. As possible alternative, the court adopted the relevance and reliability standards as provided in the Federal Rules of Evidence.

In *Daubert*’s case, the plaintiff sued the defendant Merrell Dow Pharmaceuticals for the birth defects caused by using their drug Bendectin. The plaintiff sought to introduce testimony of eight experts who had conducted in vitro (test tube) and live animal studies and concluded that Bendectin was teratogenic. Citing *United States v. Kilgus*, the district court rejected the evidence of the plaintiffs in total and granted summary judgment in favor of the defendant. The court concluded that the studies conducted by the plaintiff’s lacked the general acceptance standard insisted by Frye court. The Ninth Circuit confirmed the decision. Considering the unsettled legal issue on the admissibility of scientific evidence, the United States Supreme Court granted Certiorari to the

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508 Borrowed from http://ir.lawnet.fordham.edu/cgi/viewcontent.cgi?article=3374&context=flr, [Rule 702: Testimony by Experts: If scientific, technical, or other specified knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training or education, may testify thereto in the form of an opinion or otherwise, if (1) The testimony is based upon sufficient facts or data, (2) The testimony is the product of reliable principles and methods, and (3) The witness has applied the principles and methods reliably to the facts of the case.]

509 509 U.S. 579 (1993)

510 *Id*


512 The term teratogen means a substance capable of causing malformations in fetuses

513 571 F.2d 508 (9th Cir. 1978); Also available at http://openjurist.org/571/f2d/508/united-states-v-kilgus,(Appellants were convicted by the district court below of illegal importation of marijuana (Count II) and possessing marijuana with the intent to distribute (Count IV) (21 U.S.C. §§ 952, 960, 963, 841(a)(1), and 18 U.S.C. § 2). The Ninth Circuit court reverses appellants' convictions because the only substantial evidence which connects them with the crime (a "unique identification" of their aircraft by a Customs Officer using a Forward Looking Infrared system (FLIR)) was inadmissible
plaintiffs. The Supreme Court vacated and remanded the Ninth Circuit Court’s ruling on the ground that it relied exclusively on the general acceptance test, which could not be seen in Rule 702 of the Federal Rules of Evidence.514

The Supreme Court formulated a two-pronged test for determining the admissibility of scientific expert evidence. In the two prongs, the first one would help the trial judges in evaluating the reliability of the scientific knowledge and the second one assists them to make determination on the relevance of the evidence. Under the second prong, the trial judge must make a preliminary assessment of whether the reasoning or methodology underlying the scientific testimony was scientifically valid. If so, under the second prong, court would look into whether the reasoning and methodology was properly applied to the facts in issue of the particular case.515

Moreover, the Daubert court while looking a tool for evaluating scientific evidence’s reliability, identified ‘falsifiability’ as the technique used by scientists for evaluating the validity of a scientific technique. Regarding this Blackmun, J., for the majority said:516

‘In determining whether a theory or technique is scientific knowledge that will assist the trier of fact will be whether it can be (and has been) tested. Scientific methodology today is based on generating hypothesis and testing them to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquire.’517

Daubert court enlisted four factors to help the trial judges in evaluating the scientific reliability of proffered scientific expert evidence. These factors include:518

1. Whether the theory or technique could be or has been tested.
2. Whether the theory or technique has been subjected to peer review and publication.
3. The known or potential error rate of a technique.
4. Whether the theory or technique has received ‘general acceptance’.

515 Id, P.146
516 Id
518 Id, P.146-147
The Daubert ruling had made an opening to the judges who were undertaken the role of a gatekeeper while evaluating scientific expert evidence. Daubert court stated that the inquiry envisioned under Rule 702 was flexible one. However, court took care to limit the liberal admissibility standard in Rule 702. For that the court listed vigorous cross-examination, presentation of contrary evidence and careful instruction on the burden of proof as practicable tools for testing the strength of evidence.519

The Daubert precedent instigated the members of the United States Congress and they amended Rule 702 of the Federal Rule of Evidence in harmony with Daubert language. The Congress members affirmed the gate-keeping role of trial judges while evaluating the reliability and admissibility of scientific and other specialized expert evidence. However, the committee took the stand that the enquiry envisioned under the amended Rule 702 was flexible one and not intended to provide an excuse for an automatic challenge to the testimony of every expert. The committee opined that the trial judge had discretion to avoid full-fledged reliability checking; if he was of opinion that it was pointless to conduct such test in cases in which an expert’s method was properly taken for granted.520

Daubert ruling was further refined by Kumho Tire Co., Ltd. v. Carmichael,521 extending Daubert’s general holding to include nonscientific, or

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519 Borrowed from Dinkar V. R, Justice in Genes (Evidential Facets of Forensic DNA Fingerprinting), Asia Law House, Hyderabad, 1st Edition 2008, P. 147
520 Id, P. 148
521 526 U.S.137 (1999) Also available at http://en.wikipedia.org/wiki/Kumho_Tire_Co._v._Carmichael, (Patrick Carmichael was driving his minivan on July 6, 1993, when the right rear tire blew out. One of the passengers in the vehicle died, and others were severely injured. Three months later, the Carmichaels sued the manufacturer of the tire, claiming that the tire was defective and the defect caused the accident. The Carmichaels’ case rested largely on testimony from a tire failure expert. The tire failure expert relied on features of tire technology that the manufacturer did not dispute, as well as background facts about the particular tire on the Carmichaels' van. The expert's conclusion that a defect in the tire caused the accident rested on certain observations about the tire that Kumho Tire vigorously disputed. Kumho also disagreed with certain aspects of the tire expert's methodology, and asked the federal district court hearing the case to exclude it under Rule 702 of the Federal Rules of Evidence. The district court took its cue from Daubert v. Merrell Dow Pharmaceuticals, which had solidified a gatekeeping role for trial judges in admitting expert testimony. Under Daubert, certain factors contribute to the reliability, and hence the admissibility, of expert testimony, one of which is the general validity of the expert's methods. The district court found the tire expert's methods not to be scientifically valid, and hence excluded his testimony. This resulted in a conclusion that Kumho Tire would rightly prevail. The Carmichaels appealed to the Eleventh Circuit. The Eleventh Circuit reversed the district court's ruling. It reasoned that Daubert was expressly limited only to scientific expert testimony and did not apply to 'skill- or experience-based observation.' The tire expert's testimony rested on such unscientific ‘observation and experience’, and so the Eleventh
technical, expert testimony, and General Electric Co. v. Joiner, which held that a district court judge may exclude expert testimony when there are gaps between the evidence relied on by an expert and his conclusion, and that an abuse-of-discretion standard of review is the proper standard for appellate courts to use in reviewing a trial court’s decision of whether it should admit expert testimony. These three cases Daubert v. Merrell Dow Pharmaceuticals, Inc, Kumho Tire Co.,Ltd. v. Carmichael, and General Electric Co. v. Joiner, referred to as the ‘Daubert trilogy,’ are followed in federal court.

Today, the majority of states have adopted Daubert, if not in name, then in ways that are nearly identical doctrinally. However, within these so-called Daubert states, there is some variation. Some states have adopted the entire ‘trilogy’, while some have adopted only certain elements of the ‘trilogy’. And still others, like New Jersey, have adopted Daubert, but only in certain types of cases or circumstances. A close look at the Frye states shows similar no uniformity. Kansas, for example, will apply Frye, but only to new or developing science; Illinois does not apply Frye to expert medical testimony. In addition to Kansas and Illinois, at least 10 other jurisdictions have retained Frye.

Circuit reasoned the district court should have made a different ruling based on their legal reasoning over Rule 702 without the Daubert gloss. Kumho Tire asked the Supreme Court to review whether Daubert applied solely to scientific evidence. The Court by majority found in the text of Rule 702, a codification of Daubert, a gatekeeping function for federal trial judges who had to determine whether expert scientific testimony was admissible in a federal trial. But Rule 702 applies to ‘scientific, technical, or other specialized knowledge.’ ‘This language makes no relevant distinction between ‘scientific’ knowledge and ‘technical’ or ‘other specialized’ knowledge.’ True, Daubert only dealt with scientific knowledge. But that was the nature of the case, and did not stray beyond the facts of that case. The Court observed that the line between ‘scientific’ and ‘technical’ knowledge is not always clear. ‘Pure scientific theory itself may depend for its development upon observation and properly engineered machinery. And conceptual efforts to distinguish the two are unlikely to produce clear legal lines capable of application in particular cases.’ If the line between ‘scientific’ and ‘technical’ knowledge was not clear, then it would be difficult for federal trial judges to determine when they were to perform Daubert's gatekeeping function and when to apply some other threshold test the Court might craft for applying Rule 702. Furthermore, the Court saw no ‘convincing need’ to draw a distinction between ‘scientific’ and ‘technical’ knowledge, because both kinds of knowledge would typically be outside the grasp of the average juror. Accordingly, the Court held that the gatekeeping function described in Daubert applied to all expert testimony proffered under Rule 702.

523 Borrowed from http://www.jonesday.com/files/Publication/e96efffd-f982-45e3-a3dd-c69a9f67f89/Presentation/PublicationAttachment/b60f0f90-47e0-4d9b-9d62-cb13b651f0bf/Fryed.pdf, viewed on 03/03/2014 at 12.00pm
524 Id
5.2.5. PITFALLS REGARDING DNA IN UNITED STATES OF AMERICA IN COMPARISON WITH UNITED KINGDOM

Although all 50 states have passed DNA database legislation, many states have backlogs of convicted offender samples that have been collected but have not yet been analyzed. Although Federal funding has played an important role in reducing existing backlog, the crime fighting potential of DNA has prompted many states to revise their statutes to require nonviolent convicted offenders to provide a DNA sample for analysis and upload into CODIS. The trend towards expanding convicted offenders has significantly increased the number of DNA samples requiring collection and analysis. Although the success of using the DNA databases as a crime-solving and crime-prevention tool can easily be demonstrated once convicted offender backlogs are reduced, it should be recognized that new backlogs are instantly created by the passage of expanded DNA legislation laws. Convicted offender backlogs are an ongoing logical issue that can compound the complexity of investigating cold cases by using the DNA database. 525 Unprocessed rape kits are a clear example of this kind of backlog. Despite the established fact that rape typically yields biological evidence, as of October 1999, at least 1,80,000 rape kits remained on shelves across the country, unprocessed, because no suspects have been identified. 526

Recently a report published by the National Institute of Justice (NIJ) Special Report December 2013 found that laboratories processed 10% more forensic DNA cases in 2011 than in 2009. DNA backlogs samples (more than 30 days old) also continued to increase as demand for forensic DNA services rose to 16.4% in the same period, and the demand continues to outpace capacity. The report concluded that reducing backlogs would require hiring additional DNA analysts, retaining trained personnel, and automating work processes. 527 According to the Department of Justice, some 400,000 ‘rape kits’ are languishing in evidence lockers across the country. Because, local authorities cannot afford to process them. These kits, some of them dating back to the 1980s, contain DNA evidence that could convict rapists. Now the evidence might finally make its way

525 Available at https://www.ncjrs.gov/pdffiles1/nij/194197.pdf , viewed 08-05-2012
526 Available at https://www.ncjrs.gov/pdffiles1/nij/194197.pdf , viewed 08-05-2012
527 Available at http://www.policemag.com/channel/technology/articles/2014/02/speeding-up-dna-analysis.aspx , viewed on 03/03/2014 at 11.10pm
to prosecutors. The White House announced a little remarked upon initiative to devote $35 million of the 2015 budget to processing unopened kits and otherwise furthering sexual assault prosecutions.\textsuperscript{528}

5.2.5.1. REASONS BEHIND THE BACKLOG OF CASES

1. Private labs have a limited role in the United States; forensic services are predominantly provided by public labs. A number of private forensic firms handle excess demand, exigent requests, and specialized DNA analyses (e.g., nonhuman DNA, tests for determining ancestry or ethnicity). Private forensic laboratories might conduct DNA typing for samples that will be uploaded into CODIS, but the actual use and management of CODIS (including profile uploads) rests with criminal justice agencies. CODIS has remained the exclusive purview of public-sector laboratories, despite entreaties from some in law enforcement and the private sector to allow private sector laboratories to access CODIS directly.\textsuperscript{529}

2. In the United States, regulation is less centralized. The key elements of regulation were established in the DNA Identification Act of 1994, which gave the FBI director a mandate to appoint a DNA Advisory Board (DAB) for the sole purpose of drafting quality assurance standards (QASs) for forensic DNA for the FBI director’s approval. Periodic revision of the FBI quality assurance standards is now the responsibility of the Scientific Working Group of DNA Analysis and Methods (SWGDAM), which is largely comprised of technical leaders from government laboratories and is chaired by an appointee of the FBI director.\textsuperscript{530}

3. Turnaround time for conducting DNA analysis in the United States is 3 days to several months depending on urgency.

\textsuperscript{528} Borrowed from http://www.newrepublic.com/article/116945/rape-kits-backlog-joe-biden-announces-35-million-reopen-cases, viewed on 23/02/2014 at 07.30pm

\textsuperscript{529} Borrowed from http://www.rand.org/content/dam/rand/ pubs/technical_reports/2010/RAND_TR918.pdf, viewed on 23/02/2014 at 07.00pm

\textsuperscript{530} Id
4. U.S. forensic DNA labs lag behind their English counterparts in matters of technology and automation.\footnote{Borrowed from \url{http://www.rand.org/content/dam/rand/pubs/technical_reports/2010/RAND_TR918.pdf}, viewed on 23/02/2014 at 07.00pm}

5. The process followed in the United States for DNA analysis is lengthier than in the United Kingdom. The samples stored in the United States have peer reviewed and administrative review before loading to CODIS.

5.3. COMPARATIVE ANALYSIS FOR THE ADMISSIBILITY OF DNA TECHNOLOGY IN INDIA, UNITED KINGDOM AND UNITED STATES OF AMERICA

In India, the courts admit DNA evidence based on the facts and circumstances of the case. It does not prescribe any rule for the admissibility of DNA. In almost all the cases, while presenting DNA, the court examined the expert’s knowledge and qualification and their publication, previous experience and the test analyzed by the scientist or scientists and the statistical data of their findings along with his testimony.

In the United Kingdom, the courts admit DNA evidence based on the ruling laid down in \textit{R v. Doheny and Adams}.\footnote{\textit{Supra} note 377} The important guidelines provided under this ruling are that the scientist should adduce the evidence of DNA in comparison with crime stain and the defendant’s sample together with his calculations of random occurrence ratio. The crown should explain the details as to how the calculations had been carried out for the defense security. The expert should, on the basis of empirical statistical data should give the jury the random occurrence ratio the frequency with which the matching DNA characteristics were likely to be found in the population at large. Then, jury could decide based on the evidence placed before him. The expert should not give his personal opinion regarding the match between the crime scene and defendant’s sample. For example, the scientist should not give his opinion that the match strongly supported that the defendant only committed that particular offense. So, the expert should not influence the jury’s decision. If the expert gave his personal opinion then the defense should make an application to the judge to instruct the jury to disregard the part of the expert testimony.
The United States of America admit scientific evidence based on the ruling laid down in *Frye v. United States*, in early 1923. This ruling is generally called as Frye Standard. The Court held that the scientific principle from which testimony was based must be sufficiently established to have gained general acceptance in the particular field in which it belonged in order for the testimony to be admissible in court. The Frye Standard remained for over 50 years. In 1976, the Federal Rules of Evidence was adopted by Congress. The Federal Rules of Evidence Rule 702 was flexible than Frye Standard stressing helpfulness, reliability, and relevance of technique rather than general acceptance. After the emergence of Rule 702, the courts followed Frye Standard as well as the Federal Rules of Evidence Rule 702.

Finally in 1993, the Frye Standard was superseded by *Daubert v. Merrell Dow Pharmaceuticals*, admissibility standard. The Supreme Court formulated two-pronged test to determine the admissibility of scientific expert evidence. In the two prongs, the first one would help the trial judges in evaluating the reliability of the scientific knowledge and the second one would assists them to make determination on the relevance of the evidence. Under the second prong, the trial judge must make a preliminary assessment of whether the reasoning or methodology underlying the scientific testimony was scientifically valid. If so, under the second prong, court would look into whether the reasoning and methodology was properly applied to the facts in issue of the particular case. The court also enlisted 4 factors to help the trial judges in evaluating the scientific reliability of scientific expert evidence. These factors were:

1) Whether the theory or technique could be or has been tested
2) Whether the theory or technique has been subjected to peer review and publication
3) The known or potential error rate of a technique and
4) Whether the theory or technique has received general acceptance.

After the Daubert’s case the Congress amended Rule 702 of the Federal Rules of Evidence in harmony with the Daubert language. The Daubert’s ruling was further refined by *Kumho Tire co. Ltd v. Charmichael*, which held that

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533 *Supra* note 481
534 *Supra* note 509
535 *Supra* note 521
extending Daubert’s general holding to include not only to scientific expert testimony but also to non-scientific or technical expert testimony, and *General Electric Co. v. Joiner*, which held that a district court judge may exclude expert testimony when there are gaps between the evidence relied on by an expert and his conclusion, and that an abuse-of-discretion standard of review is the proper standard for appellate courts to use in reviewing a trial court’s decision of whether it should admit expert testimony. These three cases *Daubert v. Merrell Dow Pharmaceuticals, Inc*, *Kumho Tire Co., Ltd. v. Carmichael*, and *General Electric Co. v. Joiner*, referred to as the “Daubert trilogy,” are followed in federal court.

The majority of states followed Daubert case. Some states followed the entire Daubert trilogy, while some states followed only certain elements of the trilogy. Some states retained Frye standard, while some states applied Frye standard only to new or developing science. There was no uniformity for admitting scientific evidence in the United States.

This is how DNA is admitted in the court rooms in India, the United Kingdom, and the United States of America.

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536 *Supra note 522*